Department of Economics and Finance

Chair of Macroeconomics

Women Mentoring Women: the Role Model Effect on the Gender Gap in PhD Career Choices

Supervisor:

Prof. Giovanna Vallanti

Candidate:

Federica Iorio 258531

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Abstract

Starting from the answers of a survey conveyed to PhD students enrolled in Italy between 2008 and 2014, we have conducted an empirical analysis on the existing gender differences in students' career decisions with a focus on the role of a well-gender balanced university environment. This approach aims at studying the impact of the interaction of female student with same sex mentors and their model effect, in shaping their career decisions.

Our research shows evidence of the existence of gender inequalities in career choices, without however a significant role model effect, which is nonetheless positive.

Yet, we found that a stimulating and positive university faculty environment has a significant impact on female students' career outcomes and satisfaction. Therefore, this confirms how female students benefits from stimulating relationships with their mentors and professors.

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1. Introduction

The gender gap in the labor market has been widely discussed in the literature as it is one of the most important current issues. It is indeed of central attention to find policies and solutions that will allow to reduce and eventually close the gap.

Despite gender equality is one of the fundamental pillars of the European Union, stated in article 2[1] of the Treaty of on European Union and the numerous policies and strategies undertook by the EU[2], women still remain disadvantaged in terms of opportunities and access to labor market compared to men[3].

Some experts trace back to problem and find its roots to the educational and cultural reasons, underlying how the gap is less severe in those countries where gender roles do not profoundly shape the culture (Posel and Casale, 2014).

The gender segregation is even more widespread in those specific fields that are usually more male-dominated, mainly STEM and economics. This happens despite the fact the women obtain

[1] "The Union is founded on the values of respect for human dignity, freedom, democracy, equality, the rule of law and respect for human rights, including the rights of persons belonging to minorities. These values are common to the Member States in a society in which pluralism, non-discrimination, tolerance, justice, solidarity and equality between women and men prevail." *Consolidated versions of the Treaty on European Union and the Treaty on the Functioning of the European Union - Consolidated version of the Treaty on European Union - Protocols - Declarations annexed to the Final Act of the Intergovernmental Conference which adopted the Treaty of Lisbon, signed on 13 December 2007 - Tables of equivalences*.

[2] The Gender Equality Strategy 2020-2025 aims at making significant progress to reduce gender inequalities in Europe by 2025, by challenging gender stereotypes, closing or reducing to the maximum the gender gap in the labour market and ensuring equal opportunities and access to all the different sectors, addressing the gender pay gap and ending gender-based violence. *Communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions A Union of Equality: Gender Equality Strategy 2020-2025.*

[3] *Id*.

much higher results and achievements during their school experience than men (Legewie and DiPrete, 2014).

Women often feel forced to choose between their career or personal life, which is directly reflected in being more inclined to undertake a career in fields which might be less time-demanding. Beliefs and societal stereotypes play a big role in shaping female students' decisions on their career (Davies and Guppy, 1997). Stereotypes such as males having a "natural" inclination or possessing specific characteristics to pursue a career in scientific fields, might influence female behaviors and propensity when deciding their careers (Sabir, 2015; Scott Long, 1990). This effect is even more dominant when boys and girls are exposed to these beliefs ever since they are kids.

Therefore, women decide their careers based, not only on their personal preferences but most of the times, they also feel influenced by their biological characteristics and society's expectations and beliefs, which lead girls to underestimate themselves (Kauhanen and Napari, 2015).

Another reason which could lead female students to choose humanistic careers over a STEM career is the lack of same sex professors and mentors who function as role models for the students, throughout their studies.

One of the possible solutions that have been taken into consideration which might contribute to reduce gender inequalities, is the role model theory.

There is indeed already some literature streams that have carefully analyzed the role of a more well gender-balanced faculty (Neumark and Gardecky, 1998) and its contribution to creating gender balanced environments.

Our empirical question therefore is policy oriented and it is related to the current existing literature on the labor gender gap: is the gender gap significant also in the PhD students' career choices?

How does the faculty environment affect this result? Can this result be mitigated by a more gender-balanced faculty?

Our study will firstly focus on the analysis of the gender differences related to PhD students' decisions about their career. Specifically, the employment outcome (unemployed or not) after the student has completed her PhD, if she is willing to pursue a career in academia and finally the satisfaction relative to her current job position.

The next part will instead analyze how the previous gender differences related to the female students' career decisions are affected by the presence of a larger share of female faculty in their parent university. We are also able to control for specific students' characteristics that may affect their decisions, such as family background, university characteristics, disciplinary-scientific areas of the PhD, the university location and students' judgements on the quality of specific services offered by the university.

We conduct the study by using an Ordinary Least Square (OLS) regression and an Instrumental strategy (IV), thanks to which we were able to control for university internal environment policies (e. g. faculty gender composition) which could affect students' behaviors.

We decided to conduct our analysis by focusing on the PhD level students who have completed their studies for mainly two reasons. First of all, PhD is one of the highest levels of education a person can achieve and therefore our sample of individuals represent highly skilled and motivated people, which should be a positive factor when it comes to employment outcomes. Secondly, the PhD students are very aware of what their aspirations and career options are, meaning that the choice of the type of PhD program is already a signal of their intention of pursuing a career in the same field.

Using the aforementioned approach, we find that, in line with the existing literature, there exists a significant gender gap in PhD students' career outcomes, more precisely referring to the employment situation and the fulfillment of the current job.

On the other hand, this gender gap in career outcomes is not strongly mitigated by a larger presence of female, however it is still positive for the employment outcome.

The structure of this paper is the following. Section 2 is based on the discussion of the existing literature on the gender gap, role models and our hypothesis; section 3 presents the data and empirical strategy; section 4 shows the main findings and results and finally section 5 is focused on the conclusions.

2. The Theoretical Background

2.1 Gender gap in the labor market

Women's presence in the labor market and gender equality in the workplace are very critical issues in today's society.

Among people aged 25 to 54, female participation in the labor market in 2022 was 61.4%, whereas male participation was at 90.6%, generating a 29.2 percentage points gender gap in labor force participation[4].

The scarce presence of women in the labor market can be traced back to the educational accessibility and influence that women experience starting from primary education[5].

[4] https://www.ilo.org/wcmsp5/groups/public/---dgreports/---stat/documents/publication/wcms_870519.pdf

[5] https://commission.europa.eu/strategy-and-policy/policies/justice-and-fundamental-rights/gender-equality/women-labour-market-work-life-balance/womens-situation-labour-market_en

Indeed, education and access to primary and secondary education start to shape the trends in employment and labor market participation. In general, educational access in developing countries has increased, reducing the gender gap in primary and secondary schooling enrollment (Ozarem and King 2007; Grant and Behrman 2010).

Even though the access to higher education increased at a faster pace among women than among men, between 2000 and 2020, significant differences remain in specific fields of study and across developed and developing countries[6].

The main reason for which gender gap schooling still exists is due to economic causes: when resources are scarce in a family, parents prefer to invest in their sons' education as their labor market participation can provide greater support. On the other hand, girls' duties are associated to different types of responsibilities, mainly domestic work. Some research showed how females' different expected responsibilities negatively affect their access and enrollment to education (Assad et al., 2010; Zapata et al., 2011). In OECD countries, where gender roles are less rigidly defined, there is a clear positive relationship between education and women's labor market participation (Posel and Casale, 2014).

In particular, the labor force participation gap is mostly influenced by the compatibility of work with marriage and motherhood and evidence shows that when policies aimed at helping women reconciling the work-life balance, women's labor employment outcomes are more similar to men's (OECD, 2011).

The labor gender gap is particularly severe in some occupations that tend to be male-dominated and where, therefore, women are underrepresented. This has been supported by several empirical

[6] The gross enrollment rate in higher education increased from 19% in 2000 to 43% in 2020 among women, but only from 19% to 37% among men (UIS database), https://cdn.eventscase.com/www.whec2022.org/uploads/users/699058/uploads/c4fb749e5ddb3daca6d92dc280de404ad4ff3935e798ec3bc823a0d5cd8ca83765b71059379ec37b4d42717a7689ec02b9a9.629a0f82b4e16.pdf

studies searching for the explanation of this phenomenon. In spite of the different approaches and findings, these fields are mainly STEM (acronym for Science, Technology, Engineering and Mathematics), ICT (Information and Communication Technology), economics, outside and within academia, whereas women are much more concentrated in the area of humanistic fields (Brush 1991; Seymour 1995), and more specifically in nursing and education (Jacobs 1995). Additionally, according to a recent statistic in Europe, it turns out that those industries where women are underrepresented are characterized by high pay levels (Boll et al. 2018). On the contrary, women are overrepresented in low-paid industries. This exacerbates even more the gender wage gap, which is another crucial and current problem.

The large stream of literature addressing these gendered fields of study is known as horizontal segregation[7]. Women are underrepresented in fields like physics, computer science and engineering whereas men are underrepresented in careers like nursing, teaching and social work. Not only there is an underrepresentation of women that undertake a scientific career, but additionally more women than men drop out of science majors in college. This happens despite the fact the women have the same probability of successfully graduating from these programs (Attiyeh and Attiyeh 1997).

2.2 Gender segregation across certain fields of study and occupations

Sex segregation by field of study is generated by some stereotypes and taken-for-granted beliefs about innate gender differences and exacerbated by social forces and societal pressures (Ceci et

[7] The other mechanism by which education affects occupational choices is vertical segregation, i.e. the tendence of having greater presence of women in lower level of education. However, this literature view has been partially ignored, as recent figures, have shown that women represent the great majority of enrolled and graduated students for bachelor and master's courses in OECD countries (Flabbi 2012). Therefore, the study suggests that access and participation to higher education for women is not a significant factor for gender segregation.

al., 2009; Diekman and Eagly, 2008), as for instance the different types of cognitive skills and abilities of men and women (Bar-Haïm and Wilkes, 1989).

The gendered outcome is influenced by the social role theory (Eagly, 1987), which considers the historically different roles occupied by women and men in society as the main reason why the two sexes are subject to different expectations in behavior, including career choices (Forsman and Barth, 2016).

The influences of family, peers, mass media and school, to which girls and boys are exposed to, ever, since they are kids, shape their self-concept of their own abilities (Gonzalez-Pérez, 2020). This undoubtedly plays as a filter mechanism, discouraging and removing, from the very young age, many capable and potentially successful women to undertake a career in a scientific field. Students will be more likely to undertake studies and later pursue careers in which they feel more qualified and competent and where they believe they can excel (Eccles & Wigfield, 1995).

Therefore, the role played by gender stereotypes, according to which STEM and academia careers are stereotypically associated with male positions, contributes to the different career choices of female students (Eccles, Wigfield, & Schiefele, 1998; Guimond & Roussel, 2001). Women, indeed, tend to specialize in descriptive fields, which are more consistent with their "female" characteristics, such as caring and nurture (Anker, 1998), thus performing those jobs that are stereotyped as feminine rather than specializing in purely quantitative areas.

According to some streams of literature, this gendered outcome is also attributable to women's preferences and personal choices, both freely and constrained by biology and society: "Women choose at a young age not to pursue math-intensive careers, with few adolescent girls expressing desires to be engineers or physicists, preferring instead to be medical doctors, veterinarians, biologists, psychologists, and lawyers. Female make this choice despite earning higher math and

science grades than males throughout schooling" (Ceci and Williams 2010). However, as Leslie et al. (2015), suggest, this choice may derive mainly from the stereotypical belief that innate and "natural" abilities, talents and inclination (considered as key requirement for success) mostly belong to men, hence women self-select themselves out of some educational and careers paths in the labor market.

It has been proved indeed that women who possess both, good quantitative abilities and verbal abilities will be more likely to pursue a non-STEM track (Lubinski, Webb, Morelock, & Benbow, 2001).

According to a comprehensive meta-analysis conducted by Su et al. (2009), men exhibit stronger interest in things, whereas women tend to be more interested in people. Therefore, this suggest an explanation based on personal preferences for specific occupations, on why, STEM subjects, such as physics, technology engineering and mathematics tend to be overrepresented by men, meanwhile women outnumber men in health and social sciences.

Additionally, women due to fertility decisions and lifestyles choices, both freely-made and out of social obligation, may apply for part time jobs, reducing the opportunity to pursue academic careers which may require longer hours commitment. Women, indeed, have to make decisions that men are not required to make, constrained by biology, as opting out of full-time careers to have and rear children (see above Ceci and Williams, 2010), which further contributes exacerbating the gap. Indeed, Goulden et al. (2011) study, suggested that the most frequently mentioned reasons of female PhD students for opting out of scientific careers are marriage and childbirth.

One longitudinal study (Benbow et al., 2000) suggested how the different priorities among the two sexes influence in career decisions. If on the one hand, the average woman places more importance on achieving work-life balance, preserving time for her family and friends, on the other hand, the

average men place more importance on career success. This suggests that some men are, biologically and personally, more willing to make career-related sacrifices needed to achieve higher or top positions (Stewart-Williams & Halsey, 2020) or to work in certain fields.

Another particular interesting approach in analyzing the gender gap in specific occupations is to reverse the perspective, evaluating the role of gender stereotypes in men's interest in feminine-stereotyped occupations, as, occupational gender stereotypes are not only based on the expectations of the presence of women and men in a particular occupation, but also on the expected qualities necessary to be successful in the occupation[8] (Cejka and Eagly 1999). Therefore, research has shown that in order to attract more men to typically feminine-stereotyped occupations, it might be successful to underline the advantage of possessing specific attributes for a job that do not threaten their masculinity. As evidence, Forsman and Barth (2016) suggests that men would be more interested in those occupations if they had the "reassurance" of being allowed to exercise more stereotypically masculine behaviors and skills.

In general, the underrepresentation of women in certain fields of study constitute a problem for the economy well-being, as it may contribute to shortages in critical fields (Bettinger & Long, 2005). As a consequence, there are raising analysis and debates about how much the educational system, and more specifically, universities can influence female students' decisions to undertake occupations in fields that are usually more male-dominated.

This also translates in a lower fulfillment and enjoyment of female students' job position, as they may be discouraged and therefore not pursue those careers which satisfy them the most.

Based on the above arguments, we posit that:

[8] Occupation titles represent a crucial factor because not only do they convey gender stereotypes but also gather a set of expected skills and traits associated with people who hold a specific occupation.

H1a: female PhD students have a higher probability than men to be unemployed after completing their PhD

H1b: female PhD students are less likely to have a position in academia than men

H1c: female PhD students are less satisfied with their current job position[9] than men

2.3 Gender-balanced academic environment and gender role models

There are ongoing debates and raising attention on certain factors that before have been slightly omitted. Those are, specifically, institutional factors and the characteristics of employment in sectors as education and health, and their impact on gender differences in different lines of careers (Lazetic, 2020).

There are indeed, several explanations for the underrepresentation of women in scientific fields, outside and within academia, and one of this is the scarce, or in some cases even lack, of same-sex mentoring throughout their education.

Indeed, in most European countries, women are underrepresented in academic positions (Monroe et al. 2018; Van den Brink, M. and Benschop, Y., 2012).

The education has a significant impact on students' life, therefore it is crucial to analyze how the educational system can modify women's attitude and female students' motivations in their career choices. One way to do so is through the role models' influence. There is plenty of evidence supporting this theory and showing how students tend to prefer reaching out and following same-sex role models (Gilbert 1985; Bettinger and Long 2005; Gaule and Piacentini 2018).

[9] We are going to study the students' career choice by analyzing their satisfaction in their current job position, as it may be a direct outcome of their PhD.

However, previous research has not investigated in depth how the gender of university faculty and climate at the host university affect students' outcomes at the PhD level, but it is becoming of central focus.

Particularly, the aim of this paper is to understand whether and to what extent a better gender representation in academia might affect PhD female students' attitudes and probability to continue their career within more male-dominated fields and their consequent satisfaction.

Doctoral education was introduced in Italy in 1980[10] and it was mainly interpreted as the first step for an academic career. Indeed, data from the "Survey on the employability of Ph.D. holders" carried out by ISTAT (Italian National Institute of Statistics) in 2010 suggested that a few years after graduation, about 36% of Ph.D. holders were still employed in the academic sector[11] (Alfano et al., 2021). This highlights even more the key role that faculty may have throughout the Ph.D. studies of female students.

Women, often, tend to underestimate their abilities in those more male-dominated fields, in which they may feel discriminated in favor of male peers (Correll, 2001). Therefore, the exposure to other currently successful women in these fields, such as female professors and/or advisors could represent a crucial driver for female students' career decision, and achieving a work-personal life balance (Marx, Stapel, & Muller, 2005). In this sense, the balanced presence of female faculty role models might mitigate the current negative gendered trend and reducing social bias against women. Role modelling is based on the cognitive process characterizing individuals who observe the attributes of people engaged in social roles similar to theirs (Huyghe & Knockaert, 2015), thus encouraging them in pursuing similar paths of studies (Girgus et al. 1992; Canes and Rosen 1995).

[10] Decree of the President of the Republic n. 382/1980.

[11] However, after the policy interventions of the 1990s, the initial role of Ph.D. changed: Ph.D. education started to also allow to acquire skills and competences useful in non-academic employment as well. Nevertheless, it still represents a pivotal cycle of study to pursue an academic career.

There is evidence that the inspiration derived from role models has positive impact on female students (Ehrenberg & Brewer, 1995). These results of same-group instructors as role models suggest that they serve as examples to students as they can possibly better empathize with their particular needs. Not only there is empirical evidence on the role of female faculty members as role models for students, showing that female students who are exposed more to female faculty throughout their studies, turned out to positively succeed in usually male-dominated fields, such as STEM, (Bettinger and Long, 2005; Carrel at al., 2010; Porter and Serra, 2020), but additionally, according to Pezzoni et al. (2016), they turn out to be more productive than female students having male advisors. Additionally, Neumark and Gardecki (1998), suggested that there is rather strong evidence of effects of female faculty in reducing the amount of time of female students to complete their graduate school.

Indeed, fields as science or quantitative fields, where women are underrepresented, are also characterized by the lack or scarce presence of potential faculty role models for female students. This is increasingly becoming to have direct implications for the design of policy responses to foster an environment of gender-balanced in some specific fields. For example, there has been much effort from the government, companies and schools to increase female representation in male-dominated fields, by hiring more women faculty members[12] (Bettinger and Long, 2005). According to Gaule and Piacentini (2018) analysis, female Ph.D. students with female advisors are more than 50% more likely to become faculty themselves than female students with male advisors and the underrepresentation of women among faculty members has an impact on the PhD experience of female students and might influence the propensity of these students to drop out of science and engineering and not pursuing an academic career in those fields.

[12] For example, in 2003 Princeton University created a $10 million fund to hire and promote women faculty in science and engineering departments.

The role of faculty members is pivotal in the socialization process of PhD students and in their process of decision of continuing in the academia (Sallee, 2014). Some authors have showed that positive experiences and relationships with advisors represent higher probability to expect success in academia (Golde, 1998) and their supportive proximity and behaviors enhance the success in the sphere of academia (Austin, 2002). As Etzkowitz et al. (2000) claimed, in fact, feelings of inappropriateness and exclusion are very common among female PhD students due to gender bias and uncomfortable competition with men (Niederle and Vesterlund, 2011), causing them to have a less positive doctoral study and making it more challenging to pursue the academic career. Thus, these kinds of processes have a significant impact on the female students' employment outcomes and decisions.

Based on the above arguments, we posit that:

H2a: a larger presence of female academic faculty at the parent institution positively influences female employment outcome

H2b: a larger presence of female academic faculty at the parent institution positively influences female students' intention to continue her career in the academia

H2c: a larger presence of female academic faculty at the parent institution positively increases the satisfaction of the female student current job position.

3. Data and empirical specification

3.1 Data description

In order to analyze the gender issues related to PhD students, we use the information of a database, which is based on the responses to a questionnaire survey completed by 9,062 PhD students

enrolled in PhD programs in Italy between 2008 and 2014. This database was constructed and used in a previous study[13]. The survey was run between the end of 2014 and the beginning of 2015, therefore the PhD graduates are observed up to 7 years after their PhD completion. The survey was administrated by CINECA, an Italian consortium of universities, research institutions and the Ministry of education and Research (MUR). The questionnaire was administered to around 23,500 individuals, who represent 50% of the population of PhD students enrolled in a PhD course in the period analyzed.

The students were asked several questions, among which the most relevant ones for our study, refer to the evaluation of their PhD course and their advisors and mentors, their occupational situation before and after the PhD and some personal information about themselves and their family background.

3.2 The empirical models

In order to analyze the gender differences in career choices among PhD female students, we are going to construct two models. In the first one, we are going to capture whether female PhD students behave differently from their male colleagues in relation to three different outcomes: (a) employment outcome; (b) probability to have a position in academia; (c) satisfaction of the student's current job position.

Based on the previous hypothesis, the first OLS regression model is specified as follows:

[13] Muscio, Alessandro and Vallanti, Giovanna (2022). The Gender Gap in PhD Entrepreneurship: Why balancing employment in academia really matters.

$$y_{ijst} = \beta_0 + \beta_1 Fem_i + \beta_2 X_i + \beta_3 Z_{jst} + \varepsilon_{ijst} \quad (1)$$

where the subscript i indicates the student, j is the university where the student graduated from her/his PhD degree, s is the disciplinary scientific sector of the PhD and t is the PhD graduation year. The dependent variable y will vary according to the different research question considered (H1a, H1b or H1c).

The variable Fem is a dummy variable for female students.

The vector X includes the individual controls, i.e. all the specific students' characteristics, such as final master graduation grade (to control for the quality of the student), work experience before PhD, parents' background (education level and profession), the relationship the student has with the supervisor of her/his thesis and a dummy for the place where the student lives at the time of the survey, as it might influence students' choices. The vector Z comprehends all the parent university environment and contextual factors that affect students' employment decisions and outcome, such as unemployment rate in Italy at the time of the survey (as it affects the students' decisions and labor outcomes), access to market labor and the degree of internationalization of the specific PhD, as it may affect the available opportunities for the students, the university faculty, a dummy characterizing the different PhD specialization areas and a dummy for the location of the parent university (considering all the Italian provinces) as it might influence students' possibilities available to them.

Finally, we added a cluster for standard errors for all those factors which we may not have controlled and to adjust possible correlation.

In this model, the main variable of interest is the coefficient of Fem, which represent the gender differences in the three different specifications. Specifically, a negative β_1 captures the existance of a gender gap and would support the hypothesis 1a, 1b and 1c.

For the second model, we are going to study the effect of the gender composition of the academic environment and the role played by a more gendered balanced academic faculty at the parent university where the female students completed their PhD studies.

For this reason, we are going to add the interaction term between Fem and the share of female faculty at the parent university (Fem_Fac) to the model (1) above[14]:

$$y_{ijst} = \beta_0 + \beta_1 Fem_i + \beta_2 Fem \times Fem\_Fac_{jst} + \beta_3 Fem\_Fac_{jst} + \beta_4 X_i + \beta_5 Z_{jst} + \varepsilon_{ijst} \qquad (2)$$

In this second model, we are interested in the coefficient of the interaction term, i.e. β_2. A positive β_2, would entail that a larger presence of female in the faculty has a positive effect in the female PhD students' career choices and it would verify hypothesis 2a, 2b and 2c.

3.3 The instrumental strategy

In the two previous models, we were able to control for several observable characteristics, both related to the students and to the university. Nevertheless, the characteristics of the composition of the university faculty may not be always random. Indeed, it is confirmed by the literature (Bettinger and Long, 2005) that universities are proactively intervening in this issue through

[14] Both the variables X and Z in the model remain the same as in the previous one. The only novelty is Fem_Fac which represent the entire female faculty, including full and associate professors, lecturers and assistant professors

internal university strategies to balance the gender composition of the faculty. These policies might also have an impact on female students, specifically these strategies may attract more PhD female students who are strongly interested in pursuing usually male-dominated careers (academia and STEM fields). In this sense, considering the correlation between female PhD students' motivation in pursuing specific careers and the presence of female faculty, the Ordinary Least Square (OLS) estimator would not be the most precise one, as it would still account for this correlation.

Therefore, in order to overcome this possible endogeneity, we carry on an Instrumental variable strategy. Specifically, we use the share of female faculty at the national level in the SSD of the PhD, as the instrument, by stating that it is uncorrelated with potential internal gender and faculty policies of the university, but it is correlated with the share of female faculty at the university level. The first-stage model is the following:

$$Fem\_fac_{jst} = \delta_0 + \delta_1 Fem\_fac_{st,-sj} + all\ other\ controls\ of\ previous\ models + \omega_{ijst} \quad (3)$$

where δ_1 is the effect of the national level faculty composition in the specific SSD s on the internal female faculty of the same SSD. The other controls included in the first-stage equation are the same used in the two previous models.

4. Results

Table 1 presents the data used for the two regression models.

Table 2 presents the descriptive statistics and the t-tests for the difference in the means between males and females. In particular it shows that, considering the gender differences in relation to

career choices, there is a significant gender gap in two out of three specifications, specifically the first and the third one.

Confirming the first specification and the aforementioned literature, women are more likely than men to be unemployed after completing her/his PhD. Furthermore, they are also less satisfied than men of their current job position. However, there is no statistically significant difference concerning the pursuing of a career in academia.

Finally, we found that there are statistically significant differences between male and female career decisions. On the other hand, for the institutional and university factors of the students' parent university for PhD, the only significant differences that emerged from the analysis refer to the judgment regarding the labor market outcome and the degree of internationalization of the PhD, meaning that men students value more these two aspects of their PhD.

Table 1 Data definition

Variable	Description	Source
Dependent variables		
Employment outcome:		
1. Employed	Dummy variable taking the value 1 if the student works after completing her/ his PhD programme and 0 otherwise.	Questionnaire
Career in academia:		
2. Position in academia	Dummy variable taking the value 1 if the student has a position within the academia after completing his/her PhD and 0 otherwise.	Questionnaire
Fulfilment in current job:		
3. Current job's satisfaction	Dummy variables based on scalar variable ranging from 1 to 6 on the basis of the students' satisfaction rate for their current job. The dummy takes value 1 if the value of the scalar is equal or above the sample median (3)	Questionnaire
Research hypotheses testing		
Female	Dummy variable taking the value 1 if the student is female and 0 otherwise.	Questionnaire

Share female faculty same area	Share of female faculty in the university and disciplinary-scientific sector (SSD) of the PhD programme.	MIUR
Individual controls		
Graduation grade	Graduation final mark (66-110).	Questionnaire
No work experience	Dummy variable taking value 1 if the student had no job experience before the beginning of the PhD programme and 0 otherwise.	Questionnaire
Graduate parent	Dummy variable taking the value 1 if at least one of the student's parents holds a university degree.	Questionnaire
Articles published within 2 years	Dummy variables taking the value 1 if the student has published an article within two years of the completion of their PhD and 0 otherwise.	Questionnaire
Supervisor's influence	Dummy variables based on scalar variable ranging from 1 to 6 on the basis of the students' personal judgment. The dummy takes value 1 if the value of the scalar is equal or above the sample median (3).	Questionnaire
University and contextual control factors		
Unemployment rate	Unemployment rate in the year before graduation in the province (NUTS3) where the university is located.	ISTAT
Access to labour market	Dummy variables based on scalar variable ranging from 1 to 6 on the basis of the students' personal judgment. The dummy takes value 1 if the value of the scalar is equal or above the sample median (3).	Questionnaire
Degree of internationalization of PhD	Dummy variables based on scalar variable ranging from 1 to 6 on the basis of the students' personal judgment. The dummy takes value 1 if the value of the scalar is equal or above the sample median (3).	Questionnaire
University faculty	University faculty at parent university	MIUR
University female faculty	Share of university female faculty in the same year of graduation of the PhD the student.	MIUR

Table 2 Descriptive statistics

	Overall sample				Male	Female	
	Mean	Std. Dev.	Min	Max	Mean	Mean	Mean-comparison t-test [(1)]
Dependent variables							
Employed	0.866	0.341	0.000	1.000	0.882	0.849	**
Position in academia	0.566	0.496	0.000	1.000	0.574	0.558	

Current job's satisfaction	0.938	0.241	0.000	1.000	0.914	0.890	**
Independent variables							
Female	0.318	0.466	0.000	1.000	-	-	
Share female faculty at university	0.355	0.194	0.000	1.000	0.335	0.379	
Individual controls							
Graduation grade	108.4	3.6	80.0	110.0	108.2	108.6	
No work experience	0.450	0.500	0.000	1.000	0.469	0.430	
Graduate parent	0.390	0.488	0.000	1.000	0.404	0.385	
Articles published within 2 years	2.477	4.660	0.000	110.0	2.674	2.254	
Supervisor's influence	0.933	0.249	0.000	1.000	0.894	0.895	
University and contextual control factors							
Unemployment rate	9.566	5.058	2.171	25.661	9.517	9.615	
University research rating	1.000	0.221	0.000	1.840	0.997	1.008	
University faculty (number)	1520.0	1036.7	1	4752.0	1543.8	1573.1	
Access to labour market	0.726	0.446	0.000	1.000	0.592	0.542	**
Degree of internationalization of PhD	0.842	0.364	0.000	1.000	0.775	0.726	**
University female faculty	557.9	401.5	0	1753	563.9	580.5	

Note: (1) Ho: diff = 0; Ha: diff < (>) 0. +. *. ** indicate statistical significance at the 10%. 5% and 1% levels, respectively.

4.1 First linear regression model

Table 3 shows the results of the linear regression model (1)[15].

Column 1 shows the differences in employment outcome of women with respect to men, once they have completed their PhD degree. Column 2 estimates the probability of women to have a position in academia, after their PhD. Finally, column 3 reports the results regarding students' satisfaction with their current job position.

Table 3 Linear probability model (OLS): PhD students' employment outcome and career choices

	Employment outcome	Career decision in academia	Fulfilment in their current job position
	Employed	Position in academia	Job's position satisfaction
Female	-0.0213497+	0.0144061	-0.0273031*
	[0.0115104]	[0.0157435]	[0.0108073]
Individual controls			

[15] In both the models we did not consider all those students who had not completed their PhD degree, by eliminating their answers from the database, as they are not the focus of our study.

Graduation grade	0.0029682+ [0.0016163]	0.0058377** [0.0021926]	0.0001766 [0.0015052]
No work experience	-0.0432932** [0.01158]	0.0301295 [0.0158348]	0.002742 [0.01087]
Graduate parent	-0.0020413 [0.0115767]	-0.03314 [0.0158201]	0.0031038 [0.0108599]
Articles published within 2 years (=1 if yes)	0.0005299 [0.0012244]	0.0003739 [0.0016905]	0.0007658 [0.0011604]
Supervisor's influence	0.0547617** [0.0170854]	0.0556916* [0.023428]	0.0724383** [0.0160824]
University controls			
Unemployment rate	0.0028089** [0.0030815]	0.0049074 [0.0042263]	0.0003209 [0.0029012]
Access to labour market	0.0792474** [0.011939]	0.1169291** [0.016305]	0.1298897** [0.0111927]
Degree of international experience of the PhD	-0.0263101 [0.0131436]	0.0567481** [0.0179854]	0.0287962* [0.0123462]
University faculty	-0.0000246 [0.0000506]	-0.0001463 [0.0000692]	2.17e-06 [0.0000475]
University female faculty	0.0000577 [0.0001297]	0.000364 [0.0001774]	-0.0000172 [0.0001218]
Fixed effects	Yes	Yes	Yes
University FE	Yes	Yes	Yes
SSD FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Note: +. *. ** indicate statistical significance at the 10%. 5% and 1% levels. respectively

Confirming the existing literature on the gender gap in employment outcome, after controlling for all the aforementioned controls, we find that, the coefficient of β_1 is negative and it is also statistically significant. This means that, *ceteris paribus*, after graduating from their PhD studies, women are more likely than men to be unemployed.

Regarding column 2 and therefore the second research question, we did not find a significant gender gap for the position in academia.

In column 3, instead, we find that there exists a gender gap referred to the satisfaction of the students' current job position and it is indeed statistically significant. Women are 3% less satisfied

than men in their job position. Additionally, women are less likely (6% less) to undertake a PhD in the field of engineering and architecture than in the field of humanistic studies, which is also in line with the aforementioned literature, stating that women tend to choose a career in humanistic field rather than scientific ones. This choice therefore might also reflect their current job positions. In column 1 and 2, the graduation grade has a positive and significant effect, showing that high skilled and motivated female students might have higher probability to find an occupation after their PhD and are more willing to have a position in academia.

Another interesting result concerns the job experience before starting the PhD program. As it is shown in column 1, those students who do not have a previous work experience are negatively affected when looking for a job after having completed their doctoral studies.

Moreover, in all three columns, the coefficient associated with the supervisor's influence and relationship with the PhD student, in concordance to the existing literature, turns out to be positive and significant, underlying the fact that a positive relationship between the student's supervisor and the student herself may represent an important factor that can influence the student's decision in her career, since the professor is seen as model.

As far as the university controls are concerned, the unemployment rate is negative and statistically significant in the first column, and therefore it is a factor that negatively affect students' career outcomes. On the other hand, the PhD level of accessibility to labor market is positive and statistically significant for all three columns, meaning that students, when making their decisions, really takes into consideration the labor market possibilities. The same positive effect is played by the degree of internationalization of the PhD, in column 2 and 3.

4.2 Second linear regression model: interaction

Table 3.2 shows the results the second linear regression, where we have included the interaction term between female students and the female faculty staff in the parent university.

Table 4.2 Linear probability model (OLS): PhD students' employment outcome and career choices with interaction

	Employment outcome Employed	Career decision in academia Position within academia	Fulfilment in their current job position Job's position satisfaction
Female	-0.0473628 [0.0306133]	0.0951807* [0.0418984]	0.0089501 [0.0287755]
Share female faculty same university & ssd	-0.1419483* [0.0831471]	-0.1949165+ [0.1134888]	0.1394797* [0.0779431]
Female x share female faculty same university & ssd	0.0708226 [0.0785796]	-0.2241447* [0.1070488]	-0.0996996 [0.0735202]
Individual controls			
Graduation grade	0.0029642+ [0.0016296]	0.0060453** [0.0022019]	0.0000414 [0.0015123]
No work experience	-0.0437992** [0.0116599]	0.0302734 [0.0158823]	0.0028541 [0.0109079]
Graduate parent	-0.0030855 [0.0116689]	-0.0333117 [0.0158821]	0.0025671 [0.0109077]
Articles published within 2 years (=1 if yes)	0.0003927 [0.0012482]	0.0006605 [0.0017157]	0.0008759 [0.0011783]
Supervisor's influence	0.0542381** [0.0172013]	0.0573288* [0.0234967]	0.0700519** [0.0161373]
University controls			
Unemployment rate	0.0030778 [0.0031043]	0.0048128 [0.0042408]	0.0002233 [0.0029126]
Access to labour market	0.0786833** [0.0120165]	0.1147444** [0.0163477]	0.1307683** [0.0112274]
Degree of international experience of the PhD	-0.0260166 [0.0132248]	0.0579063** [0.018028]	0.0280265* [0.0123815]
University faculty	-0.0000255 [0.0000509]	-0.0001522 [0.0000694]	5.92e-06 [0.0000476]
University female faculty	0.0000687 [0.0001306]	0.0003924 [0.000178]	-0.000032 [0.0001223]
Fixed effects	Yes	Yes	Yes
University FE	Yes	Yes	Yes
SSD FE	Yes	Yes	Yes

Year FE	Yes	Yes	Yes

Note: +. *. ** indicate statistical significance at the 10%. 5% and 1% levels. respectively

After running this model, we did not find particularly significant results supporting the role model theory. In fact, in all three the specifications, the coefficients of the interaction term (β_2) are either negative and statistically significant or positive but not statistically significant. However, regarding the employment outcome, the interaction term is positive but less precisely estimated. According to these results, therefore, the role played by a larger share of academic women does not significantly contribute to PhD female students' decisions on their career.

Regarding the individual controls, in column 1 and column 2, the graduation grade is positive and statistically significant, meaning that a higher graduation grade positively contributes to reduce the employment gender gap and to have a position in academia. Moreover, the results in column 1, show that having no work experience prior to PhD degree has a negative and statistically significant effect in perpetuating the employment outcome gap.

In all three columns, as it happened in model (1), the results show that supervisors' influence is a factor to take into consideration when considering students' decisions and satisfaction with their current job, as it is positive and statistically significant. This implies that the role of supervisor is crucially important during a PhD student degree as it influences students' career decisions. This result is even more important in this model where we added the interaction term, as it accounts, contrary to the previous one, for a larger presence of female professors who can supervise the students.

Concerning the university controls, as in model (1) we find that the access to the labor market is positive and significant in all columns. Lastly, the same happens if we consider the degree of internationalization of the PhD, which it has indeed a positive and significant effect in column 2 and 3.

4.3 Instrumental variable strategy

Table 4 presents the first stage regressions applied to the three specifications.

Table 4 IV linear model first stages:

Dependent variables:	Employment outcome		Career decision in academia		Fulfilment in their current job position	
	Employed		Position within academia		Job's position satisfaction	
	Share female Staff same University and SSD	Female x share female faculty same university and SSD	Share female Staff same University and SSD	Female x share female faculty same university and SSD	Share female Staff same University and SSD	Female x share female faculty same university and SSD
Share female staff same SSD (national level)	1.007791** [.2594626]	-.1173764 [.1852006]	0.9779833** [0.2489686]	-0.1043631 [0.1767877]	0.9779833** [0.2489686]	-0.1043631 [0.1767877]
Female x Share female staff same SSD (national level)	0.0225384 [0.0218224]	0.9829883** [0.0155765]	0.0212099 [0.0211051]	0.9854094** [0.0149863]	0.0212099 [0.0211051]	0.9854094** [0.0149863]
Individual controls	yes		yes		yes	
University and contextual control factors	yes		yes		yes	
Fixed effects	yes		yes		yes	
University FE	yes		yes		yes	
SSD FE	yes		yes		yes	
Year FE	yes		yes		yes	
P-values	0.000		0.000		0.000	

Note: +. *. ** indicate statistical significance at the 10%. 5% and 1% levels respectively

The results show that, for each specification and controlling for all the same controls used in the previous regressions, there exist a positive and significant relation between the independent variable and our instruments. Indeed, both the coefficients of the share female faculty and of the interaction term are significant. This shows the importance and relevance that our instrument play

in the regression model, as it takes into consideration the possible correlation related to the possible internal university policies and therefore it more precisely estimates the results.

Table 5 shows the regressions for the second stage (IV).

Table 5 IV linear probability model 2SLS

	Employment outcome	Career decision in academia	Fulfilment in their current job position
	Employed	Position within academia	Job's position satisfaction
Female	-0.0832063* [.0405932]	0.1439602** [0.0522052]	0.0057883 [0.0368913]
Share female faculty same university & ssd	-2.115075+ [1.187933]	1.481337 [1.560106]	-1.371278 [1.102464]
Female x Share female faculty same university & ssd	0.1713518 [0.1070399]	-0.3593059** [0.1368758]	-0.0904041 [0.0967246]
Individual controls	yes	yes	yes
University and contextual control factors	yes	yes	yes
Fixed effects			
University FE	yes	yes	yes
SSD FE	yes	yes	yes
Year FE	yes	yes	yes

Note: +. *. ** indicate statistical significance at the 10%. 5% and 1% levels. respectively

According to the results of the second stage of the instrumental strategy, for the employment outcome after the completion of the PhD (column 1), we concluded that even though the interaction term is not significative, it is more positive than in the OLS regression model. However, by including the instrument in our model, the gender gap related to the employment outcome does still exist, as you can see by the negative coefficient β_1.

Concerning the other two specifications, however, and in line with the results obtained previously, there are no significative positive effects of a larger presence of female professors in the faculty. More specifically, regarding the pursue of an academic career, a more balanced faculty would result in an increase in the gender gap related to the academia career choice.

5. Conclusions

By using the data collected from a survey of students enrolled in a PhD program in Italy between 2008 and 2014, we have analyzed the gender gap in PhD students' career choices and outcomes and how the university environment, particularly the faculty gender balance, affects students' intentions in pursuing certain careers and their employment outcomes.

Considering our initial research questions, we have indeed proved that there exists a gender gap in terms of employment outcomes and satisfaction with the PhD students' current job position.

On the other hand, the more gender-balanced environment at the parent university is not statistically significant, but nevertheless it is positive for the employment situation.

However, what the results have suggested is that the role of a supervisor or professor is always positive and significant when it comes to students' influence and relationship.

Therefore, under a policy perspective, our findings show how the university environment represent a crucial factor in shaping and mitigating students' career decisions. A strong and positive faculty environment together with favorable relationships of students and professor, may be relevant in enhancing students' career decisions and guiding female towards those careers in which they are currently underrepresented. Students may feel indeed encouraged and inspired by those mentors whom they have supporting relations with.

Finally, universities should aim at creating a stimulating university environment, because as we have seen, it would definitely help in balancing students' intentions, but it would nevertheless require to be supported by policies (such as scholarships or promoting and networking events) to encourage female students to pursue those typical male-dominated careers.

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