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(Article begins on next page)

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Just a Matter of Time? Women's Career Advancement in Neo-Liberal Academia. An Analysis of Recruitment Trends in Italian Universities

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Abstract: Recently, the Italian higher education system has experienced two profound changes: the strong feminization of its academic staff and the implementation of market-based reforms aimed at fostering cost efficiency and economic productivity. Such reforms include the reshaping of the academic career ladder envisaged by the last university reform, the so called Gelmini reform (law 240/2010), and the adoption of a performance-based funding system. Both elements occurred in parallel with a strong cut in turnover. By accessing unique data on recruitment covering the last two decades, which were provided by the Italian Ministry of Education, University, and Research's statistical office, this study aims at investigating these changes from a gendered perspective. More specifically, it firstly aims at analyzing if the feminization of the academic staff is due to an effective improvement of gender equality in recruitment or, rather, to demographic dynamics; secondly, it investigates to what extent the recent neo-liberal transformations, and more specifically the reshaping of the career structure combined with the limitations on hiring, has had any implications in terms of women's recruitment and advancement. The results suggest that the road to gender equality is extremely slow and non-linear. The introduction, with the Gelmini reform, of the new fixed-term assistant professor has tightened female access to the tenure track. Moreover, female recruitment remained substantially unchanged over the period among associate and full professors, thus suggesting that the feminization of the academic staff is not due to an effective improvement of gender equality in recruitment, but also to demographic dynamics, such as the retirement of men who are concentrated in the older cohorts.

Keywords: Neoliberal University; Italy; academic careers; recruitment; gender inequalities

1. Introduction

In the last thirty years, university systems have undergone at least two profound changes in many western countries: the growth in the female component of the academic workforce and the implementation of market-based reforms aimed at increasing cost efficiency, accountability, and performance (Connell 2015; Krüger et al. 2018). The first element is related to the growing number of women entering the profession. In Europe in 2016, for the first time in many years, a substantial gender balance was reached at the doctoral level, with women being around 48% of PhDs, according to the last European Commission's report on gender equality in science; the well-known "She Figures" (European Commission 2019). However, inequalities still persist when moving up the career ladder, with the female proportion progressively decreasing across adjacent steps, being 46% of grade C,

40% of grade B, and 24% of grade A academic staff[1] in EU28. In this regard, Italy is no exception and, in the same year, it actually slightly under-performed Europe at grade B (37%) and grade A (22%) levels (European Commission 2019).

The second element is related to the recent reforms of the academic sector inspired by the New Public Management paradigm (Krüger et al. 2018). Centered on the dual axis of autonomy (of organizations, with the shift from State control to State supervision) and accountability (via performance-based funding systems) (Musselin and Teixeira 2013), the reforms have fostered the adoption of management principles in the universities' governance and the use of performance indicators to allocate funds, while in many countries the public budget restrictions opened up the scene to new, external funding actors. In Europe, the 1980s' reforms in the UK provided the model for the rest of the continent to progressively implement such changes during the two following decades and within the common framework of the Bologna process, which has led to the creation of the European Higher Education Area. The presence of this supranational reform agenda has certainly guaranteed that the principal pillars of change were constant across countries. However, their relative weight and the time of their implementation have differed (Krüger et al. 2018).

Given this context, the transformations of the Italian higher education system occurred relatively late compared to other countries, and were particularly harsh, because governance university changes were paralleled by the growing job insecurity in the academic labor market. Since the late 2000s, because of the combined effect of the restructuring of the academic career ladder with the block of the turnover, access to the profession, and more precisely to the tenure track positions, became very difficult. This circumstance makes the Italian case interesting to study from a gendered perspective because it can shed light on the multiple, intersecting dimensions of inequality.

Put succinctly, the "neo-liberal turn" of Italian academia was characterized by at least three main drivers. The first driver is related to the increasing pression to academic organizations to focus on quality assurance in order to receive part of their governmental funding. In this regard, quantitative-based systems of evaluation of the performance of universities, departments, and researchers have been adopted in order to allocate the (limited) research funds on a competitive basis: from the four-years based Valutazione della Qualità della Ricerca (Research Quality Evaluation) (VQR) to the very first national ranking, the 2017 "Department of Excellence" ranking.

The second one is related to the last university reforms, and more specifically to the Gelmini reform (law 240/2010), which has, *inter alia*, reshaped the first stages of the academic career by replacing the former permanent contract of the assistant professor (the so called Ricercatore Unico (RU)) with two new types of short-term contracts: an A type "Ricercatore a tempo determinato di tipo A" (RTDa), which can be considered a "junior" assistant professor, and a B type "Ricercatore a tempo determinato di tipo B" (RTDb), which can be considered a senior assistant professor[2].

The third driver concerns the cuts of the funds for higher education, both in terms of a decrease in the public, national-based research grants (e.g., the Research Projects of National Interest (PRINs)) and in terms of a ten-year block of the turnover of the tenured workforce. The former has entailed the promotion of a market-based culture where academics are encouraged to look for external grants, for example, European and private grants, in order to finance their research activities. The latter prevented universities, from 2007 to 2017, from fully replacing the professors who were retiring with an equal number of new, younger tenure-track academics.

1　The report uses the Organisation for Economic Co-operation and Development (OECD)'s definition of the academic hierarchy where the grade C include both postdocs and assistant professors, the grade B corresponds to associate professors, and the grade A to full professors.

2　Of the two types of contracts, the B type is a "quasi" "tenured" position because, once the contract is ended, and if the candidate has obtained the National Scientific Qualification (Abilitazione Scientifica Nazionale (ASN)), it automatically turns into an associate professor position. The ASN was introduced by the Gelmini reform and it represents a minimum standard quality requirement for the recruitment of associate and full professors. It is granted by a national committee on the basis of the candidate curriculum (law 240/2020, art. 16).

The combination of performance-based evaluations with the growing need of looking for external funds had the effect of pushing Italian universities towards a neo-liberal model of knowledge production, based on economic productivity, entrepreneurship, and competition. On the other hand, the precarization of the assistant professor position, coupled with cuts in the turnover, led to a reduction in stable positions (−15.6% from 2008 to 2018, including RTDs) and to a parallel increase in precarious contracts: (+16.7% was the increase of post-doc contracts in the same period)[3]. Given the particular structure of the Italian academic career—which is characterized by a long period of post-doc contracts (or other non-stable contracts) between the end of the Ph.D. and the possible appointment as assistant professor—the combination of these two elements is likely to have extended the time of precarity for young researchers.

Some recent contributions (Gaiaschi et al. 2018; Picardi 2019) suggest that these transformations have entailed some "gender implications", such as an increase in the adverse selection for women in the early stages of their career ladder and, more particularly, in access to tenure track positions. On the other hand, data on the gender distribution of men and women working in Academia point to an amelioration of the female representation in the final ranks of the career ladder, both in Italy and in Europe (European Commission 2019).

However, all these contributions are based on the *stock* of men and women across the career ladder; that is the number of female and male academics by year and position[4]. As such, they are affected by both demographic dynamics (the over-representation of men in the oldest cohorts) and by the transitions from one rank to another. This is particularly problematic, especially when the growth of the female proportion along the career ladder—and even more so among associate and full professors—is taken, as it often is, as an "amelioration" of women's opportunities of career advancement in academia. The underlying assumption of such interpretation is to think that gender inequalities are only "a matter of time", depending on the number of women entering academia and, within academia, the different scientific fields, including the traditionally male dominated Science, Technology, Engineering, and Mathematics (STEMM[5]) fields: Once women have reached a critical mass in the early phases of the career, such balance will be likely to be reproduced in the following steps. However, *stock* data cannot say whether the growth in the female component of the staff across the hierarchy is due to higher opportunities for women or not. In order to precisely understand if an amelioration, in terms of gender equality, is occurring, data on *recruitment* are needed; that is the number of female and male academics *recruited* by year and position. These data were used a few years ago by Rossi (2015, 2016). However, these works do not cover the most recent years, the ones following the last university reform. An update of recruitment trends is needed.

This study is based on stock and recruitment data on the Italian academic population from 2000 to 2018, which were provided by the Ministry of Education, University, and Research (MIUR)'s statistical office. By analyzing changes in the gender composition across ranks and fields over time, it aims at investigating two different aspects. First, to investigate the relationship between feminization and gender equality, that is to understand to what extent the feminization of the academic profession is due to an effective improvement in recruitment and/or to demographic dynamics such as, for example, the retirement of older—male-dominated—cohorts. Second, to understand the gender implications of recent university transformations, and more specifically of the increasing precariousness of early-career phases and the reduction of turnover. The analyses will also be carried on by distinguishing the

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[3]　MIUR data, authors' elaboration.

[4]　Data on the stock are publicly available on the following institutional links: http://ustat.miur.it/ and https://cercauniversita.cineca.it/php5/docenti/cerca.php.

[5]　There are several acronyms to describe the tecno-scientific fields in the public debate. The most known is certainly the acronym STEM (Science, Technology, Engineering, and Mathematics). Another, more recent, expression is STEMM, which includes medicine as well (Froschauer 2016). We have preferred to use this second acronym given that medicine has many elements in common with other STEM disciplines, that is a stunning feminization in the early cohorts (consistently with other life sciences) and an equally impressive leaky pipeline across the ladder.

different scientific fields in order to understand to which extent gender dynamics differ or do not differ across disciplines.

2. Gender Inequalities in Academic Careers: An Overview of the Existing Literature

Gender inequalities in academic and scientific careers are the object of extensive international literature that is focused on two major issues: the uneven gender distribution across scientific fields (horizontal segregation) and across different career steps (vertical segregation)[6]. The first issue deals with women's underrepresentation in the traditionally male-dominated STEMM fields, and therefore with their *access* to techno-scientific careers. The second issue is concerned with women's underrepresentation in the upper ranks of the hierarchy, and therefore with their career *advancement*. With respect to this second issue, two different aspects are of great importance to understand how it works and how to tackle it: "where" obstacles in the career advancements occur and "why" do they happen.

The first aspect is related to the positioning of female disadvantages across the different ranks of the hierarchy. Several metaphors are used in this respect in the literature: the "glass ceiling", the "sticky floors", the "leaky pipeline", and, less frequently, the "middle-level bottleneck". The "glass ceiling" refers to the existence of an invisible barrier preventing women from reaching the top positions in the hierarchy and in the organization (European Commission 1998). In its strict definition, it suggests that obstacles to women's promotion are placed at the end of the career ladder. In its broader sense, it suggests that they are stronger in the final than in the previous ranks (for the two definitions see: Baxter and Wright 2000). In both cases, it underlies the idea that the top positions are the ones where the gender disadvantage occurs (or mostly occurs). In this vein, many contributions on the academic labor market have focused on the obstacles preventing women from reaching the very end of the hierarchy; that is, to become full professors (Van den Brink and Benschop 2012; Marini and Meschitti 2018). Contrary to the idea that obstacles are concentrated at the end of the career ladder, the (more recent) metaphors of the "sticky floors" (Booth et al. 2003) and "middle-level bottleneck" (Yap and Konrad 2009) suggest that gender obstacles are concentrated also—and respectively—at the beginning and in the intermediate ranks of the hierarchy, and not only at the end, as the notion of "glass ceiling" may suggest. Both metaphors are associated with the idea of the "leaky pipeline": If obstacles persist from the early steps and up to the middle levels of the ladder, the career trajectory should be considered as a pipeline "leaking" female talents through all the ranks. Often used to described women's drop-out in academia and science, the "leaky pipeline" metaphor (Alper 1993) emphasizes the idea that women's low presence in the top positions is the result of disadvantages "piling up" since the very beginning of the career ladder (Zuckerman and Cole 1975; Valian 1998) due to their smaller probability of promotion (Filandri and Pasqua 2019) but also because they are more likely to exit Academia (Le Feuvre et al. 2019). In this perspective, many scholars have recently shifted their attention to the very early phases of the academic career track, including precarious and temporary positions (Gaughan and Robin 2004; Bozzon et al. 2017a; Murgia and Poggio 2018). However, the same attention has not been paid to the intermediate steps, which in most western countries coincide with the position of the associate professor. This paper aims to fill this gap by introducing a new segregation index focused on this specific phase of the academic career trajectory.

Parallel to the variation of the female gap in promotion along the hierarchy, a second important issue is related to its explanations. The contributions on this issue are extremely heterogeneous and suggest how these explanations are essentially *multi-dimensional*; being the gender gap the combined

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6　The first concept refers, in the study of the general labor market, to the different concentrations of men and women across occupations and sectors. Applied to the academic labor market, it denotes the different gender distributions across the scientific fields. The second concept refers to the different concentrations of women and men in particular grades and levels of responsibility (see: European Commission 1998; Bettio and Verashchagina 2009).

result of factors playing at different levels and, more specifically at micro, meso, and macro levels (Bozzon et al. 2017b; Solera and Musumeci 2017).

The micro level includes individual factors, both on the supply-side and the demand-side. Supply-side factors concern the workforce and the differences in characteristics between female and male academics; for example, the difference in care responsibilities (see, for example: Sax et al. 2002; Fox 2005; Heijstra et al. 2015) and in scientific productivity (Abramo et al. 2009; D'Amico et al. 2011; Van Arensbergen et al. 2012). Demand-side factors regard the recruiters and gender discrimination, occurring when equivalent men and women are differently evaluated in the selection processes (Bagues et al. 2017; Valian 1998).

The meso level is related to organizational and professional factors, such as the exclusion from masculine networks (Van den Brink and Benschop 2012; Falcinelli and Guglielmi 2014), the gender differences in funds and resources (Ceci and Williams 2011), and the persistence of "gender practices" (Poggio 2006) at the base of the construction and evaluation of academic excellence, which systematically generate disadvantages for women (Van den Brink and Benschop 2011, 2012; Zippel 2017).

Finally, the macro level refers to the broader institutional contexts, which include social, labor, and gender equality policies. Within the specific debate on women and Academia, many scholars have focused on the recent neo-liberal reforms of university systems, with many arguing that the new market-based culture is likely to increase existing gender inequalities as long as it fosters individual competition and promotes a gender-blind idea of "excellence" (Riegraf et al. 2010; Rees 2011; Van den Brink and Benschop 2012; Ferree and Zippel 2015; Murgia and Poggio 2018). Others are less clear-cut while recalling how the old university model entailed masculine elites preventing women's advancement in academia (Ferree and Zippel 2015). Whether the recent, market-driven university transformations have negative or positive effects in terms of female recruitment is one of the objectives of this study.

Drawing from this reach literature, this study investigates the variation of the female disadvantage in career advancement and how it has changed across time, with the aim of understanding if an amelioration of women's opportunities has occurred in the period considered and "where" across the career ladder. At the same time, it focuses on the recent reforms of the Italian higher education systems by investigating whether they have affected women's disadvantage, thus shedding light on one "macro" explanation of inequalities ("why"). In order to do so, unique data on recruitment, by gender and across time, will be used in combination with data on the stock. The use of time-series, cross-sectional data on recruitment will allow us to better understand if the growing presence of women in the academic work force corresponds to a real amelioration in the female access to the profession and in career advancement, while grasping the implications of institutional changes on career trajectories.

3. Research Questions, Data, and Methods

This article addresses two main research questions. First, it aims to explore the reasons for the process of feminization of academic Italian staff, which is observable at the *stock* level in the last two decades. More specifically, two different hypothesis will be tested: (1) The feminization is due to an effective improvement of gender equality in *recruitment*, or to (2) demographic dynamics, such as the retirement of men who are concentrated in the older cohorts.

Second, our study aims to analyze the gender implications of the recent neo-liberal reforms of the Italian university system. In this respect, our hypothesis is that the reshaping of the career ladder fostered by the 2010 Gelmini reform, combined with the 2007–2017 limitations in turnover, have decreased women's recruitment at the level of assistant professor, thus tightening their access to tenure track positions.

The analysis is based on data provided by the MIUR's statistical office on the number of researchers and professors currently on the job (*stock*) and the number of researchers and professors *recruited* as at December 31 of each year of the period 2000–2018 by gender, rank, and scientific field in Italian public

and private universities. The ranks include: the post-docs (assegnista di ricerca (AR)), the pre-reform assistant professors (ricercatore unico (RU)), the A-type post-reform assistant professor (ricercatore a tempo determinato di tipo A (RTDa)), the B-type post-reform assistant professor (ricercatore a tempo determinato di tipo B (RTDb)), the associate professor (professore associate (PA)), and the full professor (professore ordinari (PO)). The scientific fields correspond to the 14 fields identified by the National University Council (Consiglio Universitario Nazionale (CUN)), which regulates the public selections of researchers and professors[7].

Data were analyzed using descriptive statistics, including frequency distributions, cross-tables, and segregation indexes, including the glass ceiling index (European Commission 2019), the glass door index (Picardi 2019), and a new index that we propose: the bottleneck index. The Glass Ceiling Index (GCI) (European Commission 2019) is internationally used to measure the under-representation in the top positions of the academic career ladders; that is, among full professors. In the She Figures report, the European Commission defines the GCI as the ratio between the proportion of women in grades A, B, and C of the academic career in a given year [PW (a + b + c), Y] and the proportion of women in grade A in the same year [PW (a), y] (European Commission 2019). The grade A corresponds to the full professor and grade B to the associate professor (European Commission 2019). On the contrary, the definitions of grade C change from country to country, thus implying difficulties—recognized by the Commission itself—of cross-country comparisons. According to the Organisation for Economic Co-operation and Development (OECD)'s definition (OECD 2015), which is used in the She Figures report, grade C includes both assistant professors and post-docs. According to the MIUR definition, which is the definition that it is adopted in this work, grade C includes only assistant professors (the pre-reform RU and the post-reform RTDb and RTDa), while the post-doc are included in grade D (if the MIUR definition is adopted, the GCI equation changes as it coherently reports, in the nominator, grade D as well).

Paralleling the growing interest, within the debate on gender and academia, towards the early career phases, an additional index has recently been proposed, the Glass Door Index (GDI) (Picardi 2019), measuring the under-representation of women in accessing grade C. In the definition proposed by Picardi, grade C is even stricter as it includes only tenure track positions; that is, the RU for the years before the reform and the RTDb for the years after the reform. The reason for including only RTDb in the index in the years after the reform is the fact that it can be considered, if not formally at least *de facto*, a tenure position. In this vein, the RTDa is included in the broader "non-tenure" grade D.

The GCI and the GDI measure the obstacles that women experience, respectively, at the end and at the beginning of the hierarchy; that is, when they become a full professor (GCI) and when they become an assistant professor (GDI). In order to analyze the female disadvantage at the middle of the career ladder; that is, when they become associate professors, and taking inspiration from the metaphor of the "middle-level bottleneck" used in managerial studies (Yap and Konrad 2009), we will propose a new index: the Glass Bottleneck Index (GBI).

The three indexes have been computed with the aim of measuring women's disadvantage in career advancement across *adjacent* steps. The GCI computed in our work is a variation of the traditional index used in the She Figures report (European Commission 2019), where the female under-representation among the full professors is measured in comparison with the *sum* of all the previous steps of the ladder. As such, the traditional GCI measures the *cumulative* female disadvantage to reach the final rank of the career ladder. On the contrary, in our work, the GCI is computed by measuring the *adjacent* female disadvantage from B (associate professors) to A (full professors), exclusively. Contrary to the European Commission's ratio, its nominator includes only grades A and B and it therefore excludes grade C. Likewise, the GBI measures the adjacent female loss in the transition from grade C (assistant professors)

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7   Each Italian academic belongs to one of the fourteen CUN scientific areas. For the complete list, see the link: https://www.cun.it/uploads/storico/settori_scientifico_disciplinari_english.pdf.

to grade B (associate professors), while the GDI focuses on the transition from grade D (post-docs) to grade C. In this case, grade C includes the RU for the pre-reform years and—coherently with the MIUR definition of grade C adopted in this work—both the RTDa and RTDb for the post-reform years.

Below are the formulas of the three indexes:

$$\text{GCI} = \frac{\text{PW (a + b); Y}}{\text{PW (a), Y}} \quad \text{GBI} = \frac{\text{PW (b + c); Y}}{\text{PW (b), Y}} \quad \text{GDI} = \frac{\text{PW (c + d); Y}}{\text{PW (c), Y}}$$

An index greater than one indicates that women are under-represented among full (in the case of GCI), associate (in the case of GBI), or assistant (in the case of GDI) professors. The higher the index, the stronger the disadvantage. The indexes are calculated on both stock data and recruitment data and for each year of the nineteen years considered in this work. This will allow us to see the changes in the female disadvantage across the career ladder and across time.

In order to address the two abovementioned research questions, the article is structured as follows. Section 4 analyzes the gender distribution of stock-based data on Italian academics in 2000–2018. Section 5 analyzes recruitment trends across time, with the aim of investigating if a real amelioration of women's opportunities is occurring in career advancement. Section 6 addresses the two research questions by using the vertical segregation indexes. Section 7 will re-run the analysis by scientific field in order to explore the mechanisms of the horizontal segregation and how they are intertwined with the vertical segregation. In Section 8, the results of our analysis are discussed.

4. Women and Men in the Italian Academia: A *Stock*-Based Analysis

Italian universities have experienced a strong process of feminization in the period considered, with women being around 41% in 2018 against 31% in 2000. However, this growth was not homogeneous across the different levels of the career ladder. Figure 1 shows the gender distribution, in percentage points, across the hierarchy, comparing the years 2008 and 2018; that is, before and after the 2010 university reform. The figures suggests the persistence of a leaky pipeline progressively loosing women all along the different levels of the ladder, from a substantial gender balance at the beginning of the academic career; that is, among the post-docs[8], to their under-representation at the end, among the full professors[9].

However, looking at the changes in time, an amelioration of the female proportion among associate professors (where it increases from 34% in 2008 to 38% in 2018) and among full professors (from 19% to 24%) has occurred in the ten years considered. On the other hand, a one percentage point loss is reported with respect to the post-docs (but this loss widens to more than two percentage points if compared to the year 2000), while a stronger deterioration of the female proportion is apparent among assistant professors. In order to see if a change, in the stock, has occurred after the reform at this level of the hierarchy, the figure compares the female percentage of the pre-reform assistant professor in 2008 (RU) with the post-reform assistant professor in 2018 (RTDa and RTDb)[10]: In ten years, the female percentage at this level of the career ladder has decreased from 45.7% to 42.8%. If only the RTDb are considered in 2018, the female percentage decreases further to 41.5%, thus suggesting that the deterioration is stronger when only the "quasi-tenured" post-reform assistant professors are included.

8　Post-docs represent only a part of non-stable contracts, which also include occasional collaborators, adjoint professors, etc. The recruitment-based data we had access to include only the post-docs.

9　The gender and the rank are not randomly distributed in the observed population. A chi-squared test has been run on the 2018 data and the results indicate that the two variables are not statistically independent (*p* value = 0.000).

10　In order to better measure the change after the university reform at the level of assistant professors, RU were not included among the 2018 data. The reason why they have been excluded is the fact that, after 2013, very few RUs have been recruited (53 in 2013, 19 in 2014 and 2015, and so on) as long as this specific contract was progressively substituted by the new RTDs. With the downturn of recruitment of RUs, the percentage of women recruited in this specific position has strongly increased, much beyond its historical trend. Including them would have biased the results, even more so if the aim of the analysis is to understand the implications of the substitution of the former open-ended contract with the new fixed-term contract at the level of the assistant professor.
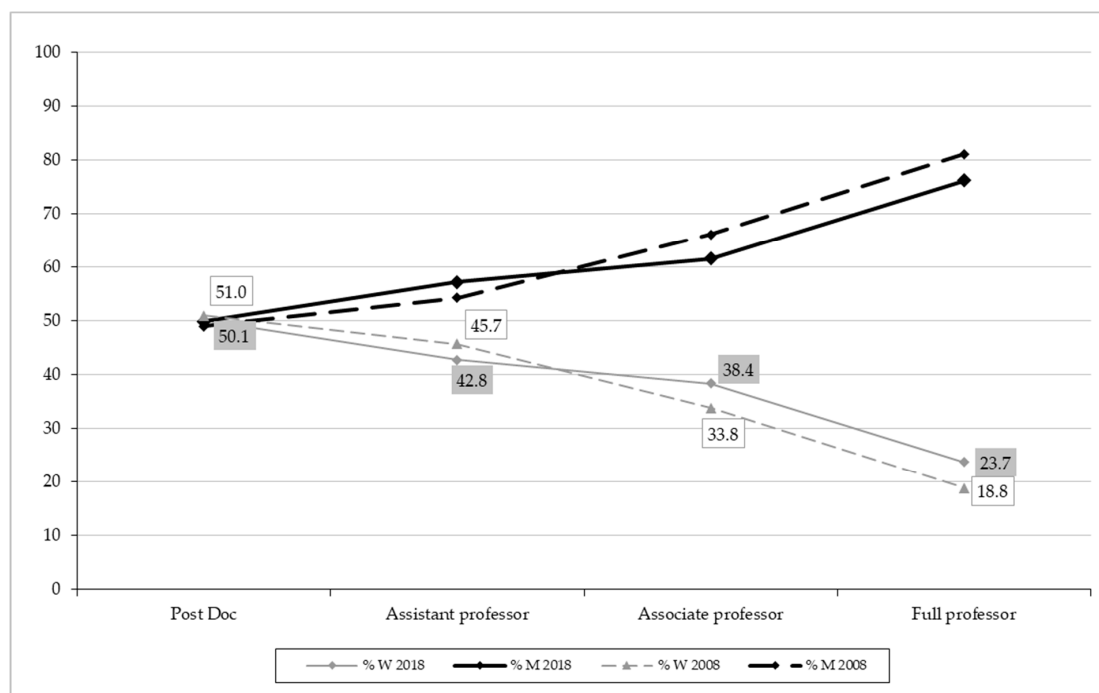
Figure 1. Academic staff by gender and rank, Italy, 2008 and 2018, stock. *Source*: Authors' elaboration on Ministry of Education, University, and Research (MIUR) data.

Measuring the percentage variation of academics across adjacent levels of the hierarchy provides a further element to understand the changes in the pipeline after the university reform. Table 1 shows how many individuals—men and women together and taken separately—are lost or gained from a rank to the following one of the academic career. For both genders, a strong improvement has occurred in the transition from the assistant to the associate professor in the ten years considered, paralleling a worsening in the previous step; that is, in the transition from the post-doc to the assistant professor. More specifically, if, in 2008, the greatest obstacle, for men and women, was positioned in the transition between the assistant and the associate professors (male associates were 12% less than male assistant professors and female associates were 46.5% less than female assistant professors), ten years after this same step appears much less problematic: Male associates are 21% more than male assistant professors and female associates professors are "only" 16% less than female assistant professors. At the same time, access to the previous career rank has become stricter: if, in 2008, male assistant professors were 131.5% more than male postdocs and female assistant professors were 87% more than female post-docs, ten years after, the change is negative for both: −54% for women, −38% for men. In both cases, women are those who—both in the transition from the post-doc to the assistant professor and in the transition from the assistant to the associate professor—register—today as yesterday—the greatest disadvantage (or the minor advantage). The "tightening" of the transition between adjacent ranks also concerns the last level of the career ladder: Male full professors were 27% more than male associate professors in 2008; they are now 21% less, while female full professors were 42% less than female associates in 2008 and they are now 61% less.

Table 1. Step by step % variation in the academic career by gender, Italy, 2008 and 2018.

	2018		2008	
	Women	**Men**	**Women**	**Men**
Assistant professor *-post doc	−53.7	−38.0	87.3	131.5
Associate professor-assistant professor **	−15.7	20.6	−46.5	−12.0
Full professor-associate professor	−60.8	−21.4	−42.3	27.2

*Note: * Post-reform assistant professor (ricercatore a tempo determinato di tipo) (RTD) (a + b) in 2018; pre-reform assistant professors (ricercatore unico) (RU) in 2008. ** RTD + RU in 2018; RU in 2008. Source*: Authors' elaboration on Ministry of Education, University, and Research (MIUR) data.

Up to now, data suggest a deterioration for women in the access to tenure-track positions, with a decrease of the female proportion among the assistant professors, and a parallel amelioration in the two last steps of the ladder; that is, among associate and full professors. However, these findings are based on the stock of men and women in each rank of the ladder. As such, they are biased both by the transitions from step to step (e.g., the variation of group A's proportion in one specific step may partly depend to the variation of group B's proportion in the previous or following step) and by demographic dynamics (e.g., the retirement of individuals in older cohorts, mostly men). In order to have more precise results, data on recruitment are needed.

5. The Growing Presence of Women in Academia: An Analysis of Recruitment Trends over Time

In the period 2000–2018, the number of women in the academic staff (stock) has increased by +57.4% (+37.5% if post-docs are not included in the computation). Considering the recruitments only, the increase of women was much smaller: +28.9% if the post-doc are included, +17.9% if they are not.

Figure 2 reports the female proportion among recruitments (dotted line) and among the stock (full line), in percentage terms, by year and rank. To make the chart readable, the lines related to the pre-reform assistant professor (RU) stop in 2012: In 2013, recruitments in this type of contract drastically dropped (−90% compared to the previous years) and progressively fell short (up to only 1 individual recruited in 2018). Always for the sake of simplicity, only the recruit (dotted) lines are shown with respect to the RTDa and RTDb positions, whose entry into the academic labor market started in 2011. The lines appear quite fluctuating, especially in the very first years, where the number of people recruited with this type of contract was still quite low. For these two positions, the trend of the stock and the trend of the recruitments are in any case very similar, having both contracts only recently being introduced. For all ranks, the dotted line "above" the full line indicates that the proportion of female recruits is greater than the proportion of women in the stock in a given position. On the contrary, if the dotted line is below the full line, this means that the proportion of female recruits is lower than the proportion of women in the stock.

Looking at the dotted (recruits) lines, a steady decrease in the female proportion of post-docs is reported, with women being 52.5% of the post-docs in 2000 and 47.5% in 2018; a decrease of five percentage points, higher than the one reported in the stock (nearly more than two percentage points). As already mentioned, the female proportion among pre-reform assistant professors (RU) has steadily increased since 2013, when the drop of this type of contract started. At the level of associate professor (PA), the figure shows a fluctuating trend, with a slight growth of women up to the pick of 2009 (when they were 41.9%), followed by a progressive decrease until 2013 (30.8%) and a further recovery up to 2018 (41%). The interesting element is the comparison between the lines of associate and assistant professor female recruits: Before the introduction of the post-reform RTD, the two lines were well separated, with the recruitment rate of female associates being clearly lower than that of the female pre-reform RUs. With the arrival of the RTD, the two lines tend to overlap, suggesting similar percentages of female recruitment. Finally, the recruitment trends of full professors look to be rather fluctuating as well. After a minimum of 17% in 2009, the female percentage progressively increased to readjust to nearly 30%. In the whole period considered, the share of women recruited at this level never exceeded a third of the total number of full professors.
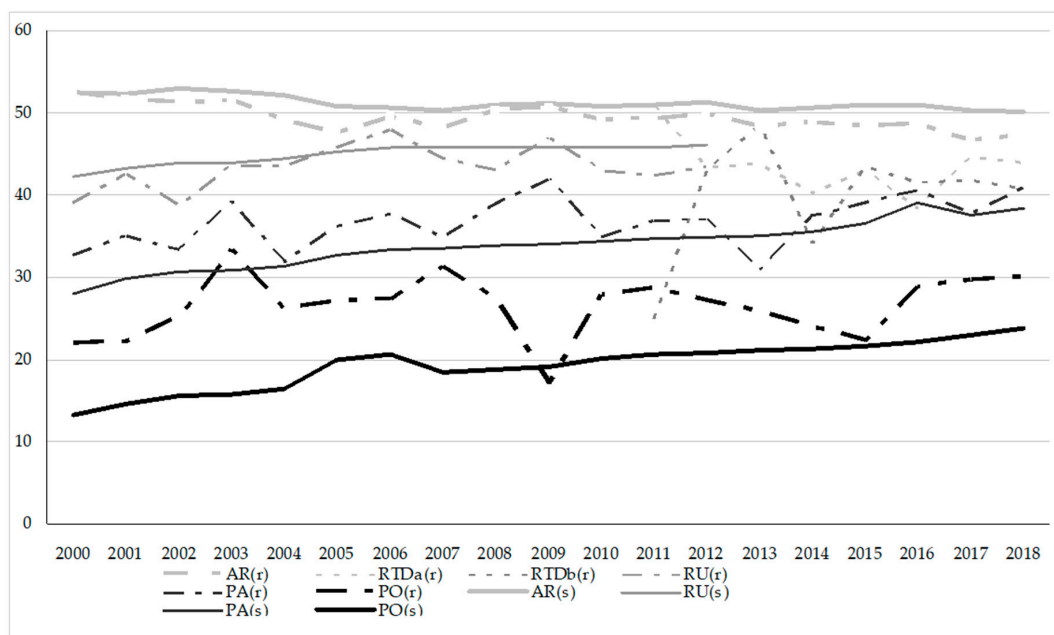
Figure 2. Female % by year and rank, 2000–2018, Italy: stock vs. recruited. *Note:* AR: (assegnisti di ricerca) Post Doc; RTDa: A-type post-reform assistant professor; RTDb: B-type post-reform assistant professor; RU: pre-reform assistant professor; PA: Associate professor; PO: full professor. *Source*: Authors' elaboration on the Ministry of Education, University, and Research (MIUR)'s statistical office.

When comparing dotted and full lines of associate and full female professors, the figure indicates a percentage of women recruited that is almost always higher than the one in the stock. Moreover, a substantial alignment is apparent, in the post-reform years, between the lines (dotted and continuous) concerning female associate professors and the line concerning female RTDs, especially RTDb. On the other hand, at the level of the post-docs, the recruitment line is almost always lower than the stock line, while the two lines at the level of RUs appear quite consistent.

In summary, the figure sheds light on three main elements. First, there is a progressive, albeit subtle, reversal trend at the level of the post-docs, with a decrease in recruitment for women over the years that is reflected in a slight decrease in the stock, which translates, today, into a perfect gender distribution in the stock. Second, with the introduction of the post-reform assistant professor, a worsening in the recruitment trend occurs at this level of the career, especially among the quasi tenure RTDb. Third, the recruitment of female associate and full professors is, at first sight, substantially constant. However, female recruitment rates are clearly higher than the percentage of women in the two groups.

Table 2 shows the average proportions of women recruited and in the stock from 2000 to 2018, overall and breaking up into two sub-periods (2000–2008 and 2009–2018). With respect to the assistant professor, it is interesting to compare the current, average proportion of the female recruits among the RTDs with the average proportion of the female recruits among the RUs before the reform, in the sub-period 2000–2009, when it was equal to 43.2%, a percentage that is consistent with the RTDa (43.5%) but not with the RTDb, which is much lower (39.7%).

Table 2. Recruitment vs. stock, female %, Mean, Italy.

2000–2018	Mean r	Mean s	2000–2008	Mean r	Mean s	2009–2018	Mean r	Mean s
AR	49.4	51.2	AR	50.1	51.7	AR	48.7	50.7
RTDa (11–18)	43.5	43.9				RTDa (11–18)	43.5	43.9
RTDb (11–18)	39.7	37.7				RTDb (11–18)	39.7	37.7
RU	44.0	45.9	RU	43.2	44.5	RU	44.8	47.2
PA	36.7	33.9	PA	35.5	31.6	PA	37.7	36.0
PO	26.5	19.3	PO	26.9	17.1	PO	26.1	21.4

Source: Authors' elaboration on Ministry of Education, University, and Research (MIUR) data.

Considering associate and full professors, the recruitment rate (36.7% and 26.5%, respectively) is higher than the stock rate (33.9% and 19.3%) over the entire period, 2000–2018. The analysis by sub-periods indicates that there has been an improvement in recruitment at the level of associate professors in recent years, but this improvement is concentrated uniquely in the years following the implementation of the university reform. The average of the female recruits among associate professors from 2009 to 2013 is in fact equal to 36.3%, while it is much higher in the years 2014–2018 (39.2%) (analysis not included in the table, available upon request). Among the full professors, there is even a slight deterioration of the female proportion (26.9% being the average in the period 2000–2008, 26.1% in the subsequent sub-period). By excluding 2009 in the second sub-period, which recorded the lowest level of female recruits, the rate of women recruited among full professors rose to 27.1%, which is in any case consistent with the rate of the previous period, thus suggesting a stable trend in recruitment.

In summary, the analysis on associate and full professors indicates that the recruitment rates are higher than the stock rates. On the other hand, the analysis also indicates that female recruitments are constant in the period 2000–2018, except for a slight amelioration at the associate level in the last five years; that is, after the university reform.

6. Measuring the Leaky Pipeline with the Vertical Segregation Indexes: The GCI, GBI, and GDI

A more precise way to measure the variation of the leaky pipeline across the ladder and across time is to use the vertical segregation indexes.

In order to do so, the glass ceiling index (GCI; European Commission 2019), the glass door index (GDI; Picardi 2019), and the new glass bottleneck index (GBI) have been computed on both stock data and recruitment data for each year. The results are reported in Table 3. With respect to the GDI, the index from 2000 to 2010 includes only the pre-reform RU (grade C) and the indexes from 2012 include only the post-reform RTDs. Because of the low number of new post-reform contracts recruited in 2011, the formula for the year 2011 includes both the RU and the RTD (a and b).

Table 3. Glass Ceiling Index (GCI), Glass Bottleneck Index (GBI), and Glass Door Index (GDI).

	STOCK			**RECRUITMENTS**		
	GCI	**GBI**	**GDI**	**GCI**	**GBI**	**GDI**
2000	1.59	1.27	1.05	1.22	1.09	1.22
2001	1.54	1.24	1.06	1.34	1.11	1.11
2002	1.49	1.22	1.06	1.20	1.05	1.24
2003	1.48	1.21	1.07	1.10	1.04	1.18
2004	1.46	1.22	1.06	1.14	1.24	1.08
2005	1.31	1.21	1.04	1.21	1.14	1.02
2006	1.30	1.20	1.03	1.23	1.16	1.02
2007	1.40	1.20	1.03	1.06	1.19	1.06
2008	1.39	1.20	1.04	1.25	1.10	1.10
2009	1.39	1.20	1.04	1.79	1.11	1.07
2010	1.37	1.20	1.04	1.18	1.14	1.12
2011	1.35	1.19	1.04	1.18	1.10	1.11
2012	1.35	1.19	1.18	1.23	1.13	1.12
2013	1.35	1.19	1.14	1.12	1.35	1.08
2014	1.38	1.18	1.16	1.51	1.02	1.20
2015	1.42	1.15	1.16	1.66	1.02	1.10
2016	1.46	1.10	1.16	1.23	0.99	1.17
2017	1.38	1.13	1.13	1.17	1.08	1.04
2018	1.38	1.11	1.11	1.24	1.02	1.07

Source: Authors' elaboration on Ministry of Education, University, and Research (MIUR) data.

Looking at stock-based indexes in Table 3, the results point to four important elements: First, there has been an improvement—in terms of gender equality—among the full (GCI) and associate (GBI) professors. Second, a worsening of the GDI in the years after the reform, from 2012 on, has occurred

instead. Third, the transition to full professor remains the most difficult for women, given that the GCI is higher than the two remaining indexes. Fourth, in the years before the reform, the GBI was higher than the GDI, suggesting that the disadvantage in the transition to associate professorship was stronger than the one related to the access to the level of assistant professor. In the years after the reforms, the two indexes show the same value, thus confirming the "convergence"—in the most recent years—of the share of women among assistant and associate professors, as the narrowing of the related lines in Figure 2 has already shown.

By comparing stock and recruitments data, one can see that the recruitment-based GCI and GBI are lower than the same stock-based indexes, thus confirming that the female recruitment rate is higher than the share of women in the respective groups. On the contrary, the recruitment-based GDI is consistent with the one computed on the stock in the post-reform phase (as it is too soon for a variance to be created) while it is worse than the stock-based one in the pre-reform phase, suggesting that the growth of women in the years before the reform was also due to the greater numbers of male transitions from RU to associate professor. Furthermore, while the stock-based indexes improve over time, those calculated on recruitment show a substantially constant—though fluctuating—trend, except for the GCI and the GDI after the reform, with the former improving and the latter worsening up until a late recovery in 2017 and 2018. Improvement and worsening translate into a sort of "convergence" of recruitment, with the GBI index reaching parity in 2018, indicating that the proportion of female recruits among associates is equal to the proportion of female recruits among assistant professors, and, thus, that the reform has anticipated the adverse selection for women from the level of associate professor to the level of assistant professor.

7. The Horizontal Segregation: Feminization and Leaky Pipeline across Scientific Fields

Women's entry into professions and occupations that were once male dominated is gradually leading to phenomena of de-segregation (Reskin and Roos 1990; Jacobs 1999). This also applies within the academic sphere, where women have recently entered into traditionally male scientific fields (European Commission 2019). This section focuses on the issue of horizontal segregation by analyzing the gender distribution across the 14 CUN fields, its changes over time, and its intertwining with vertical segregation.

First of all, what are the scientific fields where feminization is the strongest? Considering at the proportion of women by field based on the stock, in 2018, the field of Biological sciences shows the highest female proportion in the academic staff without distinguishing by rank (PO, PA, RU, etc.) (57.1%), followed by the Philological-literary and historical-artistic sciences (55.1%)—the only two scientific fields with a female majority—and the Chemical sciences, which is perfectly gender balanced (49.9%). On the other hand, Mathematics and informatics, the Physical sciences, and Industrial Engineering and Information show the lowest female proportions (respectively, 31.2%, 23.2%, and 21.7%). There is a clear distinction, within the STEMM fields, between hard sciences (the Physical sciences, Mathematics and informatics, Engineering) and life sciences (the Biological sciences, and the Chemical sciences, but also the Medical sciences), with the former being the least feminized and the latter among the more feminized, together with the humanities.

Table 4 shows the percentage variation of women in terms of stock and recruitments between 2000 and 2018. The number of women in the academic staff increased in all the fields except in Philological-literary and historical-artistic sciences and in Mathematics and informatics. The largest increase was recorded in Industrial and information engineering, with three times the number of women in 2018 compared to 2000. The number of women doubled in Economics and statistics and in Civil engineering and architecture; it also remarkably increased in Political and social sciences (+90.8%) and in the Medical sciences (+82.9%). Of course, the percentage variations are affected by the "starting base" (the fields characterized by an initial low level of "feminization" in 2000 have registered the greater percentage growth in 2018) and by female recruitments among the post-docs, which are the largest—and most feminized—"group". In all the fields except in the Physical sciences, the increase in

the number of women was much greater for the stock than for recruitments. Four fields registered a reduction of recruited women: Law, the Earth Sciences, the Philological-literary and historical-artistic sciences, and Mathematics and informatics.

Table 4. Female % variation by scientific fields 2000–2018, stock and recruited.

	Stock	Recruitments
SD09 Industrial and information engineering	+353.4	+247.3
SD13 Economics and statistics	+104.9	+21.3
SD08 Civil engineering and architecture	+103.1	+92.4
SD14 Political and social sciences	+90.8	+21.6
SD06 Medical sciences	+82.9	+77.6
SD07 Agriculture and veterinary	+78.5	+5.5
SD12 Law	+67.8	−9.1
SD03 Chemical sciences	+47.1	+7.2
SD05 Biological sciences	+44.2	+5.8
SD02 Physical sciences	+43.7	+47.3
SD11 History, philosophy, pedagogy and psychology	+41.5	+16.1
SD04 Earth sciences	+19	−16.9
SD10 Philological-literary and historical-artistic sciences	−2.2	−1.3
SD01 Mathematics and informatics	−9.4	−8.6

Source: Authors' elaboration on Ministry of Education, University, and Research (MIUR) data.

The contribution of female post-docs on the feminization of some scientific fields is apparent when intersecting vertical and horizontal segregation. In this respect, Table 5 reports the female percentage by rank and scientific field.

Table 5. Female % by rank and scientific field, stock, Italy, 2018.

	AR	RTDa	RTDb	RU	PA	PO
SD01 Mathematics and informatics	26.1	27.8	27.5	45.1	35.6	19.5
SD02 Physical sciences	30.0	26.1	21.1	29.3	21.3	12.1
SD03 Chemical sciences	55.0	53.9	51.0	64.3	47.8	27.9
SD04 Earth sciences	39.9	35.2	27.0	35.8	30.5	18.0
SD05 Biological sciences	67.1	61.5	53.4	66.5	53.4	34.0
SD06 Medical sciences	73.1	52.6	40.1	44.4	29.6	17.1
SD07 Agriculture and veterinary	56.2	49.0	46.4	48.4	42.6	19.5
SD08 Civil engineering and architecture	46.1	40.0	45.0	40.6	33.1	21.0
SD09 Industrial and information engineering	29.0	23.2	22.6	23.3	18.5	10.2
SD10 Philological-literary and historical-artistic sciences	61.2	55.0	52.9	62.5	55.9	43.1
SD11 History, philosophy, pedagogy and psychology	58.6	49.5	46.8	54.7	47.4	36.2
SD12 Law	50.1	43.0	47.4	50.0	40.9	25.4
SD13 Economics and statistics	52.3	51.0	42.2	49.7	41.5	23.5
SD14 Political and social sciences	54.3	46.5	42.5	49.5	40.5	28.2

Note: for RTDa and b the first public selections started respectively in 2011 and 2012; for SD1, SD4, SD9, and SD14, data refer to 2013; for SD10 and SD12 to 2011. RTDa: A-type post-reform assistant professor; RTDb: B-type post-reform assistant professor; RU: pre-reform assistant professor; PA: Associate professor; PO: full professor.

In 2018, the glass ceiling is still a matter of fact. In no field are women the majority among full professors, and half of the fields report a very low female proportion at this level, which is around 1/5 or less. The philological-literary and historical-artistic sciences is the best performing field in terms of women in grade A, followed by the Biological sciences, History, philosophy, pedagogy and psychology, and the Chemical sciences. These four fields are also the only ones in which women are the majority among associate professors. The Biological sciences, the Chemical sciences, and the Philological-literary and historical-artistic sciences show a majority of women among the RTDb as well, while at the RTDa level the number of female-dominated fields increases to five, with the Medical sciences and Economics and statistics joining the list and two further fields (Agriculture and veterinary;

History, philosophy, pedagogy and psychology), which are substantially gender-balanced. Contrary to tenure track positions, the post-doc level is rather feminized. Women are the minority in "only" five of the fourteen scientific fields, all of which are STEMM: Civil engineering and architecture, Earth sciences, Physical sciences, Industrial and information engineering, and Mathematics and informatics. Once again, the life-sciences go in the opposite direction, with 55% of female post-docs in the Chemical sciences and 67% in the Biological sciences. The Medical sciences performs extremely well too (73.1%), but it witnesses a huge "pipeline" in the following steps, which ends up to an extremely low percentage of women among full professors (17%).

After the Medical sciences, the worst performing fields in terms of "leaky pipeline", are Industrial and information engineering, where the loss—comparing post-docs and full professors—is around one third, and Agriculture and veterinary, where it is less than one third. Most of the fields halve women along the ladder (as in the case of the Chemical sciences, Biological sciences, Law, Earth sciences, Civil engineering and architecture, Economics and statistics, Political and social sciences). On the other hand, the humanities register a "moderate" loss, while, quite surprisingly, Mathematics and informatics is the only field reporting an increase in the female proportion across the career trajectory, with women being 26.1% among the post-docs and 35.6% among associate professors, even though the loss among full professors is remarkable (19.5%).

In Section 6, the indexes analysis (Table 3) pointed out four main elements: First, there has been an improvement in the GCI and GBI. Second, a worsening of the GDI in the years after the Gelmini reform has occurred instead. Third, the GCI is higher than the two other indexes, showing that the transition to full professorship remains the most difficult for women. Fourth, in the years before the reform, the GBI was higher than the GDI, suggesting that the disadvantage in the transition to associate professorship was stronger than the one in the previous step. In the years after the reform, the two indexes show the same value, thus confirming the recent "convergence" of the share of women among assistant and associate professors.

What is the situation with respect to the four abovementioned elements if we look at the various STEMM and SSH (Social Sciences and Humanities) scientific fields in the Italian universities?

Table 6 reports the three indexes—the GCI, the GBI, and the GDI—computed on stock data by scientific fields and considering the years 2000, 2009, and 2018.

Table 6. Glass Ceiling Index (GCI), Glass Bottleneck Index (GBI), and Glass Door Index (GDI) by scientific field and year, stock.

	GCI			GBI			GDI		
	2000	2009	2018	2000	2009	2018	2000	2009	2018
SD01 Mathematics and informatics	1.83	1.65	1.48	1.14	1.02	0.94	1.02	0.95	0.97
SD02 Physical sciences	2.13	1.69	1.51	1.32	1.30	1.03	1.03	1.05	1.17
SD03 Chemical sciences	1.90	1.83	1.49	1.38	1.25	1.02	1.05	0.98	1.09
SD04 Earth sciences	1.70	1.77	1.48	0.76	0.74	0.88	1.02	1.21	1.18
SD05 Biological sciences	1.66	1.36	1.36	1.08	1.19	0.78	1.07	1.03	1.12
SD06 Medical sciences	2.03	1.57	1.46	1.38	1.39	1.16	1.16	1.24	1.34
SD07 Agriculture and veterinary	1.85	1.71	1.74	1.41	1.21	1.05	1.13	1.07	1.12
SD08 Civil engineering and architecture	1.47	1.32	1.37	1.31	1.33	1.07	1.16	1.11	1.06
SD09 Industrial and information engineering	2.42	1.73	1.47	1.49	1.25	1.08	1.26	1.12	1.20
SD10 Philological-literary and historical-artistic sciences	1.33	1.18	1.20	1.12	1.08	0.99	0.98	1.00	1.07
SD11 History, philosophy, pedagogy and psychology	1.36	1.26	1.20	1.26	1.09	1.00	1.00	1.03	1.13
SD12 Law	1.46	1.35	1.30	1.46	1.23	1.02	1.04	1.02	1.06
SD13 Economics and statistics	1.55	1.38	1.42	1.30	1.18	1.04	1.08	1.06	1.06
SD14 Political and social sciences	1.56	1.28	1.28	1.19	1.12	1.03	1.03	1.08	1.13

Source: Authors' elaboration on Ministry of Education, University, and Research (MIUR) data.

The table shows that, in all the three years considered, the GCI is the index reporting the highest values across fields, thus suggesting that the transition to full professorship remains the most difficult

for women in all the disciplines. However, relevant differences occur in the "intensity" of the glass ceiling, with many STEMMs being particularly unequal at this level.

Looking at the year 2018, the most segregated fields are: Agriculture and veterinary (1.74), Physical sciences (1.51), Chemical sciences (1.49), Earth science (1.48), Mathematics and informatics (1.48), Industrial and information engineering (1.47), and Medical sciences (1.46), while Biological sciences and, more surprisingly, Civil engineering and architecture perform better (1.36 and 1.37, respectively). On the other hand, the STEMM fields are the ones with the strongest GCI amelioration in the 19 years considered, which is not surprising given the very high GCI values registered in the year 2000.

The GBI values indicate that, in 2018, the transition from grade C (assistant professors) to grade B (associate professors) is the least problematic in all the fields—except the Earth science. The highest value (1.16)—in the field of the Medical sciences—is in any case lower than the lowest values of the GCI and the GDI registered in the same year in all the fields. It is equal to 0 or lower (no higher than 1.03) for the greatest part of the scientific fields, indicating that, in those fields, the proportion of female recruits among associates in 2018 is equal (or higher) to the proportion of female recruits among assistant professors. Similarly to the GCI, the GBI has decreased over time across the vast majority of the fields (except for the Earth sciences).

As for the GDI, the 2018 data show that all the fields, except Mathematics and informatics, report an index that is higher than one, suggesting a loss of women in the transition from the post-doc to the RTD level. However, looking at the variation of the GDI index before and after the Gelmini reform, and thus comparing the years 2009 and 2018, the results suggest a quite heterogeneous picture, with ten fields reporting a deterioration of the GDI index, two fields reporting an amelioration (Earth sciences and Civil engineering and architecture), and two fields that do not show relevant changes (Mathematics and informatics and Economics and statistics). Moreover, if in 2000 and 2009 the GBI was higher than the GDI in all the fields except Earth sciences, in 2018 the opposite is true, with the GDI being higher than the GBI in all the fields except Civil engineering and architecture.

In summary, the field analysis of the segregation indexes has proved to be quite consistent with the equivalent analysis conducted on the whole population, with one slight divergence concerning the GDI. Coming back to the four summary points stemmed out from the previous section, the field analysis suggests that both the GCI and the GBI have ameliorated in the 19 years considered (first point). However, not all the fields experienced a deterioration of the GDI after the university reform, with four fields—three of which are STEMMs—reporting either an amelioration or a stable trend (second point). The transition to full professorship remains the most challenging for women in all the fields (third point), while the vast majority of fields report a change, after the reform, in the "positioning" of the gender obstacles across the hierarchy, with the GBI being higher than the GDI up to 2009 and the GDI being higher than the GBI after (fourth point).

8. Discussion

By using stock and recruitment data on the Italian academic population, this study aimed to investigate gender changes in the career pipeline across time. Two research questions have inspired this work: whether the feminization of the academic staff in Italian universities is due to (a) an effective improvement of gender equality in recruitments or to (b) demographic dynamics and what the gender implications were of the recent university transformations, namely the precarization of early career phases and the block of turnover.

With respect to the first research question, the results suggest that the feminization of the two last levels of the hierarchy is not due—with the exception of the very last years at the level of associate professor—to an improvement in recruitment. To the extent that the recruitment trend is substantially constant, results point out that the increase in the female proportion among associate and full professors is mostly due to demographic dynamics; that is, the higher retirement of men in the older cohorts, as already noted by Rossi (2015). Nevertheless, the analysis also indicates that female recruitment rates are better than the stock rates. This "gap"—between the recruitment rates (higher) and the stock-related

rates (lower)—is apparent from the very first years surveyed, which means that an increase in female recruitment trends did occur, but in the years before the ones observed in this work.

With respect to the second research question, our analyses have pointed to a progressive worsening in terms of female recruitment in the early stages of the career ladder after the Gelmini reform, in particular at the RTDb level. In the same post-reform period, a slight improvement in the recruitment of female associates has occurred, in a sort of "convergence" of the disadvantage. The analysis conducted on recruitment data confirms previous studies based on stock data that suggest that the reform has "anticipated" the adverse selection of women from the associate level, as it was before the reform, at the assistant professor level, and, more particularly, in the access to tenure track positions (Gaiaschi et al. 2018; Picardi 2019).

The analyses have also been carried out by distinguishing the different scientific fields with the aim of investigating the intersections between vertical and horizontal segregation. Results indicate a clear distinction, within the STEMM fields, between hard and life sciences, with the former among the least feminized and the latter among the most feminized, as in the more traditional humanities. However, within the hard sciences, some areas have recorded a considerable increase in recruitment (Engineering), while others do not grow or grow little (the Physical sciences and Mathematics).

Notwithstanding this process of feminization of the different fields, especially in the early cohorts, the leaky pipeline still persists, with most of the areas losing half of the women from the first to the last rank, except for the humanities and, surprisingly, Mathematics and informatics. As a consequence, the glass ceiling is still a matter of fact, with women being the minority among full professors across all the fields. On the other hand, four fields—two humanities (Philological-literary and historical-artistic sciences and History, philosophy, pedagogy, and psychology) and two life-sciences (Biological sciences and Chemical sciences)—have overcome or nearly reached gender parity at the level of associate professor. In summary, the analysis by scientific areas point to a strong heterogeneity, with a few fields—among which the life sciences – showing encouraging trends and others lagging behind in the process towards gender equality.

9. Conclusions

Contrary to the idea that gender equality is only a "matter of time", the analysis of recruitment data shows that women keep being recruited to a smaller extent than men among associate and full professors, and this gap has been quite constant over the last 19 years. Even more so, because of the changes in the structure of the career ladder and the cut in turnover, female access to the tenure track—which in Italy correspond to the position of assistant professor—have worsened. In summary, the results suggest that the road towards gender equality is extremely slow (Valian 1998; Palomba 2012) and non-linear. It is slow because an amelioration of recruitment trends effectively did happen, but this amelioration occurred in the years before the two decades surveyed in this work. It is non-linear, given that it may be subject to long periods of flat-rates—as in the case of female recruitment of full and associate professors since 2000—or even to back-lashes, as in the case of female recruitment of post-reform assistant professors.

This works certainly has a few limits. First, the time limit: The comparison between recruitment and stock data suggests an extremely slow change at the level of associate and full professors, which would require an analysis of the decades preceding those examined. Moreover, recruitment data do provide more accurate information than the stock because they allow better "control" of demographic dynamics and transitions. However, they cannot say much about gender differences in the selection processes. In this respect, data, by gender, on the national scientific qualifications and on recruitment processes (candidates and winners) are needed. However, neither of the two types of information are collected and harmonized by the MIUR. The only way to obtain them is to analyze the minutes of the competitions. This could be the object of a next research project. Despite these limits, we believe that the empirical material on which this research is based provides relevant insights for

understanding the phenomenon of gender inequalities in academic careers and its intersection with the broader institutional context.

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