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# GENDER INEQUALITY IN ITALIAN ACADEMIA:

# A LIFE-COURSE PERSPECTIVE ON CAREERS AND FERTILITY

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# List of contents

# Introduction

One of the most prominent socio-economic trends in recent decades has been the substantial growth of women's participation in the labour market across all industrialised countries. With the overall expansion of female employment, women have significantly improved and strengthened their labour market positions, career opportunities, and income levels. Notwithstanding these positive changes, existing research has consistently highlighted the enduring gender disparity in accessing top-level positions, even though women have caught up or even overtook men concerning educational attainment (OECD, 2015).

Academia is no exception to this. Nowadays, women represent about half of the population of PhD graduates in most EU countries (She Figures 2021). Such gender parity, however, is a relatively recent phenomenon; hence, the academic ladder still appears to be gendered in favour of men. The proportion of women among faculty significantly declines as they progress through the tenured ranks, particularly at the associate and full professor levels—a well-documented phenomenon commonly referred to as the “leaky pipeline” (Alper, 1993). This trend reaches a stark culmination, with only a quarter of professorship positions being held by women across Europe (She Figures 2021).

The persistent underrepresentation of women among faculty members, especially in high-ranking positions, is deeply rooted in pervasive gender stereotypes dictating what careers are deemed suitable for men and women. Also, the gender gap within academic hierarchies is symptomatic of systemic barriers, including gender discrimination (direct and indirect) as well as gendered organisational mechanisms, that hinder women's progression to higher academic ranks. Moreover, this disparity is compounded by the

unequal distribution of domestic responsibilities, with women shouldering a disproportionate burden of household duties, notably childcare, thereby impeding their ability to achieve the standards of the "ideal academic" (Thornton, 2013).

The intersection of work and family domains, particularly the responsibilities of childbearing and child-rearing, stands out as a crucial factor contributing to gender inequality not only in career achievements but also in other life-course outcomes. The slower career progression of women from PhD completion to tenured academic positions and their higher prevalence in precarious positions entails lower incomes over the life course, higher job-related uncertainty, later achievement of stable employment and professional recognition – all factors that may significantly impact their life trajectories in other domains, particularly fertility, by postponing or foregoing the transition to motherhood and higher-order births. Academic women, especially those in tenure-track positions, demonstrate lower marriage and fertility rates compared to academic men and lower-educated women (Baker, 2012). The decision to postpone important life events in favour of a career can be particularly ambiguous. Recent studies on highly educated individuals (e.g., in the medical profession, as noted by Gaiaschi in 2021) do not find motherhood penalties. Instead, they reveal fatherhood premiums, which exacerbate gender inequalities in career progression and income differences.

The objective of this dissertation is threefold: first, to scrutinise and assess gender inequalities within Italian academia, specifically pertaining to opportunities for entering and progressing in academic careers; second, to unveil the intricate relationship between academic careers and fertility, identified by previous research as having a significant role in perpetuating gender inequality; third, to bring men on board by investigating the ways in which academic careers influence fertility decisions for both male and female

academics. While previous qualitative research has explored this impact on women, it is essential to extend this examination to include men as well. By examining the intersection of gender, career trajectories, and fertility histories, this research seeks to contribute to understanding the persistent gender inequality in academia.

The dissertation is organised as follows. Chapter 1 provides a broad overview of theoretical and empirical research on gender inequality in academia that has been developed in the social sciences, mainly in sociology and family demography, aiming to identify pathways for future study and clarify the contribution of the current dissertation to the existing knowledge. First, chapter one will introduce the origins of gender inequality by examining the interplay between factors at the individual and organisational levels. Emphasis will be placed on understanding the role of gender-specific practices and processes within academia that significantly shape individual outcomes. Second, it will delve into the primary factors contributing to gender inequality in academia, offering an in-depth analysis based on empirical research. Fundamental mechanisms shaping the gender gap, such as personal career preferences, scientific productivity, the motherhood penalty, and gender discrimination, will be reviewed. Special attention will be given to understanding how these factors are influenced and conditioned by the institutional framework within the academic system. Third, the interplay between academic careers and fertility behaviours will be examined through the lens of the life-course approach to review existing literature on gendered fertility outcomes of academics to highlight another underexplored dimension of gender inequality—specifically, what I call the "gender fertility gap in academia".

A life-course approach allows us to investigate the timing, sequencing and quantum of life events (Billari, 2009), considering individual lives as "age-graded patterns that are

embedded in social institutions and history" (Elder et al., 2003) and recognising the role of social structures, historical time, birth cohort, social interactions and human agency (Giele & Elder, 1998; Mayer, 2004).

Accordingly, three empirical lines are followed to develop these ideas. First, I delve into the academic journey from PhD completion to employment, scrutinising potential gender disparities in career choices (Chapter 2). Employing secondary data concerning the early careers of PhD holders in Italy, I find that substantial gender differences in access to academic positions and productivity persist (in favour of male PhDs) while obtaining an early-career academic position significantly boosts scientific productivity for both genders. This analysis underscores the pivotal role of the postdoctoral transition in the labour market as a first leaking point and its role in the underrepresentation of women in academia.

Next, my attention turns to the academic sphere, delving into the convergence of family- and career-related trajectories of academics and its role in perpetuating gender inequality. Driven by the results of Chapter 2, the second empirical contribution of the dissertation (Chapter 3) investigates gender differences in academic progression in terms of the time elapsed from obtaining a PhD to being appointed to various academic positions and focuses on the role of fertility in contributing to gender disparities. Based on unique primary data that I collected via a web survey on Italian academics, I find no gender differences in the rate of career advancement from PhD completion to non-tenured academic positions (i.e., postdoctoral positions or non-tenured assistant professorships characterised by limited-duration contracts), while women, on average, wait more time compared to men to attain a tenured academic position (i.e., characterised by a limited-duration contract). Also, Chapter 3 suggests that the gender gap cannot be

explained solely by childbearing: after the birth of a child is controlled for, gender gaps in academic promotions persist.

Then, I continue to examine the academic realm, zooming in on the interplay between work and family domains (Chapter 4). My objective is to understand how the academic career shapes the fertility trajectories of both academic women and men and to ascertain the degree to which this interplay introduces an additional layer to the existing gender inequality in academia, namely the "gender fertility gap". My research reveals that male and female academics typically postpone parenthood until securing their first tenured position, but age moderates this effect, especially for women. This emphasises the challenges posed by the interconnection of academic career timing and fertile ages for both genders. However, for women, delaying childbearing carries increased reproductive risks, including involuntary childlessness or unrealised fertility, due to the inherent limitations of fertility potential.

Overall, the dissertation contributes to the gender inequality literature by shedding light on the complex interplay between career trajectories and fertility within academic settings, taking a life-course approach. The findings emphasise that gender inequality in academia is a multifaceted phenomenon shaped by how individuals navigate the dynamic, delicate balance between work and family domains amid the constraints of existing organisational and macro institutional demands. Women face more significant challenges in entering and progressing in academic careers, particularly to higher academic positions, compared with their male counterparts. These pivotal career stages represent critical bottlenecks in the academic system, necessitating further examination to understand the challenges hindering women's career progression in academia.

Furthermore, the dissertation uncovers the complex interplay between academic careers and fertility. While previous studies, despite mixed empirical evidence, continue to highlight the role of childbearing in contributing to women's disadvantages in academia, fertility does not solely account for perpetuating gender inequality in career outcomes. The rigidity of the academic system, especially regarding the timing of career progression, compels both men and women to delay having children until they reach the first stable academic stage, often occurring in advanced reproductive age. This situation poses significant risks of involuntary childlessness or reduced completed fertility, particularly for female academics, whose reproductive lifespan is shorter than that of men and who tend to partner with older men, contributing to the “gender fertility gap” in academia. Indeed, the topic of unrealized fertility is a significant concern for female academics, as multiple qualitative studies have shown. However, there has been little effort to quantify this issue to date.

Finally, the findings highlight persistent disparities and the complex interplay of factors associated with career trajectories and underscore the necessity for further research on gender inequality within academic settings.

# Empirical settings

## 1 The Italian context

Italy represents a compelling case study for gender inequality in academia for three main reasons. First, the Italian labour market exhibits enduring imbalances at the macro level, marked by low female participation, high youth unemployment, and significant market segmentation. Over the past two decades, the flexibilisation of the labour market has unfolded through selective deregulation efforts, introducing new employment contracts specifically targeting youth employment (Scherer & Barbieri, 2009). These reforms led to substantial growth in precarious employment, including fixed-term contracts, temporary positions, and atypical job contracts. These measures were designed to address pervasive unemployment and informal work while mitigating the extent of labour market segmentation. However, the non-standard forms of employment frequently come with inferior working conditions, low wages, income instability, and enduring income disadvantages (Le Feuvre et al., 2015; Garibaldi & Taddei, 2013). The dichotomy between fully included workers, enjoying open-ended contracts and robust employment protection, and marginal workers engaged in atypical and precarious employment with limited or no job security stands as a significant obstacle faced by young individuals –and particularly young women– when entering the labour market (Le Feuvre et al., 2015; Herschberg et al., 2015). This segmentation is also reflected in the academic system and significantly affects career trajectories, particularly after the introduction of Law 240/2010, the so-called "Gelmini reform" (Gaiaschi, 2022). The "Gelmini reform" abolished the position of the permanent researcher ("*Ricercatore Universitario"*), replacing it with two fixed-term positions: a non-tenured assistant professor (*"Ricercatore a Tempo Determinato di tipo A" or RTD-A)* with a non-renewable contract

duration of three to five years maximum, and a tenured assistant professor (*"Ricercatore a Tempo Determinato di tipo B" or RTD-B*) with a contract duration of three years, after which, upon a positive evaluation and having obtained accreditation through the national habilitation system, the person can be promoted to associate professor. The alteration in research contracts, accompanied by a substantial decrease in the number of tenured academic positions, has notably prolonged the period of job insecurity for young researchers (Gaiaschi & Musumeci, 2020; Gaiaschi, 2022).

Second, the Italian academic system today entails a relatively homogeneous career path and provides a convenient case study to compare the career progression of academic men and women at each academic stage; at the same time, it faces essential structural challenges contributing to gender disparities. The prevalence of precarious academic positions, especially after the introduction of the already-mentioned "Gelimini Reform", and the challenging access to tenured academic positions resulting from restructuring the academic system adds an intriguing layer to the study of the Italian case, particularly from a gender perspective. This complexity can reveal insights into various overlapping dimensions of inequality (Gaiaschi & Musumeci, 2020; Gaiaschi, 2022).

Numerous studies underscore the greater challenges women face in their academic journey compared to men in Italy. Recent research analysing career trajectories of Italian PhD holders from 1983 to 2006 reveals that women are less likely to pursue academic careers after earning their PhD (Zabetta & Geuna, 2020). Despite their adequate representation in Italian academia, women experience notably slower career advancement compared to men (Naldini & Poggio, 2023).

The organisation of PhD trajectories in Italy today follows a structured framework emphasising academic research and specialised training. PhD programs are typically

offered by universities and research institutions. In Italy, PhD programs are governed by strict regulations and guidelines set by the Ministry of Universities and Research (MUR). These regulations outline the curriculum requirements, program duration, and assessment procedures. PhD trajectories in Italy often span three to four years. Upon completing PhD programs and obtaining a PhD certificate, the career trajectory in academia involves engaging in diverse fixed-term employment arrangements. These may include post-doctoral research fellowships, lectureships, and other non-tenured positions, marking the initial stages of an academic career (Herschberg et al., 2018). A typical postdoctoral position entails a temporary appointment for a total duration not exceeding six years. However, these precarious forms of employment can lead to economic insecurity and may require individuals to be open to relocating between institutions, regions and even countries (Murgia & Poggio, 2018). Subsequent steps involved, in the past, positions as permanent researchers, and after the "Gelmini reform", tenured and non-tenured assistant professorships, followed by associate and full professorships.

Besides changing the typologies of job contracts available at the beginning of academic careers, the "Gelmini reform" also introduced the National Scientific Habilitation ("*Abilitazione Scientifica Nazionale"*). The National Scientific Habilitation, ASN in the Italian acronym, is a non-comparative assessment procedure managed directly by the Ministry of University and Research, in which national commissions –one for each scientific sector– evaluate candidates according to standardised criteria established by the Ministry. Obtaining the National Scientific Habilitation is a precondition for being eligible to participate in public competitions for both associate and full professorship. The reform aimed to set a transparent evaluation system to avoid possible biases and strengthen the significance of nationally organised accreditation procedures (Pautasso, 2015). However, some evidence points to increased gender disparities and a heightened

focus on academic productivity after the introduction of the ASN system (Le Feuvre et al., 2018; Minello & Russo, 2021).

Third, in addition to challenging labour market conditions, Italy has a family-centred welfare regime strongly influenced by traditional gender roles. This societal framework often places additional burdens on women in terms of family responsibilities, particularly childcare, impacting their career outcomes. The challenges of balancing career and motherhood are often framed within the context of gendered parental leave policies. Maternity leave in Italy consists of 5 compulsory months of leave with 80% income coverage. Paternity leave was introduced in Italy in 2012 (L. 92/2012): The stipend was 100% covered for one day in 2012 and, abiding by European regulations, for ten days from 2023. Since the "Gelmini Reform", tax laws relating to maternity and paternity also apply to post-doctoral research fellowships. Additional periods of parental leave in Italy offer considerably less generous benefits, amounting to 30% of the parent's salary. The share of places available in public childcare for children under three years of age equals 27.2% in 2020 (ISTAT 2022).

The combination of a precarious job market, challenges in reconciling work and family responsibilities, and a shortage of childcare options create a complex environment that influences individuals' decisions regarding family planning (Salvati et al., 2020). As a result, Italy continues to be among the developed nations with the lowest fertility levels (Kohler et al., 2002).

Taking into account the peculiarities of the labour market, the structural problems of the academic system, and the family-centred welfare regime, a study of gender inequality in Italian academia can provide valuable insights into the complex interplay of societal, structural, and individual factors affecting women's careers in academia – and beyond.

## 2 Data

The dissertation leverages two key sources of information: cross-sectional data from a broad-scale survey of PhD graduates conducted by the Italian National Institute of Statistics (Chapter 2) and unique longitudinal retrospective data from a large sample of academics working in Italian universities, collected by the author (Chapter 3 and Chapter 4).

The first source, "*Indagine sull'inserimento professionale dei dottori di ricerca,*" is a comprehensive set of cross-sectional data covering all individuals who obtained PhD degrees from Italian universities. I utilized data collected in 2010, 2014, and 2018, with each survey wave including information on two educational cohorts of PhD holders, surveyed 4 and 6 years after graduation. This data set offers significant advantages, such as complete coverage of the target group across all scientific disciplines, a high response rate of approximately 70%, and relevant information aligning with our research objectives, including occupational outcomes, publication productivity, and individual characteristics. The final sample consists of 41,193 respondents. However, I recognize that using cross-sectional data limits the ability to fully account for the time dimension, particularly regarding the timing of childbirth, as this information is not provided (even approximately, such as whether it occurred before or after entering the labour market).

To correctly estimate the association between childbirth and career progression, individual-level information on both fertility and career histories is needed, capturing both the occurrence (i.e., whether a childbirth and/or a career progression event took place) and the timing (i.e., the specific year these events occurred). This detailed data is essential for both academic women and men. Therefore, we implemented primary data collection to obtain our second source of information.

Using an online questionnaire and non-probability sampling, we obtain a unique original longitudinal dataset on academics in Italy. Sample participants, i.e., academics working in Italian universities in 2021-2022, were asked to provide retrospective information that allowed me to reconstruct their fertility and career histories, including professional milestones and family-related events. The survey did not include individuals who earned doctoral degrees but transitioned out of academia after completing their PhD, nor did it encompass academics who were not faculty members as of 2022.

The sampling strategy did not presuppose a certain number of cases (and quotas) at the beginning of the data collection. Nevertheless, during the data collection process, the chosen strategy allowed us to assess the quota matching (in our case, sex, academic rank, and scientific discipline) based on the structure of the general population of Italian academics, publicly available from the website of the Ministry of University and Education (similar with sequential sampling technique describe by Etikan et al., 2016).

Data collection lasted from December 2021 to April 2022, i.e., until a sufficient sample size was reached to match the structure of the general population of Italian academics. Recruitment of participants involved a twofold process. First, we completed a list of Italian scientific associations and societies of different scientific disciplines created by Google searching (using keywords), which includes 218 associations from 14 academic disciplines[1]. The list is not intended to be exhaustive but represents the most prominent scientific organisations for each academic discipline (see Appendix F, Table F1). Among the 218 associations contacted, 72 agreed to disseminate the link to the survey through their mailing list and/or their official social media pages.

[1]According to National University Council, the list of Academic disciplines for Italian University Research and Teaching includes 01 - Mathematics and Informatics; 02 - Physics; 03 - Chemistry; 04 - Earth sciences; 05 - Biology; 06 - Medicine; 07 - Agricultural and veterinary sciences; 08 - Civil engineering and architecture; 09 - Industrial and information engineering; 10 - Antiquities, philology, literary studies, art history; 11 - History, philosophy, pedagogy and psychology; 12 - Law; Area 13 - Economics and statistics; Area 14 - Political and social sciences.

Secondly, we reached out via email to the guarantee committees for equal opportunities ("*Comitato Unico di Garanzia*") or Vice-Rectors for equality and diversity at 74 out of 88 Italian universities[2]. Thirty-seven institutions agreed to distribute the survey link among their faculty members through mailing lists and/or official university communication channels (see Appendix F, Table F2). In addition, the questionnaire was advertised on the author's personal social media accounts (Facebook and Twitter).

Eligible academics (i.e., academics currently employed at an Italian university in 2021-2022) could spontaneously decide to participate in the survey by clicking on the link received via a mailing list or seen in their social media newsfeed. The questionnaire, administered in Italian and English, can be found in Appendix H. The data collection process complies with the privacy and data protection regulations in place at the University of Trento. In particular, the data collection process was reviewed by and has been given a favourable opinion from the privacy office of the University of Trento. According to the University's regulations, the project's description and the privacy declaration were filed with the Secretariat of the Department of Sociology and Social Research on the 14th of September 2021 (Appendix G).

The questionnaire has reached 4392 respondents, of whom 2443 completed all mandatory questions. After the data cleaning process, we excluded individuals without a PhD degree (as it was historically possible to enter an Italian academy without one), those who entered academia before completing their PhD, and those who provided incorrect information, thus retaining 1948 respondents.

Despite the advantages of having access to retrospectively collected information on both fertility and career histories for both women and men, the primary data collected in this

[2] According to the Ministry of Education and Research (MUR), net of legally recognised non-state telematic universities (access date 20.09.2023).

manner has some methodological limitations. The first limitation refers to a selection bias that may appear due to a non-random sampling procedure (Heckman, 1990). Since participation in the survey is voluntary, only those academics who are willing to respond to social surveys, probably due to the perceived relevance of the topic and willingness to spend time to complete the survey) filled in the questionnaire. Also, some respondents who were potentially interested in taking part in the survey might not have been reached by the advertisement of the data collection. Non-probability samples yield the same results as probability samples if there is no correlation between the dependent variable and the factors affecting respondents' survey participation (Lee & Marsh, 2000). In our case, we applied sampling weights in our analyses based on gender, scientific discipline, and academic rank, which enabled us to respect the structure of the general population and thereby improve representativeness. We assume that academics not included in the sample are not qualitatively different from those who are (although we cannot estimate the possible selection bias).

Nevertheless, the integration of both secondary and primary data provides a comprehensive approach to examining gender inequality within the Italian academic context. Large-scale administrative data on PhD holders enables the detection of potential gender differences at the initial selection into academic careers post-PhD. Meanwhile, the rich, primary-collected data on academics allows for tracking every subsequent stage of career progression in academia, accounting for a variety of individual characteristics and the timing of life and career events. Additionally, this approach enhances the validity and reliability of the research findings. Cross-verifying evidence from primary and secondary sources can ensure more accurate and credible results.

# Chapter 1

## Gender inequality in academia: Theoretical approaches and empirical literature


### Abstract

This chapter provides a critical review of the theoretical and empirical literature on gender inequality in academia to outline future research directions and highlight the dissertation's contribution to the existing body of knowledge. It delves into the origins of gender disparity in academic settings, emphasising the interplay between individual attributes and organisational dynamics while spotlighting gender-specific practices prevalent in academia. Key topics covered include gendered career preferences, gender disparities in scientific productivity, the impact of the motherhood penalty, and instances of gender discrimination observed within academic environments. Critique is directed towards the prevailing individual merit paradigm, which often disregards the pivotal role played by gender-specific social conditions. The chapter identifies parenthood as a central determinant perpetuating gender inequities, notably affecting academic mothers. Furthermore, it investigates the relationship between academic career trajectories and fertility patterns through a life-course lens, unveiling the gender-fertility gap as a dimension of gender inequality in academia that warrants further exploration.



**Keywords:** gender inequality, career choice, productivity, motherhood penalty, gender discrimination, fertility gap

## 1 Introduction. The origins of gender inequality in academia

The underrepresentation of women in top academic positions likely stems from disparities in opportunities, which can arise from variations in individual characteristics, as well as the intricate interplay of gendered organisational practices and processes. These factors combined perpetuate and reinforce gender inequalities within academic settings, ultimately contributing to the underrepresentation of women at the highest echelons of academia (Acker, 2006). According to Merton's paradigm, academia is considered the most universalistic social institution and operates based on two fundamental principles for scientific contributions: fair evaluation and fair reward (Merton, 1968). Consequently, any disparities in opportunities within this framework should primarily mirror distinctions in talents or, more accurately, the efforts exerted under particular conditions rather than resulting from social constraints. Viewed through the lens of individual merit ideology (as discussed by Van der Lee & Ellemers, 2018), the historical attribution of women's disadvantages in academic careers has primarily been centred on individual-level factors, including personal preferences, individual motivations, and scientific performance. However, the universalistic principle of the academia's functioning has faced criticism because it fails to consider the actual gender-specific social conditions that significantly influence the outcomes of individual efforts.

From a feminist perspective, classical liberal academia is seen as a site of knowledge production reproducing a form of power and, as a consequence, social inequalities since it has historically been structured in an exclusively male-centric and elitist manner (Acker & Armenti, 2004; Lund, 2012) The recent and ongoing transformation of academic institutions towards a neoliberal paradigm, which promotes efficiency and competition as the principles of academic excellence, has made the academic context

more inclusive but has not entirely eradicated gender inequality within academia (Ferree & Zippel, 2015). Furthermore, the meritocratic approach in the current academic system, reflective of historical norms, poses disadvantages for most women and the contemporary generation of men (Knights & Richards, 2003).

The roots of persistent gender inequalities, as the inequality regimes approach suggests, lie in "*inequality-producing practices and their locations in particular organising processes*" (Acker, 2009, p. 201). One of the fundamental processes through which gender inequality in academia is reproduced is the general requirements and organisation of academic work. An academic is often expected to conform to the image of the ideal worker, with the strongest commitment to research and unencumbered by other (family) engagements, including childcare responsibilities (Thornton, 2013; Lund, 2015). Indeed, the challenges associated with childbirth and subsequent child-rearing are frequently identified as the primary factors contributing to women's disadvantages in academic careers due to the ongoing unequal division of domestic responsibilities, where academic women frequently bear an additional load of childcare and household maintenance as highlighted by Wolf-Wendel & Ward (2006).

The male-centric image of the ideal academic closely aligns with the traditional "breadwinner" model, which is still exceptionally widespread in modern society but lags behind recent global changes in social norms concerning family roles, the allocation of family responsibilities within a partnership, and the level of involvement of both parents in childcare. As Russo and Minello (2021) emphasise, macro-level factors, such as labour market characteristics and welfare regime features, significantly shape individuals' life and career trajectories (e.g., Barbieri et al., 2015).

The literature highlights the incompatibility of simultaneous demands of conforming to the standards of an ideal worker and an ideal parent, which was initially developed with a focus on motherhood (e.g., Russo, 1976) and has more recently emerged in the context of fatherhood as well (e.g., Sallee, 2012). The constant pressure to publish, non-standard working hours, and intense geographical mobility associated with an academic career pose significant challenges for recent generations of academic parents, both mothers and fathers.

The trajectory of career development, specifically the timing of career advancement, also emerges as an inequality-producing process. The life-course approach emphasises that the interplay between work and family domains evolves differently at various stages of an academic career. This interplay becomes particularly intricate for female academics due to the biological constraints of reproductive age (Jacobs & Winslow, 2004). The early phase of an academic career, i.e., non-tenure phase, is characterised by a considerable level of uncertainty and, at the same time, is the most demanding and pivotal period for shaping one's future career (Fothergill & Feltey, 2003). Both male and female PhD graduates typically enter the labour market at the same age. However, for women, the initial phase of their academic careers coincides with the most biologically favourable period for childbearing in terms of their fertile age, forcing them to make difficult choices between career and reproductive uncertainties. When motherhood occurs later in a woman's reproductive years, followed by the demands of child-rearing, the career interruptions tend to be more extended. This results in higher opportunity costs linked to the decision to have a child (Vignoli et al., 2020).

The overlap between a rigid academic career and family development produces another dimension of gender inequality in academia, namely the gender fertility gap.

Demographic literature claims that economic and job security plays a crucial role in predicting fertility for both men and women (e.g., Clark & Lepinteur, 2022; Fahlén & Oláh, 2018; Lopes, 2020; Busetta et al., 2019). Thus, the high level of uncertainty of the initial academic phase, linked with precarious and short-term employment contracts and relatively low salaries, often compels academics to delay having children until reaching a more stable phase in their careers, mainly until they are promoted to their first tenure position. While low fertility rates are anticipated among academics in general, empirical evidence indicates that there are distinct gender-specific fertility patterns within this group. Academic women are more likely to experience childlessness or have fewer children compared to their male counterparts and women who are not part of Academia (e.g., in the US - Mason & Goulden, 2004; Ecklund & Lincoln, 2011; Stanfors, 2014; in Austria - Buber et al., 2011).

Existing research on gender inequality shows that while academia is supposed to be built on universalistic principles of fair evaluation and reward, i.e., the meritocratic approach, these mechanisms frequently overlook or disregard the gender-specific social conditions that shape individuals' experiences and opportunities. Consequently, gender disparities persist, undermining the very foundation of fairness and meritocracy upon which academia claims to be built.

The expectations of the ideal academic, closely resembling the traditional "breadwinner" model, clash with evolving social norms, creating challenges for academic parents. The interplay between work and family domains evolves differently throughout an academic career, particularly affecting female academics due to the constraints of reproductive age. The early, non-tenure phase poses challenges for career development, with women facing difficult choices between career advancement and reproductive uncertainties.

Moreover, the intersection of a demanding academic career and family development contributes to the gender fertility gap within academia. Economic and job security play a crucial role in predicting fertility, and the uncertainties of the initial academic phase often compel academics to delay having children until they reach a more stable career phase.

Thus, addressing gender inequalities in academia requires a comprehensive understanding of the complex interplay between individual, organisational, and macro-level factors, challenging the prevailing meritocratic ideals and fostering a more inclusive and equitable academic environment.

## 2 The main explanations for women's underrepresentation in academia

The persistent concern over the leaky pipeline phenomenon in academia has prompted extensive scholarly inquiry into the underlying mechanisms perpetuating gender imbalances in recent decades. Historically, explanations for women's disadvantage in labour markethave predominantly centred on individual-level factors, often framing them as inherent "female" characteristics, thereby rationalising why women are not suited for certain jobs. Consequently, institutional-level factors have received less attention in prior research. To some extent, this approach also characterised early research on women in academia, as Picardi (2019) notes.

Gaiaschi (2022) emphasizes the considerable heterogeneity and variety of reasons of gender inequalities in the labor market, developing a multi-level map that highlights micro, meso, and macro factors (and mechanisms) on both the supply and demand sides. Micro level pertains to individual characteristics, such as human capital (supply side), and direct gender discrimination, including gender biases (demand side). Meso level involves interactions within both public (organizational) and private (household) sectors. Macro level encompasses the broader social or national context, including labor market

characteristics, welfare regimes, and interconnected gender norms. The multi-level map offered by Gaiaschi (2022) effectively applies to the academic context and, with additional elaboration, aids in understanding gender inequality in academia, particularly concerning career and fertility outcomes (see Appendix J, Figure J1). The latter is discussed in the next section of the current chapter.

In this study the macro level remains constant, as detailed in the Italian Context section. The following section aims to offer a comprehensive overview of empirical research on key factors and mechanisms contributing to the gender gap, operating mostly on micro level, including personal career preferences, scientific productivity, the motherhood penalty, and gender discrimination. Importantly, it underscores the significance of the organisational context within the academic system (meso level) in conditioning these mechanisms.

**Self-selection into academic careers**

The initial stage where gender differences may surface is the transition from PhD completion to the first employment, where PhD graduates decide between pursuing an academic career and alternative work (and life) trajectories (Ahmad, 2017; Lörz & Mühleck, 2019). Recent research in Europe emphasises that the precarious working conditions and high-level uncertainty of the early career stage result in the overall decline in the attractiveness of academic careers for recent cohorts of PhD graduates (Huisman et al., 2002). A study from Germany underscores that most PhD students do not plan to pursue an academic career, as the non-academic labour market tends to provide more lucrative jobs and wage opportunities (Enders & Teichler, 1994). Research on young academics from Switzerland underline that the choice between academic versus non-academic jobs is largely driven by family circumstances, especially the distribution

of responsibilities within the household (Bataille et al., 2017). Furthermore, the increase in the number of PhD students aligns with a decrease in employment opportunities in academia, characterised by fewer tenure positions and an increase in precarious positions. This trend not only heightens the competitiveness and uncertainty of the academic trajectory but also has the potential to contribute to gender inequality (Musselin, 2004; 2005; Enders, 2002).

Historically, women constituted a minority among doctoral graduates, and their ongoing underrepresentation in academia was foreseeable. Indeed, the "cohort effect", meaning the underrepresentation of women among students at previous levels of education, has been a relevant explanation for the gender imbalance in academia in the past. In the last decades, there has been a notable increase in the number of women pursuing doctoral degrees; thus, except for some scientific disciplines, there are now enough female doctoral graduates to qualify for academic positions. However, the academic labour market is still gendered in favour of men.

Lörz and Mühleck (2019), in their study on academic mobility from tertiary education to post-doc employment in Germany, underscore that gender differences in dropout primarily occur during the transitions between academic stages rather than within the stages themselves. Specifically, women leave academic careers at a higher rate compared to men. As the authors suggest, the gender disparity in dropout rates is not attributed to variations in scientific performance but rather to differences in life and career preferences.

However, individual career preferences are typically influenced by specific circumstances and are, moreover, a result of social attitudes that individuals acquire long before they enter the labour market. As the role model theory claims, the young generation tends to

choose their future occupation based on the examples of the adult generation who currently represent the labour force (Bandura, 1986; Xie & Shauman, 1996). Thus, this choice primarily reflects the gender segregation and social inequalities that currently exist in labour markets. The longstanding underrepresentation of women as academic role models, which persists in STEM fields[3], can deter young female PhD graduates from pursuing academic careers (Ceci et al., 2014). In support of this claim, another study revealed that female PhD students in hard sciences are more inclined to pursue academic careers if they have female supervisors during their PhD studies (Carrell et al., 2010). While, an Italian study by Ballarino & Colombo (2010) indicates that in the social sciences and humanities, academia remains the predominant career path for PhD holders, regardless gender. Another Italian paper, using data from several cohorts of PhD holders, revealed that a gender gap in access to academic research positions varies across disciplines and career level as well The study noted that while the gap is insignificant for postdoc positions, it becomes more pronounced among assistant professors. However, scientific productivity does not drive this gap (Carriero & Naldini, 2022).

As the life-course approach posits, career development is closely intertwined with life and family domains. Most doctoral students complete their PhDs in their early 30s when career choices interplay with family formation and transitioning to parenthood, which is likely more challenging for women than for men. The demanding standards of academic productivity and the extensive geographical mobility associated with successful academic careers may pose challenges when balancing them with plans for intensive parenthood (Cañibano et al., 2020; Tzanakou, 2017; Bennion & Locke, 2010). Indeed, several qualitative studies found that female PhD students perceived academic careers as

[3] Science, Technology, Engineering, Math

incompatible with having children (e.g., Ward &Wolf-Wendel, 2016; 2006; Armenti, 2004).

Given that the initial stage of an academic career is characterised by high uncertainty and lengthy periods in non-permanent positions, female doctoral students intending to start a family in the years following their degree, thus with higher family orientation, may anticipate challenges in balancing work and child-rearing responsibilities, leading them to opt for a non-academic career (Croson & Gneezy, 2009; Pautasso, 2015; Passaretta & Triventi, 2021). A study from the US, using panel data from the 1983–1995 Surveys of Doctorate Recipients, confirms that female PhD holders are more likely to leave the labour market, particularly if they are mothers (Wolfinger et al., 2009).

Unfortunately, the limited data availability has hindered the comprehensive examination of women's attrition from academic careers and the primary reasons behind this phenomenon. Little research has been able to trace the academic trajectory from the time of obtaining a PhD to understand the factors contributing to this attrition. However, the existing literature suggests that the enduring gendered division of household responsibilities within the prevalent male breadwinner family model, coupled with the inflexible structure of academia fostering inequality, likely plays a significant role in women’s self-selection away from academic careers.

**Gender productivity puzzle**

The lower scientific productivity of women compared to men appears as one of the most frequent explanations for women’s disadvantages in academic careers. Early studies mostly from the US consistently found strong evidence of women’s disadvantages in terms of productivity that persists throughout their careers (e.g., Long, 1992; Kyvik, 1990; Shauman & Xie, 1996; Sax et al., 2002; Fox, 2005). The observed gender

difference tends to manifest in the early years following a PhD's completion and widen over time (Long, 1992). Even recent research based on longitudinal bibliomentric data demonstrates that, on average, female academics are less productive than their male colleagues, holding constant relevant individual characteristics. The consistent evidences of women's disadvantages were found the US and Canada (Morgan et al., 2021; Kim & Moser, 2021; Ghosh & Liu, 2020) and from Europe as well (Abramo et al, 2021; Lindahl et al., 2021; Lutter & Schröder, 2020). However, there is a number of studies from Europe that show that in some cases the gender gap in research productivity becomes indistinguishable and sometimes women outperform men (Frandsen et al., 2020; Mairesse & Pezzoni, 2015; Van Arensbergen et al., 2012). These results were found among the younger generation of academics and in certain scientific disciplines.

In the neo-liberal model of academia, the number of publications is seen as a primary indicator of scientific productivity, thus a cornerstone of academic excellence and a criterion of career advancement. Since scientific publications are the centrepiece of academic work, even a tiny temporary fluctuation in productivity has tangible material consequences for individuals regarding career advancement, merit pay, access to research grants, and so forth (Pereira, 2021). Indeed, COVID-19 vividly illustrated how changes in working conditions (together with increased and unequally distributed household and childcare responsibilities) can have unequal effects on productivity for different groups of academics (male and female, parents and childless), thereby exacerbating already existing structural inequalities in the academic system (Ucar et al., 2022; King & Frederickson, 2021; Krukowski et al., 2021; Squazzoni et al., 2021).

Scientific productivity as an outcome depends on many factors that are inherently not gender-neutral, reflecting existing gender asymmetries. The persistent underrepresentation of women in top-level academic positions can itself constrain

women's opportunities to enhance research productivity, as high status facilitates access to the funds necessary for research (Long & McGinnis, 1981; Long et al., 1993). Some studies reveal that when accounting for career promotion opportunities and periods of low productivity due to childcare, the gender gap in productivity diminishes (Mairesse & Pezzoni, 2015). However, even when controlling for scientific productivity levels and individual characteristics, women still face a lower probability of attaining tenured positions, particularly as full professors (De Paola et al., 2017; Marini & Meschitti, 2018; Filandri & Pasqua, 2019). This implies that the meritocracy approach, even when based on success criteria like scientific productivity, may overlook different conditions for achieving success for men and women.

Moreover, scholarly outputs, including publications, are directly influenced by the amount of time allocated to research activities and their proportion within the overall working time structure. The academic work extends beyond publication activity and encompasses various time-consuming responsibilities. These include teaching activities, administrative tasks crucial for the university's functioning as a formal organisation, and engagement in dissemination activities or public outreach (e.g., interventions in mass and social media).

Numerous studies highlight that gender inequalities in productivity may stem from gender asymmetries in the division of academic work (Heijstra et al., 2017; Macfarlane & Burg, 2019; Guarino & Borden, 2017), a phenomenon accentuated during the pandemic (e.g., Minello et al., 2021). These asymmetries also involve internal gender segregation, wherein men and women occupy the same positions but engage in different work tasks (Berggren, 2008). However, the mechanisms behind these gender asymmetries are not entirely clear, as the distribution of time among work activities is often informal, except for formal hours of lectures, consultations, and meetings. Consequently, given the lack of

solid evidence supporting this claim, the reasons for gender asymmetries in the division of academic work remain a subject of ongoing discussion in the literature.

The gender differences in research collaboration may also contribute to the gender gap in productivity. Research collaboration is considered a substantial factor in boosting scientific productivity (Lutter & Schröder, 2019; Kyvik & Teigen, 1996; Ghosh & Liu, 2020; Yousefi-Nooraie et al., 2008; Lee & Bozeman, 2005). There are many channels through which it might happen: division of labour and tasks, time efficiency, brainstorming, consolidation of skills and competencies, encouragement, and stimulation (Lee & Bozeman, 2005).

Empirical evidence suggests that women and men differ in the quality and quantity of their scientific networks (Kyvik & Teigen, 1996; Ibarra, 1992). Academic women tend to be less integrated into scientific networks or rather integrated into low-status networks (Ibarra, 1992; Ghosh & Liu, 2020) and have less interdisciplinary and international cooperation compared with male peers (Cole & Zuckerman, 1984). Such differences in research collaboration can be influenced by structural constraints related to the specificities of the academic system, including the prevalence of male academics. Thus, the gender homophily, or the tendency to collaborate with individuals of the same gender, and the underrepresentation of women among faculty members, particularly in top-level positions, can explain the limited networking opportunities for female academics compared to their male colleagues (Abramo et al., 2013).

Although empirical evidence consistently reveals that women tend to trail behind men in scientific productivity, perpetuating the gender gap within academia, it is crucial to recognise these disparities as a result of cumulative disadvantages and blocked opportunities for female academics. These factors contribute to the systematic

reproduction of unequal reward distribution, impeding women's career advancement. A phenomenon famously described as the “Matthew effect” by Merton (1968; 1988), meaning that initial advantages lead to further gains, while initial disadvantages deepen over time. This necessitates a fundamental reevaluation of academia as a social institution, prompting a critical examination of its organisational structure, career development systems, and emphasis on productivity, all of which play significant roles in creating and sustaining gender inequalities.

While job-related characteristics undoubtedly play a role, it is equally important to consider family characteristics, such as parental status, when addressing the gender productivity gap. Childbearing and subsequent involvement in child-rearing can have a crucial impact on scientific productivity and consequently (as well as directly) on career progression. The following section discusses this issue in detail.

**Motherhood penalty**

In the sociological literature, the motherhood penalty appears as a common explanation for women’s disadvantages in academia, although the empirical evidence of the childbearing effect is not so unequivocal With regards to career advancement, some previous research from the US found that promotions are postponed or reduced among mothers compared to non-mothers (Long et al., 1993; Ginther & Kahn, 2009; Wolfinger et al., 2008). The bulk of the study from Europe shows that by controlling for parenthood status, the gender gap in career outcomes disappears. Among physicists in France, women have the same rate of advancement from junior to senior researchers as men, controlling for the set of bibliometric (e.g., number of scientific publications and number of citations) and also family characteristics (e.g., presence of children) (Mairesse et al., 2020). No evidence of gender differences in the rate of obtaining the first tenured

position was found using the full panel of German academic psychologists, net of research productivity, and the presence of children (small children in particular) (Lutter et al., 2022). Also, no gender gap in the rate of career promotion to a professorship in science and engineering was found in the US (Kaminski & Geisler, 2012), however the study did not control for individual characteristics nor for publicational rate

Regarding others careeroutcomes, there was strong evidence that having a child essentially reduces women's scientific productivity, i.e., the publication rate among academic mothers is significantly lower than that of non-mothers (Zuckerman et al., 1991) and fathers as well (Long, 1990; Kyvik, 1990; Kyvik & Teigen, 1996). The motherhood penalty appears in the first years after childbearing and echoes throughout a woman's subsequent career, even though its effect declines with the age of children (Kyvik, 1990; Kyvik & Teigen, 1996).

However, especially in recent studies, the effect of having children on women's scientific productivity appears less consistent. While some recent studies still emphasise the presence of the negative effect of having (especially young) children on the scientific productivity of women (Zeng et al., 2022; Morgan et al., 2021; Lutter & Schröder, 2020; Hunter & Leahey, 2010), other studies find no significant effect (e.g., Toren, 1991; Sax et al., 2002), particularly among recent cohorts of academics (Bentley, 2012). Moreover, some research reveals a positive impact of motherhood on productivity, at least in comparison to non-mothers (e.g., Joecks et al., 2014; Kim & Moser, 2021).

Such inconsistent results may reflect the heterogeneity of the group of academic mothers. Motherhood might be experienced differently and affects work outcomes to different extent depending on the woman's individual characteristics. A recent study using longitudinal data from German sociology professors reveals that the motherhood penalty

depends on the pre-childbirth productivity of women. High-productive women do not experience an essential reduction in their publication productivity, while low-productive women suffer a great productivity penalty (Lutter & Schröder, 2020). In line with this, Joecks (2014) shows that although highly productive women experience a short-term motherhood penalty, their scientific productivity still increases after the birth of a child.

The positive self-selection mechanism may contribute to the variations in the motherhood penalty, as recent research underscores that academic mothers are an extremely selected group (Kim & Moser, 2021). So, the quality of human capital of women who decide to have children in the first stage of their careers is different from those who become a mother later or those who forego motherhood until the most favourable time. This human capital includes not only endowment characteristics but also career motivation and the ability to manage work-family balance after the birth of a child (Kemkes-Grottenthaler, 2003; Testa, 2014).

The main theoretical argumentation of motherhood penalties in terms of productivity is based on role conflict theory (Merton, 1957), which suggests that individuals have limited resources for careers and other life tasks. Therefore, an additional time-consuming role, such as the role of a parent, brings excessive strain and further interpersonal role conflict (Ward & Wolf-Wendel, 2004). Most of the past research on role conflict has been conducted among women, which is not surprising since the major part of childcare and housework was a prerogative of women (e.g., Hochschild & Machung, 2012; Aassve et al., 2014; Aassve et al., 2015).

Empirical research confirms that childbearing as an event has different consequences for men's and women's careers, at least throughout a child's early childhood. Childbearing has a strong positive impact on male productivity, as shown by Krapf and colleagues

(2017) and Stack (2004). The observed increase in scientific productivity of fathers compared to non-fathers goes in line with an increase in working time, which means male researchers with children can work harder because they simply spend less time on childcare and housework - jobs are usually taken care of by their partners. This is not always the case for mothers (especially in dual academic couples) (Ward & Wolf-Wendel, 2012). Most academic women still often shoulder an additional burden involving childcare and household upkeep (Wolf-Wendel & Ward, 2006).

However, gender attitudes have changed considerably in recent decades, resulting in modern fathers taking on domestic and parental responsibilities (Pascall & Lewis, 2004; Johansson & Klinth, 2008; Klinth, 2008). Unfortunately, very few studies among academic fathers, those out there, support the trend described above (Reddick et al., 2012; Gould & Lovato, 2019; Sallee et al., 2016).

The organisational norms and working standards in academia still reflect the past, when academic careers were designed based on the life course of an "ideal male worker." However, younger generations of women –and men– have been challenging this order of things. Recent (mostly qualitative) studies focused on academic men's perceptions of their parenting role and show that academic men are also experiencing work-family conflicts (Gould & Lovato, 2019; Steffens et al., 2019; Sallee et al., 2016). Considering the male population of PhDs, there is a clear trend for responsible fatherhood and active participation in family life. This trend is also supported by societal changes in family roles: the breadwinner model has been declining in favour of the dual-earner model, especially among the highly educated. For women, the trend extends beyond the conventional dichotomy between prioritising family or pursuing a successful career. Instead, women are increasingly demonstrating the ability to achieve fulfilment in both

realms, nurturing thriving families alongside successful careers (Goldin & Katz, 2008; McCarver, 2011).

In addition to the fundamental changes in women's and men's lifestyles after having a child, which significantly alters the work-life balance, childbearing introduces a career disruption related to parental (most commonly maternal) leave. Economic research underscores that maternal career disruption results in significant wage and productivity penalties in both the short and long term (Budig & England, 2001). The extension of maternal leave adversely impacts women's chances of reentering the labour market (Schönberg & Ludsteck, 2014) and exacerbates wage penalties.

However the extend of motherhood penalty varyes across women's earnings distribution and changes over the time. A US study using data from the National Longitudinal Survey of Youth (1979-2010) finds that among white women, those with high skills and wages face the greatest penalties. Despite having fairly continuous work experience, these women incur significant costs for even brief childrearing breaks due to their high returns to experience (England et al., 2016). Another study based on the same data confirms that motherhood penalty for highly paid women appears mainly due to lost human capital from childbearing, while for low-wage women the penalty mechanism is different. For low earners, family resources, work effort, and compensating differentials account for much of this penalty (Budig & Hodges, 2010). A study of Glauber (2018) examines trends in parenthood penalties and premiums in the US from 1980 to 2014 across different wage levels. Data from the Current Population Survey show that the motherhood wage penalty decreased, starting in the 1990s, particularly for high-earning women. By the early 2010s, this penalty was eliminated for high earners but persisted for low earners. Meanwhile, the fatherhood wage premium increased from the late 1990s,

especially for high-earning men, who received a much larger premium than low- or middle-earning men by the early 2010s. Recent reductions in maternity penalties observed in the American context may stem from the implementation of policies aimed at supporting maternal employment. Research conducted in Europe suggest that variations in the strength of the motherhood wage penalty across countries can be partially explained by differences in policies designed to facilitate maternal workforce participation. Research indicates that countries with a high proportion of young children in publicly funded child care facilities and longer periods of paid maternity leave experience a decrease in the motherhood wage penalty, regardless of the mothers' skill levels (Halldén et al., 2016).

There is limited evidence regarding the effect of maternal career disruptions on academic careers. Academic context is substantially different from other organisational contexts in terms of career development practices as well as the quality of human capital. Academics are highly educated and specialised in a field, have intrinsic solid work motivation (so-called "taste for science"), and generally benefit from independence and flexibility in their work (Roach & Sauermann, 2010). Conversely, the academic career appears "cumulative" in terms of accruing advantages, such as scientific publications and network connections, which, in turn, provide opportunities for career advancement.

McElrath (1992), drawing on original data from academics obtained through stratified random sampling, demonstrates that for women experiencing a career disruption of more than one year due to childbearing or their partner's career, the likelihood of obtaining tenure decreases, while the time to tenure (from PhD) increases. A similar trend was observed for men but was significantly less pronounced. Additionally, a one-year delay in career commencement has distinct effects on women's and men's promotion prospects:

women's chances decrease while men's chances increase (Long et al., 1993). Thus, the number and duration of maternal career disruptions contribute to the specific “gendered” career trajectories of female academics.

The intricate relationship between parenthood and academic careers is multifaceted, marked by a nuanced interplay of various factors. The motherhood penalty, often highlighted in the literature, reveals that women, particularly mothers, may face delays or reductions in promotions compared to their non-mother counterparts. Scientific productivity, a critical aspect of academic success, is notably impacted by motherhood, with academic mothers experiencing lower publication rates compared to non-mothers and fathers.

Recent studies apply a more nuanced perspective on the motherhood penalty, highlighting inconsistencies in the impact of having children on women's scientific productivity. This approach underscores the importance of recognising the heterogeneity among academic mothers, taking into account factors such as academic rank, career stage, and level of productivity. This heterogeneity plays a crucial role in understanding and explaining the mixed effects of childbearing on academic careers. Additionally, the inconsistency in the impact of having children can be data-driven, i.e., a considerable portion of previous research has overlooked the timing of childbearing concerning career events and publication levels. Consequently, the inability to consider this temporal aspect has hindered assessing a causal relationship between childbearing and academic outcomes.

Although the academic context declares a gender-neutral principle of rewards based on the accumulation of scientific publications and network connections, the organisational norms and working standards still align with historical ideals, creating challenges for work-life balance, particularly for mothers. Despite changing gender attitudes and

increased involvement of fathers in domestic responsibilities, limited studies focus on academic fathers, leaving a gap in understanding the evolving dynamics of parenting roles in academia. In the face of evolving societal changes and shifting family roles, academic institutions need to reassess their organisational norms and practices to accommodate the diverse needs of both women and men in academic careers.

**Gender discrimination in academia**

Several studies have argued that gender imbalances in academia persist, not least because of discrimination against women (Bielby & Baron, 1986; Checchi et al., 2019; De Paola & Scoppa, 2015; De Paola et al., 2017; Marini & Meschitti, 2018; Picardi, 2019; Filandri & Pasqua, 2019; Roberto et al., 2020).

Gender discrimination is a nuanced and multi-faceted phenomenon that can undoubtedly be a powerful structural barrier to women's career advancement in academia. However, defining and providing empirical evidence of its existence poses considerable challenges. Theoretically, gender discrimination refers to "*unequal and harmful treatment of people because of their sex*" (Husu, 2005; Benokraitis & Feagin, 1995, pp. 38–58). Empirically, the residual gender gap in career achievements, such as wage or chances of promotion, that persists even after accounting for all relevant observed characteristics, such as education and job experience, could be indicative of the presence of discrimination, net of unobserved characteristics However, even controlling for the differences in human capital during the academic hiring process, it is difficult to account for pre-labour market discrimination, which starts long before entering the labour market and may contribute to further women's underrepresentation in academia (Blau & Kahn, 2000; Anker, 1997).

In academia, studies on discrimination during the recruiting process have been extensive (Bagues et al., 2017; Spelke & Grace, 2007). Research on the career progression of

cardiologists in Italy, utilising survey data, reveals distinct career patterns between men and women, even after accounting for productivity, family-related factors, and individual characteristics (Modena et al., 1999). A recent investigation into professors in Italy employing administrative data uncovers a gender gap in career advancement that persists even when considering scientific productivity and the gender composition of the academic sector (Filandri & Pasqua, 2019). The research using an experimental approach highlights the existence of gender bias against women, starting from admission to entry-level academic and non-academic research positions, especially in hard sciences (Checchi et al., 2019) and economic sciences (particularly in entirely male committees) (Gërxhani et al., 2023). This bias persists in further progression to professorial positions (De Paola & Scoppa, 2015).

On the other hand, a recent study conducted in Nordic countries using an experimental design does not uncover evidence of gender discrimination against academic women during the hiring process. The study indicates that female academics are perceived as more hirable and professional compared to men. Furthermore, the study finds that even having children does not create a disadvantage for female candidates (Carlsson et al., 2020).

Patterns of discrimination manifested in terms of wages or chances of promotion, although challenging to verify, are observable. In contrast, the sources of discrimination remain unobservable while closely woven into existing organisational practices (Bohren et al., 2019).

The discrimination may arise from the beliefs regarding group characteristics, e.g., beliefs that female academics, on average, are less productive than male academics (also so-called statistical discrimination developed in economics by Arrow, 1973 and Phelps,

1972). However, the influence of these beliefs on the evaluation outcome relies on signals about worker characteristics obtained from previous evaluations. These signals, in turn, have also been formed by the actions of previous evaluators (Bohren et al., 2019). Therefore, changes in group norms (e.g., through generational change) may lead to a gradual weakening of discriminatory beliefs. Hence, women's lower productivity is often attributed to the "motherhood penalty," which implies that mothers are perceived as primary caregivers, leading to the expectation that they should devote less time to work-related activities compared to men. In light of the contemporary shift in family models away from male breadwinners toward egalitarian couples, with increasing involvement of fathers in childcare—particularly evident among the newer generations of highly educated professionals—this shift should drive alterations in mothers' work outcomes and consequently reshape expectations regarding women's roles (Steffens et al., 2019; Aranda & Glick, 2014; Bear & Glick, 2017).

Another source of discrimination against women comes from gender-biased preferences to work or interact with men rather than women (Becker, 1957), which works similarly with gender homophily and can be documented through collaboration practices and scientific networking.

To counter gender bias in promotion, universities frequently strive to establish gender-balanced appointment committees, believing it fosters a more supportive environment for women. A study by Van den Brink and colleagues (2010) discovered that gender-balanced committees tend to appoint more women. However, recent research underscores the lack of a clear and explicit criterion for evaluating candidates (especially regarding scientific productivity), leaving the field open to gender practices that disadvantage women (Marini & Meschitti, 2018; Bohren et al., 2019).

The existence of gendered practices and organisational processes (i.e., “inequality regime” by Acker, 1996) is aligned with the concept of indirect discrimination (Wilson et al., 2010) or an attempt to conceptualise discrimination on the collective level (Gallant & Cross, 1993). Indirect discrimination encompasses a broad spectrum of circumstances and practices, notably criteria for professional development, remunerative benefits, or promotion, which may inadvertently exclude academic groups statistically more likely to include women (e.g., non-tenured academics).

In conclusion, gender imbalances persist in academia, and discrimination against women has been identified as a potential contributing factor. The nuanced and multifaceted nature of gender discrimination poses challenges in defining and empirically evidencing its existence in academia. While residual gender gaps in career achievements may indicate discrimination, accounting for pre-labour market biases remains difficult.

Extensive studies on discrimination during the academic hiring process reveal distinct career patterns between men and women, even after accounting for productivity and individual characteristics. Experimental approaches highlight the existence of gender bias against women in various academic and research positions, particularly in hard and economic sciences. However, studies in Nordic countries using experimental designs show a more positive perception of female academics, challenging traditional biases during the hiring process.

Discrimination may manifest in terms of wages or promotion chances, with unobservable sources woven into existing organisational practices. Indirect discrimination, reflected in criteria for professional development, benefits, and promotion, may unintentionally exclude academic groups statistically more likely to include women. The contemporary

shift towards egalitarian family models and increased paternal involvement in childcare may influence discriminatory beliefs and reshape expectations regarding women's roles.

To counter gender bias, universities often establish gender-balanced committees, aiming for a more supportive environment for women. However, the lack of clear and explicit criteria for evaluation, especially concerning scientific productivity, leaves room for gender practices disadvantaging women.

## 3 The consequence of gender inequality in academia

The repercussions of gender inequality in academia extend across individuals, institutions, and society at large, with far-reaching consequences. It reflects and perpetuates broader societal norms and stereotypes about the roles and capabilities of men and women. Addressing these issues in academia can contribute to broader cultural shifts towards gender equality. Also, to attain economic and social development, it is essential to leverage all available human resources within a society fully.

The outflow of women from academia represents a significant loss of talent for the academic community and, more broadly, results in the underutilisation of human capital, which has far-reaching implications for society. This depletion profoundly affects research, teaching, and the overall intellectual climate. By diminishing the representation of women's perspectives and experiences, it fosters bias in research, thereby influencing the choice of research questions, methodologies, and the overall calibre of academic output. Moreover, the absence of gender diversity not only hampers collaborative and innovative research but also leads to missed opportunities for advancement across various disciplines.

The underrepresentation of women among faculty members limits diverse perspectives and role models for PhD students and aspiring academics, reinforcing existing gender segregation in the labour market. It may perpetuate gender stereotypes and limit the diversity of voices in educational settings, affecting the quality of education and the preparation of students.

From an individual standpoint, women in academia experience economic disparities in comparison to their male counterparts. This includes lower salaries, limited career advancement prospects, and a higher prevalence of precarious positions, findings consistently supported by sociological and economic research. The resulting economic and job uncertainty has profound implications on various aspects of life, particularly fertility behaviour, as elaborated in the subsequent section.

**Gender fertility gap among academics**

Previous research has seldom delved into the fertility behaviour of academics, largely because of the lack of suitable data. Furthermore, the intersection between career and family dynamics has traditionally been examined unidirectionally, specifically focusing on the influence of parenthood on career outcomes. However, recent investigations into highly educated professionals indicate the presence of gendered patterns in fertility outcomes, revealing a more nuanced relationship that goes beyond the conventional perspective.

From a life-course perspective, the timing of transitions into parenthood is strongly conditioned by a diverse array of factors, spanning from macro-societal structural and cultural forces to individual-level biological capacities and constraints. Collectively, these elements shape opportunity structures and establish transition deadlines for entering the role of a parent (Hagestad & Call, 2007).

Numerous studies conducted on the general population consistently highlight the pivotal role of economic and job security in predicting fertility outcomes for both men and women (e.g., Clark & Lepinteur, 2022; Fahlén & Oláh, 2018; Lopes, 2020; Busetta et al., 2019). Conversely, findings from Italy emphasise a correlation between economic uncertainty and low fertility (Rinesi et al., 2011; Vignoli et al., 2019). In terms of job stability, research indicates that both men's and women's employment instability can significantly influence their likelihood of parenthood (e.g., Vignoli et al., 2012 in Italy; Landaud, 2021 in France).

Also, education plays a crucial role in the context of employment uncertainty and its impact on fertility outcomes. Highly educated men and women face higher opportunity costs when dealing with employment instability, which often leads to lower fertility rates (Rindfuss et al., 1996; Adsera, 2004; Blossfeld et al., 2005; Kravdal & Rindfuss, 2008; Pailhé & Solaz, 2012). Although research on academics' fertility behaviours is relatively limited, there are reasons to believe that their patterns may be akin to those of highly educated professionals. This resemblance can be attributed to several shared factors, including delayed entry into the job market, postponed family formation resulting from extended educational pursuits, and the subsequent overlap between their career and family development trajectories. While low fertility rates are anticipated among academics in general, empirical evidence indicates that there are distinct gender-specific fertility patterns within this group. Academic women are more likely to experience childlessness or have fewer children compared to their male counterparts and women who are not part of academia (e.g., Mason & Goulden, 2004; Ecklund & Lincoln, 2011; Buber et al., 2011; Stanfors, 2014).

The existing body of research, predominantly qualitative, points to the intricate interplay between academic careers and fertility behaviours, particularly among women. Although

the impact of academic careers on family decisions is acknowledged, the scarcity of quantitative data limits a precise understanding of this relationship. Mason and Goulden's longitudinal study from the US (2004) stands as a notable exception, revealing that women working in academia exhibit distinct family patterns compared to their counterparts, particularly concerning the timing of promotions. Ollilainen (2019), comparing the US and Europe, suggests that academic women in both contexts consider maternity leave, age, and contract precarity as crucial factors influencing the decision to become a mother. A study by De Paola et al. (2022) on Italian female assistant professors supports this view, revealing that promotion to this rank increases the likelihood of having a child. However, the absence of comparable data for men limits gender comparisons and understanding of the impact of attaining a professorship on male fertility outcomes.

Consequently, the timing of academic career milestones, particularly the attainment of tenure, intersects with the biological constraints of female fertility. As the average age for receiving tenure in academia is around 40, e.g., in the US - Jacobs & Winslow (2004), the postponement of motherhood among women in academic careers creates a potential challenge. Buber and colleagues (2011) argue that low fertility appears due to the gap between fertile intentions and realised fertility, largely due to the specificities of the academic time clock. This, coupled with a tendency to underestimate the biological constraints on fertility, establishes conditions conducive to childlessness (Kemkes-Grottenthaler, 2003).

The academic career settings similarly influence the fertility choices of academic men. However, the fertility potential of men is mainly contingent on their female partners, with particular emphasis on the age of the partner. As indicated by existing literature, male academics may opt to delay parenthood with relatively lower associated risks due to their

tendency to be in relationships with younger partners. The concept of a "partnership age gap" becomes crucial in the context of deferred fertility, providing male academics with a strategic advantage. This dynamic allows them to postpone the commencement of parenthood until they have progressed further in their careers (Dudel et al., 2020).

The low fertility rate among female academics may also reflect voluntary childlessness, given that the latter is often strongly associated with high educational attainment, continuous employment, and intense geographical mobility (Bloom & Pebley, 1982). Research on the general population emphasises that the pathway to childlessness tends to be gendered; more specifically, career development (and educational attainment) enhances the likelihood of childlessness among women, while for men, it fosters the transition to fatherhood (Keizer et al., 2008). However, a study from Austria shows that among young female researchers, the share of those who express voluntary childlessness is negligible. At the same time, most women desire to have at least two children (Berghammer et al., 2016).

Therefore, narrowing the focus exclusively on the gender gap in career outcomes may offer an incomplete perspective on gender inequality within academia. It is essential to acknowledge that this gap extends beyond professional achievements to encompass disparities related to family dynamics (Mason & Goulden, 2004). A holistic examination of gender inequality in academia should consider the wide-ranging impact on both career and family outcomes. This broader life-course perspective allows for a more nuanced understanding of how gender dynamics shape individuals' experiences in academic settings, considering the strong interconnectedness of professional and personal spheres.

## 4 Conclusions

This chapter provides an analysis of the main theoretical approaches related to gender inequality in academia and a review of the most significant empirical literature to identify open questions and perspectives to develop new research.

The individual merit approach, which suggests that "*women do not fit academia*," is wode spread in literature and primarily emphasises the role of personal characteristics in determining individuals' positions within the academic hierarchy. However, this perspective overlooks the critical impact of gender-specific social conditions on the outcomes of individual efforts within academia.

Analysing gender inequality in academia requires considering the dynamic interplay between macro-, meso-, and micro-level factors. Firstly, societal gender and family roles embedded through the welfare system shape the context. Secondly, institutional settings within academia, encompassing organisational structure, reward systems, processes, and practices, play a pivotal role. Thirdly, individual behaviour adds another layer to understanding the complexity of gender dynamics in academia.

In turn, individual behaviour in the professional domain, including career preferences, decisions, and achievements, is intricately connected and intertwined with the concurrently evolving life domain. The choices and accomplishments in one's professional life are inextricably linked to and influenced by the ongoing developments and experiences in one's personal life, particularly the transition to parenthood. In addressing gender inequality in academia, parenthood emerges as a central cornerstone that establishes conditions contributing to ongoing gender disparities. The impact of parenthood on individuals within the academic environment is a crucial factor influencing the unequal outcomes experienced by different genders.

On the one hand, the transition to parenthood and the subsequent responsibility for childcare entails a redistribution of working hours and a lifelong focus on the parental responsibilities of the primary caregiver, which, in the context of the prevailing model of gender and family roles, often referred to as the "male primary breadwinner model," leads to a decline in work productivity for academic mothers (as primary caregivers) and, consequently, hampers their career achievements. Furthermore, given that the favourable reproductive age for women aligns entirely with the most demanding and crucial phase of their academic careers, during which the groundwork for successful progression in academia is established, academic motherhood stands out as the primary disadvantage contributing to the subsequent career lag experienced by women.

On the other hand, efforts to align significant life transitions, such as the transition to parenthood, with the trajectory of an academic career by delaying parenthood until a more opportune career stage or even contemplating the elimination of parenthood have distinct consequences and costs for men and women. These attempts contribute to an additional dimension of gender inequality in academia, a question that has received little attention in previous research, explicitly manifesting as the gender fertility gap.

The ongoing global shifts in gender and family roles in European societies, aimed at fostering an egalitarian family model, have not eradicated gender inequality in academia. The persistent organisational setting of the academy, i.e., "inequality regime," rooted in the past norms of an "ideal male worker," not only sustains gender disparities but also prompts concerns about the potential challenges for younger generations of male academics in effectively navigating parenthood alongside their academic careers.

In light of the diverse array of social welfare regimes and the specific design of academic systems, which collectively shape the unique circumstances influencing individuals, both

men and women, in making pivotal professional and life choices, there is a pressing need for additional research. Comprehensive research that takes into account the heterogeneity within the academic population considering factors such as gender, life and career stage, age, and educational cohort, along with precise measurements of crucial career and life transitions, is imperative. This approach is essential for understanding the underlying mechanisms and formulating effective strategies to overcome gender inequalities within the academic sphere.

# Chapter 2

## The gendered costs of career decisions. A study on the employment of PhD graduates in Italy[4]


### Abstract

Most research on the gender gap in academia suggests that transitioning from doctoral studies to employment is the first turning point in the exodus of women from academic careers. Not least, children's birth may influence a woman's decision to leave academia (as well as their scientific outcomes), as the first stages of an academic career are precarious and challenging to reconcile with motherhood. The paper contributes to understanding the gender gap in the early career outcomes of PhD graduates in Italy. Using recent data covering the entire population of Italian PhDs from six educational cohorts, we propose an analytical model that allows us to examine the relationship between scientific productivity, career choice, and having children. Controlling for pre-employment characteristics of PhD graduates, we find that for both men and women, obtaining an academic position in the early stages of a career significantly enhances scientific productivity; in turn, having children reduces the chances of working in academia. Also, substantial gender differences in access to academic positions and productivity persist (in both cases in favour of male PhD holders). At the same time, the Kitagawa-Blinder-Oaxaca decomposition shows that much of the gap in both outcomes is unrelated to gender differences in their observed characteristics and remains unexplained.



**Keywords:** gender gap, early career, scientific productivity, occupational outcomes, having children, PhD graduates


[4] The article has been submitted and is currently under review in an international peer-reviewed journal, co-authored with Enrico Rettore and Stefani Scherer.

## 1 Introduction

One of the most notable socio-economic trends in recent decades has been the rising participation of women in the labour market. With the general expansion of employment, women have significantly strengthened their labour market positions and substantially improved their career prospects. Despite these positive shifts, numerous studies point to a persistent gender gap in access to top-level positions (e.g., Hultin & Szulkin, 2003; O'Connor, 2019), even though women have caught up and overtaken men in educational attainment. In the EU, about half of PhD graduates are women; however, the gender balance achieved in the PhD completion rates is a recent phenomenon, and hence, the academic labour market still exhibits gender biases in favour of men. Female doctorates are less likely to obtain research positions inside and outside academia than male doctorates (Webber & Canche, 2018; Shauman, 2017; Wolfinger et al., 2008). According to the latest statistics, in the EU, women held only a quarter of top-level academic positions and represented only a third of non-academic researchers (She Figure 2021). Moreover, among academics, women's share sharply decreases along the steps of the occupational ladder (Picardi, 2019; Shauman, 2017; Gaiaschi & Musumesi, 2020; 2021; Filandri & Pasqua, 2021; Marini & Meschitti, 2018; Carriero & Naldini, 2022). The gender gap may result from a cohort effect, given that the supply of female PhDs has not been sufficient in the past to fill top academic positions. To accurately assess whether there is a gender difference in career chances, the timing of the career start must be considered.

In Italy, the situation is like other European countries, but with tertiary education, let alone PhD participation, still at much lower levels and with career prospects being generally more limited. Science-intensive sectors of the economy are poorly developed, especially in the social sciences and humanities, which affects employment opportunities

even for highly qualified professionals, forcing them to accept jobs below their degrees (Ballarino & Colombo, 2010; Gaeta, 2015).

Most Italian doctoral students complete their PhD in their early 30s when career choices are drawn jointly with other life-defining decisions such as family formation and transition to parenthood. Gender differences are likely to play a role in this picture. The high standards of scientific productivity and the intense geographical mobility associated with successful academic careers (Cañibano et al., 2020) may be challenging to combine with plans of intensive motherhood. Given that academic careers, especially in Italy, are characterised by a high degree of uncertainty (Picardi, 2019) and long periods in non-permanent positions, female doctorates who would like to have children as soon as they obtain their degrees may opt for non-academic careers. In turn, the decision to postpone childbearing may be conditioned by the characteristics of PhD graduates that determine the chances for a (successful) academic career. Only women with a substantial margin of success will likely pursue an academic career (Roach & Sauermann, 2010). Childbearing impacts the work-family balance of academic men and women differently since childcare, especially when the child is young, is still a woman's de facto responsibility (Jolly et al., 2014). The motherhood penalty appears in the first years after childbearing and echoes throughout a woman's subsequent career, even though its effect declines with the age of children (Kyvik, 1990; Kyvik & Teigen, 1996). While the fatherhood penalty is not such a common phenomenon, at the very least, it is barely mentioned in the scientific literature. The situation for men is different, and some studies found a ‘fatherhood premium,’ meaning a rapid increase in productivity; thus, becoming a father can even reinforce men’s careers (Stack, 2004).

So far, numerous studies point out substantial disadvantages for women regarding scientific publications (e.g., Long & McGinnis, 1981; Kyvik, 1990; Long et al., 1993),

especially for mothers (Kyvik, 1990; Kyvik & Teigen, 1996). Even very recent studies emphasise that academic women have lower scientific performance than academic men, controlling other personal characteristics (Lutter & Schröder, 2020; Morgan et al., 2021), which is already evident during the early career stage (Lerchenmueller & Sorenson, 2018). Early scientific outcomes certainly have substantial implications for future careers and provide the conditions for successful career advancement (Danell & Hjerm, 2013).

Since the number of scientific publications is one of the strongest predictors of academic promotion, the lower scientific productivity of women has been the common explanation for the persistent gender gap in academia for decades. However, the relationship between scientific productivity and career attainment is not so obvious, and it could also go the other way around (Long, 1978; Long & McGinnis, 1981; Long et al., 1993). In the academic context, in most scientific disciplines, scientific publications are the primary outcome of research work and the main criterion for career advancement. This is not always the case in non-academic research contexts. Therefore, pursuing an academic career directly after a doctoral degree creates favourable conditions and stimulates the effort to publish. In turn, the probability of getting an academic appointment can be determined by the characteristics of the PhD holders before entry into the labour market, accounting properly for attributes responsible for compliance for an academic career is crucial to ascertain the impact of the academic status on scientific productivity.

Our study focuses on the early career stage of PhD graduates in Italy and aims to examine the possible causal relationship between scientific productivity, academic career choice, and having children. We ask whether there are gender differences in early scientific productivity among PhD graduates and how much early scientific productivity is determined by academic career choice. Also, we examine to what extent having

children can explain the possible gender disparities in career chances and scientific productivity.

## 2 Research hypotheses

While doctoral program participation appears relatively equal in most disciplines, differences emerge early in the careers. Women with PhD degrees often find themselves in less advantageous and secure positions than their male peers (Fox & Stephan, 2001; Picardi, 2019). The gender gap is most pronounced in STEM fields, where women are more likely than men to be overqualified for their jobs (Bozzon et al., 2017) and employed outside their direct specialisation (Fox & Stephan, 2001). This disparity extends to lower earnings (Alfano et al., 2021) and reduced publication output for female PhD holders (Mairesse & Pezzoni, 2015).

Although scientific productivity is usually seen as the primary criterion for promotion, previous research from the US revealed that scientific productivity explains only a part of the gender gap in the rate of career advancement (Long, 1978; Long et al., 1993), and per se, it does not significantly impact the chances of being employed in prestigious research institutions (Long & McGinnis, 1981). In contrast, scholars underline the crucial role of organisational contexts in shaping scientific productivity and providing fertile ground for the growth of publication records (Way et al., 2019). Suppose male PhD holders are more likely to enter an academic track. In that case, a possible explanation for the gender gap in early scientific productivity relates to the occupational status acquired after completing their PhD. Thus, *we expect that male PhD graduates have a greater chance of working in Academia than their female counterparts (H1)*.

Childbearing is another frequently mentioned factor contributing to gender disparities in career progression in academia. Female academics who become mothers early in their

careers are less likely to get tenured positions than their male counterparts who become fathers at the same stage (Mason & Goulden, 2002). The uncertainty that characterises the early stages of an academic career can lead women who are mothers or planning to become mothers to consider leaving the academic path altogether. Research from the US underscores the importance of family-friendly work environments for highly educated mothers, highlighting a causal link between pre-birth working conditions and women's decisions to re-enter the labour market after childbirth (Herr & Wolfram, 2009). A recent paper, based on in-depth interviews with young researchers such as PhD and postdoctoral fellows, reveals that women perceive academic working norms as challenging to reconcile with motherhood, particularly during the precarious early stages of their careers (Eren, 2022). Also, women anticipate more career disadvantages in Academia due to childbearing than men (Bonache, 2022). Thus, *we expect to find a negative effect of having children on the chances of working in Academia, especially for female PhD graduates (H2).*

Childbearing and childcare responsibilities shape work-life balance, particularly of primary caregivers - usually women. A German study reveals that academic mothers tend to work less and prefer reduced work hours to their childless female colleagues and academic fathers (Sieverding et al., 2018). Balancing motherhood and a career can lead to decreased scientific productivity due to time reallocation. However, the evidence on the impact of having children on scientific productivity is contradictory. While some research consistently showed adverse effects on women's scientific output (e.g., Morgan et al., 2021; Lutter & Schröder, 2020), other studies found no such impact (e.g., Toren, 1991; Sax et al., 2002). However, specific groups of female academics, such as those becoming mothers in their early 30s (Krapf et al., 2017) or those with small children (Kyvik, 1990; Kyvik & Teigen, 1996), experience a motherhood penalty. Recent research highlights a

parental gender gap in scientific productivity, with academic fathers publishing significantly more than academic mothers (Zheng et al., 2022). This disparity can be attributed to a gendered division of domestic work, particularly childcare responsibilities, within couples (Sallee et al., 2016). It may also explain the fatherhood premium in scientific productivity and earnings noted in previous research (Fox, 2005; Stack, 2004). Consequently, *we anticipate a negative relationship between having children and early scientific productivity, particularly among women (H3).*

## 3 Data, variables, methods

### Data

We use the data collected by ISTAT - '*Indagine sull'inserimento professionale dei dottori di ricerca*' - a set of wide-range cross-sectional data on all individuals who obtain doctoral degrees in Italian universities. We use the data collected in 2010, 2014, and 2018. Each survey wave contains information on two educational cohorts of PhD holders 4 and 6 years after graduation. Several original variables were recoded and unified to obtain a coherent dataset across cohorts. The final sample comprises 41,193 respondents (19,450 men and 21,743 women). In the first wave, unemployed PhD holders were not asked about their productivity, and for the analysis, we had to concentrate on employed respondents only (38,384 respondents: 18,455 men and 19,929 women).

### Variables

We focus on two outcomes. The first one is *scientific productivity,* a self-reported indicator measuring the number of articles published from PhD completion to the interview, measured dichotomously and coded as 1 for respondents who have published more than three articles and equal to 0 for all the rest. This is the only indicator used to

measure productivity in the 2010 survey wave and, hence, the only indicator we can use to compare different cohorts. The second outcome is an *academic position,* distinguishing PhD holders employed in academic research positions by the time of the interview from all other types of occupation (net of non-employed respondents). This variable is constructed based on respondents' affirmative answers regarding their employment in the academic economic sector and identifying research as their primary activity. The data does not allow us to identify a specific academic position, but given the time elapsed since completing the PhD (4 - 6 years), we can assume that respondents hold a postdoc or researcher position.

Our main explanatory variables are *sex* and *having children* (dichotomous measure). It should be noted that the data do not report the number of children or their age at the interview time, so we can only distinguish between parents and childless PhD graduates. Since the gender gap in scientific achievements could also result from differences in the "*scientific quality*" of PhD holders - i.e., their compliance for an academic career – as of the time of PhD completion to control for this, we include four indicators. The first is a *graduation mark* (in Italian, "*voto di laurea*") with a value of 1 if it is 107 out of 110; otherwise, it is 0. The other three variables are also expressed as dummies (1 in case of a positive answer, otherwise 0): *PhD completion in time*, *visiting abroad during PhD*, and *teaching experience during PhD* To account for the differences in the *career length* among observed cohorts - four rather than six years after - that can affect the number of publications as well as for possible cohort effects, we include the variable *PhD completion year*, and additionally, we create a dummy variable six years after PhD completion that indicates those who have a career two years longer. Considering the possible variation of publication intensity and gender composition among scientific disciplines, we account for *fields of study* distinguishing natural sciences, medical

sciences, agricultural sciences, engineering and technology, and social sciences and humanities.

**Method**

The analytical strategy is twofold. First, we apply linear probability models on the outcomes, that is, scientific productivity and academic position, separately for men and women. The analytical strategy is described below. Second, we investigate how much of the gender differences in both outcomes can be attributed to the differences between parents and childless PhD graduates. We implement a threefold Kitagawa- Blinder - Oaxaca decomposition technique (Kitagawa, 1955; Oaxaca, 1973; Blinder, 1973) to distinguish the part of the gender gap due to the effect of the explanatory variable, in particular having or not children, and the other party given by the independent characteristics of male and female PhD graduates, the so-called 'within group" differences.

We start from a regression of *scientific productivity (P)* on a dummy for *academic position (A)* and a dummy for *having children (C)*. To attach a causal interpretation to those coefficients, we should control for the "academic compliance" *(Q)* that expresses the propensity for an academic career of the PhD holders by the time they complete the PhD, i.e., before they enter the labour market. This is the usual confounding problem: if individuals who are selecting (or are selected) into academic positions are, on average, different concerning $Q$ from those selected out, the coefficient on $A$ mixes up the causal effect of $A$ on $P$ and differences in $P$ due to $Q$. The same problem affects the measurement of the causal effect of $C$ on $P$: if those deciding to have children are systematically different with respect to $Q$ from those deciding to wait (or to give up to

children), again the coefficient on $C$ mixes up a causal effect and differences due to $Q$. Then, the equation we would like to estimate is

$$P = \alpha 0 + \alpha 1 * A + \alpha 2 * C + \alpha 3 * Q + \varepsilon \qquad (1),$$

i.e., an equation to estimate the effect of $A$ and $C$ on $P$ controlling for $Q$. This is unfeasible because $Q$ is not (directly) observable. If $Q$ were uncorrelated to $A$ and to $C$ – i.e., if within the time horizon we are considering, scientific quality accumulated up to the time of PhD completion were irrelevant for selection into academic position as well as for selection into *having children* - omitting $Q$ from the regression would not rise any problem for the estimation of $\alpha 1$ and $\alpha 2$. To test this hypothesis, we proceed to exploit the availability of four observable proxies plausibly correlated to $Q$: *graduation mark* ($G$), a dummy for whether they *completed the PhD within its legal duration* ($R$), a dummy for a *research stay abroad during PhD program* ($S$) and a dummy for *teaching experience during PhD* ($T$). Since there is no direct formal indicator of the quality of the results of the PhD student during the doctoral training (i.e., no marks, no final exams) except for successful thesis defence in front of a jury, we use these variables as proxies for $Q$. Let them be related to $Q$ by this equation:

$$Q = \beta 0 + \beta 1 * G + \beta 2 * R + \beta 3 * S + \beta 4 * T + \upsilon \qquad (2)$$

with $\beta 1$, $\beta 2$, $\beta 3$ and $\beta 4$ different from zero and with a positive coefficient, presumably. Linearity here is introduced only to facilitate the discussion. The key point to our discussion is that the four observable proxies are plausibly correlated to the unobservable $Q$ even if they do not precisely reproduce $Q$, as expressed by the residual term $\upsilon$. Then, replace the unobservable $Q$ in equation (1) with the right-hand side in equation (2):

$$P = \alpha 0 + \alpha 1 * A + \alpha 2 * C + \alpha 3 * (\beta 0 + \beta 1 * G + \beta 2 * R + \beta 3 * S + \beta 4 * T) +$$

$$+\alpha 3 * \upsilon + \varepsilon \qquad (3)$$

This is our feasible regression. Still, since *(G, R, S, T)* do not exactly reproduce *Q*, this replacement results in an imperfect control for *Q*, i.e. it might be that the OLS estimate of $\alpha 1$ and $\alpha 2$ in equation (3) is biased due to the correlation between the error term $\upsilon$ and *A* and *C*. Note however that our hypothesis in (2) – *(G, R, S, T)* correlated to the unobservable *Q* – bears testable implications: if the coefficient of *Q* in equation (1) is not zero – again an entirely plausible assumption, indeed - then it should be that (*G, R, S, T*) are relevant explanatory variables for *P* in equation (3).

How significant is the potential bias in estimating $\alpha 1$ and $\alpha 2$ resulting from the *Q* replacement by *(G, R, S, T)*? A plausible solution rests on the assumption that the partial omission of *Q* after controlling for *(G, R, S, T)* bears a bias on $\alpha 1$ and $\alpha 2$ smaller than the omission resulting from dropping *(G, R, S, T)* from the regression. In practice, we compare the estimates a1 and a2, including and excluding *(G, R, S, T)*, respectively. On finding that, first, *(G, R, S, T)* is relevant for *P* and, second, the omission of *(G, R, S, T)* does not affect in a relevant way the estimate of $\alpha 1$ and $\alpha 2$, we would conclude that the omission of *Q* from the regression is not biasing our analysis. This aligns with reasoning similar to the previous literature (Altonji et al., 2005).

To answer the second research question - why women have a lower probability of accessing an academic career - we regress the academic career (*A*) on a dummy for *having children* (*C*), and we also control for the "scientific quality" (*Q*) by the time they completed the PhD, i.e., prior to their entry into the labour market:

$$A = \gamma 0 + \gamma 1 * C + \gamma 3 * Q + \omega \qquad (4)$$

If those who decided to have children are systematically different with respect to *Q* from those who are not, again, the coefficient on *C* mixes up the causal effect of *C* on *A* and differences due to *Q* between those with and without children. As before, to distinguish the causal effect of *C* on *A* from the bias, we assume that the partial omission of *Q* after controlling for (*G, R, S, T*) bears a bias on γ1 smaller than the bias resulting from dropping (*G, R, S, T*) from the regression.

## 4 Results

### Gender differences in early career: descriptive findings

In the realm of early career outcomes, it becomes apparent that 4-6 years after completing their PhDs, women are less inclined than men to pursue academic careers. This gender gap varies across different cohorts, ranging from 2.6 to 7.4 percentage points (Fig. 1). Additionally, women are more likely than men to be non-employed, with the proportion of non-employed women consistently higher, showing differences ranging from 2.2 to 4.0 percentage points. The gender gap in both outcomes remains statistically significant across all educational cohorts, as shown by the t-test (Appendix I, Table I1).These disparities may stem from potential gender segregation within scientific fields, influencing the likelihood of securing employment post-PhD given that this factor is not controlled yet.

Notably, the proportion of non-employed PhD holders 4 to 6 years after completing their doctoral studies remains relatively small, at less than 10 per cent. Over time, with an increase in the number of PhD graduates, there has been a noticeable decline in academic sector employment (from 35 percent among 2004 cohort to 21 percent among 2014 cohort), whereas the non-academic sector has experienced a significant rise (from 58

percent among 2004 cohort to 72 percent amog 2014 cohort). Employment patterns 4- and 6-year post-doctorate generally exhibit similarities.

A significant gender difference in scientific publications is well-documented, along with distinctions between academic and non-academic PhDs (Fig. 2). Academics tend to publish more, with their productivity increasing as their careers progress. However, women in both subgroups display lower productivity compared to their male counterparts. The gender gaps remain statistically significant across all educational cohorts (except for 2010 with no gender differences among academics), as confirmed by the t-test (Appendix I, Table I2). Yet, among academics, the gender gap in publication output widens with career length but tends to decrease among non-academic professionals.

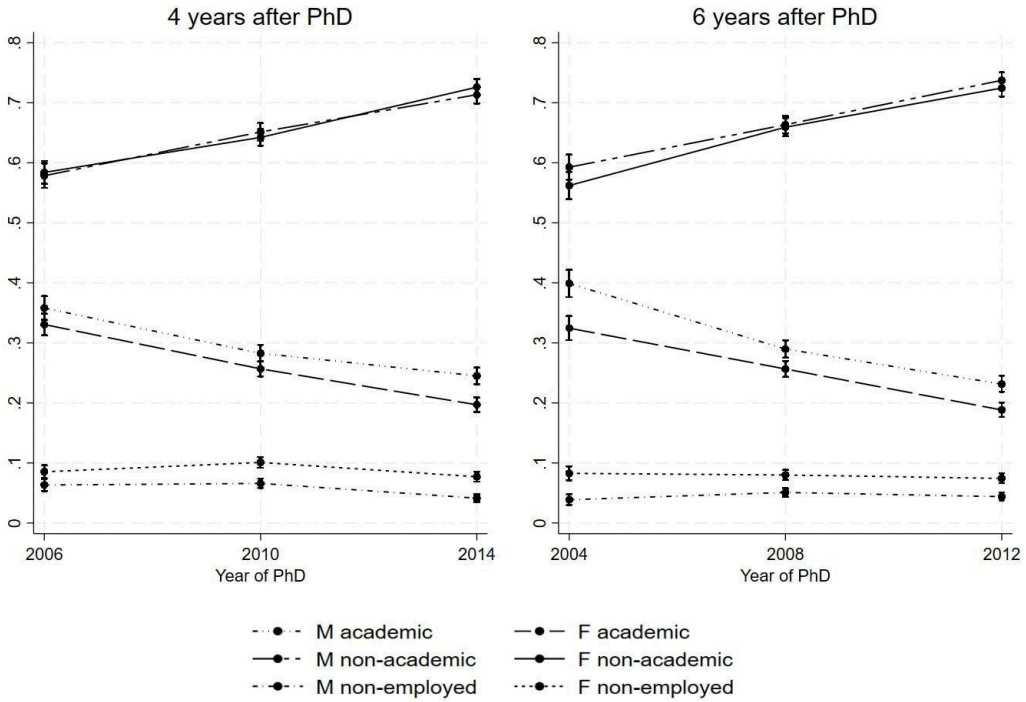



**Figure 1.** Occupational outcomes of PhD graduates across educational cohorts
4 years (2006, 2010, 2014) and 6 years (2004, 2008, 2012) after PhD completed. N =41,193

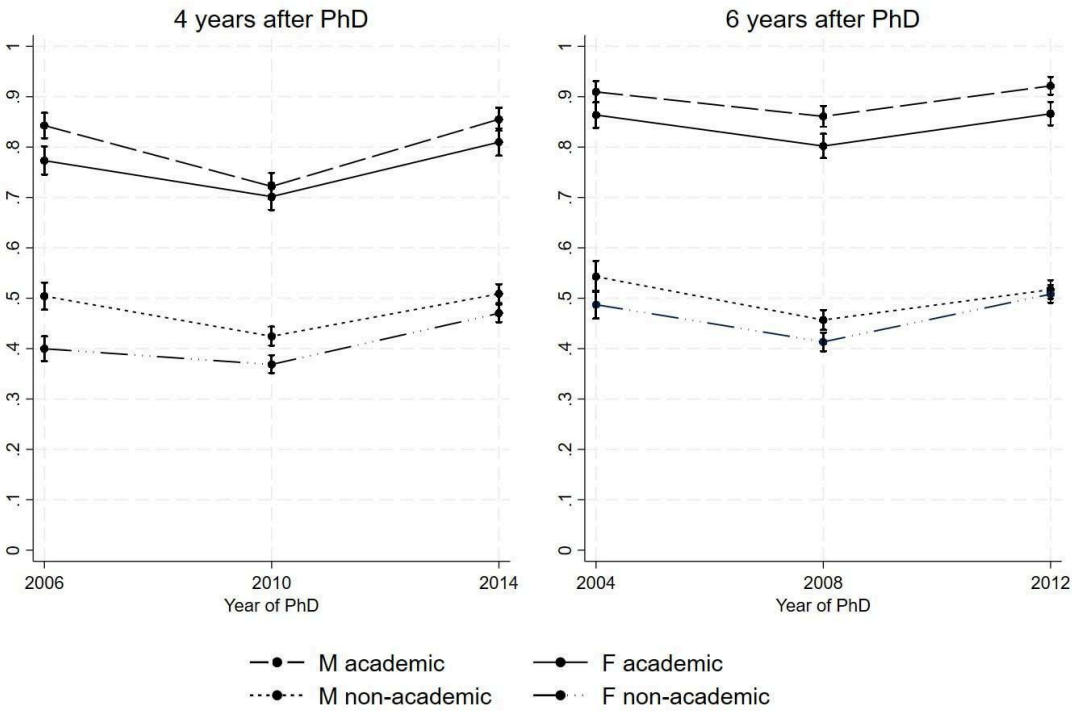



**Figure 2.** The share of PhD graduates (employed) who have more than 3 articles 4 years (2006, 2010, 2014) and 6 years (2004, 2008, 2012) after PhD completed. N = 38,384

The relationship claim we propose is based on the evidence that male and female PhD holders are very similar in terms of their compliance for an academic career as proxied by the four characteristics we can observe in our data - university final grade, the experience of a period of study abroad and teaching experience during the PhD program, completion of the PhD program within its legal duration: there is no relevant difference in 'scientific quality' between men and women when they enter the labour market. Fig.3 shows the average values and confidence intervals of the four proxy variables for men and women (see also Table A1 in the Appendix A).

We find no substantial gender differences regarding the four characteristics preceding the labour market. Female PhD graduates are likelier to have *a graduation mark* greater than or equal to 107 out of 110. In contrast, male PhD graduates tend to have more time abroad and teaching experience during their doctoral studies. In turn, most doctorates, both men and women, complete their PhD within its legal duration. Thus, the slight

differences (statistically significant but not essential) in pre-labour market characteristics of doctorates should not contribute to the gender gap observed in both productivity and career attainment.

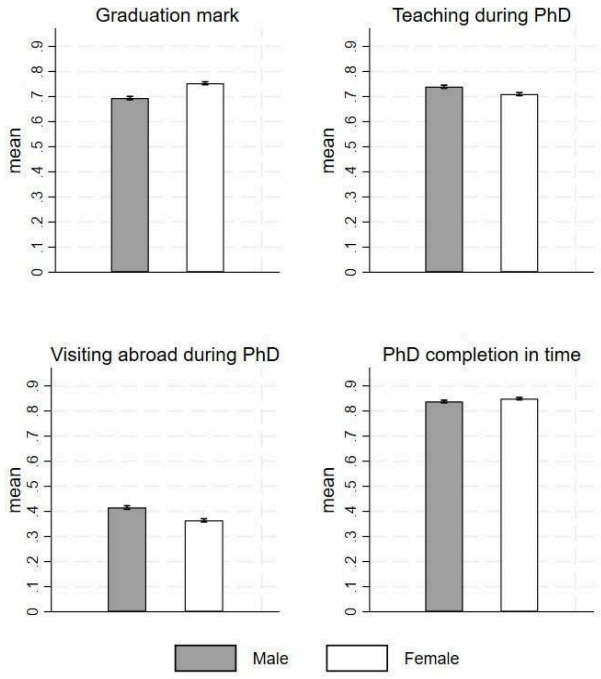



**Figure 3.** Average values of proxies for "scientific quality" by gender, N =41,193

**Do parenting and academic positions affect scientific productivity?**

Next, we explore the determinants of scientific productivity separately for men and women, including and excluding observable proxies of compliance for an academic career as explained in sec. 3 (Method), controlling for career length and field of study. Adding an interaction between career length and academic position allows us to estimate whether those in an academic position longer have any advantages compared to those who are not.

The results of the regression analyses (Tab.1) confirm that the estimated effects on scientific productivity of academic position and of having a child do not change significantly once we omit the controls for the four proxies for compliance for academic

career (*Model 2 and Model 4*). Moreover, all four proxies are relevant for scientific productivity; the coefficients are statistically significant (except for the teaching experience during PhD for male PhDs; *Model 1 and Model 3*). This is consistent with, first, our hypothesis that compliance for an academic career as proxied by our four observable characteristics is a relevant determinant of scientific productivity and, second, our argument in Section 3.3 that our model is reliably estimating the causal effect of an academic position and having children on scientific productivity.

**Table 1.** OLS estimation of scientific productivity (having more than 3 articles per career) with (Model 1, Model 3) and without controls for academic compliance (Model 2, Model 4) for men and women.

| | *Model 1 Men* | | *Model 2 Men* | | *Model 3 Women* | | *Model 4 Women* | |
|---|---|---|---|---|---|---|---|---|
| | *Coeff.* | *SE* | *Coeff.* | *SE* | *Coeff.* | *SE* | *Coeff.* | *SE* |
| Academic position | 0.304*** | 0.010 | 0.323*** | 0.010 | 0.315*** | 0.010 | 0.337*** | 0.010 |
| Having children | -0.007 | 0.007 | -0.022*** | 0.007 | -0.020*** | 0.007 | -0.037*** | 0.007 |
| *Academic compliance* | | | | | | | | |
| PhD completion in time | 0.121*** | 0.009 | | | 0.111*** | 0.009 | | |
| Graduation mark | 0.050*** | 0.007 | | | 0.031*** | 0.008 | | |
| Visiting abroad during PhD | 0.080*** | 0.007 | | | 0.100*** | 0.007 | | |
| Teaching during PhD | 0.011 | 0.008 | | | 0.035*** | 0.007 | | |
| *Career length (ref. 4 years after PhD completed)* | | | | | | | | |
| 6 years after PhD completed | 0.022*** | 0.008 | 0.024*** | 0.008 | 0.053*** | 0.008 | 0.056*** | 0.008 |
| Academic position## 6 years after PhD completed | 0.077*** | 0.014 | 0.079*** | 0.015 | 0.040*** | 0.015 | 0.037** | 0.015 |
| *Field of study (ref. Natural sciences)* | | | | | | | | |
| Medical sciences | 0.065*** | 0.012 | 0.059*** | 0.012 | 0.048*** | 0.010 | 0.032*** | 0.010 |
| Agricultural sciences | -0.035** | 0.015 | -0.041*** | 0.015 | -0.046*** | 0.014 | -0.044*** | 0.014 |
| Engineering and technology | -0.152*** | 0.009 | -0.159*** | 0.009 | -0.148*** | 0.011 | -0.151*** | 0.011 |
| Social sciences | -0.155*** | 0.009 | -0.171*** | 0.009 | -0.175*** | 0.008 | -0.185*** | 0.008 |
| Constant | 0.387*** | 0.014 | 0.570*** | 0.008 | 0.328*** | 0.014 | 0.515*** | 0.008 |
| F | 305.227 | | 402.740 | | 303.963 | | 398.475 | |
| R2 | 0.166 | | 0.149 | | 0.155 | | 0.138 | |
| N | 18,455 | | 18,455 | | 19,928 | | 19,928 | |

Note: * p<0.05; ** p<0.01; *** p<0.001

Working in academia comes with major scientific productivity. It does so similarly for men and women: the probability of having at least three publications four years after

completing the program is 30 percentage points larger for those working in academia after four years and even larger after six years. While the parenthood penalty appears for both genders, it is not statistically significant for men and is nearly two times larger for women. No relevant gender gap emerges, even with respect to the field of study.

**Does parenting affect the chances of being employed in academia?**

The decision not to pursue an academic career may be driven by the previous transition to parenthood, given that having a child significantly changes the work-family balance, especially for young mothers. Our results show that having children reduces the probability of being in an academic position for both men and women – the effect is slightly more pronounced among men. However, the difference concerning women is not statistically significant (Tab.2). Also, this result does not change controlling for the proxies of academic career compliance. As for the case of the productivity equation, we take it as evidence that the academic career compliance of the PhD holder drives no systematic selection into parenthood.

As expected, all four variables we use as a proxy for 'scientific quality' are positively associated with the probability of being employed in academia, i.e., they work as proper proxies for academic compliance. In addition, we find confirmation that the youngest cohorts have lower employment opportunities in the academic labour market - a finding already underlined in the descriptive section.

**Table 2.** OLS estimation of probability to have an academic position with (Model 1, Model 3) and without controls for 'scientific quality' (Model 2, Model 4) for men and women.

| | *Model 1 Men* | | *Model 2 Men* | | *Model 3 Women* | | *Model 4 Women* | |
|---|---|---|---|---|---|---|---|---|
| | *Coeff.* | *SE* | *Coeff.* | *SE* | *Coeff.* | *SE* | *Coeff.* | *SE* |
| Having children | -0.040*** | 0.007 | -0.058*** | 0.007 | -0.031*** | 0.006 | -0.047*** | 0.006 |
| *Academic compliance* | | | | | | | | |
| PhD completion in time | 0.076*** | 0.009 | | | 0.060*** | 0.009 | | |
| Graduation mark | 0.033*** | 0.007 | | | 0.022*** | 0.008 | | |
| Visiting abroad during PhD | 0.114*** | 0.007 | | | 0.117*** | 0.007 | | |
| Teaching during PhD | 0.070*** | 0.008 | | | 0.062*** | 0.007 | | |
| *Year of PhD defense (ref. 2004)* | | | | | | | | |
| 2006 | -0.040*** | 0.015 | -0.037*** | 0.015 | 0.001 | 0.013 | 0.002 | 0.013 |
| 2008 | -0.117*** | 0.013 | -0.104*** | 0.013 | -0.081*** | 0.012 | -0.071*** | 0.012 |
| 2010 | -0.120*** | 0.013 | -0.112*** | 0.013 | -0.079*** | 0.012 | -0.069*** | 0.012 |
| 2012 | -0.178*** | 0.013 | -0.168*** | 0.013 | -0.156*** | 0.012 | -0.146*** | 0.012 |
| 2014 | -0.169*** | 0.013 | -0.159*** | 0.013 | -0.151*** | 0.012 | -0.142*** | 0.012 |
| *Field of study (ref. Natural sciences)* | | | | | | | | |
| Medical sciences | 0.065*** | 0.012 | 0.083*** | 0.012 | 0.029*** | 0.010 | 0.054*** | 0.010 |
| Agricultural sciences | -0.058** | 0.015 | -0.060*** | 0.015 | -0.023*** | 0.014 | -0.018*** | 0.014 |
| Engineering and Technology | -0.030*** | 0.009 | -0.030*** | 0.009 | -0.026*** | 0.011 | -0.023*** | 0.011 |
| Social sciences | -0.004 | 0.009 | -0.015* | 0.009 | -0.01 | 0.008 | -0.011 | 0.008 |
| Constant | 0.268*** | 0.017 | 0.458*** | 0.012 | 0.232*** | 0.016 | 0.390*** | 0.011 |
| *F* | 65.387 | | 41.469 | | 65.523 | | 43.378 | |
| *R2* | 0.047 | | 0.022 | | 0.044 | | 0.021 | |
| *N* | 18,455 | | 18,455 | | 19,928 | | 19,928 | |

Note: * p<0.05; ** p<0.01; *** p<0.001

## Is parenting responsible for the gender gap in early career outcomes?

Our findings confirm that having children and obtaining an academic position affect scientific productivity, and parental status comes with significantly lower career chances. This is true for both male and female PhD graduates. Hence, we investigate the extent to which these factors could account for the observed gender disparity.

The Kitagawa-Blinder-Oaxaca decomposition is a simple way to isolate 1) the fraction of the observed gap due to differences between men and women with respect to their observable characteristics included as explanatory variables in our regression, which is

named difference due to *endowment* and 2) the fraction of the observed gap we would observe even if men and women were on average equivalent concerning their observable characteristics, which is named difference due to *coefficients* (plus a third component we ignore here being empirically irrelevant in our case). The decomposition results are summarized in Table 3, with detailed output in the Appendix A (Table A2, Table A3).

**Table 3.** Threefold Kitagawa-Blinder-Oaxaca decomposition of the gender gap in scientific productivity and academic position. Summary table.

| | *Scientific productivity* | | *Academic position* | |
|---|---|---|---|---|
| | *Coeff.* | *SE* | *Coeff.* | *SE* |
| Group 1: women = 0 | 0.594*** | 0.004 | 0.302*** | 0.003 |
| Group 2: women = 1 | 0.537*** | 0.004 | 0.270*** | 0.003 |
| Gender gap (men vs women) | 0.057*** | 0.005 | 0.032*** | 0.005 |
| Endowments | 0.003 | 0.003 | 0.006*** | 0.002 |
| Coefficients | 0.060*** | 0.005 | 0.025*** | 0.005 |
| Interaction | -0.006*** | 0.002 | 0.001 | 0.002 |

Note: * p<0.05; ** p<0.01; *** p<0.001

As for scientific productivity, the gender gap is as large as 0.057 in favour of men and statistically significant, i.e., men have an advantage of 6 percentage points over women to fall in the productive group, with more than three publications. This gap is largely due to across-gender differences in the coefficients of our regression (the fraction of endowments as well as the interaction are negligible), meaning that even if men and women had, on average, the same value of the explanatory variables we included in our regression, men would still have higher scientific productivity as compared to women.

Despite being clear from Tab. 3 that the gender gap in productivity is driven by an across-gender difference in the regression coefficients, looking separately at the difference with respect to every single coefficient, no statistically significant difference emerges (see Table A2 in the Appendix A). Our interpretation is that our data has enough

statistical precision to detect an overall difference in the coefficients but not enough to identify which coefficients are responsible for that difference.

Concerning academic position, the results of the Kitagawa-Blinder-Oaxaca decomposition are quite similar. The statistically significant gender gap in favour of men is as large as 0.032. It appears mainly due to differences in the coefficients part (the fraction of endowments as well as the interactions are very small). Even here, looking at gender differences with respect to each single coefficient, it is difficult to spot the culprit. In any case, small differences to the disadvantage of women emerge in social sciences, as well as in the oldest educational cohort. In contrast, the career advantage of women in medical science fosters overall gender parity.

## 5 Conclusions and discussions

The under-representation of women in top academic positions is still a burning agenda in most European countries. Although the reasons for the leaky pipeline in science are still being debated, the scholars suggest that the first crucial point is the transition from completing doctoral studies (where women represent half of the PhD population in most scientific disciplines) to employment, thus, the moment of choosing an academic career over other labour market alternatives (e.g., Ahmad, 2017).

In support of this claim, we find that as early as 4 to 6 years after the PhD completion, there are visible gender differences in scientific productivity and occupational attainment in favour of male PhD holders (in line with Carriero & Naldini, 2022). However, our model suggests that these gender differences in both outcomes cannot be attributed to differences in the endowments - pre-employment characteristics - of the PhD graduates. Comparative and decomposition analysis shows that both men and women are quite equal in their compliance to an academic career: there are no significant differences

between the genders in any of the four characteristics (a graduation mark, PhD completion in time, research stay abroad during PhD training, and teaching experience during PhD training) we consider. Thus, even having the same attributes at the end of their doctoral studies, men and women obtain different outcomes in the labour market. These findings highlight that at high levels of educational attainment, given the high selectivity of PhD candidates, the difference in career outcomes is largely due to the attributes (advantages and disadvantages) that men and women acquire over time, not least because of the existence of organisational processes and practices that support gender inequality.

In line with previous research, our analysis reveals that early scientific productivity strongly depends on the occupational position obtained after a PhD completion. Working in an academic environment increases the productivity of both men and women. Predictably, both men and women increase their productivity with career years, but among non-academics, women enhance their productivity at a more intense rate than men. Our findings reflect possible gender differences in the publication patterns that were discovered by previous research (Kim & Moser, 2021) and emphasise the importance of career choices during the transition to the labour market.

In turn, we discover that, on average, parents have lower publication records than their childless counterparts, notwithstanding the fact that they have similar characteristics of academic compliance. The parenthood penalty is slightly more pronounced among women, which - as research suggests - may be due to their greater parental load compared to fathers (Jolly et al., 2014). Although the occupational position and parental status bear an effect on research productivity for men and women, they explain quite a small part of the gender gap observed.

Our research reveals that both male and female parents have lower chances of working in academia than childless PhD graduates. This inclination toward non-academic careers might stem from concerns about avoiding work-family conflicts. For fathers, this choice may be influenced by their roles as primary earners, seeking occupations with higher wages and job security, which can be challenging to find in academia due to the instability of early academic careers and relatively lower sector incomes. On the other hand, given the demanding nature of early academic careers, mothers may anticipate greater difficulties balancing their work and family responsibilities.

Although the motherhood penalty cannot explain the gender disparity in the chances of entering academia, our results suggest that this may be due to differences in the distribution of PhD graduates across different scientific fields. The lack of a female academic role model due to the systematic underrepresentation of women in specific fields may discourage women from pursuing academic careers (Gillooly et al., 2021). Moreover, the social sciences and humanities are fields with low employment opportunities outside academia (Passaretta et al., 2019), reinforcing the competition for academic positions. As a result, women may avoid highly competitive environments and not apply for a position if it involves a high contest (Pautasso, 2015) or if the perceived chances of success are weak (De Paola et al., 2017).

We are aware that using cross-sectional data, we cannot fully account for the time dimension; in particular, there is no information about the time of childbirth (even roughly - before or after entering the labour market). Since parents can be quite heterogeneous with respect to children's characteristics, the negative effect of parenthood may be slightly biased (probably underestimated). The same limitation is relevant to an occupational position. The data do not allow us to estimate the current employment duration or account for previous positions. However, we can assume a relative

homogeneity among PhD holders, given that the academic career path in Italy is rather standardised; accordingly, early career opportunities are limited to postdoc or research positions (Ballarino & Colombo, 2010).

Nevertheless, our findings stress that the issue of equal gender opportunities in the labour market for PhD graduates remains highly relevant. Given that the gender gap in early career outcomes of PhD holders remains largely unexplained, while it can have far-reaching career consequences, our study emphasises the importance of further research to explore possible mechanisms through which this gap materialises. If we exclude that this is due to the cross-gender differences in individual characteristics we observe in our data, there is room to argue that the gender gaps we observe are also due to gender discrimination. This is suggested in recent experiment-based studies in Italy, which revealed gender bias against women in the admission to entry-level academic and research positions in hard science (Checchi et al., 2019), economic sciences, but only by an all-male selection committee (Gërxhani et al., 2023), and overall, in further progression to professorial positions (De Paola & Scoppa, 2015). The gender gap in hiring chances disappears if gender-balanced commissions assess candidates. Thus, following existing discussions on the importance of a transparent gender-neutral evaluation and promotion system and the application of compensatory gender policies (Filandri et al., 2023; Pautasso, 2015), our study suggests that further research in this area must inform the development of evidence-based measures and strategies to bridge the gender gap in academia.

# Chapter 3

## The path to tenure: Does parenthood really matter? An event history analysis of academic careers in Italian universities


### Abstract

A vast body of literature demonstrates the existence of a gender gap in academia: academic women are less represented in leading positions and have slower careers compared to academic men. Among the explanations for such gender gaps, motherhood penalties are frequently mentioned. However, little previous research was able to measure the possible causal link between fertility and career progression due to the lack of longitudinal data on academic women and, especially, on academic men. Using unique primary-collected data, we reconstruct the career histories of a sample of 1,948 academic men and women in Italy, together with their fertility histories. Applying Cox Proportional Hazard models, we can estimate, more accurately compared to previous studies, the effect of parenthood on the path to tenure and compare the impact of parenthood between academic women and men. Results show no gender differences in the chances of career advancement from PhD completion to non-tenured academic positions. At the same time, there is a statistically significant gender gap to the detriment of women in the hazard of obtaining a tenured academic position. Results show that, on average, women wait longer than men for tenure. This gender gap remains significant even after controlling for the transition to parenthood and to a second birth. For women, childbearing is unrelated to academic promotions, net of scholarly productivity, and other controls. For men, the birth of a first child often acts as a powerful catalyst, driving advancements in their careers, from non-tenured assistant professorships to tenured positions and even to the esteemed rank of associate professor. Conversely, the arrival of a second child frequently signals a setback, particularly noticeable in the early stages of their careers, such as postdoctoral positions, non-tenured assistant professorships, and permanent researcher roles. Our results disprove the existence of a motherhood penalty in academia for Italy but confirm the existence of both a fatherhood penalty and a premium.



**Keywords:** academia, childbearing, event history analysis, gender inequality, academic promotions, Italy.

## 1 Introduction

Despite significant progress towards gender equality in academia has been made and equality and diversity policies aimed at creating equal opportunities for all groups of academics have been promoted in the past decades (Roberto et al., 2020), a large body of literature shows the persistence of gender gaps in academia (Carlsson et al., 2021; Filandri & Pasqua, 2021; Fox & Gaughan, 2021; Kim & Moser, 2021; Huang et al., 2020; Van den Besselaar & Sandström, 2016; Shaik & Fusulier, 2015; Shauman, 2017; Webber & Canche, 2018), especially in accessing top-level academic positions and, more generally, in terms of career progression (Roberto et al., 2020; Picardi, 2019; Ceci, 2018; De Paola et al., 2018; Box-Steffensmeier et al., 2015). Gender gaps in career progression are particularly evident in the Italian context, the focus of this contribution (Bozzon et al., 2017; Marini & Meschitti, 2018; Picardi, 2019; Gaiaschi & Musumeci, 2020; Carriero & Naldini, 2022; Carriero et al., 2023).

At the doctoral level, in most scientific disciplines, women and men are equally represented: as of 2018, i.e., the latest data available at the time of writing, women represented 47.8% of the total doctoral students in Europe and 50.5% in Italy. However, starting from the very first steps of the academic career, there is a significant outflow of female doctorates from the academic track, generally labelled a “leaky pipeline.” Those women who stay in academia have slower careers compared to men (Sabatier, 2010); in particular, women are less likely or slower to be tenured, i.e., to be given a permanent post, compared to men (Box-Steffensmeier et al., 2015; Lutter et al., 2022) and are less likely to reach top-level academic positions. In Europe, women hold only 26.2% of full professor positions; in Italy, the under-representation of women is even more marked, with only 23.7% of women holding said positions (She Figures 2021).

Recent research on Italian academia shows that female doctorates are less likely to stay in Academia compared to male doctorates (Zabetta & Geuna, 2020; Carriero et al., 2023). In addition, the transition from a precarious academic position to a stable one, measured by the so-called “glass door index”, i.e., the ratio between academics with a fix-term contract and those with a permanent contract, is higher for academic women than for academic men (Picardi, 2019). Moreover, men have a higher probability of being promoted to tenured academic positions, at least among the pool of those who obtained the national scientific habilitation that, in Italian academia, is a prerequisite to being promoted to the role of Associate and Full Professor (Marini & Meschitti, 2018; Filandri & Pasqua, 2019).

Despite the abundance of research on the existence of gender inequality in career progression in academia, few are empirical contributions on the mechanisms leading to the existing gender gaps. The literature frequently mentions parenthood among such mechanisms (e.g., Mason et al. 2019). Pregnancy, maternity leave, and subsequent childcare responsibilities –that continue to be disproportionately shouldered by mothers in the general population as well as in academia (Suitor et al., 2001; Derrick et al., 2022)– may explain why academic women are less likely to progress onto the academic ladder compared to their male peers.

However, existing research failed to properly evaluate the gendered consequences of childbearing for career advancement among academics. To our knowledge, no previous study has attempted to empirically test the effect of parenthood on career progression by comparing academic women and men. Such lack of knowledge is not surprising given that, to properly test the association, information on both academic women's and men's career histories and fertility histories is needed – but such data is not readily available.

Also, the association between parenthood and career progression among academic fathers is seldom studied. However, an emerging scholarship suggests that –at least some– academic fathers are increasingly engaged in child rearing (e.g., Sallee, 2014; Damaske et al., 2014; Derrick et al., 2022).

This contribution aims at closing these two knowledge gaps. Using unique primary-collected retrospective data, we reconstruct the career and fertility histories of a sample of 1,948 academics working in Italian universities in 2023. Applying event history analysis, we can empirically estimate the role of childbirth on academic careers among academic women and men. More specifically, this study investigates two research questions:

RQ1: *Does the gender gap in academic career progression in Italy persist after controlling for individual and job-related factors, such as parental status and scientific productivity?*

RQ2: *Is the effect of parenthood on academic career progression gendered? In other words, do we find evidence, for Italy, of a motherhood penalty and a fatherhood premium?*

## 2 Background

Some studies document a recent shift towards gender parity in specific academic disciplines and countries. In Sweden, among recent cohorts of PhD graduates, there are no gender differences in the chances of obtaining a first academic appointment (Danell & Hjerm, 2013). Among physicists in France, women have the same chances of advancement from junior to senior researchers as men, controlling for a set of bibliometric (e.g., number of scientific publications, number of citations) and

family-related characteristics (e.g., presence of children) (Mairesse et al., 2020). No evidence of gender differences in the chances of obtaining the first tenured position was found using a panel of German psychologists, net of research productivity, and the presence of children (small children in particular) (Lutter et al., 2022). Also, no gender gap in the chances of career promotion to a professorship in science and engineering was found in the US (Kaminski & Geisler, 2012).

Despite these encouraging exceptions, most of the existing literature shows that women, on average, still tend to have lower chances of being promoted to top-level academic positions and have slower career progressions compared to men. Gaiaschi and Musumeci (2020) note that the trend towards gender parity among academic staff may result from demographic change (e.g., the retirement of the oldest male cohorts) rather than the removal of existing gender barriers. A recent study from Italy detects the presence of a "glass door" effect, i.e., the accumulation of women, but not men, in precarious academic positions regardless of the scientific discipline (Picardi, 2019). In social sciences in the US, academic men are more likely to be promoted to associate professors than academic women (Box-Steffensmeier et al., 2015). Also, gender differences in promotion were found among biologists in France: women obtain senior researcher positions more slowly than men, especially at the beginning of their career, net of research productivity and other characteristics (Sabatier, 2010).

Two interrelated factors are considered to be responsible for the persistent disadvantage of women in academia: women's lower scientific productivity compared to men and childcare responsibility. Empirical analyses show that, on average, women publish less than men (Huang et al., 2020; Jappelli et al., 2017; Uhly et al., 2017; Filandri & Pasqua, 2019; Ooms et al., 2019). Women's reduced scientific productivity compared to men would be, in turn, responsible for their slower career progression. Therefore, it is

beneficial to examine the explanations presented in scholarly works elucidating gender disparities in scientific productivity. With the caveat that gender differences in research performance are highly conditional on which indicator of productivity is taken into account (Nygaard & Bahgat, 2018), attempts were made to link women's lower scientific productivity with lower research abilities (Ceci et al., 2014) –an argument that has been repeatedly refuted by evidence that women's contributions to science are of similar if not higher quality than those of men (Hengel, 2017)–, smaller research networks (Leahey & Reikowsky, 2008; Lutter, 2015; Ductor et al., 2021; Zheng et al., 2022) and choice of less rewarding research specialisation (Leahey, 2006; 2007). Yet, the more common explanation put forward by the literature for the observed productivity-gender gap in academia is parenthood (e.g., Ahmad, 2017; Mason et al., 2013; Castaneda & Isgro, 2013; Ward & Wolf-Wendel, 2004; 2012; Suitor et al., 2001). Assuming that women and men at the beginning of their careers have similar abilities and motivation, women's underperformance in terms of scientific productivity, which in turn contributes to a lag in career advancement, can be the result of a gendered allocation of time between work and family, i.e., academic women may spend less time on research activities compared to academic men due to family-related responsibilities, in particular, childcare (Sieverding et al., 2018). The academic path entails a long pre-career stage: on average, PhD students defend their dissertation in their early 30s. This is also the median age at first childbirth in Europe (Source: OECD family database): the first stages of one's academic career overlap with family formation. Therefore, childbearing can significantly alter scientific productivity and shape academic career paths (Kyvik & Teigen, 1996; Joecks, 2014; Lutter & Schröder, 2019).

The responsibility of childcare can reduce the available time for research activities and limit opportunities for expanding professional networks, including attendance at

conferences, meetings, and social gatherings within the academic community. These factors can indirectly influence one's scholarly productivity. Childbearing and childrearing (especially of young children) can lead to a short-term (the so-called "productivity shock") as well as long-term reduction of scientific productivity due to reallocation of time between (research) work and family around and after childbirth (Lutter, 2015; Mairesse et al., 2020), which may contribute to a slower career progression for academic parents.

While child penalties are in principle common to both mothers and fathers in the general population, in practice, mothers tend to devote considerably more time to childcare and other home activities than fathers – a result that holds across different national settings, in particular in Italy, despite an increase in fathers' time spent with children over time in the general population (e.g., Altintas & Sullivan, 2016). Such gender differences in childcare are also evident among academics: academic mothers are disproportionately more likely to be the main carer for their child(ren) than academic fathers, including when their partner is also an academic (Derrick et al., 2022). Gender differences in the time spent on childcare and work activities relate to gendered ideals of what it means to be a "good" parent: "intensive motherhood" norms prescribe that mothers prioritise their children over other spheres of life (Ennis, 2014; Heys, 1996), whereas a man, in order to be a "good father" must be employed and a provider of acceptable income (Petts, 2022; Bernard, 1981; Kaufman, 2013). As a result, male and female academics are subject to different gendered expectations regarding parenting and work: mothers may feel entitled (or obliged) to take time off for child-rearing.

Furthermore, childbearing creates a career disruption due to pregnancy, childbirth, breastfeeding, and a period of compulsory maternity leave (at the time of writing, in Italy, the compulsory period of maternal leave equals five months fully paid for mothers and

ten days for fathers; both parents can request an additional period of leave of seven months paid 30% of their salary) that can affect mothers' scientific productivity and career progression more than fathers'. Research on non-academic women shows that, in the general population, women have a strong penalty in terms of productivity and earnings after taking maternity leave (Aslim et al., 2021; Doren, 2019; Akgunduz & Plantenga, 2013), while there is little evidence of how maternity leave affects academic women. Research from the US shows that academic women experience a productivity penalty after taking maternity leave, reducing their chances to be hired in tenured positions (Antecol et al., 2018) and increasing the time to promotion (McElrath, 1992; Morrison et al., 2011). Since the academic's workload is flexible enough to allow women to combine work and family, in contexts where maternity leave is not (well) paid, female academics may prefer to take only short periods of leave or do not take official maternity leave at all, to maintain the same level of earnings (Armenti, 2004).

Research on academic fathers is limited but attracting a growing scholarly interest. Such literature reveals great heterogeneity in how academic men approach work and family, ranging from breadwinning men with strong work devotion to men who consciously reduce their devotion to work to prioritise egalitarian partnerships (Damaske et al., 2014). A recent US study showed that academic fathers and mothers experience a productivity penalty in terms of scientific publications, citations, and scientific collaborations compared to non-parents –a "parenthood gender gap"–although mothers are penalised more than fathers (Zheng et al., 2022). Qualitative research documented that younger cohorts of academic fathers are willing to spend equal time with their children as their female partners (Reddick et al., 2012) and report similar challenges linked to their work-family balance as academic mothers (Sallee, 2014). Furthermore, academic fathers appear to have slow careers, similar to academic mothers, when they are the lead or the

sole parent(Derrick et al., 2022). This evidence suggests that, in principle, the negative effects of childcare on academic productivity and promotion can also apply to –at least some–academic fathers, particularly those belonging to the younger cohorts.

On the other hand, another strand of literature identified a "fatherhood premium" in various indicators of academic outcomes for men. Academic fathers tend to have higher scientific productivity, more citations, bigger collaboration networks, and score better in terms of subjective perception of scholarly recognition and satisfaction with their career (Hunter & Leahey, 2010; Kelly & Grant, 2012; Zheng et al., 2022) compared to academic mothers and childless men, while childless women and childless men score similarly. In particular, on average, fathers tend to publish more than mothers and non-fathers (Morgan et al., 2021; Krapf et al., 2017). Among German psychologists, parenthood is positively associated with the probability of becoming a professor for academic men, whereas the association is negative, though not statistically significant for women (Lutter et al., 2022). The "fatherhood premium" adds up to the existing "motherhood penalty" –mothers are less often promoted or are promoted later compared to non-mothers (e.g., Ginther & Kahn 2004; Wolfinger et al., 2008)– to enlarge gender gaps in academia further. Overall, this evidence suggests that parenthood and, more generally, childbearing have gendered implications for academic careers. Indeed, some scholars have argued that the observed gender gaps in academic achievement are, in fact, “parental gender gaps” (Zheng et al., 2022).

Most of such previous studies, however, have some limitations. They generally operationalise childcare as a dummy variable (parent vs. childless) and cross-sectionally evaluate its association with scientific productivity or career stage/promotion. Such an approach prevents a proper evaluation of a potential causal relationship between

childbearing and scientific productivity or career progression –a limitation we intend to overcome with this contribution.

On the other hand, reverse causality may be in place: promotions may trigger fertility. High-educated, career-oriented women tend to postpone fertility to later ages to accommodate longer education periods and establish their work careers (e.g., Nitsche & Brückner, 2021; Vitali et al., 2009). Thus, to avoid negative effects on their careers, academic women may delay having their first child until they have attained a stable, possibly tenured, academic position. In support of this claim, research from Italy, using administrative data, found that promotion to associate professor increases the probability of having a child among academic women (De Paola et al., 2021). In other words, only after being promoted are women more prone to become mothers, a result that further supports claims that career advancement and childbearing are incompatible among academic women.

## 3 Data, variables, and methods

### Data

In order to correctly estimate the association between childbirth and career progression to evaluate to what extent childbearing is responsible for the gender gap in academia, individual-level information on both fertility and career histories recording the quantum (i.e., whether a childbirth and/or a career progression occurred) and the timing (in what year did they occur) of events are needed for both academic women and men. To our knowledge, secondary data representative of an entire academic community is unavailable. Hence, we implement primary data collection.

Using an online questionnaire and non-probability sampling, we obtain a unique original longitudinal dataset on academics in Italy. Sample participants, i.e., academics working in Italian universities in 2021-2022, were asked to provide retrospective information that allowed us to reconstruct their fertility and career histories, including professional milestones and family-related events. The survey did not include individuals who earned doctoral degrees but transitioned out of academia after completing their PhD, nor did it encompass academics who were not faculty members as of 2022.

The questionnaire has reached 4392 respondents, of whom 2443 completed all mandatory questions. After the data cleaning process, we excluded individuals without a PhD degree (as it was historically possible to enter an Italian academy without one), those who entered academia before completing their PhD, and those who provided obviously incorrect information, thus retaining 1948 respondents.

The sample includes 389 postdoctoral fellows (58% of which are women), 225 non-tenured assistant professors (61% of which are women), 220 tenured assistant professors (55% of which are women), 131 permanent researchers (66% of which are women), 685 associate professors (66% of which are women), and 298 full professors (38% of which are women). To strengthen the representativeness of the sample, we created and applied sample weights (according to the logic of quota sampling) concerning gender, academic rank, and academic discipline (see Appendix B, Table B1), using publicly available administrative data on the entire population of Italian academics (Italian Ministry of Education, University and Research 2020). A visual comparison of the sample structure and population structure can be found in the Appendix section (Appendix B, Figure B1).

**Variables**

The dependent variable is the hazard of being promoted to a given academic position (event). The main explanatory variables are *gender,* i.e., a time-constant dummy variable, and *parenthood status*, i.e., a time-varying variable that measures transitions to a first and second child before promotion and distinguishes between childless respondents, those with one child and those with two children at each time point (year) of analysis. The survey allowed respondents to identify their gender, non-binary or other, but very few respondents identified with options different from males or females. The time-varying variables are constructed by splitting the data into two episodes before and after an event (if it happens during the observation windows) based on respondents' self-reported information on their parenthood status at the interview and each child's birth year. Thus, for childless respondents, the parenthood status variable is zero throughout the observation window. For parents, it is zero at the start of the observation and until the year before the child's birth, when it changes to one after a first birth and two after a second birth. If a respondent was already a parent of one or two children before the start of the observation window, the corresponding variable(s) would be assigned a value of one or two, respectively, upon entering the risk set for promotion. Also, *parental status* is used as a time-constant dummy variable for descriptive proposals, distinguishing between childless respondents and parents at the moment of the interview.

We have included several available control variables in the analysis (all time-constant). In particular, a dummy variable, *"PhD cohort,"* distinguishes those who obtained their PhD before or after the 2010 Gelmini reform, which significantly shapes career trajectories. The variable "*age at the PhD"* indicates the age at which the respondent completed his/her doctoral studies. The categorical variable *"field of study"* encompasses Natural

sciences, Engineering and Technology, Medical sciences, Agricultural and Veterinary sciences, Social sciences, and Humanities. The "*geographical macro-area"* of residence includes three categories: Center, North, South and Islands. We also control for a proxy of "*scholarly productivity,"* i.e., the average number of published scientific articles per year since PhD completion. In order to construct this variable, the original variable ("total number of articles"') was transformed from an interval to a metric scale (as the average value of the interval) and then used to calculate the average annual number of publications.

Table 1 provides descriptive statistics of the independent variables as of the interview date. For detailed descriptive statistics of the male and female samples, please refer to Appendix B, Table B2.

**Table 1.** Summary statistics at the moment of interview, wights are applied

| | *Postdoc Fellows* | *N/tenured Assistant Professors* | *Tenured Assistant Professors* | *Permanent Researchers* | *Associate Professors* | *Full Professors* |
|---|---|---|---|---|---|---|
| Female | 46.8 | 47.7 | 41.5 | 56.6 | 42.8 | 28.4 |
| *Parental status:* | | | | | | |
| Childless | 79.7 | 59.0 | 42.9 | 31.9 | 21.4 | 16.2 |
| 1 child | 13.2 | 22.8 | 27.0 | 25.5 | 28.8 | 26.8 |
| 2 (or more) children | 7.1 | 18.2 | 30.1 | 42.6 | 49.8 | 57.0 |
| Scholarly productivity | 6.8 | 5.1 | 4.6 | 2.0 | 2.6 | 1.9 |
| Age | 33.6 | 36.6 | 40.4 | 50.9 | 49.2 | 56.6 |
| *PhD cohort:* | | | | | | |
| 2009 & older | 2.2 | 11.0 | 31.2 | 91.8 | 88.5 | 98.8 |
| 2010 & recent | 97.8 | 89.0 | 68.9 | 8.2 | 11.5 | 1.2 |
| *Field of study:* | | | | | | |
| Natural sciences | 30.8 | 27.9 | 27.9 | 27.4 | 26.2 | 23.9 |
| Engineering and technology | 27.6 | 23.0 | 17.5 | 14.9 | 17.5 | 16.9 |
| Medical sciences | 8.3 | 13.4 | 12.0 | 13.2 | 11.3 | 11.2 |
| Agricultural sciences | 6.6 | 6.0 | 4.8 | 6.9 | 5.6 | 4.8 |
| Social sciences | 13.1 | 17.3 | 18.4 | 26.5 | 19.9 | 24.8 |
| Humanities | 13.7 | 12.6 | 19.3 | 11.2 | 19.6 | 18.4 |
| *Geographical macro-area:* | | | | | | |
| Center | 43.4 | 21.4 | 29.2 | 31.4 | 29.1 | 28.7 |
| North | 44.1 | 57.4 | 43.5 | 49.0 | 51.7 | 54.2 |
| South & Islands | 12.4 | 21.2 | 27.3 | 19.6 | 19.2 | 17.1 |
| N. | 389 | 225 | 220 | 131 | 685 | 298 |

## Method

We apply event history (survival) analysis to estimate the hazard of being promoted to a particular academic rank of the Italian academic career (postdoctoral fellow, non-tenured assistant professor, tenured assistant professor, permanent researcher, associate professor, full professor). This method enables us to go beyond merely estimating the observed disparities in academic rank by gender and parenthood status, as commonly seen in previous studies, which have been acknowledged for their limitations, as outlined in the background section. Crucially, event history analysis empowers us to gauge not only the observed differences but also the duration—specifically, the time (measured in years) taken by women and men, both with and without children, to attain a particular academic rank. Taking advantage of the longitudinal aspect of our data set, event history analysis facilitates the exploration of whether and to what degree childbirth impacts the likelihood and timing of subsequent academic promotions while controlling for other relevant factors. Additionally, it allows us to discern whether these effects vary between genders.

Another notable advantage of event history analysis is its incorporation of right-censored cases, encompassing respondents who have not yet experienced the event within the observation window (up to 2022). These individuals still contribute to the calculation of the average time to promotion. Consequently, at the outset, all respondents possessing the requisite characteristics bear a risk of advancement to an academic position spanning from postdoctoral researcher to full professor.

In the first descriptive step, we employ Kaplan-Meier survival curves, a widely adopted method for illustrating survival patterns. By comparing male and female curves across all academic promotion stages, we can evaluate potential gender disparities within each rank of the academic trajectory. Additionally, by juxtaposing Kaplan-Meier survival curves

across parenthood status and gender, we can discern the presence of potential parenthood-related penalties in academic advancements for both women and men.

Borrowed from epidemiology, where they were first used to study mortality, survival curves graphically show the risk of "dying" and the average time between entering the risk of dying and death for individuals in a given group. In our case, 'death' represents success, i.e., promotion to the next academic rank. The longer the survival, the slower the academic career. In turn, entry into risk varies according to the requirements for a given academic rank. Table 2 summarises the criteria for inclusion in the risk set of all career-related transitions that our data allow us to examine.

**Table 2.** Promotion matrix

| | *Postdoc Fellows* | *N/tenured Assistant Professors* | *Tenured Assistant Professors* | *Permanent Researchers* | *Associate Professors* | *Full Professors* |
|---|---|---|---|---|---|---|
| Entrance into risk (t0) | Year of PhD completion | Year of PhD completion, (1) | (1), (2) | Year of PhD completion | (2), (3), (4) | (5) |
| N. at risk | 1,141 | 1,922 | 1,103 | 1,085 | 1,269 | 857 |
| N. of events | 627 | 402 | 292 | 672 | 847 | 283 |
| Exit from the risk set: | | | | | | |
| Experience of promotion | Year of promotion to (1) (2), (3) | Year of promotion to (2) (3), (5) | Year of promotion to (3) (5) | Year of promotion to (4) (5) | Year of promotion to (5) (6) | Year of promotion to (6) |
| Right censoring | Survey year | Survey year | Survey year | Survey year | Survey year | Survey year |

In Italy, the transition to the postdoctoral fellow, non-tenured assistant professors, and, in the past, to permanent researchers can happen immediately after obtaining a PhD degree (t0); therefore, all respondents from our sample are exposed to the risk of being promoted to each of these academic ranks. Further, respondents remain in the observation windows until they experience the event. Censored cases, i.e., those in the risk set but, at the time of the survey, have not been promoted yet, remain under observation until the interview year or until an alternative event. Thus, those respondents who skipped the postdoc

position and were promoted directly to a non-tenured assistant professorship or permanent researcher immediately after PhD completion leave the observation window (i.e., remain censored until) in the year of obtaining the corresponding position. The same logic is valid for the non-tenured assistant position: those directly promoted to a tenured assistant professor or to permanent researcher exit from the observation in the year of obtaining the position.

To be eligible for tenured assistant professor, a person must be at least a postdoctoral fellow. The person leaves the at-risk group as soon as he/she is promoted to a tenured assistant professor or if a person directly obtained a permanent researcher or associate professor (which is highly unlikely); otherwise, he/she will remain censored until the survey year.

For the transition to associate professor, only those in non-tenured assistant professor positions, tenured assistant professor positions, or permanent researchers positions are at risk of being promoted. Thus, these respondents enter the risk set of being promoted to associate professor in the year they first obtain one of the mentioned positions. Respondents remain in the observation window until they are promoted to associate professor or are censored until the year of the interview.

To become a full professor, a person must currently hold an associate professor rank. Thus, in this case, respondents enter the risk set in the year they are promoted to associate professor and exit from the observation window when they experience the event or are censored until the year of the interview.

In the second step, we implement a semiparametric approach using a Cox Proportional Hazard model. Unlike the Kaplan-Meier method, the Cox Proportional Hazards model furnishes an effect estimate by measuring the disparity in hazards between groups (men

and women) while accommodating the confounding effects of additional variables. The essential assumption of the Cox model is the proportionality of risk (hazard), implying that the relative risk remains consistent over time across different levels of predictors or covariates. Post-estimation survival curves generated after the Cox model offer predictions for career progression among male and female academics while controlling for all other factors and covariates at their mean values.

To answer RQ 1 (*Does the gender gap in academic career progression in Italy persist after controlling for individual and job-related factors?*), we run six Cox proportional hazard models, one for each academic rank, from postdoctoral fellow to full professor. The dependent variable is the hazard of being promoted to each academic position. The primary explanatory variable is *gender*. We are interested in estimating whether the effect of gender on the hazard of academic progression remains statistically significant after including controls for parenthood and scholarly productivity, among others.

To answer RQ 2 (*Is the effect of parenthood on academic career progression gendered?*) again, we also use Cox proportional hazard models on the hazard of being promoted to each academic position. The dependent variable is the hazard of being promoted to each academic position. However, in this case, we run separate models for male and female samples, and the primary explanatory variable is *parental status*. Additionally, to ascertain the statistical significance of gender differences in the impact of parenthood, we employed Cox Proportional Hazard models on the pooled sample to analyse the likelihood of promotion to each academic position, including interactions between *gender* and *parental status.*

## 4 Results

### Descriptive findings. Are women still lagging behind?

Figure 1 shows the Kaplan-Meier survival curves reporting the time (in years) from entry into the risk of being promoted to promotion to various academic ranks by gender. The curves for men and women grossly overlap during the initial phases of the academic career (i.e., for the transition to a postdoctoral researcher, non-tenured assistant professors, tenured assistant professors, and, in the past, permanent researchers). In other words, there are no evident gender differences in the likelihood of obtaining academic positions nor in the time it takes to be promoted during the initial steps of the academic career in Italy. On average, women tend to have (slightly) faster transitions to a postdoctoral position following the completion of their PhD than men but (slightly) slower progression to tenured assistant professorships and, in the past, to the position of permanent researcher. In the subsequent phases of the academic career, gender differences to the detriment of women become evident. We find a significant gender gap in the promotion to associate professor and an even more significant gender gap in the promotion to full professor. On average, women tend to have slower careers than men.

The median time that academic men wait to reach the associate professor position is eight years after entering the risk set (i.e., 50% of men wait, on average, eight years). In contrast, for academic women, it is longer and equals ten years –hence, the gender gap equals two years. The gender gap in the median promotion time to a full professor is even more significant –about four years– with men waiting on average ten years and women fourteen years between the promotion to associate and the promotion to full professor. In both cases, the persistence of the gender gap is a matter of probability: female academics have lower chances of being promoted to professorship during the observation window (the curves do not intersect at the end of the observation). These descriptive analyses

hence confirm that the gender gap in academic careers that was documented by previous studies with different data sources is also present in our sample.

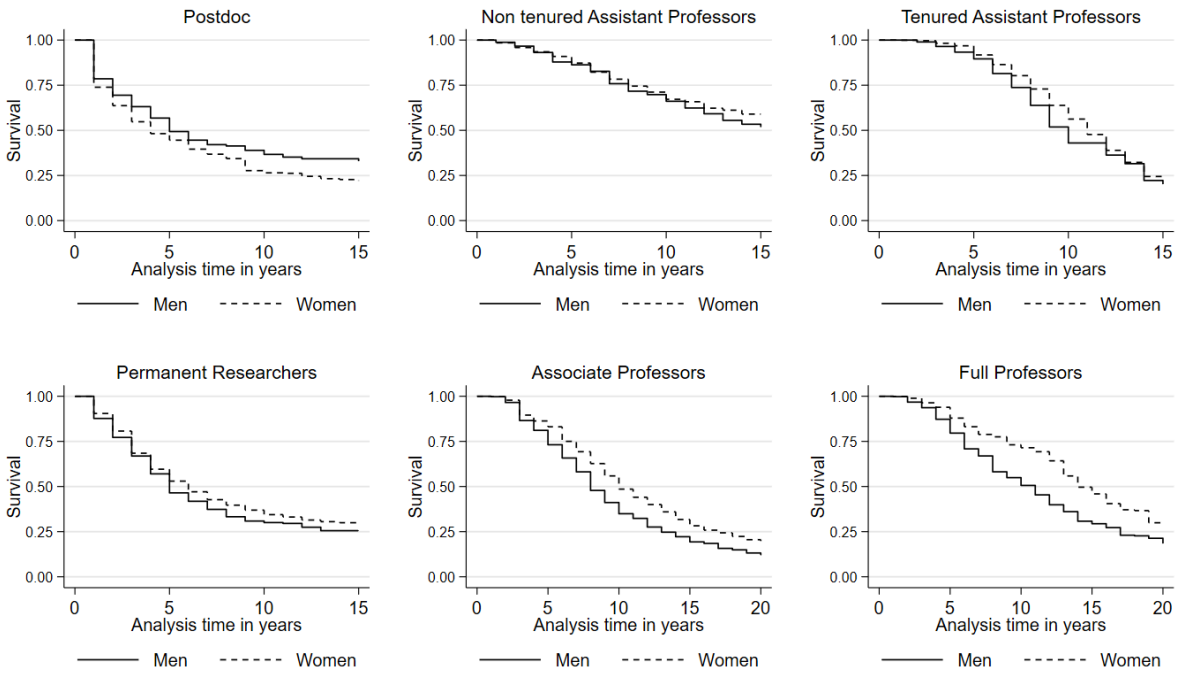



**Figure 1.** Kaplan-Meier survival curves. Time to academic promotion to various academic ranks by gender

Figure 2 visualises the Kaplan-Meier survival curves, delineating the duration (in years) from the inception of the risk set to the attainment of various academic ranks, categorised by gender and parental status (using as a dummy variable), namely childless men, childless women, fathers, and mothers. Notably, a discernible trend emerges during the early career phase (postdoc and non-tenured assistant professor), indicating that parents progress at a slower pace compared to their childless counterparts. Furthermore, fathers require even more years to secure postdoc positions compared to mothers, a phenomenon often referred to as the parental gender gap. The curves largely converge during the transition to tenured assistant professor and permanent researcher ranks, suggesting no significant gender or parental disparities in the likelihood of obtaining academic positions or the time taken for promotion. However, a distinct pattern emerges regarding the

progression to professorship, characterised by a fatherhood premium. Fathers exhibit shorter timelines in attaining associate and full professor positions, while mothers notably lag, particularly in achieving full professor status. Hence, the preliminary descriptive analysis suggests that parenthood likely plays a role in the enduring gender gap in career progression. However, its effect appears to be nuanced and not entirely straightforward.

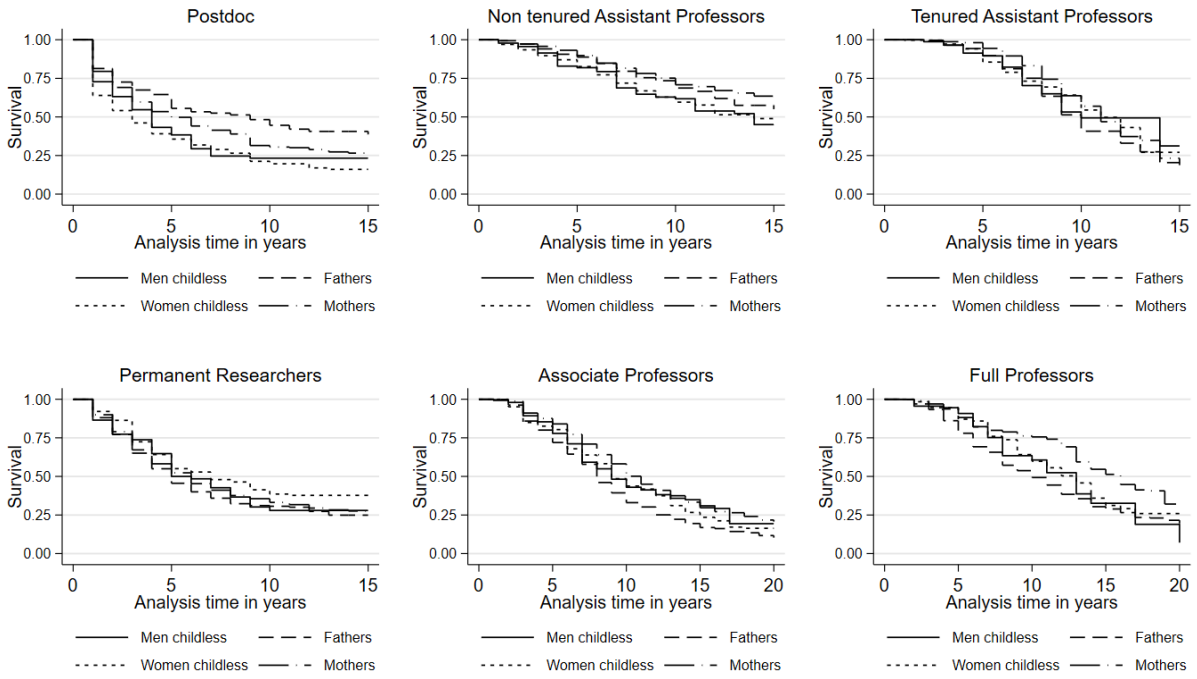



**Figure 2.** Kaplan-Meier survival curves. Time to academic promotion to various academic ranks by gender and parenthood status

## Does childbearing explain the gender gap?

Given that the transition from a precarious position to a tenured academic position generally overlaps with the ages when union formation and first birth typically occur, i.e., in the case of Italy, during one's early thirties (Bozzon et al., 2017), we now turn to analyse the association between parenthood and academic career, with the aim of understanding to what extent childbearing can be responsible for slowing down women's path to tenure.

Thus, we are interested in answering RQ1, i.e., understanding whether the existing gender gap that emerged from the descriptive analyses presented in the previous section is explained once parental status, scientific productivity –i.e., the two explanations generally put forward in the literature to explain the gender gap in academic achievements as reviewed in the background section–, and other controls are accounted for.

Tables 3.1 - 3.2 report the results of the Cox Proportional Hazard models on the transition to each academic position, from postdoctoral researcher to full professor. Results are expressed in exponentiated coefficients, i.e., hazard ratios (standard errors in parenthesis). Hazard ratios equal to 1 indicate no association between the independent and the dependent variable; hazard ratios higher than 1 indicate a positive association, hence a more likely and faster transition to a given academic position, whereas hazard ratios lower than one indicates a negative association, hence a less likely and a slower transition. The hazard ratio is assumed to be stable across all the groups under consideration.

The results comprise three models for each academic position: (1) the null model solely accounts for gender effects, (2) the second model incorporates both gender and parental status effects, and (3) the full model extends to encompass gender, parental status, and additional control variables.

**Table 3.1.** Cox Proportional Hazard regression models on the hazard of being promoted to each academic position, separate models: postdoc fellows, non-tenured assistant professors, and tenured assistant professors

| | Postdoc fellows | | | Non-tenured Assistant Professors | | | Tenured Assistant Professors | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (1) | (2) | (3) | (1) | (2) | (3) |
| Female | 1.249* | 1.284** | 1.281** | 0.92 | 0.95 | 1.00 | 0.79 | 0.78 | 0.731* |
| | (0.11) | (0.12) | (0.12) | (0.11) | (0.12) | (0.13) | (0.11) | (0.11) | (0.11) |
| *Parenthood status:* | | | | | | | | | |
| Childless (*ref*) | | 1 | 1 | | 1 | 1 | | 1 | 1 |
| | | (.) | (.) | | (.) | (.) | | (.) | (.) |
| 1 child | | 0.756* | 0.86 | | 1.09 | 1.23 | | 1.15 | 1.18 |
| | | (0.11) | (0.12) | | (0.17) | (0.20) | | (0.20) | (0.21) |
| 2 children | | 0.561** | 0.645* | | 0.512** | 0.592* | | 1.09 | 1.32 |
| | | (0.11) | (0.13) | | (0.11) | (0.12) | | (0.22) | (0.24) |
| Scholarly productivity | | | 1.155*** | | | 1.378*** | | | 1.300*** |
| | | | (0.02) | | | (0.03) | | | (0.06) |
| Age at PhD completion | | | 0.964* | | | 0.97 | | | 0.909*** |
| | | | (0.02) | | | (0.02) | | | (0.02) |
| *Field of study:* | | | | | | | | | |
| Natural sciences (*ref*) | | | 1 | | | 1 | | | 1 |
| | | | (.) | | | (.) | | | (.) |
| Engineering and technology | | | 0.87 | | | 0.99 | | | 0.75 |
| | | | (0.14) | | | (0.19) | | | (0.16) |
| Medical sciences | | | 0.67 | | | 0.68 | | | 1.12 |
| | | | (0.15) | | | (0.19) | | | (0.40) |
| Agricultural and Veterinary | | | 1.08 | | | 1.14 | | | 0.85 |
| | | | (0.15) | | | (0.22) | | | (0.20) |
| Social sciences | | | 1.18 | | | 1.31 | | | 1.543** |
| | | | (0.14) | | | (0.20) | | | (0.25) |
| Humanities | | | 1.18 | | | 0.68 | | | 0.98 |
| | | | (0.14) | | | (0.15) | | | (0.23) |
| *Geographical macro-area:* | | | | | | | | | |
| Center (*ref*) | | | 1 | | | 1 | | | 1 |
| | | | (.) | | | (.) | | | (.) |
| North | | | 0.84 | | | 1.451* | | | 0.82 |
| | | | (0.09) | | | (0.23) | | | (0.13) |
| South & Islands | | | 0.779* | | | 1.08 | | | 0.94 |
| | | | (0.09) | | | (0.19) | | | (0.16) |
| N | 1375 | 1375 | 1375 | 2258 | 2258 | 2258 | 1495 | 1495 | 1495 |

Exponentiated coefficients (i.e., hazard ratios); standard errors in parentheses. N - number of episod-persons. P-value: * p<0.05, ** p<0.01, *** p<0.001

**Table 3.2.** Cox Proportional Hazard regression models on the hazard of being promoted to each academic position, separate models: permanent researchers, associate professors, full professors.

| | Permanent Researchers | | | Associate Professors | | | Full Professors | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (1) | (2) | (3) | (1) | (2) | (3) |
| Female | 0.89 | 0.91 | 0.89 | 0.730** | 0.719*** | 0.726*** | 0.627*** | 0.629*** | 0.603*** |
| | (0.07) | (0.07) | (0.07) | (0.07) | (0.07) | (0.07) | (0.08) | (0.08) | (0.08) |
| *Parenthood status:* | | | | | | | | | |
| Childless (*ref*) | | 1 | 1 | | 1 | 1 | | 1 | 1 |
| | | (.) | (.) | | (.) | (.) | | (.) | (.) |
| 1 child | | 0.86 | 0.792* | | 1.19 | 1.21 | | 0.93 | 0.96 |
| | | (0.10) | (0.09) | | (0.13) | (0.13) | | (0.16) | (0.17) |
| 2 children | | 0.701* | 0.678* | | 1.20 | 1.15 | | 1.06 | 1.08 |
| | | (0.11) | (0.10) | | (0.14) | (0.13) | | (0.17) | (0.17) |
| Scholarly productivity | | | 0.712*** | | | 1.216*** | | | 1.19 |
| | | | (0.04) | | | (0.04) | | | (0.14) |
| Age at PhD completion | | | 1.02 | | | 0.98 | | | 0.97 |
| | | | (0.02) | | | (0.01) | | | (0.02) |
| *Field of study:* | | | | | | | | | |
| Natural sciences (*ref*) | | | 1 | | | 1 | | | 1 |
| | | | (.) | | | (.) | | | (.) |
| Engineering and technology | | | 1.26 | | | 1.05 | | | 0.95 |
| | | | (0.15) | | | (0.13) | | | (0.20) |
| Medical sciences | | | 0.82 | | | 0.71 | | | 1.35 |
| | | | (0.17) | | | (0.19) | | | (0.38) |
| Agricultural and Veterinary | | | 1.335* | | | 0.88 | | | 1.00 |
| | | | (0.19) | | | (0.13) | | | (0.22) |
| Social sciences | | | 1.264* | | | 1.28 | | | 1.422* |
| | | | (0.14) | | | (0.17) | | | (0.24) |
| Humanities | | | 0.87 | | | 1.410** | | | 1.32 |
| | | | (0.12) | | | (0.18) | | | (0.27) |
| *Geographical macro-area:* | | | | | | | | | |
| Center (*ref*) | | | 1 | | | 1 | | | 1 |
| | | | (.) | | | (.) | | | (.) |
| North | | | 0.92 | | | 1.17 | | | 0.90 |
| | | | (0.09) | | | (0.13) | | | (0.13) |
| South & Islands | | | 0.84 | | | 1.09 | | | 0.681* |
| | | | (0.10) | | | (0.14) | | | (0.13) |
| *PhD cohorts:* | | | | | | | | | |
| 2009 & older (*ref*) | | | | | | 1 | | | 1 |
| | | | | | | (.) | | | (.) |
| 2010 & recent | | | | | | 1.856*** | | | 0.71 |
| | | | | | | (0.30) | | | (0.49) |
| N | 1524 | 1524 | 1524 | 1895 | 1895 | 1895 | 996 | 996 | 996 |

Exponentiated coefficients (i.e., hazard ratios); standard errors in parentheses. N - number of episod-persons. P-value: * p<0.05, ** p<0.01, *** p<0.001

The findings show that the dummy variable for females –hence the gender gap in favour of men– remains statistically significant after controlling for the parenthood status and other individual characteristics when estimating the promotion to tenured assistant professor, associate and full professor. Women are less likely to wait longer than men to achieve the position of tenured assistant professor (HR=0.731, p<0.05), associate (0.726,

p<0.001), and full professor (HR=0.603, p<0.001). Specifically, women have 27 per cent lower chances to be promoted to tenured assistant professors, 27 per cent lower chances to obtain associate professors, and 40 per cent lower chances to be promoted to full professors than men, holding all control variables constant. At the beginning of the academic career, instead, the reversal holds (HR=1.281, p<0.01): women are 28 per cent more likely than men to obtain a postdoc position, and there are no gender differences in the chances of promotion to non-tenured assistant professor and permanent researcher.

Figure 3 displays the post-estimation predicted survival curves, adjusted for controls, to facilitate the interpretation of results. The predicted survival curves start from the first unit of time, i.e., one year after entering the risk set. The figure shows the hazard rates for a given academic position separately for men and women through the time of observation, holding all other covariates at their mean constant. Hence, after controlling for childbirth, scientific productivity, and other characteristics, descriptive results in Figure 1 are confirmed in Figure 3: there are no gender differences in the first stages of the academic career; if anything, women are at an advantage as they transit to a postdoctoral research position (slightly) faster than men. Also, it is noteworthy that PhD candidates swiftly secure their first academic appointments; more than 20 per cent of respondents land a postdoctoral position within one year of completing their PhD, while approximately 10 per cent secure a permanent researcher position. However, gender differences become noticeable, starting from the transition to tenured assistant professor and widening as women move across the academic ladder. In other words, women's careers are slower than men's, even after controlling for parenthood and productivity.

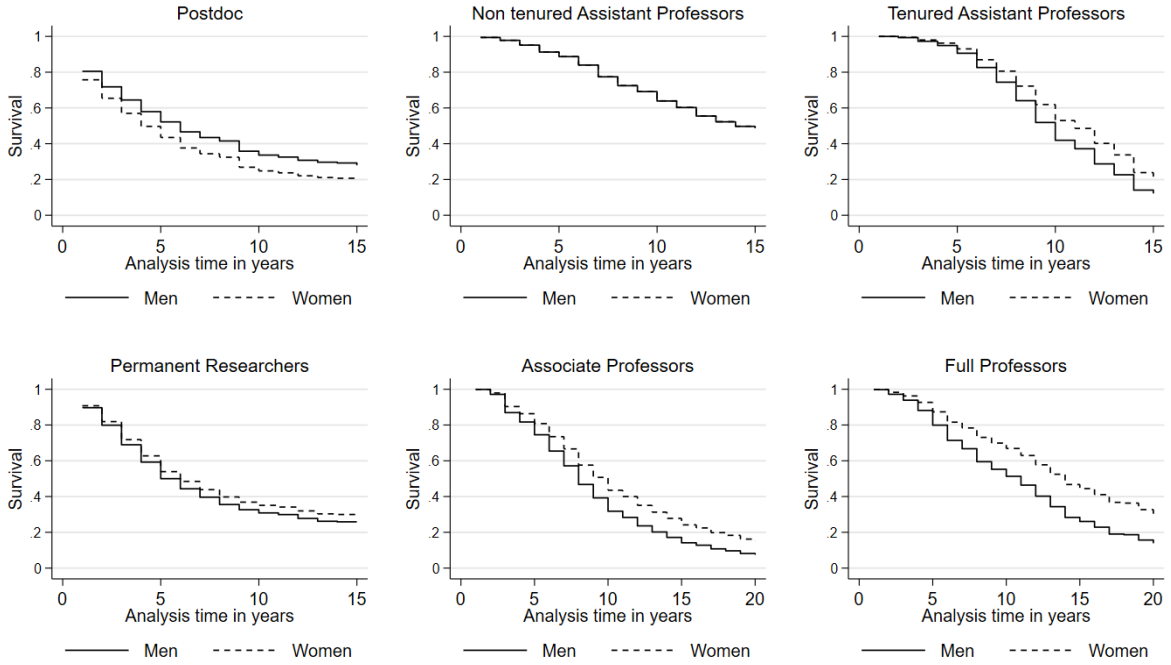



**Figure 3.** Cox predicted survival curves. Time to academic promotion across academic ranks by gender. All other covariates are constant at their means.

Concerning the relationship between parenthood and academic advancement, the findings do not reveal a clear pattern. The sign of the association indeed varies depending on the academic position. Having a first child reduces the chances of being promoted to permanent researcher (HR=0.792, $p<0.05$). The hazard ratios are also lower than one but not statistically significant (possibly due to a small sample size) for the transition to a postdoctoral fellow and full professor. In turn, becoming a first-time parent increases the chances of obtaining a non-tenured assistant professor by 23 per cent. This effect is not statistically significant (possibly due to a small sample size) but quite substantial (HR=1.23, $p>0.05$). Similarly, it increases the hazard of obtaining a tenured assistant professor (HR=1.18, $p>0.05$) and associate professor (HR=1.21, $p<0.05$) positions by 18 and 21 per cent, respectively; however, in both cases, the difference in the hazard between parents and childless academics is not statistically significant.

We find a strong negative effect of the transition to a second child on academic promotion to postdoc fellows (HR=0.645, $p<0.01$), non-tenured assistant professors (HR=0.592, $p<0.05$), and permanent researchers (HR=0.678, $p<0.05$). Therefore, academics with two children are less likely to attain these positions within the same timeframe as their childless counterparts.

Concerning other covariates, the publication record, as expected, has a positive impact (HR>1) on the hazard of being promoted to all positions except for permanent researchers; it also remains statistically significant for all positions except for full professors. We observe a slightly negative effect of age at the time of PhD completion on the transition to postdoctoral positions and tenured assistant professorships: older academics are less likely to be promoted to these positions within the same timeframe as their younger counterparts. Additionally, we include controls for PhD cohorts, restricting this variable to assess the transition to associate and full professor positions. This decision stems from the Gelmini Reform, wherein promotion to both positions entails a two-stage evaluation. While this reform aims to enhance the transparency and predictability of the promotion process, it may lead to variations in the time required to obtain professorships before and after its implementation. Those who obtained their PhD after 2010, i.e., after the Gelmini Reform, are also significantly more likely to progress to associate professor positions and do so faster than their predecessors (HR=1.856, $p<0.001$), possibly, it is as a result of the institution of tenured assistant professorship that is automatically progressed onto associate professorship upon award of the national habilitation. However, younger PhD cohorts face a disadvantage in attaining full professorship compared to their predecessors, though the coefficient is not statistically significant (HR=0.71, $p>0.05$).

We find only limited variation across scientific fields. Academics in social sciences have a higher hazard of being promoted to tenured assistant professors, permanent researchers, and full professors (54, 34, and 47 per cent more likely, respectively) compared to academics in natural sciences. Also, the progression to associate professor is significantly faster in humanities than among the scholars in natural sciences (HR=1.410, $p<0.01$), and the promotion to permanent researchers was faster in agricultural and veterinary sciences compared to the scholars in natural sciences (HR=1.335, $p<0.05$).

Additionally, there is almost no difference in the career progression rate among Italian macro-regions, except for the promotion to full professor, which is 33 per cent less likely in the South and Islands compared to central Italian regions (HR=0.681, $p<0.05$). In comparison, the progression to non-tenured assistant professor is about 45 per cent higher in the North (HR=1.451, $p<0.05$).

**Childbearing and gendered academic careers**

To explore whether the impact of parenthood on career advancement exhibits gendered patterns, we conduct Cox proportional hazard models separately for men and women as part of addressing RQ2. This approach allows us to examine whether the transition to parenthood and subsequent births exert differing effects on the likelihood of promotion to a given academic position for women and men. In essence, we aim to discern the existence of motherhood penalties and/or fatherhood premiums within Italian academia. Moreover, by conducting separate analyses for each gender, we can also investigate how the association between other control variables and the hazard of promotion varies by gender.

Detailed regression results with exponential coefficients (i.e., hazard ratio) are reported in Appendix C (Table C1.1-C1.2). Figure 3 displays the regression coefficients of the main

explanatory variables, i.e., transition to a first child and transition to a second child and scholarly productivity. The significance of scholarly productivity in career advancement has been consistently emphasised in the literature. Moreover, recent research indicates that women may benefit more from publishing articles than men (e.g., Lutter & Schröder, 2019). To facilitate interpretation, we present regression coefficients instead of exponential values. In this format, a coefficient below zero signifies a negative effect of the variable, while a coefficient above zero denotes a positive effect.

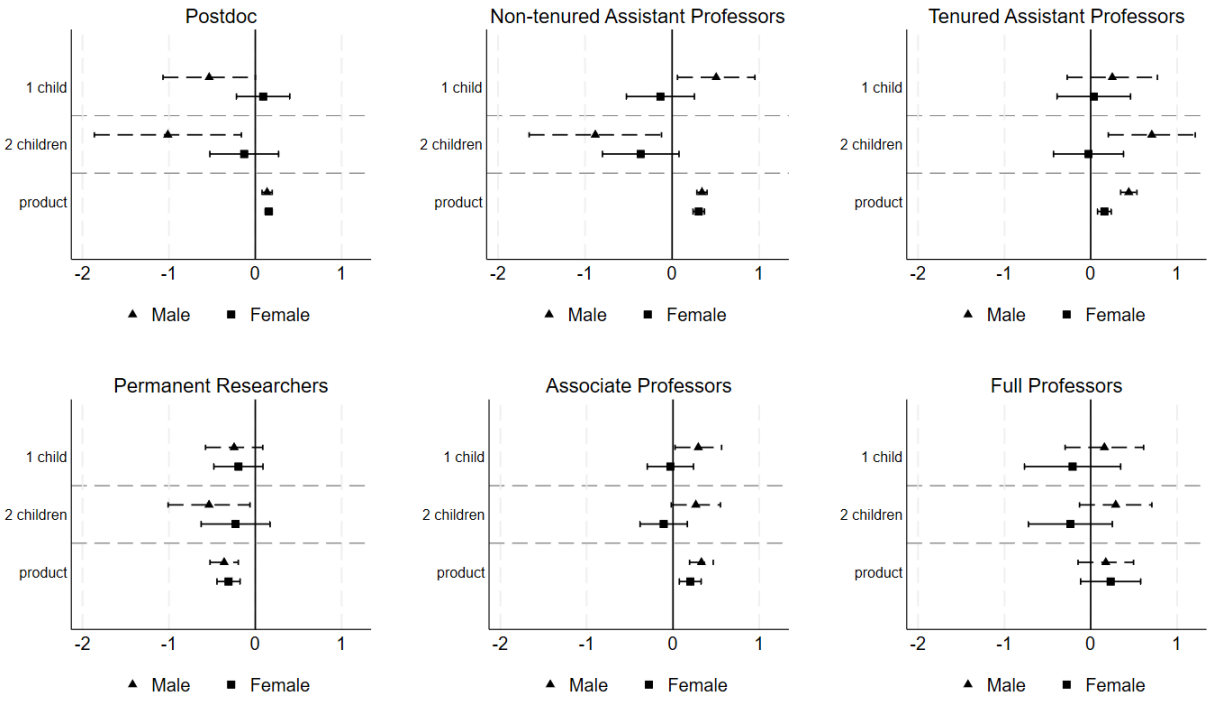



**Figure 4.** Cox Proportional Hazard Regression coefficient: the effect of parental status (reference categories are "childless men" for the male sample and "childless women" for the female sample) and scholarly productivity on the transition to a given academic rank, separate models for male and female samples. All other covariates are constant at their means.

The results from the separate male and female models clarify the role of parenthood in the persistent gender gap observed in career progression. First, parenthood appears to be unrelated to women's academic careers once scholarly productivity and other relevant control variables are included in the model. For women, parenthood –independent of whether respondents have one or two children or no children– is not significantly

associated with the hazard of progressing to any academic rank. Second, for men, parental status does make a difference, but the effect appears to be mixed. Fatherhood tends to be associated with a higher hazard of career progression, i.e., "fatherhood premium." In particular, fathers of one child have a significantly higher hazard of progressing to non-tenured assistant professors (HR=1.659, $p<0.05$) and associate professor (HR=1.341, $p<0.05$) positions compared to childless men. Also, fathers with a second child before promotion have a significantly higher hazard of becoming tenured assistant professors than childless men (HR=2.028, $p<0.01$). However, the transition to a second child is associated with a fatherhood penalty while progressing to a postdoc (HR=0.363, $p<0.05$), non-tenured assistant professor (HR=0.414, $p<0.05$), and permanent researcher (HR=0.585, p-value$<0.05$) positions. Notably, the impact of scholarly productivity does not exhibit a gendered pattern, with only one exception: during the progression to tenured assistant professors, scholarly productivity contributes more among men than among women.

In the next step, to estimate whether the observed gender difference in the effects of parenthood is statistically significant, we run additional Cox proportional hazards models using a pooled sample with an interaction between gender and parental status. To streamline the interpretation of the interaction, we create a variable encompassing six distinct groups: childless men, fathers of one child, fathers of two children, childless women, mothers of one child, and mothers of two children. The detailed regression results are presented in Appendix C (Tables C2.1 - C2.2). Figure 5 shows Cox predicted survival curves for each academic rank by gender-parental status.

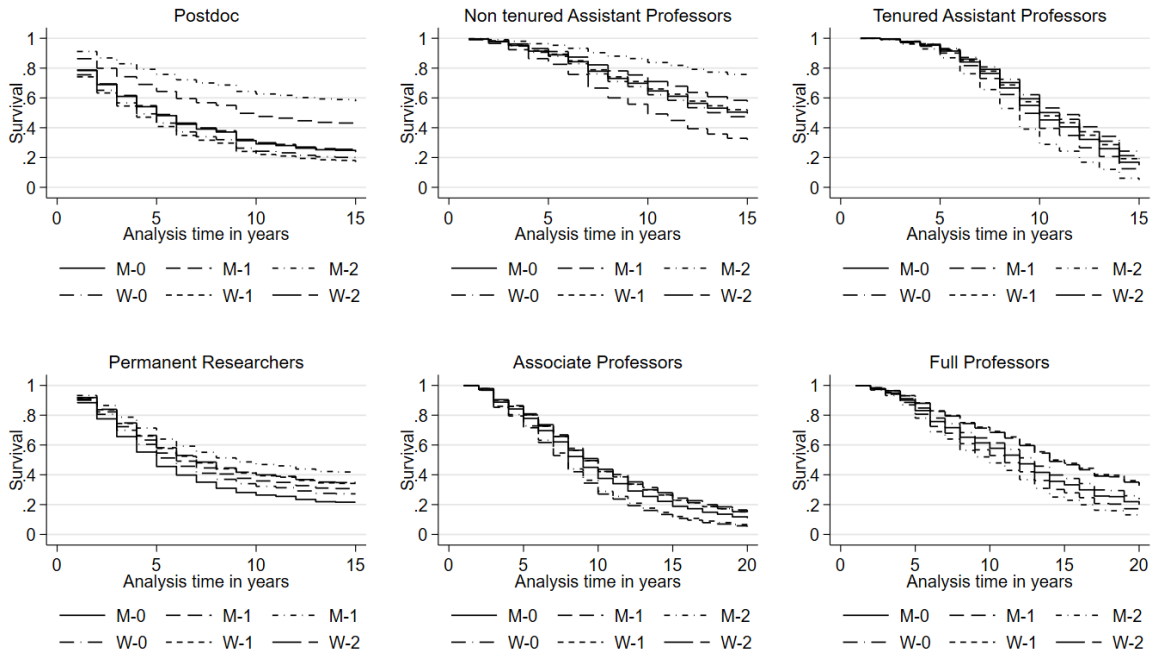



**Figure 5.** Cox predicted survival curves. Time to academic promotion across academic ranks by gender-parenthood status: (M-0) childless men, (M-1) fathers of one child, (M-2) fathers of two children, (W-0) childless women, (W-1) mothers of one child, (W-2) mothers of two children. All other covariates are constant at their means.

The results validate the statistical significance of gender differences in the impact of parenthood within both parental groups of postdoctoral fellows: fathers require more time to secure this position compared to mothers. Furthermore, the significance of the "fatherhood premium" is affirmed: among parents with one child, fathers attain a non-tenured assistant professor position more rapidly than mothers; among parents with two children, fathers achieve a tenured assistant professor rank more expediently than mothers. Moreover, we identify a fatherhood premium linked to one child and two children while progressing to associate and full professorships.

These findings unequivocally confirm that the impact of parenthood on career advancement is indeed gendered. Additionally, they suggest the existence of a "parental gender gap" mentioned in recent literature (e.g., Zheng et al., 2022).

## 5 Conclusions and discussions

This contribution investigated gender differences in academic careers in Italy, focusing on the extent to which childbearing can be responsible for the gender gap in academic career progression. Based on primary-collected retrospective survey data on a large sample of academics currently working across all academic ranks and all scientific disciplines in Italian universities, we find no gender differences in the chances of career progression from PhD completion to the early-career academic ranks (i.e., non-tenured assistant professor and, in the past, permanent researcher); moreover, women are more likely than men to obtain postdoctoral positions. In contrast, we find statistically significant gender differences in the chances of obtaining all tenured academic positions (i.e., tenured assistant professor, associate, and full professor). The results align with previous research emphasising that, in Italy, women are disproportionately distributed across academic ranks: the greater share of academic women are concentrated in precarious positions with fixed-term contracts compared to those in tenured positions (Picardi, 2019). Furthermore, our results confirm that transitioning to a tenured position is a major bottleneck in the academic pipeline (Marini & Meschitti, 2018).

Nevertheless, the noted advantage of women in attaining postdoctoral positions warrants additional scrutiny to mitigate potential biases. We explore two possible explanations, which are partially associated with the constraints of the applied methodology. Firstly, after completing a PhD, individuals can potentially pursue postdoctoral positions or apply directly for non-tenured assistant professor roles, representing competing events or competing risks. This term denotes events that may hinder the occurrence of the primary event of interest. Neglecting to consider these competing risks can lead to inflated estimates of cumulative incidence (using the Kaplan-Meier complement) and predicted risk (using Cox regression). Consequently, if men are more inclined to progress directly

to non-tenured assistant professor positions compared to women, any gender gap observed favouring women among postdoc fellows might be exaggerated. However, it is noteworthy that this career trajectory is not widespread in Italian academia overall, and in our sample, there are limited cases available for comparison. Secondly, it is important to note that both Kaplan-Meier and Cox methods consider overlapping events, meaning promotions occur in the year of entering the risk set (PhD completion), which is common for many PhD students. To address this, we conducted a robustness check by adjusting t0 from the year of PhD completion to one year before completion. The results remain robust: while the gender gap favouring women narrowed, it still persists (see Appendix D, Figure D1).

Although the motherhood penalty is one of the most frequently mentioned explanations for the gender gap in academia, our findings suggest that gender differences observed in the path to tenure cannot be explained by childbearing, at least in the Italian case. Having collected ad-hoc longitudinal retrospective information on career progression as well as on fertility histories and employing event history analysis that allows us to consider the effect of parenthood and progression to a second or higher-order parity on career progression longitudinally, we can come close to the evaluation of a potential causal relationship between parenthood and academic promotions. Importantly, we can compare mothers and fathers, contributing to a small but growing literature on academic fathers. Our findings do not support the existence of a motherhood penalty. However, we find a fatherhood penalty and a fatherhood premium. Fathers with two children have a lower chance of obtaining a postdoc, non-tenured assistant professor position, and permanent researcher compared to childless men (74, 69, and 41 per cent, respectively) but a 103 per cent higher chance of becoming a tenured assistant professor net of controls. In turn,

fathers with one child have a 66 per cent and 34 per cent higher chance of becoming a non-tenured assistant professor and an associate professor, respectively.

One of the possible reasons for the absence of the motherhood penalty among academic women in Italy is linked to selection mechanisms. It is plausible that mothers may opt to leave academia more frequently than childless women and fathers due to the perception that an academic career is challenging to balance with intensive motherhood duties (Armenti, 2004). Our study aims to evaluate the impact of parenthood on the likelihood and the timing of academic promotions; relatedly, we analyse the group of women and men who did pursue an academic career. Nevertheless, the leaky pipeline means that, by inducing women and mothers to leave academia more often than men and fathers, penalties related to gender and parenthood make the pool of women who remain in academia a highly selected group, among which we find little effect of parenthood on academic promotion. In support of this claim, recent research from the US underlines a high selectivity of female academics in terms of scientific productivity (Kim & Moser, 2021; Pull & Backes-Gellner, 2013), which protects them from the possible negative effect of childbearing: women who have a high level of productivity before childbearing experience a smaller penalty after childbirth (Lutter & Schröder, 2019). Yet, academic women may postpone having children until they attain tenure or until they attain a promotion (Joecks et al., 2014). Indeed, recent research on Italian academic women showed that obtaining an associate professor position increases the likelihood of having a first child (De Paola et al., 2021).

The contradictory effect of fatherhood on career progression also calls for reflection. The fatherhood penalty appearing during the transition to the postdoc position refers to a quite short period between PhD completion and the first academic appointment (about three years). Having a child during this period may force male PhD graduates to look for work

outside the academic market to support their families and return to academia later. By contrast, a fatherhood premium may be driven by a strong motivation to obtain tenure and a higher salary. If, in principle, such considerations may hold for women too, previous literature suggests that academic women are considerably more likely than academic men to be the lead parent for their children, whereas academic men are more likely to be the chief earner for their families compared to academic women (e.g., Derrick et al., 2023). This pattern is also visible among our respondents. Descriptive results demonstrate (Appendix D, Figure D2) that the share of those who declare to provide all or more than half of the family income is higher among academic men than women in all observed groups of academics, regardless of parental status. Academic men's contribution to their family income increases with their academic rank (and salary), whereas for women, such an increase is much contained; for example, over 75 per cent of male full professors declare to earn all or more than half of their family income vs less than 40 per cent of female full professors.

Academic women tend to have employed partners who earn the same or more than they do, whereas academic men tend to have non-employed partners or partners who frequently earn less. Being the secondary earner for one's family, especially in the case of a time-flexible job such as an academic career, may entail more responsibilities for childcare and other household-related tasks compared to being a primary earner. On the other hand, being a primary earner may entail the possibility of devoting more time to one's job –particularly to research work– also with the support of one's partner because a career progression for a primary earner means more economic resources (stability via tenure, higher income) for the entire family.

Hence, partnership status and the characteristics of one's partner may be important mediators of the association between parenthood status and career progression. As

Derrick et al.'s (2023) research indicates, parenting style is more important than gender for predicting academic productivity and, most likely, also for predicting other academic outcomes, among which career progression. Unfortunately, due to the retrospective nature of our data, we cannot reconstruct the exact parenting styles of the respondents or their partners. However, we do have some proxies to test this hypothesis. The results are somewhat mixed, but we found that both men and women in egalitarian families - where childcare responsibilities are shared equally - are less likely to be promoted to a postdoctoral position than their childless counterparts. Conversely, taking on the primary caring role reduces the likelihood of female academics being promoted to associate professor compared to their childless counterparts. These findings suggest that increased parental involvement may indeed lead to a reduction in career outcomes (see Appendix D, Tables D1-D2).

As discussed above, one of the mechanisms through which childbearing affects the career progression of parents is through the reduction of scientific productivity (e.g., Morgan et al., 2021; Joecks et al., 2014; Lutter & Schröder, 2019), so by keeping this parameter and other relevant factors (e.g., academic rank, career length, scientific discipline) constant, the gender gap is expected to become insignificant. By incorporating self-reported indicators for the number of scientific articles published, we account for scientific productivity and validate its role in enhancing the likelihood of promotion. This factor emerges as a significant predictor for promotion to all current academic ranks, except for full professor, for both male and female candidates. Nevertheless, despite its significance, it fails to elucidate the gender gap in promotion rates. As previous research showed, men still have a higher chance of being promoted to professorship than women with similar levels of scientific productivity (Marini & Meschitti, 2018; Pasqua & Filandri, 2019).

**Study limitations**

While our data can offer valuable insights, we must acknowledge the limitations of its relatively small sample size. These include reduced statistical power, less precise estimates of population parameters leading to wider confidence intervals, an increased risk of inflated Type I error rates, and difficulty in detecting complex relationships. We aimed to mitigate potential distortions by carefully selecting variables for inclusion in our models and conducting additional robustness checks.

The study collects retrospective information on respondents' fertility histories. However, it does not collect detailed information about conditions in place at the time of birth of one's child(ren) regarding, e.g., availability of childcare services, family support, and partners' characteristics. We acknowledge that these factors can significantly change the parenting burden and, hence, shape the effect of childbearing and parenting on career outcomes (Tattarini et al., 2022).

The retrospective mode of data collection also limited the possibility of accurately reconstructing the academic publication history. Hence, we could only obtain information on the total number of publications at the moment of the interview. Simultaneously, measuring scholarly productivity in a time-constant manner may obscure potential reverse relationships between promotion and the number of publications, as well as the potential mechanism of the impact of childbearing on career progression through a plausible decrease in productivity.

We also acknowledge that the number of published scientific articles is not a perfect measurement of scientific productivity since we cannot control for the quality of such publications, the number of co-authors, or the journal's impact factor. Moreover, for some scientific disciplines, other scientific contributions (e.g., patents in STEM fields and

books and book chapters in social sciences) can be as important as or even more important than journal articles.

Finally, our study focuses on the gendered effects of parenthood on academic careers among respondents who hold an academic position at the time of the survey. We exclude PhD holders who left academia to pursue other careers. Our results, hence, are useful to explain existing gender and parenthood differences among current cohorts of academics but most likely underestimate the total effect of parenthood and gender on academic careers because parents may be more likely to exit academia compared to childless peers and previous literature documented that such transitions are more pronounced among women than men.

**Policy implications**

The results of our study once again emphasise the vulnerability of young researchers and especially fathers, when they decide to become parents before obtaining a stable position, which requires the development and implementation of not only gender but also parenting policies aimed at supporting young fathers and mothers at this stage of their lives and careers. As previous studies have pointed out, instability is a typical feature of early career researchers in many European countries (e.g., Bozzon et al., 2017; Jones,2023), but the situation of researchers in Italy seems to be particularly dramatic (almost no paternity leave, relatively short maternity leave and its disadvantages compared to the legal preservation of the work contract). The above factors may encourage graduates planning to have children in their early 30s to leave the academic pathway or to postpone parenthood until they obtain a more stable academic position.

Consistent with past research, we found a bottleneck in women's academic careers: the transition to stable academic positions. Since our research focuses on the Italian context,

it is essential to consider the different requirements for a specific academic rank. The slower women's progression from the first postdoc contract to a tenured assistant professor may indicate gender bias against women academics and require close attention from the academic community. Given that the selection of candidates for such positions occurs at the university level, it becomes especially critical to ensure an impartial, transparent, and gender-neutral assessment of candidates by a gender-balanced academic committee (e.g., Checchi, 2019).

Further progression - i.e., transition to associate and full professor - involves the national scientific habilitation aimed to provide a reliable external assessment of candidates. However, a recent study claims that evaluation criteria are not explicit; thus, highly-performing candidates (even those who have published in high-impact factor journals) are not always successfully accredited by evaluation committees (Fini et al., 2022). Notably, a recent study found no gender differences in the success rate of obtaining national scientific habilitation. However, it showed that the number of female applications is still lower than men's (Pautasso, 2015). Thus, it is crucial to explore other hidden barriers that may stand in the way of women's career progression, e.g., imposter syndrome (Laux, 2018), lack of role-model (Herrmann, 2016), highly competitive environment (De Paola & Gioia, 2016), and thus to encourage women to apply for accreditation.

Nevertheless, given the long-standing underrepresentation of women in academia, the mere introduction of a gender-neutral evaluation and promotion system is insufficient to bridge the existing gender gap at the highest levels of academic positions (Filandri et al., 2023). Thus, in support of the existing debate on the implementation of compensatory gender policies such as maternity bonuses and gender quotas (Filandri & Pasqua, 2021),

our study also suggests that in order to achieve gender parity in Italian academia, a combination of measures aimed at supporting women academics is crucial.

# Chapter 4

## The best time to become a parent:
Tenure and fertility among academic women and men in Italy


### Abstract

Previous literature showed that women who work in academia tend to have slower careers compared to their male peers and are less likely to reach top academic positions. Childbearing was frequently mentioned as one of the main drivers of the existing gender gaps in academia. While the association between fertility and career progression is widely studied, little do we know about the reverse link: does career progression foster fertility among academic women? And what about academic men? This contribution aims to verify whether and how academic promotion impacts three fertility-related outcomes: the transition to parenthood, the transition to the second child, and short-term fertility intentions. We use a unique source of primary-collected survey data on a large sample of Italian academics, including retrospective information on fertility- and career-related histories. We implement discrete-time event-history analysis to model the transition to the first and second childbirth and logistic regression analysis to model fertility intentions separately for men and women. Results show that the transition to first birth considerably increases, for both academic women and men, upon obtaining a tenured position; however, the "fertility window" for men is more prominent than for women. Conversely, we find no significant differences between tenured and non-tenured academics regarding the transition to second birth. Finally, tenure enhances the short-term fertility intentions of young childless women, whereas we find no association for older women nor for men.



**Keywords:** academia, fertility, fertility intentions, job security, tenure, gender gap

## 1 Introduction

A rich economic and sociological literature documents the existence of a gender gap in academia: academic women tend to have slower careers than their male peers and are less likely to reach top-level academic positions. Empirical evidence suggests that childrearing, a responsibility generally shouldered primarily by women, contributes significantly to the gender gap in academia (e.g., Ginther & Kahn, 2004; Mason et al., 2004, 2019; Wolfinger et al., 2008; Carreri et al., 2022). Although the impact of fertility on career advancement in academia has been widely studied, we know little about the inverse relationship: does career progression foster fertility among academics? And are there gender differences in the effect of career promotion on fertility?

The strong commitment to research, constant pressure to publish, and geographical mobility associated with successful careers in the so-called "neo-liberal" academia bring about work-family trade-offs (Ferree et al., 2015). Work commitments are incompatible with ideals of intensive motherhood, which are still widespread in many advanced societies, including among the highly educated and particularly in contexts characterised by little welfare to families with children, such as in Italy (Barbieri et al., 2015). Moreover, academic careers frequently entail substantial job-related uncertainty, particularly in their initial phases. This uncertainty is marked by precarious employment, short-term employment contracts, relatively low salaries, and no guarantee of a stable position (Ivancheva et al., 2019; Bozzon et al., 2018; De Angelis & Grüning, 2020; Morgan & Wood, 2017). Early-career academics tend to face greater opportunity costs than their tenured colleagues, primarily because the years immediately following the completion of a PhD are often the most demanding and critical for establishing a future career (Fothergill & Feltey, 2003). As highlighted by numerous qualitative studies, women generally consider parenthood as an obstacle to achieving successful academic

careers (Bozzon et al., 2017), and the timing of childbearing becomes a pivotal concern for academic women as they navigate the transition to parenthood (e.g., Ward & Wolf-Wendel, 2016; 2006; Armenti, 2004). This often compels female academics to delay having children until they reach a relatively stable phase in their careers, for example, until they are promoted to a tenured position (in the US Mason & Goulden, 2004) or even to an associate professorship (De Paola et al., 2022).

A wealth of studies has consistently shown that, in the general population, economic and job security plays a crucial role in predicting fertility levels for both men and women, whereas employment-related uncertainty is associated with low fertility (e.g., Clark & Lepinteur, 2022; Fahlén & Oláh, 2018; Kristensen & Lappegard, 2022; Lopes, 2020; Busetta et al., 2019). Such evidence also applies to Italy (e.g., Alderotti et al., 2022; Barbieri et al., 2015; Rinesi et al., 2011; Vignoli et al., 2019). In particular, employment instability can significantly impact the likelihood of becoming parents for both women and men (for Italy: Vignoli et al., 2012; for France: Landaud, 2021).

Education is crucial in shaping the association between employment uncertainty and fertility. Highly educated men and women encounter significant opportunity costs when confronted with employment instability. Consequently, individuals with higher levels of education who experience job uncertainty, particularly at the outset of their careers, often defer parenthood longer compared to their less-educated counterparts (Rindfuss et al., 1996; Kravdal & Rindfuss, 2008). Despite higher education being linked to fertility postponement to later ages, it is also linked to higher fertility: in current cohorts, higher-educated men and women are less likely to be childless and more likely to have larger families compared to lower-educated peers –though the association for women was reversed in previous cohorts – (Jalovaara et al., 2019). Although research on the fertility of academics is relatively limited, there are reasons to believe that their patterns may be

akin to those of highly educated professionals (Li & Shen, 2022). This resemblance can be attributed to several shared factors, including delayed entry into the job market (the average age of completing doctoral studies in European countries does vary, but it is typically around 30 years old or slightly older[5]), postponed family formation resulting from a prolonged period spent in education, and the subsequent overlap between the initial phases of the career and mature childbearing ages. While low fertility rates are anticipated among academics in general, empirical evidence indicates distinct gender-specific fertility patterns within the academic population. Academic women are more likely to experience childlessness and to have fewer children compared to their male counterparts and compared to non-academic women (Mason & Goulden, 2004; Ecklund & Lincoln, 2011; Buber et al., 2011; Stanfors, 2014; Gorodetskaya et al., 2023).

Thus, existing research supports the idea that in academia, being awarded tenure and, more generally, being promoted to a stable academic rank may trigger fertility among academic women. Research on fertility among men is considerably scarcer than research on fertility among women in the general population (Lappegård, 2020), and it is no surprise that this is the case also for research on fertility among academic men. We contribute to the body of knowledge regarding the connection between job uncertainty and fertility by examining primary data on a sample of academic women and men in Italy.

This paper focuses on the relationship between academic career progression –measured by promotion to a given academic rank and by the award of a tenured, i.e., permanent, academic position– and fertility –measured by three different outcomes: the transition to parenthood, the transition to the second child, and short-term fertility intentions. The first two fertility-related outcomes are based on observed transitions to the first and second

[5] OECD, 2019

child. In contrast, the third outcome refers to the intention to have a(nother) child in the near future –a measure regarded as the key proximate determinant of fertility behaviours (Ajzen & Klobas, 2013).

## 2 Literature review & Research questions

Parenthood in academia is frequently framed as a women's issue, which is not surprising, considering that childbirth and subsequent child-rearing are often cited as the primary reasons for women's disadvantages in academic careers, i.e., chances for promotion (Wolfinger et al., 2008; Long et al., 1993), scientific productivity (Cannito et al., 2023; Bozzon et al., 2017; Morgan et al., 2021; Kim & Moser, 2021; Lutter & Schröder, 2020) and their further underrepresentation in top-level academic positions (Kim & Moser, 2021). Past studies underscore that due to the inherent rigidity of an academic career, often involving a lengthy tenure process (e.g., Basset, 2005), the intersection of work and family responsibilities in academia presents more challenges for female academics than their male counterparts, particularly for women of earlier generations (Baker, 2012; O'Laughlin & Bischoff, 2005). This can be attributed to the fact that academia was historically founded and operates based on a traditional "male" model of the ideal worker (Acker, 1990, 1992), with limited household responsibilities and high devotion to work.

While quantitative studies on this matter are limited, qualitative research offers a comprehensive insight into gender-specific barriers hindering academic career progression and work-life balance. Many of these challenges are related to the lack of institutional support, e.g., insufficient maternal leave and inadequate childcare services are frequently cited as significant hurdles. Indeed, adequate childcare is for academic mothers –but one might expect the same to be true for some fathers– related to their

academic retention and career progression (Morgan et al., 2021; Di Carlo et al., 2023; Gorodetskaya et al., 2023).

It can be assumed that new generations of academic fathers, especially those in the early stages of their careers, can also encounter similar challenges as those encountered by mothers when becoming parents, given the rise of the dual-earner couple, global changes in social norms regarding family roles, and fathers' increasing involvement in childcare. However, recent qualitative research shows that even in a gender-equal welfare regime such as Norway, which, e.g., offers a generous parental leave policy, female academics still report double standards regarding motherhood and fatherhood, particularly the expectations regarding the return from parental leave. The incompatibility of effectively balancing family and work commitments within an institution as "greedy" as academia (Coser, 1974) often leads to work-family conflict due to the simultaneous demands of conforming to the standards of an ideal worker and an ideal parent that first was developed around motherhood (e.g., Russo, 1976) and recently also appears with regards to fatherhood (e.g., Sallee, 2012). However, scholars contend that while there may be shared challenges in achieving a work-family balance, women often bear a more significant burden. Female academics, especially those in the early stages of their careers, face unique and often more significant challenges when navigating the complex intersection of academic work and motherhood. The challenges stem from the physical implications of motherhood, societal gender norms dictating family responsibilities, and the persistent unequal distribution of domestic duties, where academic women still often shoulder an additional "second shift" involving childcare and household upkeep.

The institutional norms within academia can moderate the extent of work-family conflict (Hardy et al., 2018). A US study revealed that motherhood tends to be more challenging in institutions with high expectations for rapid career advancement and a strong emphasis

on research productivity. Teaching-oriented institutions provide greater flexibility and support for combining parenthood with a career (Wolf-Wendel & Ward, 2006). While institutional policies hold significance, their effectiveness is greatly influenced by the prevailing culture and norms within individual departments (Wolf-Wendel & Ward, 2015).

The life-course approach highlights that the interplay between the work and family domains varies at different stages of an academic career (Jacobs & Winslow, 2004). A study by Wolf-Wendel & Ward (2016) points out that reconciling family and work life improves over time due to reduced childcare loads (children grow up) and a shift in life priorities in favour of a balance between career and family rather than due to career development – though at later life-course stages. New responsibilities linked to caring for elderly parents may arise, again falling mainly on women's shoulders.

Additionally, the complexity of academic motherhood arises not only from the difficulty of reconciling the roles of the ideal worker and the good mother but also from health concerns and reproductive risks associated with delaying motherhood. When motherhood occurs at an advanced reproductive age, the opportunity costs associated with having a child are higher, while the probability of conceiving a child is lower.

Wolf-Wendel and Ward (2006), drawing from over a hundred interviews with academic mothers, identify several recurring issues women must consider before and during motherhood, among which the timing of childbirth appears to be a crucial point (see also Garey, 1999). A Canadian qualitative study (Armenti, 2004) exploring whether women prefer to give birth before or after obtaining a tenured position describes two strategies for embedding motherhood into an academic career such as “May babies” and “post-tenure babies.”

The first strategy involves the attempt to schedule motherhood during the least demanding period of the academic year. In other words, to mitigate the possible negative impact of childbearing on their productivity (as well as judgment from senior colleagues), women plan childbearing towards the end of the spring semester. This way, their maternity leave coincides with the summer holiday months, allowing them to avoid career interruptions and be able to teach and participate in scientific conferences, among other professional obligations. However, there is still the looming threat of a long-term motherhood penalty on one's career. This is especially true among early-career academics who grapple with significant job uncertainty and face higher opportunity costs in comparison to their more established, tenured colleagues.

The second strategy concerns planning childbearing during the most favourable career period, i.e., after obtaining a stable, tenured position. However, this strategy carries another risk, namely reproductive risks. Since most academics receive tenure on average around age 40 (in the US, Jacobs & Winslow, 2004), by postponing the transition to motherhood, women are exposed to the risk of involuntary childlessness or will have fewer children than they desire (e.g., Caplan & Caplan, 1993; Cooney & Uhlenberg, 1989). Ecklund and Lincoln (2011) find that, among a sample of American academics in science, women have, on average, fewer children than men. They also find that a considerable share of academics has fewer children than desired –especially women (over one in two among postdoctoral fellows and just below one in two among faculty)– and a non-negligible share expressed concern about not being able to have a family prior to graduate school –again, especially among women (over one in ten among postdoctoral fellows and faculty and almost one in three among graduate students). Similar fertility patterns among (mainly female) academics are also found in Europe (e.g.,

Kemkes-Grottenthaler, 2003; Buber et al., 2011; Stentz, 2016; Gorodetskaya et al., 2023) and are also described in the second empirical paper of this dissertation.

While existing –predominantly qualitative– studies indicate that academic careers have an impact on fertility behaviours, particularly among women, leading to the postponement of childbearing until they reach a more stable career phase, it is challenging to precisely assess this effect due to the lack of quantitative data. To our knowledge, only one American study has attempted to identify the connection between achieving a tenured position and its impact on family-related outcomes. Using longitudinal data, Mason and Goulden's study (2004) unveiled that tenured women exhibited distinct family patterns compared to tenured men and other women holding a PhD (such as non-tenured, part-time, or non-working). The authors further demonstrated that women who achieved tenure within three years of obtaining their PhD were less likely to have a (young) child or be married.

Additionally, examining survey data from faculty members, the study delineates the fertility trends among male and female academics concerning the year of their promotion. The findings indicate that male academics are more likely to have children around the time of their promotion. In contrast, female academics tend to have a more evenly spread distribution of childbirth across their careers. Male academics are more prone to have children between the ages of 24 and 36, as well as after reaching 40. While female academics tend to experience a notably shorter fertility window, typically between 36 and 40. Furthermore, women are more likely than men to either be childless or to express that they have fewer children than they initially wished for.

The US and the EU exhibit distinct variations in family policies and academic career structures. As a result, the interplay between family and work domains can result in

different fertility patterns. However, comparing the US and European (particularly Finnish) contexts, Ollilainen (2019) highlights that academic women in both contexts consider the condition of the maternity leave, age (fertility potential), and precarity of the contract as the main factors affecting the decision to become a mother. In support of this claim, De Paola and colleagues (2022), based on Italian administrative data, showed that promotion to associate professors increases the likelihood of having a child, highlighting the existence of an association between achieving a permanent position and the transition to parenthood. This study fails to understand whether and how promotion affects male fertility to the same extent as women's because the administrative data used only allows to reconstruct the information about the birth of a child via information on compulsory maternity leave for mothers. Furthermore, it provides only a partial depiction of the fertility behaviours of female academics since it concentrates on a specifically selected group ( assistant professors) and does not account for academics in the earlier career stages. Indeed, the probability of becoming a parent, as well as the average number of children, increases with age. Still, reducing economic uncertainty and attaining a stable job position is crucial for the transition to parenthood in academia.

Following the literature, our first research question *(RQ1),* building on prior research, is: *Does attaining a tenured academic position foster the transition to parenthood? And are there gender differences in the association between attaining tenure and transition to a first child?*

It is evident that female academics tend to have fewer children than male academics and often have fewer children than desired, a trend attributed to the challenges of balancing academic career obligations with family burdens that force them to postpone or forego parenthood. Consequently, when motherhood is delayed to an advanced reproductive age, conception becomes more difficult. This delay restricts the time window available for

female academics to realise their desired fertility. Having a shorter career interruption due to maternal leave breaks may mitigate the overall negative impact of childbearing on career outcomes. Based on this assumption, the concept of a "time-squeeze effect," meaning having the shortest possible interval between the first and subsequent childbirths, was introduced to describe the fertility patterns of highly educated women. This concept is applicable to academic women as well. Studies from Western Germany (Kreyenfeld, 2002), Western Germany and France (Köppen, 2006), and France and Spain (Compans et al., 2023) came up with a similar result:highly-educated women have a second child more frequently (in Spain and France) and with shorter birth spacing (in Spain) than lower-educated women.

Additionally, broader research encompassing various populations suggests that external factors, including economic conditions, together with institutional support (e.g., parental leave policies, availability of childcare services) play a pivotal role in influencing the transition to a second child (Compans et al., 2023; Kreyenfeld, 2002). In support of this claim, a study on the general population from Western Germany showed that the man's education (rather than the woman's), a proxy for high earnings and stability, strongly impacts the probability of having a second child (Kreyenfeld, 2002). Similarly, research from Italy has identified the man's education as a strong predictor of the woman's intention to have a second child (Rinesi et al., 2011). Only in France, the likelihood of a woman having a second child is not influenced by her partner's level of education. This is likely due to the robust institutional support and the flexibility that enables women to harmonise their work and family obligations without experiencing a drop in income (Köppen, 2006). Gender-equal family policies, meaning shared parental leave between mother and father, emerge as a crucial condition for continued childbearing. The research from Northern Europe applying event-history analysis on administrative population data

reveals a positive impact of a father taking leaves on a couple's likelihood of having a second or third child. Also, in families with two children, an extended period of maternity leave for the mother is positively associated with the likelihood of having a third child (Duvander & Andersson, 2006; Duvander et al., 2010; 2019).

While research on the fertility behaviour of academics remains limited, existing literature indicates that the factors influencing the decision to have a second child may differ from those affecting the transition to parenthood. However, insights from studies on female researchers highlight the continued significance of occupational conditions, such as job security and flexible working hours for mothers, in shaping decisions about having a second child. Conversely, concerns about potential career risks, such as a decline in publication rates, have emerged as deterrents against choosing to have a second child (Hu & Mei, 2021).

Thus, our second research question *(RQ2)* is: *Does attaining a tenured academic position foster the transition to the second child? And are there gender differences in the association between attaining tenure and transition to second birth?*

The timing of academic career milestones, particularly the attainment of tenure, intersects with the biological constraints of female fertility. The postponement of motherhood among women in academic careers may result in reduced realised fertility and, coupled with a tendency to underestimate the biological constraints on fertility, establishes conditions conducive to childlessness (Kemkes-Grottenthaler, 2003). A study from Austria focusing on the fertility behaviour of a sample of female scientists reviewing recent statistics underlines that women in Academia are more likely to be childless compared to their male counterparts and the overall female population (Buber et al., 2011). The authors argue that low fertility appears due to the gap between fertility

intentions and realised fertility, largely due to the specificities of the academic profession (non-standard working hours, geographical mobility, long periods of precarity, and high commitment to work). Buber and colleagues (2012), comparing several European countries, found that fertility intentions are strongly related to the duration of a working week; however, it is also gender-specific—women who work more than 50 hours report lower fertility intentions than women who work less. For men, it is the opposite: having a long working week comes with the highest desire to have a child in the near future. In such circumstances, childlessness can be seen as a consequence of a rigid institutional structure of academia, combined with a tendency to underestimate the constraints posed by biological fertility (Kemkes-Grottenthaler, 2003). The academic settings may similarly influence the fertility choices of academic men; however, the fertility potential of men is largely contingent on their female partners, particularly on the partner's age. Men who delay parenthood have relatively lower risks of infertility and involuntary childlessness compared to women: first, men tend to be in relationships with slightly younger female partners (Dudel et al., 2020); second, men's fertility generally starts to decline later compared to women's (De la Rochebrochard and Thonneau, 2003).

The investigation of fertility behaviours would not be comprehensive, given that the low fertility rate among female academics may also reflect voluntary childlessness. The literature on the general population emphasises that voluntary childlessness is strongly associated with high educational attainment, continuous employment, and intense geographical mobility (Bloom & Pebley, 1982). Also, the pathway to childlessness tends to be gendered; more specifically, career development and educational attainment) increases the likelihood of childlessness among women, while for men, it fosters the transition to fatherhood (Keizer et al., 2008). However, changes are in place, as higher

education is now linked to a lower likelihood of being childless among younger generations of women –at least in Scandinavian countries– (Jalovaara et al., 2019).

Previous research on fertility intentions among academics is scant. A study from Austria reveals that among young female researchers, the percentage of those expressing voluntary childlessness is minimal, with the majority desiring to have at least two children (Berghammer et al., 2016). Academic women are significantly more likely than men to have fewer children than desired (Ecklund & Lincoln, 2011).

In an effort to contribute to the current literature on fertility intention, our third research question *(RQ3) is: Does attaining a tenured position increase short-term fertility intentions? And are there gender differences in the association between attaining tenure and fertility intentions?*

To sum up, based on prior research, we expect that in a demanding academic context where the balance between career and parenting is challenging for academic women and, increasingly, academic men, securing a tenured position –i.e., escaping the job uncertainty– may increase the likelihood to have the first child. It can also be assumed that the promotion effect may be gendered, given that postponing childbearing for women is associated with reproductive risks of remaining childless or having fewer children than they desire due to women's shorter reproductive window compared to men. For this reason, we expect age to be an essential correlate of realised and intended fertility, especially for women. We also expect that net of other characteristics, transition to first and second birth and intentions to have a child will be more likely among tenured women and men in advanced parental age. Finally, we expect that academic promotion may have a different meaning on realised and intended fertility depending on the academic rank. The already-mentioned study by De Paola et al. (2022) finds a significant

increase in fertility upon promotion to associate professor among academic women in Italy; however, due to the nature of its data, this study cannot distinguish between first or second births, nor can it compare the promotion-fertility link among men. On this basis, we expect promotion to associate professor to be linked to an increased risk of first and second birth for both women and men. We expect to find such a positive association for the transition to a tenured assistant professor. In contrast, we expect the transition to a non-tenured assistant professor to be unrelated to fertility as the latter contract is of limited duration. Because promotion to full professor generally happens at late or past childbearing age, we expect the transition to parenthood to be unaffected by this particular promotion, at least for women. At the same time, it may increase the risk of having a first or second birth among men.

Previous studies were unable to correctly estimate the promotion effect for either academic men or women due to the lack of suitable data collecting information on career- and fertility histories simultaneously. Furthermore, there is a dearth of research that specifically delves into the experiences of academic parents, exploring the factors that drive their choices regarding having a second child and the potential gender-related disparities in these decisions.

## 3 Data and methods

We use a unique source of primary-collected survey data on a large sample of Italian academics defined through a non-probability sampling procedure (N = 1,948 complete questionnaires collected between November 2021 and March 2022). The final sample includes academics of all academic ranks (postdoctoral researchers, non-tenured and tenured assistant professors[6], permanent researchers, associate professors, and full

[6] According to Italian legislation (see Law 2010/240), non-tenured assistant professors correspond to assistant professors "of type A", whose contract has a fixed duration, and tenured assistant professors correspond to assistant professors "of type B", for whom a career progression into a tenure-track position is

professors) from all 14 scientific disciplines. In order to enhance the representativeness of the sample, we created and applied weights concerning gender, academic rank, and scientific discipline using publicly available administrative data (MIUR 2020). More details about the survey are provided in the Empirical setting section of this dissertation (2 Data, pp 13-16) and the related Appendices (Appendices F, G, H).

To answer RQ1 and RQ2, we apply discrete-time event-history models on the transition to the first and second child conception with annual observations for each person and robust standard errors at the individual level. To answer RQ3, we implement logistic regression models on fertility intentions. All model specifications were estimated separately for men and women.

First, for investigating the association between career progression and parenthood, the risk set is formed by childless people at the time of PhD completion, and the time at risk starts in the year when respondents conclude their PhD This choice relates to the fact that nowadays, in Italy, having completed a PhD is a prerequisite for an academic career. Second, to model the association between career progression and transition to second birth, the risk set is formed by those who have had a first child, and the risk of having a second child starts one year after the first childbirth occurred. If a woman/man has conceived her/his first child before completing the PhD but has conceived her/his second child afterwards, s/he enters the risk set for the transition to second-child conception at the age at which the PhD is completed. In both cases, the event of interest is the woman/man's first or second conception leading to a live birth. The baseline hazard is the woman's or man's age, grouped into four categories: younger than 35, 35–39, 40-44, and 45-49. Cases are censored if reaching the age of 49 without experiencing the event of interest (i.e., first or second birth) or at the interview date, whichever occurred first.

guaranteed except for extraordinary cases.

The key time-varying explanatory variable is the attainment of an academic position with a tenured status. In other words, using retrospective information on the year when respondents attained each of their academic positions, we model the transition from non-tenured (i.e., PhD holders looking for jobs, postdoctoral researchers, and non-tenured assistant professors) to their first tenured positions (permanent researchers, tenured assistant professors, associate professors, and full professors –obviously, transitions from non-tenured position directly to associate professors and full professors are a minority in the sample). Then, we control for the PhD cohort (doctorate awarded before or after 2010) and the field of study (distinguishing among Natural Sciences, Engineering and Technology, Medical sciences, Agricultural and Veterinary sciences, Social sciences, and Humanities).[7]

First, we apply event history discrete-time models for the transition to first-child conception in order to detect the attaining a tenured position, net of other controls (*Model 1*). Second, conscious that (especially) a woman's age is an important predictor of childbearing, we replicate Model 1, including an interaction term between tenure and respondent's age (*Model 2*). Third, due to the uneven gender distribution across various academic ranks within the tenured category, we delved further into the influence of specific academic positions (with the following categories: early career, non-tenured assistant professor, tenured assistant professor, associate, and full professor) on the likelihood of transitioning to parenthood. Here, we aim to discern whether the association between career progression and fertility varies by academic rank. This nuanced, specific approach enables us to account for the potential disparities in gender representation within different

[7]Natural sciences (*Mathematics and Informatics, Physics, Chemistry, Earth sciences, Biology*); Engineering and Technology (*Civil Engineering and Architecture, Industrial and information engineering*); Medical sciences (*Medicine*); Agricultural and Veterinary sciences (*Agricultural and veterinary sciences*); Social sciences (*Law, Economics and Statistics, Political and social sciences*); Humanities (*Antiquities, philology, literary studies, art history; History, philosophy, pedagogy, and psychology*).

ranks and draw more refined conclusions about the relationship between academic positions and the transition to parenthood (*Model 3*). Fourth, we apply event history discrete-time models to transition to second-child conception, net of other controls (*Model 4*). Finally, we rely on logistic regression to investigate the relationship between tenure and respondents' fertility intentions at the moment of the interview; in this manner, the data are cross-sectional (*Model 5*).

The target sample for the Model 5 is limited to women up to 45 years old and men with partners up to 45 years old. The outcome variable is a dummy that expresses the intention to have a(another) child in the next three years. The main explanatory variable is tenure-parenthood status, a categorical variable distinguishing non-tenured childless respondents, non-tenured parents, tenured childless respondents, and tenured parents. We structure the variable in this manner because fertility intentions are closely linked to parenthood status. For instance, respondents who do not have children often express a strong intention to have a child in the near future. Conversely, those who have already attained their desired family size tend to indicate intentions not to have additional children. This approach allows us to capture the dynamic nature of fertility intentions and account for variations based on individuals' current parenthood status and family planning goals. The sample size for this analysis is reduced compared to the one used in previous models because fertility intentions are asked only of respondents of reproductive ages. When working with a modest sample size, it is imperative to exercise caution in selecting variables for analysis. Thus, we cannot incorporate numerous variables, such as the number of children or diverse academic ranks, since it may lead to overcontrolled models.

As in previous models, in Model 5, we also control for respondents' age in classes (younger than 36; 36-40; 41-45), PhD cohort and field of study. Additionally, we control for a macro area of residence (North, Centre, and South/Islands) and whether respondents

live with a partner or are single. Such additional controls are not included in models of realised fertility because we do not have retrospective information on partnership status or area of residence at the time of birth, but only at the moment of the interview.

To facilitate the interpretation of results, besides tables with coefficient estimates from the regression models, we also present results in graphical form using Average Marginal Effects (AME) for Models 1-4 and coefficient estimates with confidence intervals (CI) for Model 5. We employ CIs at the 83% significance level because it strikes a balance between the precision of estimation and the coverage of potential values. This level of significance allows us to capture a reasonably wide range of potential outcomes while still providing a meaningful level of confidence in our estimates. Additionally, it offers a nuanced perspective that may uncover insights not readily apparent at more conventional significance levels.

The following tables outline the characteristics of three distinct groups: the samples at risk for the transition to a first and second child (Table 1) and the target sample utilised to explore fertility intentions (Table 2).

**Table 1:** Description of samples (time-constant variables only) used for studying the transition to first (Models 1-3) and second (Model 4) child conception, by gender

| | Male academics (N) | Female academics (N) |
|---|---|---|
| **Transitions to 1st child** | | |
| N. persons-years | 5,241 | 5,995 |
| N. obs at risk, among which: | 727 | 876 |
| *PhD cohort:* | | |
| 2009 or earlier | 437 | 516 |
| 2010 and more recent | 290 | 360 |
| *Field of study* | | |
| Natural sciences | 321 | 249 |
| Engineering and technology | 91 | 131 |
| Medical sciences | 52 | 37 |
| Agricultural and Veterinary sciences | 70 | 75 |
| Social sciences | 216 | 175 |
| Humanities | 126 | 60 |
| **Transitions to 2nd child** | | |
| N. persons-years | 2,372 | 3,105 |
| N. obs at risk, among which: | 463 | 589 |
| *PhD cohort:* | | |
| 2009 or earlier | 379 | 449 |
| 2010 and more recent | 84 | 140 |
| *Field of study* | | |
| Natural sciences | 216 | 157 |
| Engineering and technology | 60 | 88 |
| Medical sciences | 37 | 28 |
| Agricultural and Veterinary sciences | 42 | 48 |
| Social sciences | 160 | 105 |
| Humanities | 74 | 37 |

**Table 2.** Description of sample used for studying short-term fertility intentions for Model 5, by gender

| | Male academics (%) | Female academics (%) |
|---|---|---|
| Plan to have a (another) child in the next three years | 30.93 | 36.84 |
| *Tenure-parenthood status* | | |
| no kids, no-tenured | 19.93 | 22.25 |
| parent, non-tenured | 9.46 | 22.25 |
| no kids, tenured | 17.32 | 15.52 |
| parent, tenured | 53.28 | 39.98 |
| *Partnership* | | |
| single/not living together | 29.14 | 20.14 |
| living with a partner | 70.86 | 79.86 |
| *Age class* | | |
| up to 35 | 16.79 | 10.83 |
| 36 - 40 | 23.55 | 46.03 |
| 41 - 45 (and older for men) | 59.66 | 43.15 |
| *Macro region of residence in Italy* | | |
| Nord | 48.84 | 51.33 |
| Center | 33.84 | 28.89 |
| South and Islands | 17.32 | 19.78 |
| *Field of study* | | |
| Natural sciences | 25.14 | 26.65 |
| Engineering and technology | 29.19 | 13.31 |
| Medical sciences | 6.52 | 9.73 |
| Agricultural and Veterinary sciences | 4.83 | 9.34 |
| Social sciences | 21.03 | 20.23 |
| Humanities | 13.29 | 10.74 |
| N. | 353 | 374 |

# 4 Results

## Descriptive findings

Figure 1 reports the average number of children by gender for two groups of respondents: the subsample of male and female academics at the interview date (current fertility) and the subsample of male academics with partners older than 45 years and female academics aged over 45 (completed fertility). While there is virtually no gender difference in current fertility patterns in our sample, i.e., among the younger generation of academics, the data reveals that among the older generation, i.e., among male academics with partners older than 45 years and female academics aged over 45, the proportion of childless female academics is twice as high as that of male academics (24 per cent vs 12 per cent). Moreover, this group's percentage of female academics with two children is about 5 points lower than their male counterparts (40 per cent vs 45 per cent). Similarly, the proportion of female academics with three or more children lags behind that of male academics by five percentage points. Hence, overall, the completed fertility rate of academic women aged 46 and over is lower than that of academic men in Italy.

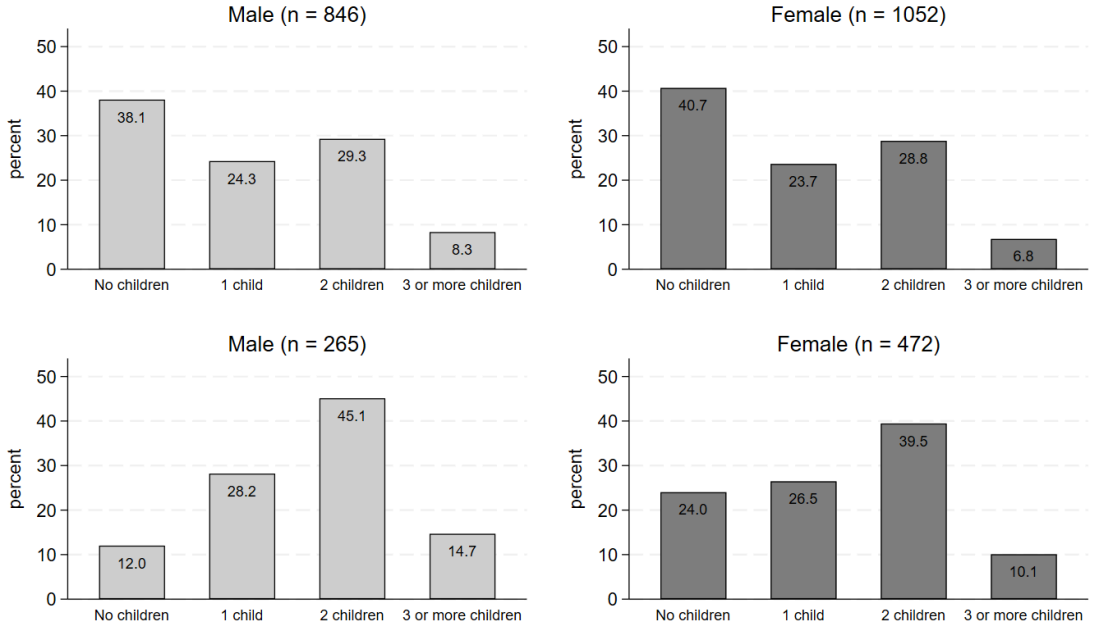



**Figure 1.** Fertility outcomes of Italian academics: current vs completed fertility by gender.

When examining the age at which individuals have their first and second child and the spacing between these two events, the data also highlight gender differences (Table 3). Women tend to have both first and second births on average one and a half years earlier than men (the difference is statistically significant), with the average distance between births equal to about 3.5 years (the same is valid for men). In the general Italian population, the age at the first childbearing for women is equal to 31.6, the highest among the European Union[8]; compared to women in the general population, academic women tend to postpone motherhood for two and a half years – to age 34.1, on average. Official statistics on the mean age of fathers at first birth are unavailable for the general population.

**Table 3.** The age at first and second childbirth by gender

| | Male academics | | | Female academics | | | Gender Difference (Men – Women) |
|---|---|---|---|---|---|---|---|
| | N. | mean | S.E. | N. | mean | S.E. | |
| Age at 1st childbirth | 530 | 35.78 | (0.211) | 656 | 34.19 | (0.185) | 1.59*** |
| Age at 2nd childbirth | 326 | 37.81 | (0.255) | 390 | 36.58 | (0.255) | 1.23*** |
| Distance between 1st and 2nd childbirth | 326 | 3.32 | (0.115) | 390 | 3.53 | (0.108) | -0.21 |

[8] Source: Eurostat, 2021 series tps0001, https://doi.org/10.2908/TPS00017.

Figure 2 displays the timing of promotion to tenure in relation to the timing of first birth for academic men and women. To conduct this descriptive analysis, we used an unconditional sample, including individuals who transitioned to parenthood before completing their PhD

Academic men tend to have their first child around the year of promotion to a tenured position, with the highest rate of first childbearing in the year of promotion and the following year. In turn, the fertility trajectory for women is less distinct. A considerably higher number of women commence their childbearing journey before securing a tenured position compared to men, and overall, the distribution of first-time mothers appears to be relatively evenly spread during their careers. Nevertheless, for women, the highest rates of childbearing also appear around attainment of tenure, particularly 2 to 3 years after tenure.

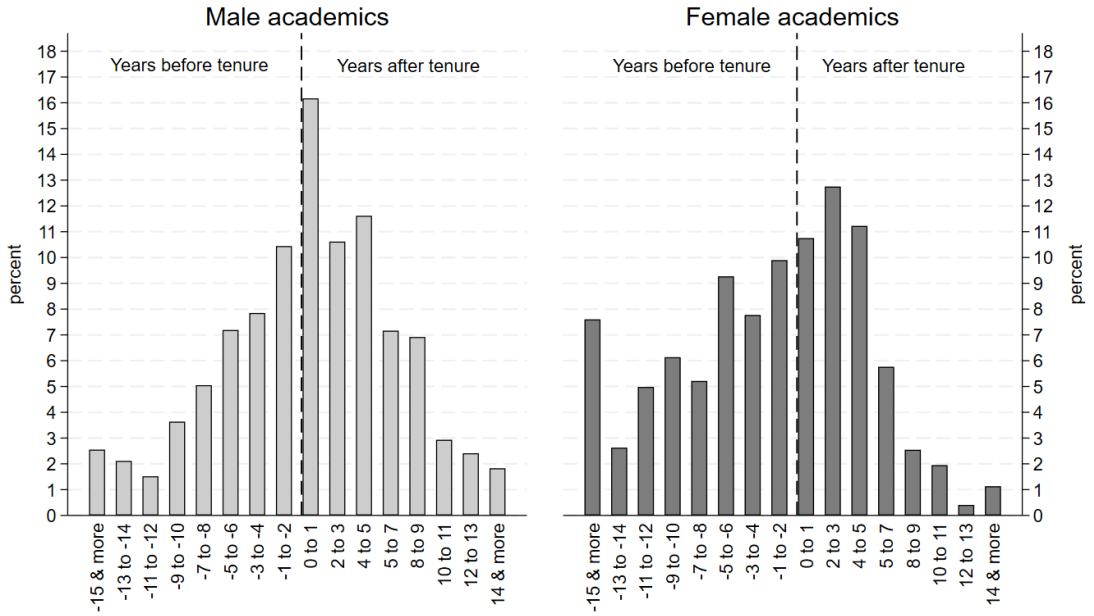



**Figure 2.** Timing of first birth in relation to the timing of promotion to tenure by gender, $N_{Men} = 470$; $N_{Women} = 537$.

## Transition to parenthood

Results from regression analyses aimed at answering RQ1 (*Does attaining a tenured academic position foster the transition to parenthood? And are there gender differences in the association between attaining tenure and transition to first birth?*) are presented in Table 3 and also reported graphically in Figure 3.

While some slight variation exists between men and women, the overall trend suggests a strong positive association between obtaining tenure and transition to first birth for both (Figure 3). Net of age, PhD cohort, and field of study, for academic men, tenure significantly increases the hazard of becoming a father in the following years (i.e., the hazard of conceiving a child after the year of promotion) by 62 per cent compared to non-tenured men (OR=1.62, $p<0.001$); for academic women, by 44 per cent compared to non-tenured women (OR=1.44, $p<0.01$).

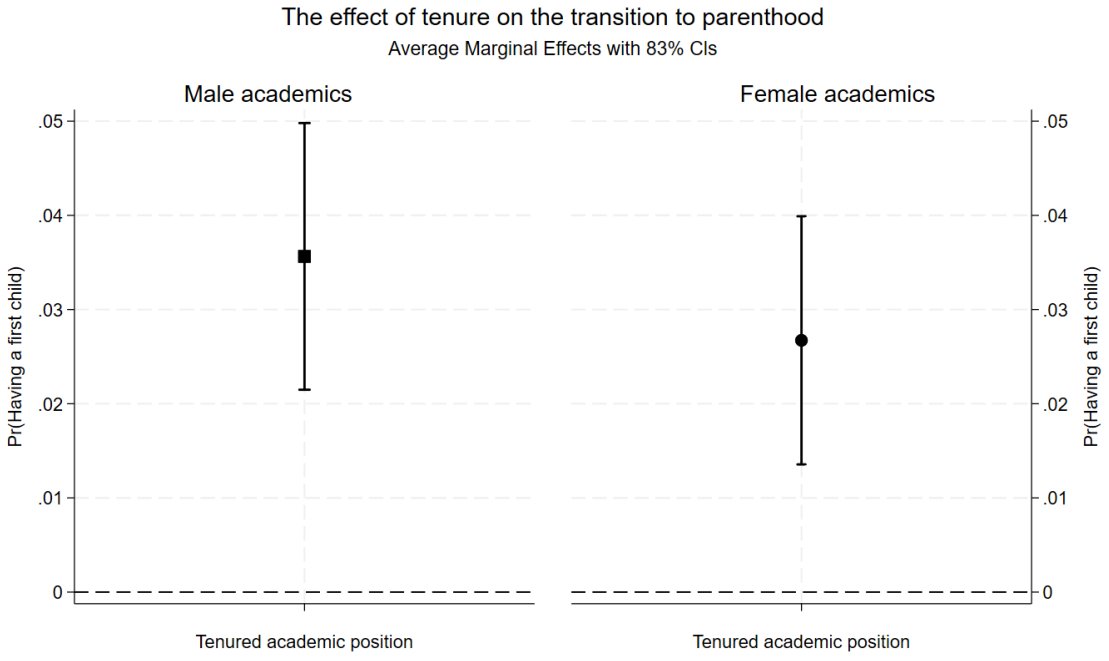



**Figure 3.** Average Marginal Effects (AMEs) of conceiving a first child among male academics (left) and female academics (right) by tenured vs. non-tenured academic position (Model 1). All control variables (age class, field of study, and PhD cohort) are fixed to their means.

The model reveals gender differences across age groups (Table 4). Among women, the probability of becoming a mother significantly decreases after age 40, with no significant differences between the late 30s and earlier ages. In contrast, for men, the probability of transitioning to fatherhood is highest between ages 35 and 39, and it begins to decline only after age 45. We find the transition to first birth independent of the PhD cohort and field of study, with the exception of women in Humanities, who are significantly less likely to transition to first birth than women in Natural sciences. Such results are robust to different model specifications in Model 2 and Model 3.

**Table 4.** Discrete-time event history regression model on the transition to first-child conception by gender. Results from Model 1.

| | Male academics | | Female academics | |
|---|---|---|---|---|
| | OR | S.E. | OR | S.E. |
| Tenured | 1.62*** | (0.219) | 1.44** | (0.182) |
| *Age class (ref. Younger than 35):* | | | | |
| 35 - 39 | 1.36* | (0.193) | 1.13 | (0.151) |
| 40 - 44 | 1.11 | (0.252) | 0.58** | (0.107) |
| 45 - 49 | 0.24*** | (0.092) | 0.09*** | (0.045) |
| *Field of study (ref. Natural sciences):* | | | | |
| Engineering and technology | 1.06 | (0.173) | 1.28 | (0.234) |
| Medical sciences | 1.31 | (0.280) | 1.03 | (0.191) |
| Agricultural and veterinary sciences | 0.94 | (0.188) | 0.88 | (0.192) |
| Social sciences | 1.10 | (0.197) | 1.18 | (0.161) |
| Humanities | 1.08 | (0.222) | 0.64* | (0.118) |
| *PhD cohort (ref. 2009 and earlier):* | | | | |
| 2010 and more recent PhD cohorts | 0.99 | (0.146) | 0.95 | (0.132) |
| N. | 5,241 | | 5,995 | |

Note: * p<0.05, ** p<0.01, *** p<0.001

Next, we include an interaction between tenure and age class in the analysis (Model 2, Fig. 4 and Tab. 5). Our findings confirm that, for women, age strongly moderates the tenure effect. Independently of whether they obtained tenure or not, women who are close to the end of their reproductive ages, i.e., past age 45, have a similarly low hazard of becoming mothers and are both significantly less likely to become mothers compared to the reference category, i.e., non-tenured women younger than 35 years old (OR=0.013, p<0.001 and OR=0.07, p<0.05, respectively). Also, among women aged 40 to 44, the hazard of becoming mothers is independent of tenure, i.e., it is not statically different from the

hazard for non-tenured women younger than 35 (OR=0.84, p>0.01 and OR=0.76, p>0.01, respectively). However, tenure is significantly and positively associated with transitioning to a first conception among younger women. Being tenured increases the hazard of becoming a first-time mother among women aged less than 35 (OR=1.72, p<0.01). Among women aged 35-39, those with a non-tenured academic position are as likely as younger, non-tenured women to become mothers (OR=1.30, p>0.01), whereas those with a tenured academic position are significantly more likely than younger, non-tenured women to become mothers (OR=1.60, p<0.01; AME=0.039).

Similarly, for men, even if tenured, the hazard of becoming a father past age 45 is lower than it is among non-tenured fathers younger than 35 (OR=0.45, p<0.01). There are too few non-tenured men aged 45-49 with children in the sample; hence, the corresponding coefficient cannot be estimated. Tenure increases the hazard of becoming a father among academic men aged 40 to 45 years old compared to non-tenured men aged less than 35 years (OR=1.87, p<0.01), whereas the hazard of becoming a father is the same among tenured men aged less than 35 years old and those aged 40-45 (OR=1.09, p>0.01). Compared to non-tenured men aged less than 35, the hazard of becoming a father increases among academic men in their late 30s for both those who have a tenured position (OR=2.15, p<0.001) and those who do not (OR=1.52, p<0.01). Although the odds/AMEs for those with a tenured position are larger than for those who do not have a tenured position, the difference is not statistically significant; hence, the transition to parenthood is independent of tenure for academic men aged 35-39 years old. Among academic men aged less than 35 years old, instead, tenure significantly increases the hazard of becoming a first-time father (OR=1.76, p<0.05). For all age classes and for both women and men, the hazard of becoming a parent among academics with a tenured position is higher than the

hazard among those with a non-tenured position, even if the differences are, as mentioned, not always statistically significant.

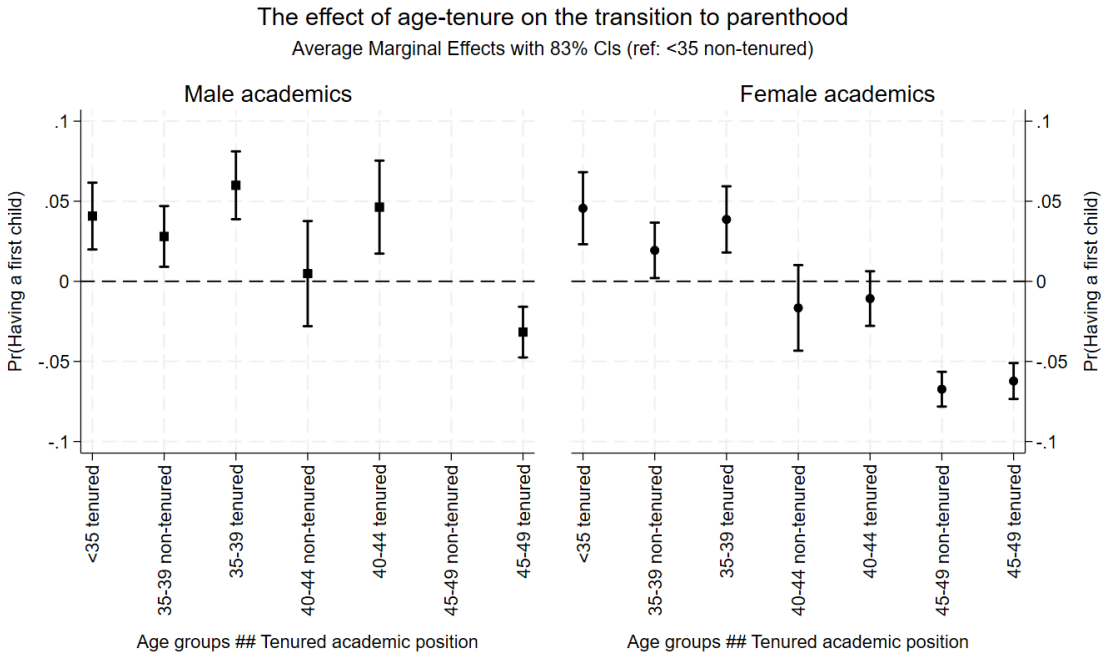



**Figure 4.** AMEs of conceiving a first child among academic men (left) and women (right) by tenured vs. non-tenured academic position and age group (Model 2). All control variables (field of study and PhD cohort) are fixed to their means. There are too few non-tenured men aged 45-49 with children in the sample; hence, the corresponding coefficient cannot be estimated.

**Table 5.** Discrete-time event history regression model on the transition to first child-child conception by gender. Results from Model 2.

| | Male academics | | Female academics | |
|---|---|---|---|---|
| | OR | S.E. | OR | S.E. |
| *Age class## tenured (ref. Younger than 35, Non-tenured):* | | | | |
| Younger than 35, Tenured | 1.76** | (0.329) | 1.72** | (0.296) |
| 35 - 39 Non-tenured | 1.52* | (0.286) | 1.30 | (0.208) |
| 35 - 39 Tenured | 2.15*** | (0.357) | 1.60** | (0.269) |
| 40 - 44 Non-tenured | 1.09 | (0.434) | 0.76 | (0.276) |
| 40 - 44 Tenured | 1.87* | (0.461) | 0.84 | (0.175) |
| 45 - 49 Non-tenured | - | - | 0.07** | (0.068) |
| 45 - 49 Tenured | 0.45* | (0.171) | 0.13*** | (0.073) |
| *Field of study (ref. Natural sciences):* | | | | |
| Engineering and technology | 1.05 | (0.173) | 1.27 | (0.232) |
| Medical sciences | 1.32 | (0.277) | 1.02 | (0.191) |
| Agricultural and veterinary sciences | 0.94 | (0.188) | 0.87 | (0.191) |
| Social sciences | 1.10 | (0.196) | 1.17 | (0.159) |
| Humanities | 1.08 | (0.223) | 0.64* | (0.117) |
| *PhD cohort (ref. 2009 and earlier):* | | | | |
| 2010 and more recent PhD cohorts | 0.99 | (0.146) | 0.97 | (0.135) |
| N | 5200 | | 5995 | |

Note: * p<0.05, ** p<0.01, *** p<0.001.
There are no observations in the male group "45 - 49 Non-tenured".

Results of modelling the impact of specific academic positions on the transition to parenthood (Fig. 5 and Tab. 6) show that for men, the highest propensity of becoming a father is observed among associate and full professors. Also, compared with early career academics, attaining tenured and –unexpectedly– also non-tenured assistant professorships significantly increases the probability of transitioning to fatherhood (114 and 58 per cent, respectively). Regarding women, the highest propensity of becoming a mother appears among tenured assistant professors, i.e., the first stable academic rank. Also, awarding a non-tenured assistant professor position increases the probability of becoming a mother by 57 per cent, compared to early career researchers, though the difference is not statistically significant. In turn, the effect of attaining full and associate professorships is negligible and statistically not significant.

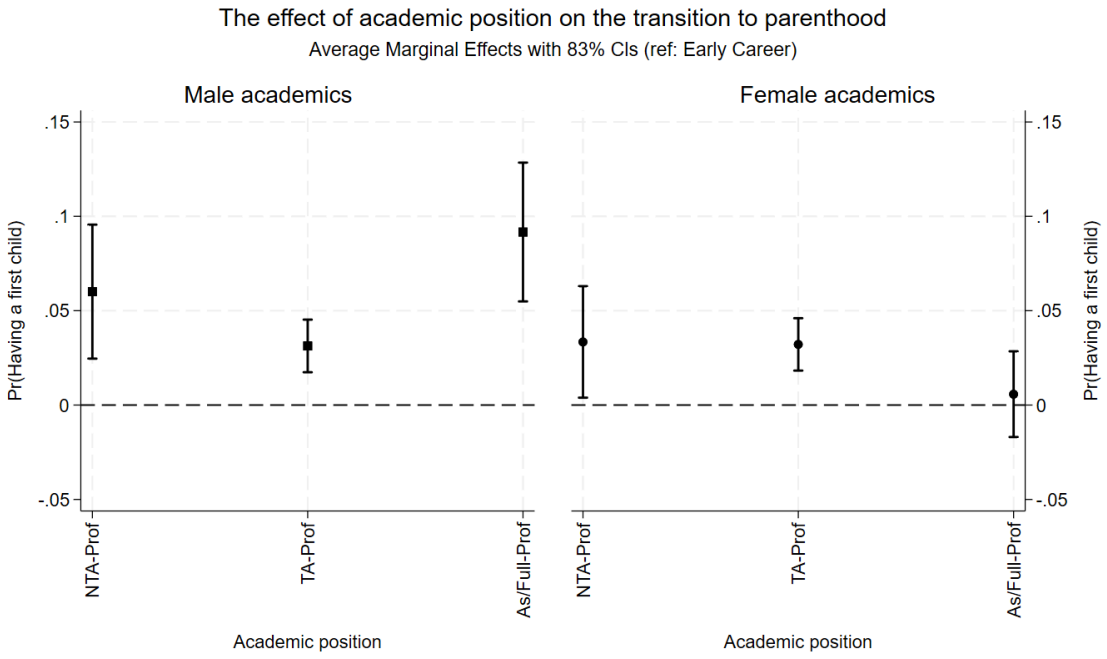



**Figure 5.** AMEs of conceiving a first child among male academics (on the left) and female samples of academics (on the right), by detailed academic position (Model 3). All control variables ( age (in classes), field of study, and PhD cohort) are fixed to their means. NTA-Prof: Non-Tenured Assistant Professor; TA-Prof: Tenured Assistant Professor; Assoc/Full-Prof: Associate or Full Professor.

**Table 6.** Discrete-time event history regression model on the transition to first-child conception by gender. Results from Model 3.

| | Male academics | | Female academics | |
|---|---|---|---|---|
| | OR | S.E. | OR | S.E. |
| *Academic position (ref. Early Career):* | | | | |
| Non-tenured Assistant Professors | 2.14** | (0.549) | 1.57 | (0.393) |
| Tenured Assistant Professors | 1.58** | (0.224) | 1.55*** | (0.202) |
| Associate and Full Professors | 2.82*** | (0.659) | 1.10 | (0.277) |
| *Age class (ref. Younger than 35):* | | | | |
| 35 - 39 | 1.25 | (0.184) | 1.12 | (0.151) |
| 40 - 44 | 0.94 | (0.230) | 0.60** | (0.113) |
| 45 - 49 | 0.19*** | (0.071) | 0.10*** | (0.051) |
| *Field of study (ref. Natural sciences):* | | | | |
| Engineering and technology | 1.04 | (0.173) | 1.26 | (0.230) |
| Medical sciences | 1.36 | (0.282) | 1.01 | (0.188) |
| Agricultural and veterinary sciences | 0.93 | (0.185) | 0.88 | (0.192) |
| Social sciences | 1.09 | (0.190) | 1.19 | (0.164) |
| Humanities | 1.08 | (0.224) | 0.65* | (0.121) |
| *PhD cohort (ref. 2009 and earlier):* | | | | |
| 2010 and more recent | 0.92 | (0.138) | 0.92 | (0.130) |
| N | 5241 | | 5995 | |

Note: * p<0.05, ** p<0.01, *** p<0.001

## Transition to a second child

We did not find any significant differences between tenured and non-tenured academics with regard to the decision to have a second child for either men or women (Model 4, Fig. 6, Tab. 7): the hazard of becoming a second-time parent among tenured academics is not different from the hazard of academics in non-tenured position. The association is not significant for both men and women, but for men, the odds ratio is close to 1 (OR = 1.08, p>0.05), whereas, for women, it is higher (OR=1.21, p>0.05), being suggestive that –beyond lack of statistical significance– tenure may be more important for women than men in transitioning to the second birth.

Our findings highlight a significant trend across both genders: the likelihood of having a second child diminishes notably after age 40. Specifically, male academics aged 40-44 exhibit a 65% reduction in the hazard of becoming second-time fathers (OR=0.35, p<0.001) compared to those under 35. This decline steepens for men aged 45-49

(OR=0.16, p<0.001). Similarly, the trend persists among women: female academics aged 40-44 experience a 79% decrease in the hazard of becoming mothers for the second time (OR=0.21, p<0.001) compared to their younger counterparts. For women aged 45-49, the probability of becoming second-time mothers is negligible, underscoring a predictable decline in fertility. We do not find any variation across fields of study nor PhD cohorts.

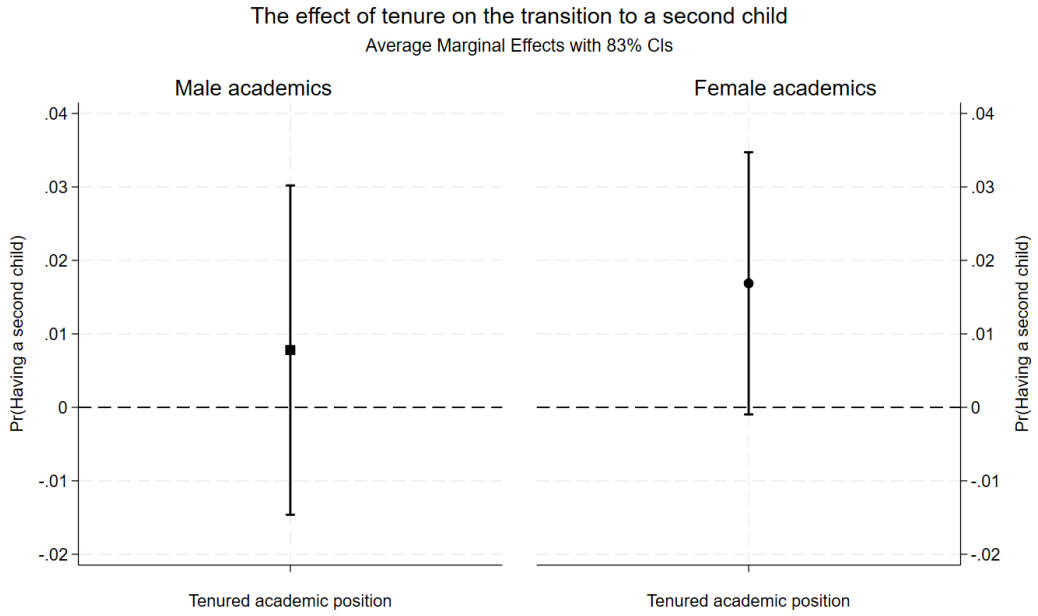



**Figure 6.** AMEs of conceiving a second child among male academics (on the left) and female academics (on the right), tenured vs non-tenured. All control variables (age group, field of study, PhD cohort) are fixed to their means.

**Table 7.** Discrete-time event history regression model on the transition to a second child by gender. Results from Model 4

| | Male academics | | Female academics | |
|---|---|---|---|---|
| | OR | S.E. | OR | S.E. |
| Tenured | 1.08 | (0.179) | 1.21 | (0.176) |
| *Age class (ref. Younger than 35):* | | | | |
| 35 - 39 | 0.74 | (0.120) | 0.90 | (0.124) |
| 40 - 44 | 0.35*** | (0.080) | 0.21*** | (0.046) |
| 45 - 49 | 0.16*** | (0.050) | 0.04*** | (0.021) |
| *Field of study (ref. Natural sciences):* | | | | |
| Engineering and technology | 1.49 | (0.312) | 0.96 | (0.199) |
| Medical sciences | 1.04 | (0.374) | 1.11 | (0.338) |
| Agricultural and veterinary sciences | 1.16 | (0.299) | 0.65 | (0.201) |
| Social sciences | 1.22 | (0.254) | 0.85 | (0.139) |
| Humanities | 1.06 | (0.299) | 0.87 | (0.191) |
| *PhD cohort (ref. 2009 and earlier):* | | | | |
| 2010 and more recent PhD cohorts | 1.40 | (0.273) | 0.86 | (0.170) |
| N | 2,372 | | 3,105 | |

Note: * p<0.05, ** p<0.01, *** p<0.001

**Fertility intentions**

Our third research question seeks to understand whether tenure attainment increases short-term fertility intentions and whether this association is gendered. The results (Fig. 8 and Tab. 8) show that attaining a tenured position is positively associated with short-term fertility intentions of young childless women (OR=2.96, $p<0.05$), while fertility intentions are independent of tenure for childless men (OR=0.96, $p>0.05$). As expected, parents are significantly less likely to intend to have another child than childless academics (for mothers: OR=0.37, $p<0.05$; for fathers: OR=0.12, $p<0.05$).

As expected, cohabitation with a partner positively impacts the fertility intentions of both men (OR=5.07, $p<0.01$) and women (OR=2.78, $p<0.05$), while intentions decrease with age, for women starting at age 36-40 and for men at age 41-45 (Table 8).

There are notable differences in short-term fertility intentions among men across various fields of study. Specifically, academic men in medical sciences and agricultural and veterinary sciences exhibit a higher likelihood of planning to have another child within the next three years compared to those in natural sciences. Additionally, women residing in the central regions of Italy express higher fertility intentions compared to those from the northern regions.

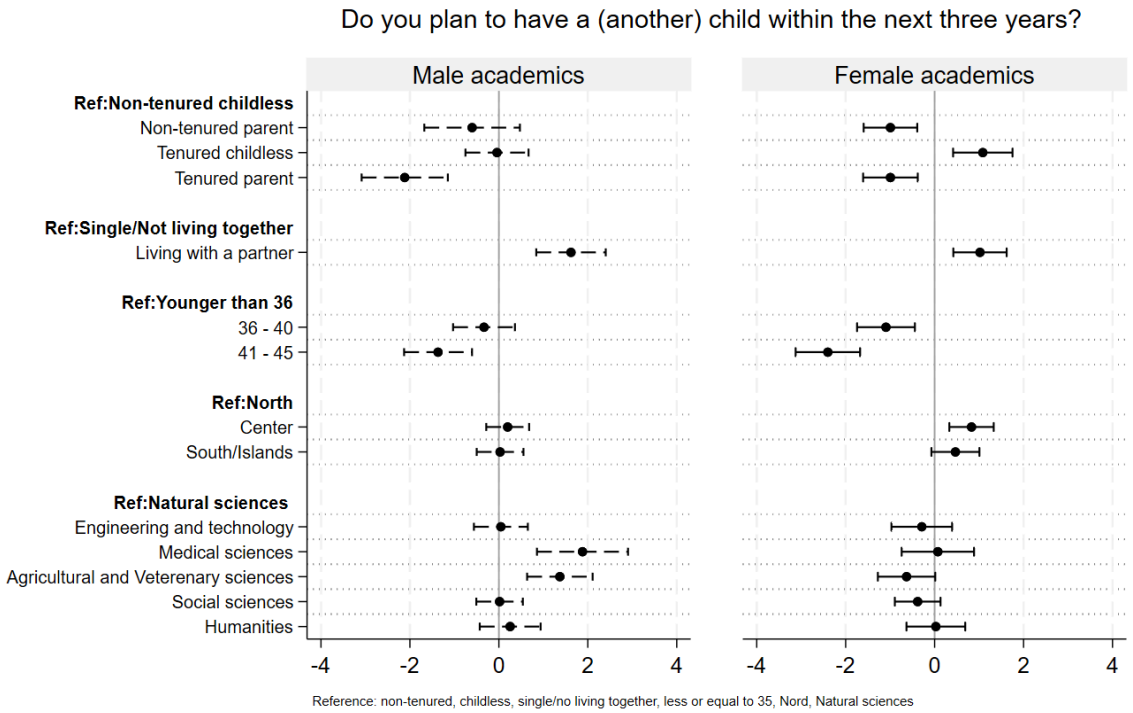



**Figure 7.** Logistic regression coefficients of short-term fertility intentions among male academics (on the left) and female academics (on the right). Cls 83%.

**Table 8.** Logistic regression on the effect of academic position (interaction tenure-having children) on short-term fertility intentions by gender. Results from Model 5.

| | Male academics | | Female academics | |
|---|---|---|---|---|
| | OR | S.E. | OR | S.E. |
| *ref. Non-tenured, childless* | | | | |
| Non-tenured, parents | 0.55 | (0.429) | 0.37* | (0.163) |
| Tenured, childless | 0.96 | (0.496) | 2.96* | (1.439) |
| Tenured, parents | 0.12** | (0.085) | 0.37* | (0.166) |
| *ref. Single/Have a partner, but not living together* | | | | |
| Living with a partner | 5.07** | (2.883) | 2.78* | (1.212) |
| *Age class (ref. Younger than 36):* | | | | |
| 36 - 40 | 0.72 | (0.363) | 0.34* | (0.159) |
| 41 - 45 | 0.26* | (0.142) | 0.09*** | (0.048) |
| *Macro region of residence (ref. North):* | | | | |
| Center | 1.22 | (0.429) | 2.29* | (0.834) |
| South and Islands | 1.03 | (0.394) | 1.60 | (0.628) |
| *Field of study (ref. Natural sciences):* | | | | |
| Engineering and technology | 1.05 | (0.462) | 0.75 | (0.373) |
| Medical sciences | 6.56* | (4.895) | 1.08 | (0.638) |
| Agricultural and veterinary sciences | 3.94* | (2.115) | 0.53 | (0.250) |
| Social sciences | 1.02 | (0.387) | 0.68 | (0.256) |
| Humanities | 1.29 | (0.643) | 1.03 | (0.495) |
| N | 353 | | 371 | |

Note: * p<0.05, ** p<0.01, *** p<0.001

## 5 Conclusions and discussions

Existing literature, including Chapter 3 of this dissertation, suggests that one's fertility history impacts in many ways academic careers. This Chapter shows that the reversal also holds true: academic careers impact fertility decisions.

With ad-hoc primary collected data, we find that in Italy, academic women tend to have lower fertility compared to academic men: they are more often childless and have fewer children, on average –a result also found in previous literature on different countries and specific disciplines (e.g., Ecklund & Lincoln, 2011). These findings may reflect higher barriers to fertility for academic women than for men. Childlessness in Academia may result from a rigid institutional structure and a tendency to underestimate the constraints imposed by biological fertility (Kemkes-Grottenthaler, 2003), impacting women more than men due to women's shorter reproductive ages compared to men. Lower fertility rates among women could potentially indicate several factors, including the consequences of delayed motherhood, such as unintentional childlessness or having fewer children than desired. However, it may also reflect a broader trend wherein academic women exhibit a reduced inclination towards parenthood or larger families than their male counterparts. This difference in fertility preferences could stem from the disproportionate impact of parenthood on women's academic careers relative to men, leading to a divergence in family planning choices between genders within academic settings.

While childlessness can be a deliberate choice of both men and women, it is essential to note that a study conducted in Austria, specifically among young female researchers, indicates that voluntary childlessness is infrequent among academics. Instead, the majority of these women express a desire to have at least two children (Berghammer et al., 2016). In turn, having fewer children than desired is associated with lower satisfaction with life

outside of work among academic men and women (Ecklund & Lincoln, 2011). Despite having fewer children than desired reduces one's life satisfaction more among academic men than women (Ecklund & Lincoln, 2011), the considerably lower fertility of academic women compared to men that we find in Italy deserves attention from future studies.

Our findings show that academic women and men wait to become first-time parents until attaining a tenured position entailing job stability –i.e., a permanent contract, which is, e.g., necessary to access a mortgage in the Italian credit market–the perspective of a higher salary and the achievement of a career progression. However, age moderates such a "tenure effect," especially for female academics. Men tend to delay fatherhood until more advanced ages (up to 44), and within each age group, the effect of tenure enhances the propensity of conceiving a first child. Women tend to become mothers after attaining tenure. However, mostly in their 30s, i.e., at the age when fertility potential is still quite high, and after the age of 40, the risk of becoming a first-time mother sharply declines.

Our data suggest that male academics, particularly those in the advanced stages of their careers, may delay parenthood with relatively low associated risks, primarily because they are predominantly involved in relationships with younger partners (see Appendix E, Table E2, Figure E). Among the subset of men in our sample who have partners (constituting 86 per cent of the 869 men surveyed), 63 per cent are observed to have partners who are younger, with an average age difference of 4.6 years. The concept of a "partnership age gap," as elucidated in existing literature (e.g., Dudel et al., 2020), emerges as a pivotal factor within the context of deferred fertility. This dynamic confers a strategic advantage for male academics, facilitating the postponement of parenthood to later ages until they reach a more advanced stage in their careers. Women, instead, face a double disadvantage: their reproductive lifespan is shorter than that of men, and they tend to partner with slightly older men, whose fecundability may hence also be reduced.

Contrary to our expectations, attaining tenure does not impact the transition to a second child for either men or women. As the literature suggests, the factors influencing the decision to have a second child may differ from those which trigger the transition to parenthood. Together with the occupational conditions of parents, including job security and flexible working hours, external factors like the availability of childcare services, networks of support, and the support of one's partner may play a crucial role in determining the decision to have a second child (Hu & Mei, 2021; Compans et al., 2023). Unfortunately, our data do not allow us to assess the impact of these factors due to the lack of information on partnership status and partner's characteristics at the time of conception. The potential interpretations of this result are diverse. For instance, experiencing career-related consequences due to the first child may discourage the birth of a second child, even if contractual conditions change. Alternatively, factors influencing the decision for a second birth, including the desire for multiple children, may not exclusively pertain to economic or job-related spheres.

Clearly, it is not tenable to assume a universal desire for parenthood among individuals in academia. Our study underscores the profound interconnection between the planning and realisation of fertility, emphasising the intricate interweaving of career trajectories and life paths. Our findings indicate that holding a tenured position positively influences the short-term fertility intentions of young, childless women, underscoring the pivotal role of job security as a precursor to embracing parenthood for both women and men. This observation aligns with the extensive discussions in previous literature regarding the intricate relationship between career progression and life choices in academic settings.

Our findings align with previous research indicating the significant challenges academic women face in balancing career advancement with the desire for motherhood, especially during the critical early stages of their academic journey, which coincide with prime

reproductive years. However, extending beyond existing literature, our results suggest that male academics may also adjust their fertility decisions in response to the demands and dynamics of an academic career, delaying fatherhood until achieving tenure, i.e., greater stability in their professional trajectory. These findings not only underscore the need for a reevaluation of parental support policies but also prompt critical reflections on the current logic of career progression within the Italian academic system.

# Conclusion

Within the academic realm, despite the growing emphasis on gender equality, gender differences continue to persist. Gender inequality in academia is a complex and multifaceted phenomenon that encompasses various aspects, including but not limited to reduced representation and slower career advancement for women compared to men, gender segregation across scientific fields, gender disparities in earnings and research opportunities, and also gender discrimination. Thus, addressing gender inequality in academia is crucial for fostering diversity, equity, and inclusion, which involves promoting equal opportunities, challenging stereotypes, and creating an environment where all individuals, regardless of gender, can thrive and contribute to the academic community.

The investigation of gender inequality in academic settings has been a focus of particular attention from social scientists for two main reasons: to understand its causes and its consequences. According to Merton's paradigm, academia is often conceptualised as the epitome of a universalistic social institution where fair evaluation and merit-based rewards prevail (Merton, 1968). Within this framework, any observed disparities in opportunities and outcomes are typically assumed to stem from differences in individual talents or, more precisely, the efforts exerted under specific circumstances rather than being a consequence of social and other types of constraints.

Gaiaschi (2022) points out that historically, scholars have posed the question, "*What is wrong with women?*" attributing women's disadvantages in academic careers predominantly to individual-level factors such as personal preferences, motivations, and scholarly performance; however, over time, the academic discourse shifted the attention

towards "*What's wrong with academia?*". This shift is in response to previous research operating within the individual merit paradigm, consistently revealing the absence of significant disparities between male and female academics regarding academic aptitude and suitability for academic roles. Consequently, scholars have pivoted their focus towards examining the tangible gendered social conditions and societal constraints that significantly influence individual outcomes.

The development of new theoretical frameworks, particularly the life course approach (e.g., Giele & Elder 1998), has stimulated research on gender differences in work-life balance, i.e., the challenges faced by academics, especially women, in reconciling academic careers with family responsibilities. The challenges associated with academic parenthood –childbearing and childrearing– have become the litmus test signalling that the causes of persistent gender inequality may be related not only to individual characteristics and peculiarities of the academic system but may also be rooted in the existing widespread family model and welfare regime. Thus, to thoroughly understand and address gender inequality in academia, it is essential to adopt a multi-dimensional perspective encompassing micro, meso, and macro levels of analysis (Gaiaschi, 2022).

Examined through the lens of the life course approach, highlighting the interweaving and mutual influence of career and life trajectories, gender inequality in academia yields far-reaching social consequences that extend beyond the professional realm. For academic institutions, the underrepresentation and obstacles women face may result in the loss of valuable talent, which can limit the diversity of perspectives and hinder the richness of the academic environment. From the individual perspective, gender inequality can impede women's career advancement, affecting their promotion opportunities, salary increases, and access to leadership roles. This may perpetuate gender gaps in academic achievements, including research productivity and scholar recognition. Moreover, the

challenges of reconciling professional and personal lives in academia, especially given societal expectations tied to caregiving roles, often designated as female responsibilities, can influence women's choices related to family planning and parenthood. This may lead to decisions of postponing motherhood to later ages, which may result in involuntary childlessness or lower-than-desired family size – outcomes that may be associated with low life satisfaction and subjective well-being, impacting women more than men.

This dissertation focused on Italy. By narrowing the scope of analysis and delving deep into the Italian case, this research unveils insights that contribute to both the scholarly discourse and may inform policymakers in addressing gender inequality in academia (and beyond). Overall, this research contributes to the literature on gender inequality in academia by investigating the interplay between personal and professional lives in both directions. First, I ask *whether and how parenthood affects the career* of men and women in terms of entering (Chapter 2) and progressing (Chapter 3) in academia. Secondly, I wonder *whether and how academic progression affects men's and women's fertility behaviour* (Chapter 4).

The empirical chapters (2 to 4) were preceded by a review of the theories and empirical evidence on the causes (origins and mechanisms) and consequences of gender inequality in academia, with particular attention given to parenthood in academic settings (Chapter 1).

Of the three empirical chapters, Chapter 2 focused on transitioning from doctoral study to employment, scrutinising potential gender disparities in career choices. I applied an analytical model that allowed me to examine the intricate interplay between scientific productivity, career choice, and parental status. Controlling for pre-employment characteristics of PhD graduates, I found that for both men and women, obtaining an

academic position in the early stages of a career significantly enhances scientific productivity; in turn, having children reduces the chances of working in academia after PhD completion. Also, substantial gender differences in access to academic positions and productivity persist in both cases in favour of male PhDs. However, the Kitagawa-Blinder-Oaxaca decomposition shows that much of the gap in both outcomes is unrelated to gender differences in their observed characteristics and remains unexplained. These findings have prompted the suggestion that career choices may be influenced even before the completion of doctoral studies, possibly by factors such as lifestyle preferences or perception of existing gender inequalities that self-select women out of academic career. These elements, often reflective of entrenched gender stereotypes and attitudes, can, in turn, play a pivotal role in shaping individuals' decisions regarding the transition to parenthood.

Driven by the results of Chapter 2, the second empirical contribution of the dissertation (Chapter 3) investigates the possible link between fertility and academic career progression using a longitudinal, life-course approach made possible only by undergoing a primary data collection. I explore gender differences in academic progression regarding the time elapsed from obtaining a PhD to being appointed to various academic positions and estimate the role of childbearing in contributing to gender disparities. First, I find no disadvantage for women in the rate of career advancement from PhD completion to early career academic positions, suggesting that among the most recent cohorts of PhD holders, academic women are as likely as academic men to access early-career academic positions in Italy and the length of time between PhD completion and access to such positions is the same, on average for both genders. At the same time, there is a statistically significant gender gap in the hazard of obtaining a tenured academic position. Results show that, on average, women wait longer than men to attain a tenured academic position. Second, this

gender gap cannot be explained solely by childbearing: after the birth of a child is controlled for, gender gaps in academic promotions persist. Moreover, I found a significant paternity penalty at the beginning of the academic career, whereas there is a paternity bonus in the transition to a tenured academic position. For women, however, academic promotions remain unaffected by childbearing. This result prompted two suggestions. First, the progression to a tenured position represents a significant hurdle in women's career advancement. Therefore, there is a pressing need for heightened scrutiny of the habilitation procedure and hiring procedures (a factorial experimental approach may be a suitable approach to address it) to mitigate the risk of potential indirect discrimination. Secondly, this dissertation contributes to a small but growing literature (see, e.g., Derrick et al., 2022; Damaske et al., 2014; Jacobs & Winslow, 2010; Tattarini et al., 2022) showing that academics, and particularly academic parents, constitute a highly heterogeneous group, with diversity stemming not only from factors such as lifestyle preferences regarding work and family, age and the number of children, but also from their partnership status and, if present, the characteristics of the partner, such as his/her employment status, job-related characteristics, parenting style and contribution to the total household's income, that may significantly moderate the effect of parenthood on the career outcomes.

In Chapter 4, the focus shifts from considering parenthood as a precursor to examining it as an outcome of gender inequality within academia. The objective is to investigate the impact of academic promotion on three fertility-related outcomes: the transition to parenthood, the transition to a second child, and short-term fertility intentions. The findings reveal that both male and female academics typically postpone parenthood until they secure their first tenured position; however, men generally have a broader "fertility window" compared to women. Surprisingly, there are no significant disparities between

tenured and non-tenured academics concerning the decision to have a second child. Conversely, the attainment of tenure appears to increase the short-term fertility intentions of young, childless women, while no similar effect is observed for men. This result prompted the suggestion that escaping job uncertainty by attaining a tenured academic position does impact the transition to parenthood for both men and women.

There are three fundamental take-home messages from this dissertation.

First, despite increased attention and the implementation of gender policies, gender inequality persists in academia. Using two sources of Italian data, the first one covers the entire population of six educational cohorts of PhD holders (Chapter 2), and the second one includes a large sample of academics who work in Italian universities (Chapter 3), I was able to examine crucial career transitions to identify and address disparities in opportunities between men and women. I identified two bottlenecks in career development that may be responsible for gender inequality. Women have lower chances to enter academic careers and spend more time advancing to the tenured academic ranks than their male counterparts. In both cases, the women's disadvantage is unrelated to motherhood; the gender gap persists after parenthood status or childbirth has been controlled. These results suggest that we cannot exclude the presence of gender discrimination, especially in the progression to the top-level academic ranks.

Second, although childbearing does not explain the observed gender gap in career progression, it negatively affects the career progression of fathers, namely the paternity penalty, particularly during early career transitions. Academic fathers have received limited attention in the literature, partly because work-life balance is perceived as primarily a woman's issue. However, neglecting the impact of fatherhood on academic outputs and careers carries two risks. Firstly, it overlooks the emergence of a new

generation of “involved” and “engaged” fathers and “egalitarian partners” redefining cultural norms surrounding fatherhood (LaRossa, 2004; Grau Grau et al., 2022), including within academia (Salle, 2014; 2016; Damaske et al., 2014). Secondly, it reinforces the assumption that caregiving responsibilities, predominantly borne by women, are the sole impediment to achieving the “right” level of scholarly productivity and, consequently, career promotion (Mason et al., 2013; Corbera et al., 2020; Pereira, 2021). This neglects other family-related factors such as partnership status, partner's employment status and occupation (Jacobs et al., 2004; Damaske et al., 2014), and parenting style (Derrick et al., 2022).

Third, the academic career shapes the fertility behaviour of both male and female academics. The rigour and demanding nature of an academic career, characterised by high publication standards and extensive geographical mobility, pose challenges in balancing parental responsibilities. Moreover, the prolonged job precariousness during the early stages of academic careers compels academics to defer the decision to have children until securing the first tenured position. While male academics can postpone the decision to have a child with relatively low risks, female academics grapple with the intricate task of managing potential career risks associated with having a child during the precarious early academic stage and the reproductive risks of delaying childbirth until the tenured stage, typically occurring at an advanced reproductive age.

The dissertation also prompted questions for future research on the topic.

Measuring career choice drivers has been and remains a challenge for social scientists. While sociological literature has concentrated on job-related characteristics of PhD holders, including career preferences, family-related features have rarely been considered, mainly because of the lack of available data. This dissertation has tried to

investigate whether career choices are determined by parental status, based on the assumption that reconciling parenthood with the academic job, especially during the early career stage, presents a particular challenge for female PhD candidates. Thus, female PhDs who already have children before entering the labour market or plan to have them in the near future are more likely to opt for non-academic careers (Chapter 2). However, due to the cross-sectional nature of our data, we could not account for a time dimension, i.e., to identify whether childbirth occurred before or after entering the labour market. So, despite finding a negative relationship between parental status and the likelihood of working in academia for both men and women, our results do not explain the gender gap or assert causality. Thus, more work is needed in this area.

While work-life balance in academia is commonly framed as a women's issue, the reconciliation of fatherhood and academic careers should be given more attention. Our study indicates that the impact of childbearing on men's academic careers can vary, leading to either a paternity penalty or a paternity bonus. The timing of parenthood plays a crucial role in determining these effects. This highlights the evolving dynamics of family roles and the adoption of an egalitarian family model, with a growing number of fathers actively involved in child-rearing. The existing paradigm of an "ideal academic worker" and the precariousness during the early career stage pose substantial obstacles to achieving fertility goals in light of changing family dynamics. Thus, future research should investigate this issue further.

Moreover, there is a pressing need for additional research to delve deeper into the determinants of fertility behaviour among highly educated individuals, especially concerning higher-order births. Understanding the intricacies of fertility behaviour among academics can provide valuable insights for crafting policies and initiatives aimed at

fostering family-friendly environments within academic institutions. Given the pervasive gender inequalities in academia, it is essential to examine how fertility decisions intersect with gender dynamics. Our study highlights that academic career trajectories significantly influence the fertility behaviour of both men and women; however, the changes in fertility behaviour pose greater reproductive risks for women than for men. Therefore, investigating potential differential "career" impacts on men and women in academia regarding family planning can illuminate existing inequalities and guide efforts toward promoting gender equity.

# Appendix

## **Appendix A.** Threefold Blinder-Oaxaca decomposition

**Table A1.** The average values of proxies for "scientific quality".

| | *Mean* | *SE* | *Confidence Intervals* | | *N* |
|---|---|---|---|---|---|
| *Graduation mark* | | | | | |
| Male | 0.694 | 0.003 | 0.688 | 0.701 | 19,450 |
| Female | 0.753 | 0.003 | 0.747 | 0.759 | 21,773 |
| *Teaching during PhD* | | | | | |
| Male | 0.739 | 0.003 | 0.733 | 0.746 | 19,450 |
| Female | 0.710 | 0.003 | 0.704 | 0.716 | 21,773 |
| *Visiting abroad during PhD* | | | | | |
| Male | 0.415 | 0.004 | 0.408 | 0.422 | 19,450 |
| Female | 0.364 | 0.003 | 0.358 | 0.371 | 21,773 |
| *PhD completion in time* | | | | | |
| Male | 0.838 | 0.003 | 0.833 | 0.843 | 19,450 |
| Female | 0.849 | 0.002 | 0.844 | 0.854 | 21,773 |

**Table A2.** Threefold Blinder-Oaxaca decomposition of the gender gap in scientific productivity 4 - 6 years after PhD completion.

| | *Coefficient* | *SE* | *Endowment* | *SE* | *Interaction* | *SE* |
|---|---|---|---|---|---|---|
| Academic position | 0.000 | 0.003 | 0.011*** | 0.002 | 0.000 | 0.000 |
| Having children | 0.005 | 0.004 | 0.001** | 0.000 | -0.001 | 0.001 |
| PhD completion in time | 0.005 | 0.011 | -0.001*** | 0.000 | -0.000 | 0.000 |
| Graduation mark | 0.015 | 0.008 | -0.002*** | 0.000 | -0.001 | 0.001 |
| Visiting abroad during PhD | -0.005 | 0.004 | 0.005*** | 0.001 | -0.001 | 0.000 |
| Teaching during PhD | -0.019** | 0.008 | 0.001*** | 0.000 | -0.001 | 0.000 |
| 2004 | 0.000 | 0.001 | -0.000 | 0.000 | -0.000 | 0.000 |
| 2006 | 0.005*** | 0.001 | 0.000 | 0.000 | -0.000 | 0.000 |
| 2008 | -0.000 | 0.002 | -0.000 | 0.000 | -0.000 | 0.000 |
| 2010 | 0.000 | 0.002 | -0.000 | 0.000 | 0.000 | 0.000 |
| 2012 | -0.007*** | 0.002 | -0.000 | 0.000 | 0.000 | 0.000 |
| 2014 | -0.002 | 0.002 | 0.000 | 0.000 | -0.000 | 0.000 |
| Natural sciences | -0.003 | 0.002 | 0.000 | 0.000 | -0.000 | 0.000 |
| Medical sciences | 0.002 | 0.002 | -0.008*** | 0.001 | -0.001 | 0.000 |
| Agricultural sciences | -0.000 | 0.001 | 0.000 | 0.000 | -0.000 | 0.000 |
| Engineering and technology | -0.001 | 0.001 | -0.011*** | 0.001 | -0.001 | 0.001 |
| Social sciences | 0.004 | 0.003 | 0.007*** | 0.001 | -0.001 | 0.001 |
| constant | 0.060*** | 0.017 | | | | |

Note: * p<0.05; ** p<0.01; *** p<0.001

**Table A3.** Threefold Blinder-Oaxaca decomposition of the gender gap in the probability of having an academic position 4 - 6 years after PhD completion.

| | *Coefficient* | *SE* | *Endowment* | *SE* | *Interaction* | *SE* |
|---|---|---|---|---|---|---|
| Having children | -0.004 | 0.004 | 0.002*** | 0.000 | 0.001 | 0.001 |
| PhD completion in time | 0.013 | 0.011 | -0.001*** | 0.000 | -0.000 | 0.000 |
| Graduation mark | 0.008 | 0.008 | -0.001*** | 0.000 | -0.001 | 0.001 |
| Visiting abroad during PhD | -0.001 | 0.003 | 0.006*** | 0.001 | -0.000 | 0.001 |
| Teaching during PhD | 0.006 | 0.007 | 0.002*** | 0.000 | 0.000 | 0.000 |
| 2004 | 0.003** | 0.001 | -0.000 | 0.000 | -0.000 | 0.000 |
| 2006 | -0.002 | 0.001 | -0.000 | 0.000 | 0.000 | 0.000 |
| 2008 | -0.002 | 0.002 | -0.000 | 0.000 | -0.000 | 0.000 |
| 2010 | -0.003 | 0.002 | -0.000 | 0.000 | -0.000 | 0.000 |
| 2012 | 0.001 | 0.002 | 0.000 | 0.000 | -0.000 | 0.000 |
| 2014 | 0.001 | 0.002 | -0.000 | 0.000 | 0.000 | 0.000 |
| Natural sciences | 0.003 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 |
| Medical sciences | -0.004** | 0.002 | 0.001 | 0.000 | 0.002 | 0.001 |
| Agricultural sciences | -0.001 | 0.001 | -0.000 | 0.000 | 0.000 | 0.000 |
| Engineering and technology | 0.001 | 0.001 | -0.001 | 0.001 | 0.001 | 0.001 |
| Social sciences | 0.007** | 0.003 | -0.001 | 0.000 | -0.001** | 0.001 |
| constant | -0.003 | 0.017 | | | | |

Note: * p<0.05; ** p<0.01; *** p<0.001

# **Appendix B.** Sample characteristics: weights, structure, summary statistics

**Table B1.** Sample weights

| | *Full Professors* | | *Associate Professors* | | *Non-tenured Assistant Professors* | | *Tenured Assistant Professors* | | *Permanent Researchers* | | *Postdoc fellows* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *M* | *F* | *M* | *F* | *M* | *F* | *M* | *F* | *M* | *F* | *M* | *F* |
| 1. Mathematics and informatics | 1.35 | 0.77 | 1.14 | 0.81 | 0.83 | 0.29 | 0.84 | 0.43 | 2.01 | 1.27 | 1.36 | 0.47 |
| 2. Physics | 1.50 | 0.64 | 0.92 | 0.57 | 2.75 | 0.48 | 0.95 | 1.32 | 5.28 | 1.08 | 1.43 | 0.70 |
| 3. Chemistry | 2.51 | 1.48 | 1.92 | 0.65 | 0.73 | 0.55 | 1.20 | 1.32 | 4.96 | 1.13 | 2.79 | 1.07 |
| 4. Earth sciences | 0.37 | 0.28 | 0.49 | 0.21 | 0.23 | 0.11 | 0.88 | 0.17 | 0.57 | 0.26 | 0.70 | 0.36 |
| 5. Biology | 0.83 | 0.54 | 0.55 | 0.44 | 0.38 | 0.42 | 0.68 | 0.37 | 1.80 | 0.99 | 1.01 | 0.59 |
| 6. Medicine | 2.15 | 1.15 | 2.53 | 0.89 | 4.26 | 1.43 | 1.99 | 0.63 | 11.27 | 3.57 | 1.54 | 1.99 |
| 7. Agricultural and Veterinary | 0.51 | 0.77 | 0.65 | 0.42 | 0.41 | 0.26 | 0.41 | 0.52 | 0.74 | 0.87 | 1.31 | 1.34 |
| 8. Civil engineering and architecture | 2.48 | 1.25 | 1.77 | 0.94 | 1.06 | 0.72 | 1.00 | 0.54 | 4.36 | 1.37 | 1.56 | 1.76 |
| 9. Industrial and information engineering | 1.21 | 0.41 | 1.43 | 0.85 | 1.70 | 0.49 | 0.71 | 0.65 | 1.75 | 1.90 | 2.75 | 2.09 |
| 10. Antiquities, philology, literary studies, art history | 3.15 | 1.64 | 2.95 | 1.38 | 0.00 | 1.13 | 1.05 | 0.69 | 0.00 | 5.95 | 1.02 | 0.80 |
| 11. History, philosophy, pedagogy, and psychology | 1.43 | 1.45 | 2.33 | 0.89 | 2.81 | 0.58 | 1.40 | 0.50 | 0.00 | 1.96 | 1.28 | 1.21 |
| 12. Law | 1.19 | 0.54 | 1.48 | 0.65 | 0.92 | 0.70 | 0.83 | 0.31 | 6.91 | 1.35 | 1.26 | 2.96 |
| 13. Economics and statistics | 1.11 | 0.72 | 1.10 | 0.50 | 0.51 | 0.51 | 0.55 | 0.43 | 1.75 | 0.77 | 0.50 | 0.40 |
| 14. Political and social sciences | 0.00 | 0.58 | 1.15 | 0.80 | 1.27 | 0.28 | 0.43 | 0.27 | 0.60 | 0.94 | 0.46 | 0.31 |

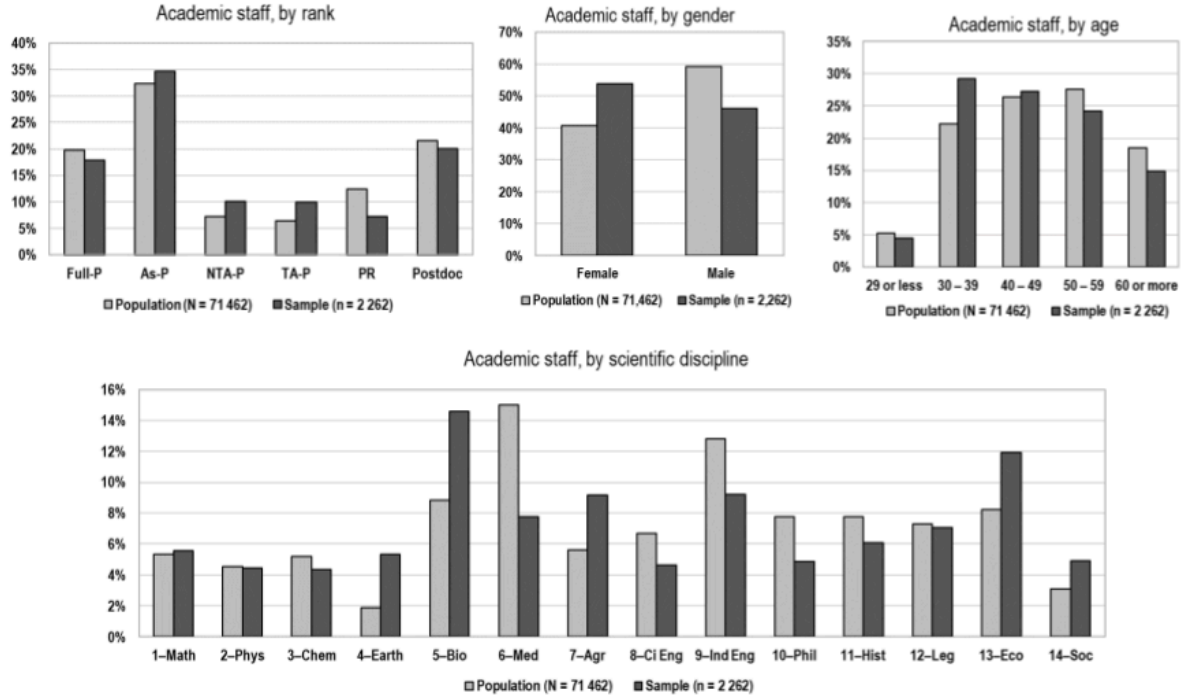



**Figure B1.** Sample structure (2,262) vs. Population structure (71,462) (MIUR 2020)

**Table B2.** Summary statistics for male and female samples at the moment of interview, weights are applied

| | *Postdoc fellows* | | *Non-tenured Assistant Professors* | | *Tenured Assistant Professors* | | *Permanent Researchers* | | *Associate Professors* | | *Full Professors* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *M* | *F* | *M* | *F* | *M* | *F* | *M* | *F* | *M* | *F* | *M* | *F* |
| *Parental status* | | | | | | | | | | | | |
| Childless | 81.3 | 77.9 | 65.8 | 51.6 | 46.7 | 37.6 | 41.3 | 24.8 | 20.9 | 22.1 | 10.5 | 30.3 |
| 1 child | 13.4 | 12.9 | 18.9 | 27.1 | 27.0 | 26.9 | 29.0 | 22.8 | 28.7 | 28.9 | 26.7 | 27.2 |
| 2 or more children | 5.3 | 9.2 | 15.3 | 21.4 | 26.2 | 35.6 | 29.8 | 52.4 | 50.3 | 49.1 | 62.8 | 42.5 |
| Scholarly productivity (mean) | 7.6 | 5.8 | 5.1 | 5.1 | 5.4 | 3.6 | 2.3 | 1.8 | 2.8 | 2.4 | 1.9 | 1.9 |
| Age (mean) | 33.6 | 33.7 | 36.9 | 36.2 | 39.9 | 41.2 | 51.6 | 50.3 | 48.4 | 50.4 | 56.7 | 56.3 |
| *PhD cohort:* | | | | | | | | | | | | |
| 2009 & older | 1.1 | 3.4 | 12.4 | 9.5 | 24.8 | 40.1 | 94.7 | 89.5 | 85.9 | 92.0 | 98.6 | 99.3 |
| 2010 & recent | 98.9 | 96.6 | 87.6 | 90.5 | 75.2 | 59.9 | 5.3 | 10.5 | 14.1 | 8.0 | 1.4 | 0.7 |
| *Field of study:* | | | | | | | | | | | | |
| Natural sciences | 31.0 | 30.5 | 28.5 | 27.1 | 29.0 | 26.5 | 25.4 | 29.0 | 25.4 | 27.2 | 25.3 | 20.4 |
| Engineering and technology | 34.1 | 20.3 | 29.9 | 15.3 | 20.7 | 13.1 | 24.9 | 7.2 | 21.7 | 11.8 | 19.6 | 10.0 |
| Medical sciences | 6.4 | 10.5 | 10.9 | 16.1 | 12.1 | 11.8 | 13.4 | 13.0 | 12.8 | 9.4 | 12.2 | 8.8 |
| Agricultural sciences | 4.9 | 8.5 | 5.8 | 6.2 | 4.5 | 5.3 | 8.8 | 5.5 | 5.1 | 6.2 | 4.7 | 5.1 |
| Social sciences | 13.0 | 13.1 | 17.6 | 16.8 | 17.7 | 19.5 | 27.6 | 25.6 | 19.8 | 20.0 | 23.9 | 27.1 |
| Humanities | 10.6 | 17.2 | 7.2 | 18.5 | 16.1 | 23.7 | 0.0 | 19.7 | 15.1 | 25.6 | 14.3 | 28.7 |
| *Geographical area of residence:* | | | | | | | | | | | | |
| Center | 47.4 | 38.9 | 24.1 | 18.5 | 33.0 | 23.8 | 28.4 | 33.7 | 28.8 | 29.6 | 33.2 | 17.4 |
| North | 40.5 | 48.3 | 55.9 | 59.0 | 41.4 | 46.5 | 59.0 | 41.4 | 52.2 | 51.1 | 49.5 | 66.2 |
| South & Islands | 12.1 | 12.8 | 20.0 | 22.5 | 25.6 | 29.7 | 12.6 | 25.0 | 19.0 | 19.4 | 17.4 | 16.4 |
| N | 165 | 224 | 87 | 138 | 100 | 120 | 45 | 86 | 287 | 398 | 185 | 113 |

# **Appendix C.** Cox proportional hazard models (by gender, with interactions)

**Table C1.1.** Cox proportional hazard regression model on the hazard of being promoted to each academic position, separate models by gender

| | *Postdoc fellows* | | *Non-tenured Assistant Professors* | | *Tenured Assistant Professors* | |
|---|---|---|---|---|---|---|
| | *M* | *F* | *M* | *F* | *M* | *F* |
| *Parenthood status* | | | | | | |
| Childless (*ref*) | 1 | 1 | 1 | 1 | 1 | 1 |
| | (.) | (.) | (.) | (.) | (.) | (.) |
| 1 child | 0.59 | 1.10 | 1.659* | 0.88 | 1.28 | 1.04 |
| | (0.16) | (0.17) | (0.38) | (0.17) | (0.34) | (0.23) |
| 2 children | 0.363* | 0.88 | 0.414* | 0.70 | 2.028** | 0.98 |
| | (0.16) | (0.18) | (0.16) | (0.16) | (0.52) | (0.20) |
| Scholarly productivity | 1.147*** | 1.168*** | 1.409*** | 1.358*** | 1.554*** | 1.172*** |
| | (0.03) | (0.02) | (0.04) | (0.05) | (0.07) | (0.05) |
| Age at PhD completion | 0.98 | 0.947* | 0.99 | 0.96 | 0.910* | 0.916* |
| | (0.03) | (0.02) | (0.04) | (0.03) | (0.03) | (0.03) |
| *Scientific field* | | | | | | |
| Natural sciences (*ref*) | 1 | 1 | 1 | 1 | 1 | 1 |
| | (.) | (.) | (.) | (.) | (.) | (.) |
| Engineering and Technology | 0.97 | 0.84 | 1.11 | 0.82 | 0.69 | 0.90 |
| | (0.20) | (0.19) | (0.27) | (0.25) | (0.18) | (0.28) |
| Medical sciences | 0.56 | 0.83 | 0.51 | 0.92 | 1.01 | 0.91 |
| | (0.21) | (0.19) | (0.25) | (0.26) | (0.57) | (0.28) |
| Agricultural and Veterenary | 1.05 | 1.14 | 1.46 | 0.89 | 0.91 | 0.72 |
| | (0.24) | (0.21) | (0.38) | (0.24) | (0.35) | (0.22) |
| Social sciences | 1.25 | 1.12 | 1.46 | 1.24 | 1.803* | 1.25 |
| | (0.23) | (0.16) | (0.33) | (0.25) | (0.42) | (0.33) |
| Humanities | 1.25 | 1.17 | 0.71 | 0.63 | 1.12 | 0.80 |
| | (0.25) | (0.17) | (0.25) | (0.15) | (0.42) | (0.21) |
| *Region of residence* | | | | | | |
| Center (*ref*) | 1 | 1 | 1 | 1 | 1 | 1 |
| | (.) | (.) | (.) | (.) | (.) | (.) |
| North | 0.87 | 0.83 | 1.694* | 1.24 | 0.83 | 0.82 |
| | (0.14) | (0.11) | (0.38) | (0.23) | (0.19) | (0.18) |
| South and Islands | 0.648* | 0.91 | 1.19 | 0.89 | 0.76 | 1.21 |
| | (0.13) | (0.13) | (0.29) | (0.22) | (0.19) | (0.30) |
| N | 577 | 798 | 963 | 1295 | 615 | 880 |

Exponentiated coefficients (i.e., hazard ratios); standard errors in parentheses. N - number of episod-persons. P-value: * p<0.05, ** p<0.01, *** p<0.001

**Table C1.2.** Cox proportional hazard regression model on the hazard of being promoted to each academic position, separate models by gender

| | *Permanent Researchers* | | *Associate Professors* | | *Full Professors* | |
|---|---|---|---|---|---|---|
| | *M* | *F* | *M* | *F* | *M* | *F* |
| *Parenthood status* | | | | | | |
| Childless (*ref*) | 1 | 1 | 1 | 1 | 1 | 1 |
| | (.) | (.) | (.) | (.) | (.) | (.) |
| 1 child | 0.78 | 0.82 | 1.341* | 0.97 | 1.17 | 0.81 |
| | (0.13) | (0.12) | (0.18) | (0.13) | (0.27) | (0.23) |
| 2 children | 0.585* | 0.80 | 1.30 | 0.90 | 1.34 | 0.79 |
| | (0.14) | (0.16) | (0.19) | (0.13) | (0.29) | (0.20) |
| Scholarly productivity | 0.697*** | 0.733*** | 1.390*** | 1.221** | 1.19 | 1.26 |
| | (0.06) | (0.05) | (0.10) | (0.08) | (0.20) | (0.22) |
| Age at PhD completion | 1.01 | 1.03 | 0.98 | 0.99 | 0.96 | 0.99 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.03) | (0.02) |
| *Scientific field* | | | | | | |
| Natural sciences (*ref*) | 1 | 1 | 1 | 1 | 1 | 1 |
| | (.) | (.) | (.) | (.) | (.) | (.) |
| Engineering and Technology | 1.22 | 1.426* | 0.94 | 1.24 | 0.91 | 0.96 |
| | (0.20) | (0.25) | (0.15) | (0.24) | (0.22) | (0.34) |
| Medical sciences | 0.75 | 0.94 | 0.74 | 0.60 | 1.31 | 1.06 |
| | (0.21) | (0.28) | (0.26) | (0.20) | (0.43) | (0.53) |
| Agricultural and Veterenary | 1.731** | 1.02 | 0.80 | 0.93 | 1.07 | 0.80 |
| | (0.33) | (0.21) | (0.15) | (0.21) | (0.29) | (0.31) |
| Social sciences | 1.19 | 1.328* | 1.37 | 1.27 | 1.36 | 1.33 |
| | (0.19) | (0.17) | (0.26) | (0.19) | (0.29) | (0.31) |
| Humanities | 0.80 | 0.95 | 1.38 | 1.429* | 1.30 | 1.24 |
| | (0.18) | (0.16) | (0.24) | (0.25) | (0.37) | (0.36) |
| *Region of residence* | | | | | | |
| Center (*ref*) | 1 | 1 | 1 | 1 | 1 | 1 |
| | (.) | (.) | (.) | (.) | (.) | (.) |
| North | 0.93 | 0.92 | 1.03 | 1.526** | 0.74 | 1.795* |
| | (0.13) | (0.12) | (0.15) | (0.22) | (0.13) | (0.51) |
| South and Islands | 0.689* | 1.05 | 1.35 | 0.86 | 0.607* | 1.20 |
| | (0.12) | (0.16) | (0.21) | (0.15) | (0.15) | (0.41) |
| *PhD cohort* | | | | | | |
| 2009 & older | | | 1 | 1 | 1 | 1 |
| | | | (.) | (.) | (.) | (.) |
| 2010& recent | | | 1.48 | 1.57 | 1.00 | 0.00 |
| | | | (0.35) | (0.41) | (0.84) | (.) |
| N | 647 | 877 | 863 | 1032 | 507 | 489 |

Exponentiated coefficients (i.e., hazard ratios); standard errors in parentheses.N - number of episod-persons. P-value: * p<0.05, ** p<0.01, *** p<0.001

**Table C2.1.** Cox proportional hazard model on the hazard of promotion to each academic position, including an interaction term. References category: (1) childless men, (2) Fathers of one, (3) Fathers of two

| | *Postdoc fellows* | | | *Non-tenured Assistant Professors* | | | *Tenured Assistant Professors* | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (1) | (2) | (3) | (1) | (2) | (3) |
| *Sex*Parental status* | | | | | | | | | |
| Men childless | 1 | 1.66 | 2.636* | 1 | 0.615* | 2.458* | 1 | 0.86 | 0.64 |
| | (.) | (0.45) | (1.10) | (.) | (0.13) | (0.91) | (.) | (0.21) | (0.17) |
| Fathers of one | 0.60 | 1 | 1.59 | 1.627* | 1 | 4.000*** | 1.17 | 1 | 0.75 |
| | (0.16) | (.) | (0.74) | (0.35) | (.) | (1.54) | (0.29) | (.) | (0.23) |
| Fathers of two | 0.379* | 0.63 | 1 | 0.407* | 0.250*** | 1 | 1.57 | 1.34 | 1 |
| | (0.16) | (0.29) | (.) | (0.15) | (0.10) | (.) | (0.43) | (0.42) | (.) |
| Women childless | 1.15 | 1.909* | 3.032** | 1.09 | 0.67 | 2.686** | 0.79 | 0.68 | 0.506* |
| | (0.11) | (0.51) | (1.25) | (0.17) | (0.14) | (0.98) | (0.16) | (0.18) | (0.14) |
| Mothers of one | 1.23 | 2.034* | 3.231** | 0.95 | 0.586* | 2.345* | 0.93 | 0.79 | 0.59 |
| | (0.20) | (0.59) | (1.38) | (0.19) | (0.14) | (0.89) | (0.20) | (0.21) | (0.17) |
| Mothers of two | 0.98 | 1.62 | 2.579* | 0.79 | 0.484** | 1.94 | 0.87 | 0.74 | 0.554* |
| | (0.20) | (0.50) | (1.12) | (0.18) | (0.13) | (0.74) | (0.20) | (0.20) | (0.16) |
| Scholarly productivity | 1.153*** | 1.153*** | 1.153*** | 1.376*** | 1.376*** | 1.376*** | 1.301*** | 1.301*** | 1.301*** |
| | (0.02) | (0.02) | (0.02) | (0.03) | (0.03) | (0.03) | (0.07) | (0.07) | (0.07) |
| Age at PhD completion | 0.965* | 0.965* | 0.965* | 0.97 | 0.97 | 0.97 | 0.908*** | 0.908*** | 0.908*** |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| *Scientific field* | | | | | | | | | |
| Natural sciences | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | (.) | (.) | (.) | (.) | (.) | (.) | (.) | (.) | (.) |
| Engineering and Technology | 0.90 | 0.90 | 0.90 | 1.01 | 1.01 | 1.01 | 0.72 | 0.72 | 0.72 |
| | (0.14) | (0.14) | (0.14) | (0.19) | (0.19) | (0.19) | (0.16) | (0.16) | (0.16) |
| Medical sciences | 0.68 | 0.68 | 0.68 | 0.69 | 0.69 | 0.69 | 1.13 | 1.13 | 1.13 |
| | (0.15) | (0.15) | (0.15) | (0.20) | (0.20) | (0.20) | (0.40) | (0.40) | (0.40) |
| Agricultural and Veterenary | 1.08 | 1.08 | 1.08 | 1.13 | 1.13 | 1.13 | 0.85 | 0.85 | 0.85 |
| | (0.15) | (0.15) | (0.15) | (0.22) | (0.22) | (0.22) | (0.20) | (0.20) | (0.20) |
| Social sciences | 1.19 | 1.19 | 1.19 | 1.33 | 1.33 | 1.33 | 1.542** | 1.542** | 1.542** |
| | (0.14) | (0.14) | (0.14) | (0.21) | (0.21) | (0.21) | (0.25) | (0.25) | (0.25) |
| Humanities | 1.19 | 1.19 | 1.19 | 0.67 | 0.67 | 0.67 | 0.96 | 0.96 | 0.96 |
| | (0.14) | (0.14) | (0.14) | (0.15) | (0.15) | (0.15) | (0.23) | (0.23) | (0.23) |
| *Region of residence* | | | | | | | | | |
| Center | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | (.) | (.) | (.) | (.) | (.) | (.) | (.) | (.) | (.) |
| North | 0.84 | 0.84 | 0.84 | 1.458* | 1.458* | 1.458* | 0.81 | 0.81 | 0.81 |
| | (0.09) | (0.09) | (0.09) | (0.23) | (0.23) | (0.23) | (0.13) | (0.13) | (0.13) |
| South and Islands | 0.783* | 0.783* | 0.783* | 1.06 | 1.06 | 1.06 | 0.93 | 0.93 | 0.93 |
| | (0.09) | (0.09) | (0.09) | (0.19) | (0.19) | (0.19) | (0.16) | (0.16) | (0.16) |
| N | 1375 | 1375 | 1375 | 2258 | 2258 | 2258 | 1495 | 1495 | 1495 |

Exponentiated coefficients (i.e., hazard ratios); standard errors in parentheses.N - number of episod-persons. P-value: * p<0.05, ** p<0.01, *** p<0.001

**Table C2.2.** Cox proportional hazard model on the hazard of promotion to each academic position, including an interaction term. References category: (1) Childless men, (2) Fathers of one, (3) Fathers of two

| | *Permanent Researchers* | | | *Associate Professors* | | | *Full Professors* | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (1) | (2) | (3) | (1) | (2) | (3) |
| *Sex*Parental status* | | | | | | | | | |
| Men childless | 1 | 1.30 | 1.759* | 1 | 0.749* | 0.79 | 1 | 0.86 | 0.75 |
| | (.) | (0.22) | (0.41) | (.) | (0.11) | (0.12) | (.) | (0.20) | (0.16) |
| Fathers of one | 0.77 | 1 | 1.36 | 1.335* | 1 | 1.05 | 1.16 | 1 | 0.87 |
| | (0.13) | (.) | (0.36) | (0.19) | (.) | (0.16) | (0.27) | (.) | (0.16) |
| Fathers of two | 0.569* | 0.74 | 1 | 1.27 | 0.95 | 1 | 1.34 | 1.16 | 1 |
| | (0.13) | (0.20) | (.) | (0.19) | (0.15) | (.) | (0.29) | (0.21) | (.) |
| Women childless | 0.85 | 1.10 | 1.49 | 0.88 | 0.659** | 0.694** | 0.89 | 0.77 | 0.67 |
| | (0.08) | (0.18) | (0.35) | (0.13) | (0.11) | (0.10) | (0.24) | (0.18) | (0.15) |
| Mothers of one | 0.700* | 0.91 | 1.23 | 0.88 | 0.662* | 0.696** | 0.67 | 0.580* | 0.502** |
| | (0.10) | (0.18) | (0.32) | (0.14) | (0.11) | (0.09) | (0.18) | (0.14) | (0.11) |
| Mothers of two | 0.69 | 0.90 | 1.21 | 0.85 | 0.633** | 0.667** | 0.69 | 0.596** | 0.516*** |
| | (0.13) | (0.21) | (0.34) | (0.13) | (0.10) | (0.09) | (0.16) | (0.12) | (0.09) |
| Scholarly productivity | 0.710*** | 0.710*** | 0.710*** | 1.218*** | 1.218*** | 1.218*** | 1.18 | 1.18 | 1.18 |
| | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.14) | (0.14) | (0.14) |
| Age at PhD completion | 1.02 | 1.02 | 1.02 | 0.98 | 0.98 | 0.98 | 0.97 | 0.97 | 0.97 |
| | (0.02) | (0.02) | (0.02) | (0.01) | (0.01) | (0.01) | (0.02) | (0.02) | (0.02) |
| *Scientific field* | | | | | | | | | |
| Natural sciences | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | (.) | (.) | (.) | (.) | (.) | (.) | (.) | (.) | (.) |
| Engineering and Technology | 1.271* | 1.271* | 1.271* | 1.05 | 1.05 | 1.05 | 0.96 | 0.96 | 0.96 |
| | (0.16) | (0.16) | (0.16) | (0.13) | (0.13) | (0.13) | (0.20) | (0.20) | (0.20) |
| Medical sciences | 0.83 | 0.83 | 0.83 | 0.70 | 0.70 | 0.70 | 1.32 | 1.32 | 1.32 |
| | (0.17) | (0.17) | (0.17) | (0.19) | (0.19) | (0.19) | (0.38) | (0.38) | (0.38) |
| Agricultural and Veterenary | 1.332* | 1.332* | 1.332* | 0.87 | 0.87 | 0.87 | 1.01 | 1.01 | 1.01 |
| | (0.19) | (0.19) | (0.19) | (0.13) | (0.13) | (0.13) | (0.23) | (0.23) | (0.23) |
| Social sciences | 1.264* | 1.264* | 1.264* | 1.29 | 1.29 | 1.29 | 1.425* | 1.425* | 1.425* |
| | (0.14) | (0.14) | (0.14) | (0.17) | (0.17) | (0.17) | (0.24) | (0.24) | (0.24) |
| Humanities | 0.87 | 0.87 | 0.87 | 1.386* | 1.386* | 1.386* | 1.29 | 1.29 | 1.29 |
| | (0.13) | (0.13) | (0.13) | (0.18) | (0.18) | (0.18) | (0.27) | (0.27) | (0.27) |
| *Region of residence* | | | | | | | | | |
| Center | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | (.) | (.) | (.) | (.) | (.) | (.) | (.) | (.) | (.) |
| North | 0.92 | 0.92 | 0.92 | 1.19 | 1.19 | 1.19 | 0.91 | 0.91 | 0.91 |
| | (0.09) | (0.09) | (0.09) | (0.13) | (0.13) | (0.13) | (0.13) | (0.13) | (0.13) |
| South and Islands | 0.84 | 0.84 | 0.84 | 1.10 | 1.10 | 1.10 | 0.69 | 0.69 | 0.69 |
| | (0.10) | (0.10) | (0.10) | (0.14) | (0.14) | (0.14) | (0.14) | (0.14) | (0.14) |
| *PhD cohorts* | | | | | | | | | |
| 2009 & older | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | (.) | (.) | (.) | (.) | (.) | (.) |
| 2010 & recent | | | | 1.846*** | 1.846*** | 1.846*** | 0.77 | 0.77 | 0.77 |
| | | | | (0.29) | (0.29) | (0.29) | (0.52) | (0.52) | (0.52) |
| N | 1524 | 1524 | 1524 | 1895 | 1895 | 1895 | 996 | 996 | 996 |

Exponentiated coefficients (i.e., hazard ratios); standard errors in parentheses.N - number of episod-persons. P-value: * p<0.05, ** p<0.01, *** p<0.001

# **Appendix D.** Robustness checks

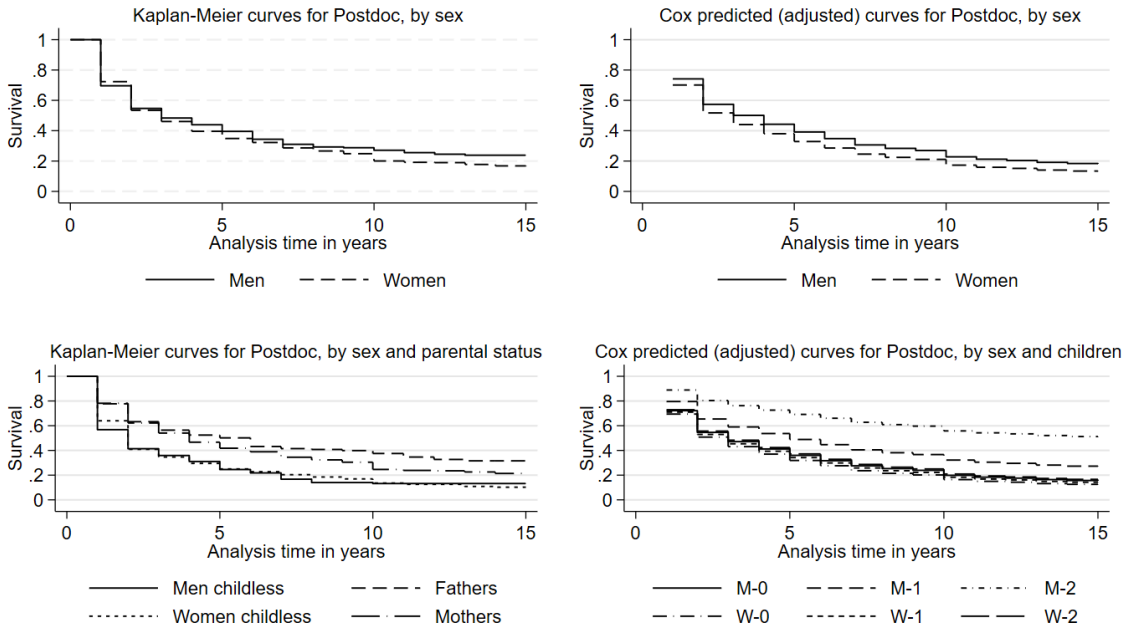



**Figure D1.** Promotion to postdoc fellow position by sex. Entering riskset (t0) is one year before PhD completion.

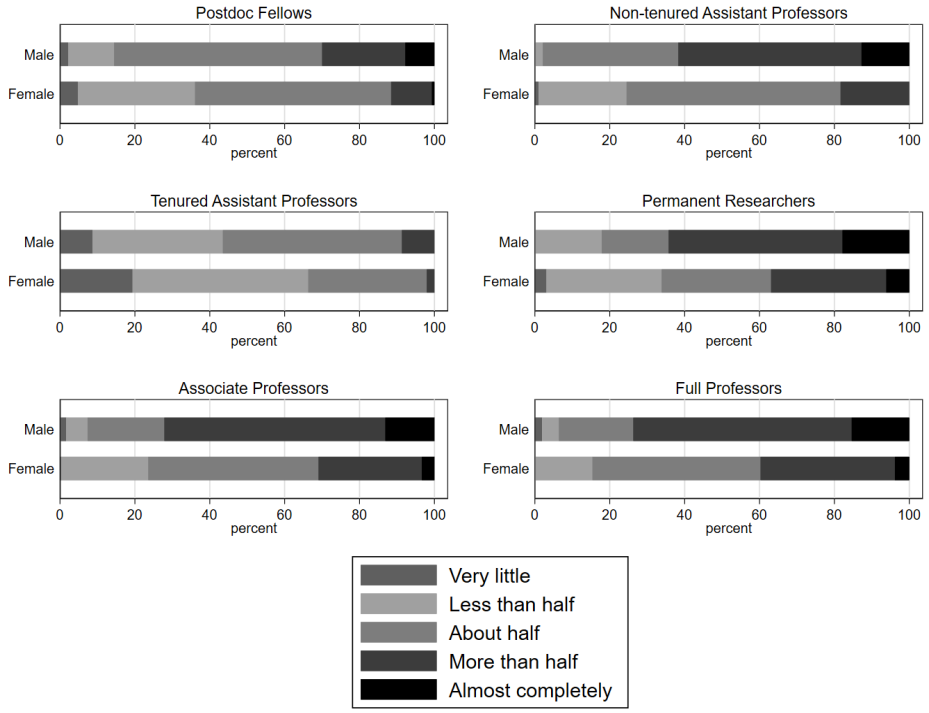



**Figure D2.** Respondent's share in family income across academic ranks by gender

**Table D1.** Cox proportional hazard model on the hazard of promotion to postdoc position, by gender. (1) including variable "*Income family model",* (2) including variable "*Childcare family model"*, (3) including both variables for family models.

| | *Male postdoc fellows* | | | *Female postdoc fellow* | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (1) | (2) | (3) |
| *Paretnal status* | | | | | | |
| Childless (ref) | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 |
| | (.) | (.) | (.) | (.) | (.) | (.) |
| 1 child | 0.575* | 0,63 | 0,64 | 1,06 | 1,29 | 1,26 |
| | (0,16) | (0,18) | (0,18) | (0,17) | (0,22) | (0,22) |
| 2 children | 0.348* | 0.387* | 0.383* | 0,79 | 1,00 | 0,93 |
| | (0,15) | (0,17) | (0,17) | (0,16) | (0,22) | (0,21) |
| *Income family model* | | | | | | |
| No partner (ref) | 1,00 | | 1,00 | 1,00 | | 1,00 |
| | (.) | | (.) | (.) | | (.) |
| Egalitarian family (50/50 income) | 0,98 | | 1,11 | 1,23 | | 1.373* |
| | (0,21) | | (0,26) | (0,18) | | (0,20) |
| Male breadwinner | 1,16 | | 1,33 | 1,29 | | 1.389* |
| | (0,21) | | (0,27) | (0,19) | | (0,21) |
| Female breadwinners | 1,30 | | 1,49 | 0,87 | | 0,98 |
| | (0,28) | | (0,32) | (0,16) | | (0,18) |
| *Childcare family model* | | | | | | |
| Childless (ref) | | 1,00 | 1,00 | | 1,00 | 1,00 |
| | | (.) | (.) | | (.) | (.) |
| Traditional (F- main carer) | | 0,96 | 0,86 | | 0,86 | 0,81 |
| | | (0,18) | (0,18) | | (0,12) | (0,11) |
| Egalitarian (M/other-main carers) | | 0,76 | 0.679* | | 0.622** | 0.590** |
| | | (0,14) | (0,13) | | (0,10) | (0,09) |
| Scholarly Productivity | 1.151*** | 1.134*** | 1.133*** | 1.167*** | 1.159*** | 1.160*** |
| | (0,04) | (0,04) | (0,04) | (0,02) | (0,03) | (0,02) |
| Age at PhD | 0,98 | 0,97 | 0,98 | 0.949* | 0.945* | 0.945* |
| | (0,03) | (0,03) | (0,03) | (0,02) | (0,02) | (0,02) |
| *Field of study*: | | | | | | |
| Natural sciences (ref) | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 |
| | (.) | (.) | (.) | (.) | (.) | (.) |
| Engineering and technology | 0,93 | 0,98 | 0,95 | 0,82 | 0,80 | 0,79 |
| | (0,20) | (0,21) | (0,21) | (0,18) | (0,19) | (0,18) |
| Medical sciences | 0,54 | 0,59 | 0,56 | 0,82 | 0,89 | 0,89 |
| | (0,19) | (0,22) | (0,20) | (0,18) | (0,19) | (0,19) |
| Agricultural and Veterenary | 1,10 | 1,13 | 1,08 | 1,11 | 1,10 | 1,10 |
| | (0,23) | (0,25) | (0,23) | (0,20) | (0,20) | (0,20) |
| Social scinces | 1,21 | 1,28 | 1,22 | 1,11 | 1,15 | 1,15 |
| | (0,22) | (0,22) | (0,21) | (0,15) | (0,16) | (0,16) |
| Humanities | 1,25 | 1,30 | 1,30 | 1,17 | 1,12 | 1,13 |
| | (0,25) | (0,26) | (0,26) | (0,17) | (0,16) | (0,16) |
| *Geographical macro-area of residence:* | | | | | | |
| Center (ref) | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 |
| | (.) | (.) | (.) | (.) | (.) | (.) |
| Notrh | 0,88 | 0,83 | 0,85 | 0,83 | 0,83 | 0,82 |
| | (0,14) | (0,14) | (0,14) | (0,10) | (0,10) | (0,10) |
| South and Islands | 0.641* | 0.621* | 0.618* | 0,92 | 0,90 | 0,94 |
| | (0,12) | (0,12) | (0,12) | (0,14) | (0,13) | (0,14) |
| N | 576 | 576 | 576 | 788 | 788 | 788 |

Exponentiated coefficients (i.e., hazard ratios); standard errors in parentheses.N - number of episod-persons. P-value: * p<0.05, ** p<0.01, *** p<0.001

**Table D2.** Cox proportional hazard model on the hazard of promotion to associate professor position, by gender. (1) including variable "*Income family model",* (2) including variable "*Childcare family model"*, (3) including both variables for family models.

| | *Male Associate Professors* | | | *Female Associate Professors* | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (1) | (2) | (3) |
| *Parental status* | | | | | | |
| Childless (ref) | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 |
| | (.) | (.) | (.) | (.) | (.) | (.) |
| 1 child | 1,27 | 1,24 | 1,21 | 0,93 | 1,29 | 1,21 |
| | (0,17) | (0,18) | (0,18) | (0,13) | (0,26) | (0,24) |
| 2 children | 1,23 | 1,19 | 1,17 | 0,85 | 1,20 | 1,12 |
| | (0,18) | (0,20) | (0,20) | (0,12) | (0,25) | (0,23) |
| *Income family model* | | | | | | |
| No partner (ref) | 1,00 | | 1,00 | 1,00 | | 1,00 |
| | (.) | | (.) | (.) | | (.) |
| Egalitarian family (50/50 income) | 1.570* | | 1.492* | 1.391* | | 1.405* |
| | (0,28) | | (0,29) | (0,23) | | (0,23) |
| Male breadwinner | 1,18 | | 1,13 | 0,73 | | 0,78 |
| | (0,20) | | (0,21) | (0,15) | | (0,15) |
| Female breadwinners | 0,72 | | 0,69 | 1,09 | | 1,14 |
| | (0,28) | | (0,27) | (0,18) | | (0,19) |
| *Childcare family model* | | | | | | |
| Childless (ref) | | 1,00 | 1,00 | | 1,00 | 1,00 |
| | | (.) | (.) | | (.) | (.) |
| Traditional (F-carer) | | 1,17 | 1,09 | | 0.601* | 0.622* |
| | | (0,28) | (0,27) | | (0,14) | (0,14) |
| Egalitarian (M or other carers) | | 1,29 | 1,18 | | 0,81 | 0,78 |
| | | (0,28) | (0,26) | | (0,19) | (0,18) |
| Scholarly Productivity | 1.437*** | 1.396*** | 1.436*** | 1.213** | 1.224** | 1.214** |
| | (0,10) | (0,10) | (0,10) | (0,08) | (0,08) | (0,08) |
| Age at PhD | 0,98 | 0,98 | 0,98 | 0,99 | 0,98 | 0,98 |
| | (0,02) | (0,02) | (0,02) | (0,01) | (0,02) | (0,01) |
| *Field of study* | | | | | | |
| Natural sciences (ref) | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 |
| | (.) | (.) | (.) | (.) | (.) | (.) |
| Engineering and technology | 0,97 | 0,97 | 0,97 | 1,33 | 1,29 | 1,33 |
| | (0,15) | (0,15) | (0,15) | (0,26) | (0,24) | (0,25) |
| Medical sciences | 0,68 | 0,70 | 0,67 | 0,71 | 0,63 | 0,71 |
| | (0,24) | (0,26) | (0,24) | (0,20) | (0,20) | (0,20) |
| Agricultural and Veterenary | 0,82 | 0,83 | 0,83 | 0,98 | 0,90 | 0,94 |
| | (0,15) | (0,15) | (0,16) | (0,22) | (0,21) | (0,22) |
| Social scinces | 1.414* | 1,38 | 1.421* | 1,28 | 1,23 | 1,27 |
| | (0,25) | (0,25) | (0,24) | (0,20) | (0,19) | (0,20) |
| Humanities | 1,36 | 1,34 | 1,33 | 1.515* | 1,42 | 1.504* |
| | (0,24) | (0,24) | (0,24) | (0,29) | (0,26) | (0,29) |
| *Geographical macro-area of residence* | | | | | | |
| Center (ref) | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 |
| | (.) | (.) | (.) | (.) | (.) | (.) |
| Notrh | 1,10 | 1,06 | 1,10 | 1.455** | 1.485** | 1.437* |
| | (0,15) | (0,15) | (0,15) | (0,21) | (0,22) | (0,20) |
| South and Islands | 1.409* | 1.362* | 1.408* | 0,82 | 0,84 | 0,81 |
| | (0,22) | (0,21) | (0,21) | (0,15) | (0,15) | (0,15) |
| *PhD cohort* | | | | | | |
| 2009&older | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 |
| | (.) | (.) | (.) | (.) | (.) | (.) |
| 2010&younger | 1,28 | 1,48 | 1,31 | 1.726* | 1,49 | 1,60 |
| | (0,31) | (0,36) | (0,31) | (0,43) | (0,40) | (0,41) |
| N | 859 | 859 | 859 | 1018 | 1018 | 1018 |

Exponentiated coefficients (i.e., hazard ratios); standard errors in parentheses.N - number of episod-persons. P-value: * p<0.05, ** p<0.01, *** p<0.001

# **Appendix E.** Couples' age composition by gender

**Table E1.** Couples' age composition by gender

| | Male | Female |
|---|---|---|
| % older than their partner | 63% | 18% |
| (*mean age difference*) | 4.6 years | 2.8 years |
| % younger than their partner or same age | 37% | 82% |
| (*mean age difference*) | 1.4 years | 4.1 years |
| N. | 745 | 896 |

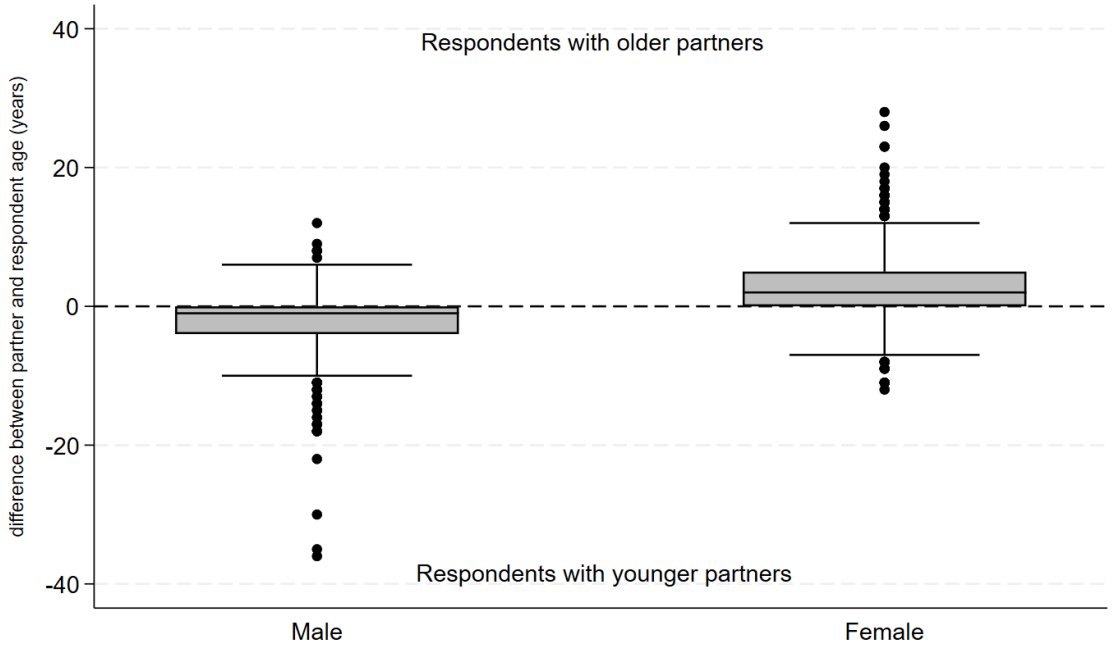
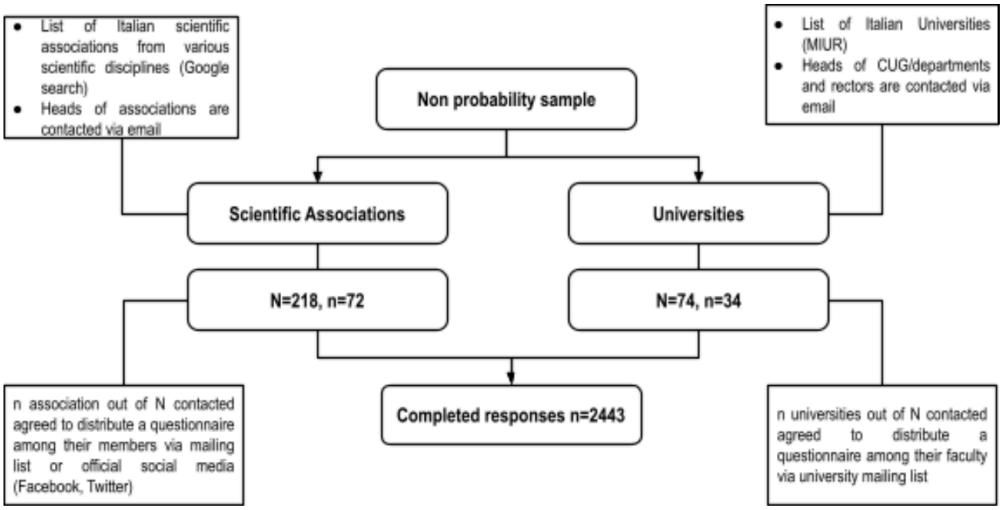



**Figure E1.** Partnership age gap by gender, N = 1641

# **Appendix F.** Sampling strategy




**Picture F1.** Sampling strategy

**Table F1.** Italian scientific associations have spread the questionnaire (72) out of those contacted (218)

| N | Association Name | Spread |
|---|---|---|
| 1 | Accademia Italiana di Economia Aziendale | |
| 2 | Accademia Nazionale delle Scienze detta dei XL | Yes |
| 3 | Associazione Dottorandi Italia (ADI) | Yes |
| 4 | Associazione Italiana di Sociologia - Studi di Genere | Yes |
| 5 | Associazione Italiana Studi di Popolazione | Yes |
| 6 | Associazione Antropologica Italiana | |
| 7 | Associazione Civilisti Italiani | |
| 8 | Associazione dei Docenti delle Discipline Ecclesiasticistiche, Canonistiche e Confessionali nelle Università italiane. | |
| 9 | Associazione della Fisica Tecnica Italiana | |
| 10 | Associazione di Diritto pubblico comparato ed europeo | |
| 11 | Associazione Docenti e Ricercatori Italiani di Tecnologie e Legislazione Farmaceutiche | |
| 12 | Associazione Donne e Tecnologie | |
| 13 | Associazione Genetica Italiana | |
| 14 | Associazione GTTI - Gruppo Telecomunicazioni e Tecnologie dell'Informazione | |
| 15 | Associazione Italiana degli Slavisti | |
| 16 | Associazione Italiana dei Costituzionalisti | |
| 17 | Associazione Italiana dei Professori di Diritto Amministrativo | |
| 18 | Associazione Italiana delle Società Scientifiche Agrarie | Yes |
| 19 | Associazione Italiana di Agrometeorologia | |
| 20 | Associazione italiana di diritto comparato | Yes |

| | | |
|---|---|---|
| 21 | Associazione Italiana di Diritto del Lavoro e della Sicurezza Sociale | |
| 22 | Associazione Italiana di Diritto della Navigazione e dei Trasporti. | |
| 23 | Associazione Italiana di Economia Agraria e Applicata, | Yes |
| 24 | Associazione Italiana di Economia Sanitaria | |
| 25 | Associazione Italiana di Economisti del Lavoro | Yes |
| 26 | Associazione Italiana di Elettrotecnica, Elettronica, Automazione, Informatica e Telecomunicazioni | |
| 27 | Associazione Italiana di Epidemiologia | |
| 28 | Associazione Italiana di Filosofia della Religione | |
| 29 | Associazione Italiana di Fisica Medica e Sanitaria | |
| 30 | Associazione Italiana di Ingegneria Agraria | |
| 31 | Associazione Italiana di Ingegneria Economica | |
| 32 | Associazione italiana di Ingegneria Gestionale | |
| 33 | Associazione Italiana di Linguistica Applicata | |
| 34 | Associazione Italiana di Linguistica Computazionale | |
| 35 | Associazione Italiana di Logica e sue Applicazioni | Yes |
| 36 | Associazione Italiana di Logica e sue Applicazioni | |
| 37 | Associazione Italiana di Patologia Veterinaria | |
| 38 | Associazione Italiana di Psicologia | |
| 39 | Associazione Italiana di Psicologia | Yes |
| 40 | Associazione Italiana di Scienza e Tecnologia dei Cereali | |
| 41 | Associazione Italiana di Scienza e Tecnologia delle Macromolecole | |
| 42 | Associazione Italiana di Scienze dell'Atmosfera e Meteorologia | |
| 43 | Associazione Italiana di Scienze della Voce | |
| 44 | Associazione Italiana di Scienze Regionali | Yes |
| 45 | Associazione Italiana di Sociologia | Yes |
| 46 | Associazione Italiana di Storia della Medicina Veterinaria e della Mascalcia | |
| 47 | Associazione Italiana di Studi Bizantini, | |
| 48 | Associazione Italiana di Studi Semiotici | |
| 49 | Associazione Italiana di Studi Tardoantichi | |
| 50 | Associazione Italiana di Systems Engineering | Yes |
| 51 | Associazione Italiana Donne Medico | |
| 52 | Associazione Italiana Fra Gli Studiosi Del Processo Civile | |
| 53 | Associazione Italiana per l'Informatica e il Calcolo Automatico | |
| 54 | Associazione Italiana Veterinari Igienisti | |
| 55 | Associazione Nazionale Docenti Universitari | |
| 56 | Associazione Nazionale Infettivologi Veterinari | |
| 57 | Associazione Orizzonti del Diritto Commerciale | |
| 58 | Associazione per la Matematica Applicata alle Scienze Economiche e Sociale | Yes |
| 59 | Associazione per la Scienza e le Produzioni Animali | Yes |
| 60 | Associazione per la Storia della Lingua Italiana | |
| 61 | Associazione per Le Neuroscienze Giuseppe Moruzzi | |
| 62 | Associazione Ricercatori Nutrizione Alimenti | |

| | | |
|---|---|---|
| 63 | Associazione Scientifica Farmacisti Italiani | |
| 64 | Associazione scientifica per la sanità digitale | |
| 65 | Associazione tra gli studiosi del processo penale G .D. Pisapia | |
| 66 | AREA Science Park (Fisica Sperimentale) | |
| 67 | Centro interdipartimentale Mente/Cervello dell'Università di Trento | |
| 68 | Centro Interdipartimentale per gli Studi di Genere - ABCD - Unimib | Yes |
| 69 | Centro Interdisciplinare di Ricerche per la Computerizzazione dei Segni dell'Espressione | Yes |
| 70 | Centro Interdisciplinare di Studi Cognitivi sul Linguaggio | |
| 71 | Collegio dei Docenti Universitari MED Medicina Interna | |
| 72 | Collegio dei Professori Ordinari di Biochimica | |
| 73 | Comitato Pari Opportunità dell'Unione Matematica Italiana | Yes |
| 74 | Commissione di Genere della Società Italiana di Economia | Yes |
| 75 | Comunità Scientifica di Diritto Agrario | Yes |
| 76 | Conferenza per l'Ingegneria | |
| 77 | Consorzio Interuniversitario Nazionale "Energia e Sistemi Elettrici" | |
| 78 | Consulta Universitaria di studi latini | |
| 79 | Direttore Scientifico FISM | |
| 80 | Donne e scienza | Yes |
| 81 | Federazione della Società Medico-Scientifiche Italiane | |
| 82 | Federazione Italiana di Scienze della Natura e dell'Ambiente | Yes |
| 83 | Federazione Italiana Scienze della Vita | |
| 84 | GEA (Gendering Academia) | Yes |
| 85 | Gruppo di Ingegneria Chimica dell'Università | |
| 86 | Gruppo di Ingegneria Informatica | |
| 87 | Gruppo di Intervento e di Studio nel Campo dell'Educazione Linguistica | |
| 88 | Gruppo di Studio sulla Comunicazione Parlata | |
| 89 | Gruppo di Studio sulle Politiche Linguistiche | |
| 90 | Gruppo Nazionale di Coordinamento di Elettrotecnica | |
| 91 | Gruppo Nazionale di Fondamenti e Storia della Chimica | |
| 92 | Il Centro di ricerca Linguistica su Corpora | Yes |
| 93 | Italian Association of Environmental and Resource Economists | |
| 94 | L'Associazione Italiana dei Morfologi Veterinari | |
| 95 | L'Associazione Italiana dei Professori e degli Studiosi di Diritto Tributario (A.I.P.S.D.T.) | |
| 96 | La mailing list di giuslavoristi Diritto del Lavoro | Yes |
| 97 | La Sezione Abruzzo della Società Chimica Italiana | |
| 98 | La Sezione Basilicata della Società Chimica Italiana | |
| 99 | La Sezione Calabria della Società Chimica Italiana | |
| 100 | La Sezione Campania della Società Chimica Italiana | |
| 101 | La Sezione Emilia Romagna della Società Chimica Italiana | |
| 102 | La Sezione Friuli Venezia Giulia della Società Chimica Italiana | |
| 103 | la Sezione Lazio della Società Chimica Italiana | |
| 104 | La Sezione Liguria della Società Chimica Italiana | |

| | | |
|---|---|---|
| 105 | La Sezione Lombardia della Società Chimica Italiana | |
| 106 | La Sezione Marche della Società Chimica Italiana | |
| 107 | La Sezione Piemonte e Valle d'Aosta della Società Chimica Italiana | |
| 108 | La Sezione Puglia della Società Chimica Italiana | |
| 109 | La Sezione Sicilia della Società Chimica Italiana | |
| 110 | La Sezione Toscana della Società Chimica Italiana | |
| 111 | La Sezione Trentino Alto Adige/Südtirol della Società Chimica Italiana | |
| 112 | La Sezione Veneto della Società Chimica Italiana | |
| 113 | La società di Clinica Medica Veterinaria (SICLIM-VET) | |
| 114 | labouratorio CRILeT | |
| 115 | Newsletter "Rete, Ambiente e Società" | Yes |
| 116 | Octopus-Lab - Ricerca Unibo: disuguaglianze di genere in ambito lavorativo | Yes |
| 117 | Parenting in Academia | Yes |
| 118 | Rete Nazionale di Immunologia Veterinaria | |
| 119 | Agenzia Spaziale Italiana | |
| 120 | SECS in the city | Yes |
| 121 | Segreteria Nazionale del Coordinamento Intersedi Professori Universitari di Ruolo | |
| 122 | Segreteria Unione Zoologica Italiana ETS | Yes |
| 123 | SIMAI (Società Italiana di Matematica Applicata e Industriale) | |
| 124 | SIMP - Società Italiana di Mineralogia e Petrologia | |
| 125 | SIS (Società Italiana di Statistica) | Yes |
| 126 | SISEC (Società Italiana di Sociologia Economica) | Yes |
| 127 | SISMED ets, Società Italiana Scienze Mediche | Yes |
| 128 | Società agrarie e botaniche italiane | |
| 129 | Società Astronomica Italiana | Yes |
| 130 | Società Botanica Italiana | Yes |
| 131 | Societa Chimica Italiana | |
| 132 | Società Dantesca Italiana | Yes |
| 133 | Società di Filosofia del linguaggio | |
| 134 | Società di Linguistica Italiana | |
| 135 | Società di Linguistica Italiana (vicepresidente) | Yes |
| 136 | Società di Medicina Diagnostica e Terapeutica | |
| 137 | Società di Studi Trentini di Scienze Storiche | Yes |
| 138 | Società Entomologica Italiana | Yes |
| 139 | Società Filosofica Italiana | |
| 140 | Società Geografica Italiana | Yes |
| 141 | Società Geologica Italiana | Yes |
| 142 | Società Italiana Caos e Complessità | |
| 143 | Società Italiana degli Storici della Fisica e dell'Astronomia | Yes |
| 144 | Società italiana degli Studiosi del diritto civile | |
| 145 | Società Italiana degli Urbanisti | |
| 146 | Società Italiana dei Docenti e Ricercatori di Automatica | Yes |

| | | |
|---|---|---|
| 147 | Società Italiana della Tecnologia dell'Architettura | |
| 148 | Società Italiana delle Scienze Forensi Veterinarie | |
| 149 | Società Italiana delle Scienze Veterinarie (SISVET). | |
| 150 | Società Italiana delle Storiche | Yes |
| 151 | Società Italiana di Bioinformatica | |
| 152 | Società Italiana di Biologia Evoluzionistica | Yes |
| 153 | Società Italiana di Biologia Marina | |
| 154 | Società Italiana di Biologia Sperimentale | Yes |
| 155 | Società Italiana di Biologia Vegetale | Yes |
| 156 | Società Italiana di Chimica Agraria | |
| 157 | Società Italiana di Chimica Biologica | |
| 158 | Società Italiana di Demografia Storica | Yes |
| 159 | Società Italiana di Design | |
| 160 | Società Italiana di Diritto Internazionale e di Diritto dell'Unione Europea | |
| 161 | Società Italiana di Econometria | |
| 162 | Società Italiana di Economia | Yes |
| 163 | Società Italiana di Economia Agraria | |
| 164 | Società italiana di economia pubblica | |
| 165 | Società italiana di economia, demografia e statistica | |
| 166 | Società Italiana di Elettromagnetismo | Yes |
| 167 | Società Italiana di Elettronica | |
| 168 | Società Italiana di Estimo e Valutazione | Yes |
| 169 | Società Italiana di Farmacologia e Tossicologia Veterinaria | |
| 170 | Società Italiana di Filologia Romanza | Yes |
| 171 | Società Italiana di Filosofia del diritto. | |
| 172 | Società italiana di Filosofia Morale | |
| 173 | Società Italiana di Filosofia Politica | |
| 174 | Società italiana di Filosofia teoretica | |
| 175 | Società Italiana di Fisica | Yes |
| 176 | Società Italiana di Fisiologia | Yes |
| 177 | Società Italiana di Fisiologia Veterinaria | Yes |
| 178 | Società Italiana di Genetica Agraria | Yes |
| 179 | Società Italiana di Genetica Umana | |
| 180 | Società Italiana di Glottologia | |
| 181 | Società Italiana di Logica e Filosofia delle Scienze | Yes |
| 182 | Società Italiana di Meccanica Celeste e Astrodinamica | |
| 183 | Società Italiana di Mutagenesi Ambientale e Genomica | Yes |
| 184 | Società Italiana di Neuroetica e Filosofia delle Neuroscienze | |
| 185 | Società Italiana di NeuroPsicologia | Yes |
| 186 | Società Italiana di Neuroscienze | Yes |
| 187 | Società Italiana di Nutrizione Umana | |
| 188 | Società Italiana di Parassitologia | |
| 189 | Società Italiana di Psicologia | |

| | | |
|---|---|---|
| 190 | Società Italiana di Psicologia | |
| 191 | Società Italiana di Relatività Generale e Fisica della Gravitazione | Yes |
| 192 | Società Italiana di Scienza Politica | |
| 193 | Società italiana di Scienze Bibliografiche e Biblioteconomiche | |
| 194 | Società Italiana di Scienze del Turismo | |
| 195 | Società Italiana di Scienze Matematiche e Fisiche | |
| 196 | Società Italiana di Scienze Naturali | Yes |
| 197 | Società Italiana di Storia della Filosofia | |
| 198 | Società Italiana di Storia della Filosofia Antica | |
| 199 | Società Italiana di Storia della Medicina | |
| 200 | Società Italiana di Storia delle Matematiche | |
| 201 | Società Italiana di Storia del Diritto | |
| 202 | Società Italiana di Storia, Filosofia e Studi Sociali della Biologia e della Medicina | Yes |
| 203 | Società Italiana di Tossicologia | |
| 204 | Società Italiana Docenti di Trasporti | |
| 205 | Società Italiana per il Restauro dell'Architettura | |
| 206 | Società italiana per la ricerca nel diritto comparato. | Yes |
| 207 | Società italiana per le donne in filosofia | Yes |
| 208 | Società Italiana per lo studio del pensiero medievale | Yes |
| 209 | Società Italiana Scienze Naturali | Yes |
| 210 | Società Scientifica dell'Architettura Tecnica | |
| 211 | Società Scientifica Italiana di Informatica Biomedica | |
| 212 | Società scientifica nazionale dei docenti di progettazione architettonica | |
| 213 | Società Scientifica ProArch (Progettazione Architettonica e Urbana) | Yes |
| 214 | SoIS - Società Italiana di Sociologia | Yes |
| 215 | The AXA Gender Lab | Yes |
| 216 | Unione Italiana per il Disegno | |
| 217 | Unione Matematica Italiana | Yes |
| 218 | Unione Sindacale dei Professori e Ricercatori Universitari | |
| 219 | Unione Zoologica Italiana | Yes |

**Table F2.** Italian universities which have spread the questionnaire (34), out of those contacted (74)

| N | University Name | Spread |
|---|---|---|
| 1 | Humanitas University | Yes |
| 2 | Libera Università di Bolzano | Yes |
| 3 | Libera Università di Lingue e Comunicazione | Yes |
| 4 | Libera Università Maria S. Assunta | |
| 5 | Luiss (La Libera università internazionale degli studi sociali "Guido Carli" ) | Yes |
| 6 | Politecnico di Bari | |
| 7 | Politecnico di Milano | Yes |
| 8 | Politecnico di Torino | |

| | | |
|---|---|---|
| 9 | Scuola di Medicina dell'Università di Catania | |
| 10 | Scuola Internazionale Superiore di Studi Avanzati | Yes |
| 11 | Scuola Normale Superiore (Pisa) | Yes |
| 12 | Scuola Superiore Sant’Anna (Pisa) | Yes |
| 13 | Università Bocconi | |
| 14 | Università Ca' Foscari Venezia | |
| 15 | Università Campus Bio-Medico di Roma | |
| 16 | Università Cattolica del Sacro Cuore | |
| 17 | Università degli Studi “G. d’Annunzio” Chieti-Pescara | |
| 18 | Università degli Studi "Magna Graecia" di Catanzaro | Yes |
| 19 | Università degli Studi del Salento | |
| 20 | Università degli Studi del Sannio di Benevento | |
| 21 | Università degli studi dell'Insubria | Yes |
| 22 | Università degli Studi della Basilicata | |
| 23 | Università degli Studi della Campania Luigi Vanvitelli | |
| 24 | Università degli Studi di Brescia | |
| 25 | Università degli Studi di Cagliari | Yes |
| 26 | Università degli Studi di Camerino | Yes |
| 27 | Università degli Studi di Cassino e del Lazio Meridionale | Yes |
| 28 | Università degli Studi di Ferrara | Yes |
| 29 | Università degli Studi di Foggia | |
| 30 | Università degli Studi di Genova | Yes |
| 31 | Università degli Studi di L'Aquila | Yes |
| 32 | Università degli Studi di Macerata | |
| 33 | Università degli Studi di Messina | Yes |
| 34 | Università degli Studi di Milano | Yes |
| 35 | Università degli Studi di Molise | |
| 36 | Università degli Studi di Napoli “Parthenope” | |
| 37 | Università degli Studi di Pavia | Yes |
| 38 | Università degli Studi di Perugia | |
| 39 | Università degli Studi di Roma "Foro Italico" | |
| 40 | Università degli studi di Roma "La Sapienza" | |
| 41 | Università degli studi di Roma Tor Vergata | |
| 42 | Università degli Studi di Salerno | Yes |
| 43 | Università degli Studi di Sassari | Yes |
| 44 | Università degli Studi di Siena | |
| 45 | Università degli Studi di Teramo | Yes |
| 46 | Università degli Studi di Torino | Yes |
| 47 | Universita degli studi di Udine | |

| | | |
|---|---|---|
| 48 | Università degli Studi Internazionali di Roma | |
| 49 | Università degli Studi Mediterranea di Reggio Calabria | Yes |
| 50 | Università degli studi Roma Tre | |
| 51 | Università del Piemonte Orientale | Yes |
| 52 | Università della Calabria | |
| 53 | Università della Valle d'Aosta | Yes |
| 54 | Università di Bergamo | |
| 55 | Università di Bologna | Yes |
| 56 | Università di Catania | |
| 57 | Università di Firenze | |
| 58 | Università di Modena e Reggio Emilia - Unimore | Yes |
| 59 | Università di Napoli Federico II | |
| 60 | Università di Napoli L'Orientale | |
| 61 | Università di Palermo | |
| 62 | Università di Parma | |
| 63 | Università di Pavia | |
| 64 | Universita di Pisa | |
| 65 | Universita di Torino | Yes |
| 66 | Università di Trento | Yes |
| 67 | Università di Trieste | |
| 68 | Università di Tuscia | Yes |
| 69 | Università Iuav di Venezia | |
| 70 | Università per Stranieri di Perugia | |
| 71 | Università per Stranieri di Siena | Yes |
| 72 | Università Politecnica delle Marche | Yes |
| 73 | Università San Raffaele | |
| 74 | Università Suor Orsola Benincasa | Yes |

## **Appendix G.** Information on the processing of personal data

**INFORMATIVA SUL TRATTAMENTO DEI DATI PERSONALI**
**PER FINALITÀ DI RICERCA SCIENTIFICA**
**(ART. 13 E 14 REG. UE 2016/679)**

**Titolo del Progetto di ricerca (di seguito "Progetto"):**

**DISUGUAGLIANZA DI GENERE NEL MONDO ACCADEMICO. (NON)OVVIO EFFETTO DEI FIGLI: IL RUOLO DELLE INTERRUZIONI DI CARRIERA NEI RISULTATI SCIENTIFICI.**

Gentile partecipante,
desideriamo informarla che la normativa vigente in materia di protezione dei dati, con particolare riguardo all'ambito della ricerca (Regolamento UE 2016/679 sulla protezione dei dati personali - GDPR, il D. lgs. n. 196/2003 "Codice in materia di protezione dei dati personali" come modificato dal D. lgs. 101/2018 e s.m.i., le "Regole deontologiche per i trattamenti a fini statistici o di ricerca scientifica" - Provvedimento del Garante per la protezione dei dati personali n. 515 del 19 dicembre 2018 nonché le varie Prescrizioni del Garante in materia) sancisce il diritto di ogni persona alla protezione dei dati di carattere personale che la riguardano.
In conformità alla normativa citata, il trattamento dei dati personali nell'ambito del progetto di ricerca sarà improntato al rispetto dei principi di cui all'art. 5 del GDPR e, in particolare, liceità, correttezza, trasparenza, pertinenza, non eccedenza, riservatezza ed in modo da garantire un'adeguata sicurezza dei dati stessi.
In qualità di Interessato, Le forniamo le seguenti informazioni relative al trattamento dei dati personali.

**TITOLARE DEL TRATTAMENTO**
Il Titolare del trattamento è l'Università degli Studi di Trento, via Calepina n. 14, 38122 Trento, email: ateneo@unitn.it; ateneo@pec.unitn.it.

**DATI DI CONTATTO DEL RESPONSABILE DELLA PROTEZIONE DEI DATI**
Il Responsabile della protezione dei dati (RDP) può essere contattato al seguente indirizzo email: rpd@unitn.it.

**FINALITÀ E BASE GIURIDICA DEL TRATTAMENTO**
Il trattamento dei dati personali è effettuato:
☒ nell'ambito dei compiti di interesse pubblico del Titolare, in particolare per la realizzazione delle finalità scientifiche del Progetto di ricerca: **DISUGUAGLIANZA DI GENERE NEL MONDO ACCADEMICO. (NON)OVVIO EFFETTO DEI FIGLI: IL RUOLO DELLE INTERRUZIONI DI CARRIERA NEI RISULTATI SCIENTIFICI.**

Il Progetto è stato redatto conformemente agli standard metodologici del settore disciplinare interessato ed è depositato e conservato per cinque anni dal 01/07/2021 presso il Dipartimento di Sociologia e ricerca Sociale dell'Università degli Studi di Trento

**FONTE DEI DATI PERSONALI E CATEGORIE DI DATI PERSONALI**

I dati personali sono stati raccolti presso:

☒ l'interessato;

Nella realizzazione del Progetto verranno trattati i seguenti dati personali:
☒ dati anagrafici;
☒ dati di contatto: emails
☒ opinioni personali espresse, se associate a dati che consentono l'identificazione della persona: opinione sulle differenze in termini di carriera a produttività tra uomini e donne, genitori e non;

**MODALITÀ DEL TRATTAMENTO**
Il trattamento dei Suoi dati verrà effettuato mediante i seguenti strumenti Scegliere un elemento.:
☒ piattaforme di analisi di dati, in particolare: **R, Stata**;
☒ applicazioni per questionari/sondaggi (*survey*), in particolare: **LimeSurvey**

e adottando le seguenti misure di sicurezza:
☒ archiviazione protetta;

In particolare, nel caso di utilizzo di questionari o sondaggi:
☐ Le risposte alle domande del questionario/sondaggio non verranno collegate al nome dell'utente o alle eventuali informazioni di contatto fornite, perciò i dati rimarranno anonimi;
In alternativa (in caso di mancata anonimizzazione dei dati):
☒ Per i partecipanti che acconsentono a rilasciare l'indirizzo email o l'orcid, le risposte alle domande del questionario/sondaggio verranno collegate alle seguenti informazioni: numero pubblicazioni per tipo (articolo, libro, capitolo, pubblicazioni di fascia A, presenza di coautori stranieri, numero coautori) e anno fornite con le seguenti modalità: attraverso email o orcid si accederà alla lista completa delle pubblicazioni tramite portali di ricerca come google scholar o web of science.Fare clic o toccare qui per immettere il testo.
I Suoi dati personali saranno trattati esclusivamente da soggetti autorizzati nell'ambito della realizzazione del Progetto

**PERIODO DI CONSERVAZIONE DEI DATI**
Al termine del Progetto i dati personali saranno conservati soltanto in forma anonima.

**NATURA DEL CONFERIMENTO DEI DATI**
Il conferimento dei dati per le suddette finalità di ricerca è indispensabile per la realizzazione del Progetto di ricerca ed il mancato conferimento determina l'impossibilità di parteciparvi.

**DESTINATARI DEI DATI ED EVENTUALE TRASFERIMENTO ALL'ESTERO**

☒ I suoi dati non saranno oggetto di trasferimento verso Paesi extra SEE

**DIVULGAZIONE DEI RISULTATI DELLA RICERCA**
La divulgazione dei risultati statistici e/o scientifici (ad esempio mediante pubblicazione di articoli scientifici e/o la creazione di banche dati, anche con modalità ad accesso aperto, partecipazione a convegni, ecc.) potrà avvenire soltanto in forma anonima e/o aggregata e comunque secondo modalità che non la rendano identificabile.

**DIRITTI DELL'INTERESSATO**
In qualità di Interessato ha diritto di chiedere in ogni momento al Titolare/RPD presso i contatti sopraindicati l'esercizio di diritti di cui agli artt. 15 e ss. del GDPR e, in particolare, l'accesso ai propri dati personali, la rettifica, l'integrazione, nonché se ricorrono i presupposti normativi, la cancellazione degli stessi, la limitazione del trattamento dei dati e il diritto di opporsi al loro trattamento. Resta salvo il diritto di proporre reclamo all'Autorità Garante per la protezione dei dati personali ai sensi dell'art. 77 del GDPR e Per informazioni relative al Progetto può rivolgersi al Responsabile scientifico del Progetto al seguente recapito: agnese.vitali@unitn.it.

Per presa visione in caso di consegna cartacea della presente informativa

Data, lì 20-06-2021

Firma

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# **Appendix H.** Questionnaire (EN)

**Career and family: the life journey of academics in Italy**

Dear participant,

The purpose of this survey is to explore the life trajectories of scholars in Italy. By completing the questionnaire, you will help to gather data for my PhD project aimed at exploring the relationship between family formation and career progression.

- Depending on your life situation, the survey may take about 10-15 minutes.
- Will be more comfortable answering questions keeping your CV next to you.
- You can interrupt the survey at any time and continue at a later moment.
- If for some reason you do not want to answer a particular question, you can skip it and move on to the next one
- If you have already participated in this survey, please, do not do it again.

I really appreciate your contribution!
Thank you!

**Current situation: Current employment situation and career path**

**[Q1]Let's start with general questions. Please indicate the main scientific field in which you are currently working:**
Please choose only one of the following:

- Mathematical and computer sciences
- Physical sciences
- Chemical sciences
- Earth sciences
- Biological sciences
- Medical sciences
- Agricultural and Veterinary Sciences
- Civil Engineering and Architecture
- Industrial Engineering and Information Systems
- Sciences of Antiquity, Philology, Literature and Art History
- Historical, philosophical, pedagogical and psychological sciences
- Legal sciences
- Economics and Statistics
- Political and social sciences

**[Q2]Indicate your gender:**
Please choose only one of the following:

- Female
- Male
- Other/Prefer not to say

**[Q3]How old are you?**
Please choose only one of the following:

- 26 or less
- …
- 75 or more

**[Q4]Where were you born?**

Please choose only one of the following:

- Italy
- Another country (please specify which one)

**[Q5]Could you indicate the region of Italy where you are currently working?**
Please choose only one of the following:

- North
- Center
- South and Islands

**[Q6]Now, let's talk about your job situation. Please indicate your current occupational position in academia:**
Please choose only one of the following:

- Full professor
- Associate professor
- Full-time assistant professor
- Tenured assistant professor
- Non-tenured assistant professor
- Post-doctoral research fellowship position
- Other

**[Q7]Can you indicate the year when you have obtained this academic position?**
Please choose only one of the following:

- 2021
- …
- 1960 or earlier

**[Q8]I would like to reconstruct your academic career so far. Could you indicate the year when you were promoted to a given academic position?**
Only answer this question if the following conditions are met: Answer was 'Full professor' at question '6 [Q6]' (Now let's talk about your job situation. Please indicate your current occupational position in academia:) Comment only when you choose an answer. Please choose all that apply and provide a comment:

- Post-doctoral research fellowship position
- Non tenured assistant professor
- Tenured assistant professor
- Full-time assistant professor
- Associate professor

*In a case if you have skipped some position, leave the field empty*

**[Q9]I would like to reconstruct your academic career so far. Could you indicate the year when you were promoted to a given academic position:**
Only answer this question if the following conditions are met: Answer was 'Associate professor' at question '6 [Q6]' (Now let's talk about your job situation. Please indicate your current occupational position in academia:) Comment only when you choose an answer. Please choose all that apply and provide a comment:

- Post-doctoral research fellowship position
- Non tenured assistant professor
- Tenured assistant professor
- Full-time assistant professor
- Other:

*In a case if you have skipped some position, leave the field empty*

**[Q10]I would like to reconstruct your academic career so far. Could you indicate the year when you were promoted to a given academic position:**
Only answer this question if the following conditions are met: Answer was 'Full-time assistant professor' at question '6 [Q6]' (Now let's talk about your job situation. Please indicate your current occupational

position in academia:) Comment only when you choose an answer. Please choose all that apply and provide a comment:

- Post-doctoral research fellowship position
- Other:

*In a case if you have skipped some position, leave the field empty*

**[Q11]I would like to reconstruct your academic career so far. Could you indicate the year when you were promoted to a given academic position:**
Only answer this question if the following conditions are met: Answer was 'Tenured assistant professor' at question '6 [Q6]' (Now let's talk about your job situation. Please indicate your current occupational position in academia:) Comment only when you choose an answer. Please choose all that apply and provide a comment:

- Post-doctoral research fellowship position
- Non tenured assistant professor
- Other:

*In a case if you have skipped some position, leave the field empty*

**[Q12]I would like to reconstruct your academic career so far. Could you indicate the year when you were promoted to a given academic position:**
Only answer this question if the following conditions are met: Answer was 'Non tenured assistant professor' at question '6 [Q6]' (Now let's talk about your job situation. Please indicate your current occupational position in academia:) Comment only when you choose an answer. Please choose all that apply and provide a comment:

- Post-doctoral research fellowship position
- Other:

*In a case if you have skipped some position, leave the field empty*

**[Q13]I would like to reconstruct your academic career so far. Indicate the year when you were promoted to a given academic position:**
Only answer this question if the following conditions are met: Answer was 'Other' at question '6 [Q6]' (Now let's talk about your job situation. Please indicate your current occupational position in academia:) Comment only when you choose an answer. Please choose all that apply and provide a comment:

- Post-doctoral research fellowship position
- Non tenured assistant professor
- Tenured assistant professor
- Full-time assistant professor
- Associate professor
- Full professor
- Other:

*In a case if you have skipped some position, leave the field empty*

**[Q14]Could you indicate the year when you completed your PhD degree?**
Please choose only one of the following:

- I do not have a PhD degree
- 2020
- …
- 1956 or earlier

**[Q15]Did you obtain your doctorate in Italy or in another country?**
Choose one of the following answers Please choose only one of the following:

- In Italy
- In another country

**Research activity: Working loads**

**Q16]I would like to ask you about your research activity. Please indicate how many scientific articles you have published in the last three year, possibly indicating how many were published in A-class (Fascia A)* journals (if it applies to your discipline).**

| | Number of articles | Number of A-class articles |
|---|---|---|
| In 2020 | | |
| In 2019 | | |
| In 2018 | | |

*A-class (Fascia A) sceintific journals according to ANVUR (Agenzia Nazionale di Valutazione del Sistema Universitario e della Ricerca)

**[Q17]Since the start of your career how many scientific articles have you published?**

Please choose only one of the following:

- 0
- 1 - 4
- 5 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 50 or more

**[Q18]Since the start of your career how many of your scientific articles were published in the A-class (Fascia A)* scientific journals?**

Only answer this question if the following conditions are met:Answer was 'Civil Engineering and Architecture ' or 'Sciences of Antiquity, Philology, Literature and Art History' or 'Historical, philosophical, pedagogical and psychological sciences' or 'Legal sciences' or 'Economics and Statistics ' or 'Political and social sciences' at question '1 [Q1]' (Let's start with general questions. Please indicate the main scientific field in which you are currently working:)

Please choose only one of the following:

- 0
- 1 - 3
- 4 - 6
- 7 - 9
- 10 - 12
- 13 - 14
- 15 - 20
- 21 or more

**A-class (Fascia A) sceintific journals according to ANVUR (Agenzia Nazionale di Valutazione del Sistema Universitario e della Ricerca)*

**[Q19]For whole your career how many books have you published?**

Only answer this question if the following conditions are met: Answer was 'Civil Engineering and Architecture ' *or* 'Sciences of Antiquity, Philology, Literature and Art History' *or* 'Historical, philosophical, pedagogical and psychological sciences' *or* 'Legal sciences' *or* 'Economics and Statistics ' *or* 'Political and social sciences' at question '1 [Q1]' (Let's start with general questions. Please indicate the main scientific field in which you are currently working:)

Please choose only one of the following:

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8 or more

**[Q20]As of today, your H-index is:**
Please choose only one of the following:

- 2 or less
- 3 - 5
- 6 - 8
- 9 - 11
- 12 - 14
- 15 - 17
- 18 - 20
- 21 or more

**[Q21]Have you tried to obtain the national scientific qualification (ASN) in your field?**
Only answer this question if the following conditions are met: Answer was greater than or equal to 'Full-time assistant professor' at question '6 [Q6]' (Now let's talk about your job situation. Please indicate your current occupational position in academia:) Please choose only one of the following:

- Yes
- No

**[Q22]Did you obtain the national scientific qualification (ASN)?**
Only answer this question if the following conditions are met: Answer was 'Yes' at question '21 [Q21]' (Have you tried to obtain the national scientific qualification (ASN) in your field?)
Please choose only one of the following:

- Yes
- No

**[Q23]In your own estimation, has your scientific productivity changed during the pandemic (after March 2020)?**
Choose what best characterizes you.
Please choose only one of the following:

- I have become more productive in terms of publishing
- Overall my scientific productivity has not changed
- I have become less productive in terms of publishing

**[Q24]Please estimate how many hours a week you usually devote to your work. Sometimes working hours for academics vary considerably during the year. Give the estimate of your last academic semester.**
Please choose only one of the following:

- 50 or more
- …
- 20 or less

"Work" includes all research, teaching, and administrative activities

**[Q25]Imagine your usual weekly academic life of the last semester. How many hours do you usually spend on:**

| | |
|---|---|
| Teaching activity (preparing and holding lectures, supervising, etc.) | |
| Research activity | |
| Other loads (administrative, technical, etc.) | |

**[Q26]During your last academic semester, how often do you worked at weekends?**
Please choose only one of the following:

- Never
- Rarely
- Sometimes
- Often
- Other

**[Q27]Have you ever spent more than 6 months working abroad during your academic career?**

Only answer this question if the following conditions are met: Answer was 'In Italy' at question '15 [Q15]' (Did you obtain your doctorate in Italy or in another country?)
Please choose only one of the following:

- Yes
- No

**[Q28]Have you ever had to move to another country or region to get the academic position you want?**
Please choose only one of the following:

- Yes
- No

**[Q29]Could you indicate the positions for which you had to move to another country or region of Italy respect to the previous one?**
Only answer this question if the following conditions are met: Answer was 'Yes' at question '28 [Q28]' (Have you ever had to move to another country or region to get the academic position you want?) Check all that apply.
Please choose all that apply:

- Full professor
- Associate professor
- Full-time assistant professor
- Tenured assistant professor
- Non tenured assistant professor
- Post-doctoral research fellowship position
- Other:

**Family situation. Partner and children**

**[Q30]Now let's talk about your family situation. What best describes your current marital status?**
Please choose only one of the following:

- Married cohabiting with spouse
- Civilly united (cohabiting with a partner)
- Single
- Married not cohabiting with spouse (includes de facto separated persons)
- Divorced
- Widowed
- Other

**[Q31]How old is your partner?**
Only answer this question if the following conditions are met: Answer was 'Married cohabiting with spouse' or 'Civilly united (cohabiting with a partner)' at question '30 [Q30]' (Now let's talk about your family situation. What best describes your current marital status?)
Please choose only one of the following:

- 25 or less
- 26 - 35
- 36 - 45
- 46 or more

**[Q32]What year you started living together with your current partner?**
Only answer this question if the following conditions are met: Answer was 'Married cohabiting with spouse' or 'Civilly united (cohabiting with a partner)' at question '30 [Q30]' (Now let's talk about your family situation. What best describes your current marital status?)
Please choose only one of the following:

- Prefer not to answer
- 2021
- …
- 1960 or earlier

**[Q33]Which of the following categories best describes your partner's main occupation?**
Only answer this question if the following conditions are met: Answer was 'Married cohabiting with spouse' or 'Civilly united (cohabiting with a partner)' at question '30 [Q30]' (Now let's talk about your family situation. What best describes your current marital status?)
Please choose only one of the following:

- Employed in an academic positions
- Employed in a research position outside of academia
- Employed in a non-research position
- Self-employed
- Unemployed or not employed
- I do not know
- Other

**[Q34]Please indicate your partner's current position in academia:**
Only answer this question if the following conditions are met: Answer was 'Employed in an academic positions' at question '33 [Q33]' (Which of the following categories best describes your partner's main occupation?)
Please choose only one of the following:

- Full professor
- Associate professor
- Full-time assistant professor
- Tenured assistant professor
- Non tenured assistant professor
- Post-doctoral research fellowship position
- I do not know
- Other

**[Q35]Is your partner on a full- or part-time contract?**
Only answer this question if the following conditions are met:
-------- Scenario 0 --------
Answer was 'Employed in a research position outside of academia' at question '33 [Q33]' (Which of the following categories best describes your partner's main occupation?)
-------- or Scenario 1 --------
Answer was 'Employed in a non-research position' at question '33 [Q33]' (Which of the following categories best describes your partner's main occupation?)
Choose one of the following answers Please choose only one of the following:

- Full-time contract
- Part-time contract
- I do not know

*Full-time employment means a full working day and a working week exceeding 40 hours, part-time is defined as a contract equivalent to 80% or less of a full-time contract.*

**[Q36]Is your partner on a permanent/open-ended or fixed- term/temporary contract?**
Only answer this question if the following conditions are met: Answer was 'Employed in a research position outside of academia' or 'Employed in a non- research position' at question '33 [Q33]' (Which of the following categories best describes your partner's main occupation?)
Choose one of the following answers Please choose only one of the following:

- Permanent contract
- Fixed-term contract
- I do not know

**[Q37]What is the highest qualification level that your partner has obtained?**
Only answer this question if the following conditions are met: Answer was 'Married cohabiting with spouse' or 'Civilly united (cohabiting with a partner)' at question '30 [Q30]' (Now let's talk about your family situation. What best describes your current marital status?)

- Please choose only one of the following:
- Primary school or no formal education
- Lower secondary education
- Upper secondary education or vocational education
- Bachelor's degree

- Master's degree or single cycle
- PhD degree
- I do not know
- Other

**[Q38] To what extent do you yourself contribute to your family's total income?**
Please choose only one of the following:
- Very little
- Less than half
- About half
- More than half
- Almost Completely

**[Q39] Do you have children? Please consider also adopted/fostered children.**
Please choose only one of the following:
- Yes
- No

**[Q40]How many children do you have?**
Only answer this question if the following conditions are met: Answer was 'Yes' at question '38 [Q38]' ( Do you have children? Please consider also adopted/fostered children. )
Please choose only one of the following:
- 1 child
- 2 children
- 3 children
- 4 children
- 5 children or more

Please consider also adopted/fostered children

**[Q41]Does your partner have children (from a previous relationship or adopted children for whom you are not the legal guardian) living in the same house as you?**
Only answer this question if the following conditions are met: Answer was 'Married cohabiting with spouse' or 'Civilly united (cohabiting with a partner)' at question '30 [Q30]' (Now let's talk about your family situation. What best describes your current marital status?)
Please choose only one of the following:
- Yes
- No

**[Q42]Could you indicate how many of your partner's children (from a previous relationship or adopted children for whom you are not the legal guardian) live in your house?**
Only answer this question if the following conditions are met: Answer was 'Yes' at question '41 [Q41]' (Does your partner have children (from a previous relationship or adopted children for whom you are not the legal guardian) living in the same house as you?) Choose one of the following answers
Please choose only one of the following:
- 1 child
- 2 children
- 3 or more children

**[Q43]Currently do you have child(ren) 6 years old or younger living with you?**
Only answer this question if the following conditions are met: Answer was 'Yes' at question '39 [Q39]' ( Do you have children? Please consider also adopted/fostered children. )
Please choose only one of the following:
- Yes
- No

**[Q44]Please indicate the year when your child was born?**
Only answer this question if the following conditions are met: Answer was '1 child' at question '40 [Q40]' (How many children do you have?)

**[Q45]Please indicate the year when your children were born?**
Only answer this question if the following conditions are met: Answer was '2 children' at question '40 [Q40]' (How many children do you have?)

**[Q46]Please indicate the year when your children were born?**
Only answer this question if the following conditions are met: Answer was '3 children' at question '40 [Q40]' (How many children do you have?)

**[Q47]Please indicate the year when your children were born?**
Only answer this question if the following conditions are met: Answer was '4 children' at question '40[Q40]' (How many children do you have?)

**[Q48]Please indicate the year when your children were born?**
Only answer this question if the following conditions are met: Answer was '5 children or more' at question '40 [Q40]' (How many children do you have?)

**[Q49] Can you remember what type of childcare services you used? If you have more than one child, remember your youngest child.**
Only answer this question if the following conditions are met: Answer was 'Yes' at question '39 [Q39]' ( Do you have children? Please consider also adopted/fostered children. ) and Answer was 'No' at question '43 [Q43]' (Currently do you have child(ren) 6 years old or younger living with you?) Check all that apply
Please choose all that apply:

- I did not use any childcare survises
- Nursery or infant school
- A babysitter
- Grandparent's support
- Other

**[Q50] What type of childcare services you currently used?**
Only answer this question if the following conditions are met: Answer was 'Yes' at question '43 [Q43]' (Currently do you have child(ren) 6 years old or younger living with you?) Check all that apply
Please choose all that apply:

- I do not use any childcare survises
- Nursery or infant school
- A babysitter
- Grandparent's support
- Other:

**[Q51]Thinking about the total time spent with the child(ren) during the working week, who takes care of the children (cooking, supervision, etc.)?**
Only answer this question if the following conditions are met: Answer was 'Single' at question '30 [Q30]' (Now let's talk about your family situation. What best describes your current marital status?) and Answer was 'Yes' at question '42 [Q42]' (Currently do you have child(ren) 6 years old or younger living with you?)
Please choose only one of the following:

- Only me
- Mostly me
- Mostly others
- Other

**[Q52]Thinking about the total time spent with the child(ren) during the working week, who takes care of the children (cooking, supervision, etc.)?**
Only answer this question if the following conditions are met: Answer was less than or equal to 'Civilly united (cohabiting with a partner)' at question '30 [Q30]' (Now let's talk about your family situation. What best describes your current marital status?) and Answer was 'Yes' at question '42 [Q42]' (Currently do you have child(ren) 6 years old or younger living with you?)
Please choose only one of the following:

- Only me
- Mostly me
- Both my partner and I, equally
- Mostly partner or someone else

- Only partner or someone else
- Other

**[Q53]Going back in time to when your children were young and thinking about the total time spent with the child(ren) during the working week, who took care of the children (cooking, supervision, etc.)?**
Only answer this question if the following conditions are met: Answer was 'Single' at question '30 [Q30]' (Now let's talk about your family situation. What best describes your current marital status?) and Answer was NOT 'Yes' at question '42 [Q42]' (Currently do you have child(ren) 6 years old or younger living with you?)
Please choose only one of the following:
- Only me
- Mostly me
- Mostly others
- Other

**[Q54]Going back in time to when your children were young and thinking about the total time spent with the child(ren) during the working week , who took care of the children (cooking, supervision, etc.)?**
Only answer this question if the following conditions are met: Answer was less than or equal to 'Civilly united (cohabiting with a partner)' at question '30 [Q30]' (Now let's talk about your family situation. What best describes your current marital status?) and Answer was NOT 'Yes' at question '42 [Q42]' (Currently do you have child(ren) 6 years old or younger living with you?) Please choose only one of the following:
- Only me
- Mostly me
- Both my partner and I, equally
- Mostly partner or someone else
- Only partner or someone else
- Other

**[Q55]Do you think that your career so far has been affected by the fact of having had children?**
Only answer this question if the following conditions are met: Answer was 'Yes' at question '38 [Q38]' ( Do you have children? Please consider also adopted/fostered children. )
Please choose only one of the following:
- Yes, mostly positively
- Yes, more positively than negatively
- No, neither positively nor negatively
- Yes, more negatively than positively
- Yes, mostly negatively

**[Q56]In assessing the time of the pandemic (after March 2020), has your work-family balance changed from previous years?**
Only answer this question if the following conditions are met: Answer was 'Yes' at question '39 [Q39]' ( Do you have children? Please consider also adopted/fostered children. )
Please choose only one of the following:
- My work-family balance has not changed
- Since the beginning of the pandemic I spend more time on family duties
- Since the beginning of the pandemic I spend more time working

**[Q57]Would you like to have a (another) child within the next 3 years?**
Only answer this question if the following conditions are met: Answer was 'Female' at question '2 [Q2]' (Indicate your gender:) and Answer was less than or equal to '45' at question '3 [Q3]' (How old are you?)
Please choose only one of the following:
- Yes
- No

**[Q58]Would you like to have a (another) child within the next 3 years?**
Only answer this question if the following conditions are met: Answer was 'Male' at question '2 [Q2]' (Indicate your gender:) and Answer was less than '46 or more' at question '31 [Q31]' (How old is your partner?)

Please choose only one of the following:

- Yes
- No

**[Q59]Ideally, how many children in total would you like to have?**
Only answer this question if the following conditions are met: Answer was 'Female' at question '2 [Q2]' (Indicate your gender:) and Answer was less than or equal to '45' at question '3 [Q3]' (How old are you?)
Choose one of the following answers Please choose only one of the following:

- I do not want to have children  1 child
- 2 children
- 3 children
- 4 children
- 5 children or more
- Other

*Including the number of children you already have (if you have any)*

**[Q60]Ideally, how many children in total would you like to have?**
Only answer this question if the following conditions are met: Answer was 'Male' at question '2 [Q2]' (Indicate your gender:) and Answer was less than '46 or more' at question '31 [Q31]' (How old is your partner?) Choose one of the following answers
Please choose only one of the following:

- I do not want to have children
- 1 child
- 2 children
- 3 children
- 4 children
- 5 children or more
- Other

Including the number of children you already have (if you have any)

**Personal data.**

**[Q61] Could you leave your professional email address or ORCID below?**

By providing your email address or your ORCID, you give your consent to access your publication history and link it to your answers to this survey. In so doing, you will allow me to properly investigate the role of family characteristics on the productivity and careers of academics in Italy.
Please write your answer here:

If you would like to know more about the project or receive more information on how privacy will be dealt with, please contact me  olga.gorodetskaya@unitn.it or write to supporto.privacy@unitn.it.

**[Q62]Thank you for your participation! If you have any comments or suggestions, you can write it below:**

Thank you
for your participation!

# **Appendix I.** Descriprive findings (t-tests)

*Table I1. Gender differences in occupational outcomes (T-test), across PhD cohorts. Standard errors in parentheses. * p<0.05, ** p<0.01, *** p<0.001*

| | *2004* | | *2006* | | *2008* | | *2010* | | *2012* | | *2014* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *d(M-F)* | *SE* | *d(M-F)* | *SE* | *d(M-F)* | *SE* | *d(M-F)* | *SE* | *d(M-F)* | *SE* | *d(M-F)* | *SE* |
| Academic | 0.07*** | 0.02 | 0.03* | 0.01 | 0.03*** | 0.01 | 0.03** | 0.01 | 0.04*** | 0.01 | 0.05*** | 0.01 |
| Non-academic | -0.03 | 0.02 | -0.01 | 0.01 | -0.004 | 0.01 | 0.01 | 0.01 | -0.01 | 0.01 | -0.01 | 0.01 |
| Non-employed | -0.04*** | 0.02 | -0.02** | 0.01 | -0.03*** | 0.01 | -0.04*** | 0.01 | -0.03*** | 0.01 | -0.04*** | 0.01 |
| N | 3928 | | 4886 | | 7888 | | 8434 | | 8172 | | 7885 | |

*Table I2. Gender differences in scientific productivity (T-test) among academics and non-academics, across PhD cohorts. Standard errors in parentheses. * p<0.05, ** p<0.01, *** p<0.001*

| | *2004* | | *2006* | | *2008* | | *2010* | | *2012* | | *2014* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *d(M-F)* | *SE* | *d(M-F)* | *SE* | *d(M-F)* | *SE* | *d(M-F)* | *SE* | *d(M-F)* | *SE* | *d(M-F)* | *SE* |
| Academics | 0.05** | 0.02 | 0.07*** | 0.02 | 0.06*** | 0.02 | 0.02 | 0.02 | 0.06*** | 0.02 | 0.05* | 0.02 |
| N | 1409 | | 1678 | | 2149 | | 2270 | | 1705 | | 1732 | |
| Non-academics | 0.06** | 0.02 | 0.10*** | 0.02 | 0.04** | 0.01 | 0.06*** | 0.01 | 0.01 | 0.01 | 0.04** | 0.01 |
| N | 2273 | | 2841 | | 5218 | | 5454 | | 5977 | | 5678 | |

**Appendix J.** The multi-level map of key factors and mechanisms of gender inequality in academia

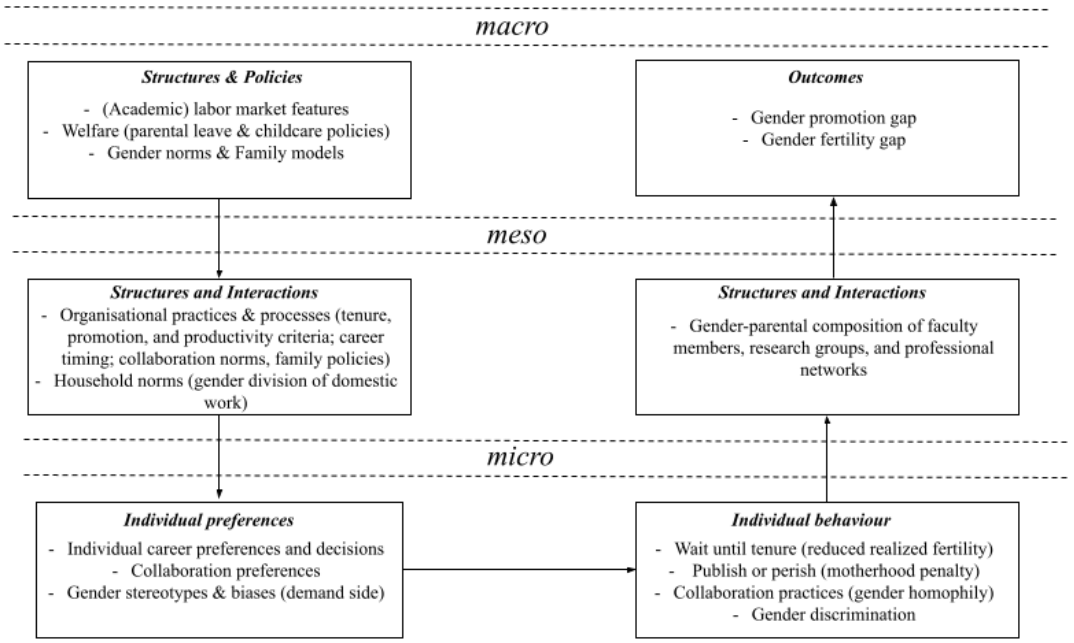


**Figure J1.** The multi-level map of key factors and mechanisms of gender inequality in academia

# List of figures

## Chapter 2



## Chapter 3



## Chapter 4

# List of tables

## Chapter 2



## Chapter 3



## Chapter 4

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