Gendered academia

Inequality and inclusiveness in changing Italian academic governance

Edited by
Maria Carmela Agodi, Adele Lauria, Ilenia Picardi

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Is it just a memory from the past? An analysis of the gender productivity gap of Italian academics in 2015-2016

Monia Anzivino, Annalisa Dordoni

Abstract
This chapter investigates the gender productivity gap in Italian universities, in order to provide a picture of women's disadvantages in academic career advancement before the Covid-19 pandemic crisis. Survey data from a national study on Italian academics carried out between the end of 2015 and the beginning of 2016 were used. The data allowed us to observe the relationship between gender and scientific productivity in a large representative sample of academics (N=5.123) from all disciplinary fields, providing insight on the production of two types of scientific publications: monographies (1), and journal articles and chapters in edited volumes (2). Moreover, the data allowed us to examine the gender productivity gap focusing on the generational issue, assuming that this gap narrows among younger researchers, as various scholars in other national contexts underlined.
Results show that the gender productivity gap persists in the Italian Academia, albeit with specific differences in the type of scientific product and the disciplinary field: it is significant in SSH for both books (1) and articles and chapters (2), but the gap concerns only the second type of publication (2) in STEM. Moreover, in STEM disciplines younger women and men are equally productive, whereas in SSH younger women continue to publish fewer articles than younger men. Different explanatory hypotheses from the literature are proposed for these results, taking into account gender bias and the neoliberal turn in the academic organisational culture.

1. Introduction

Over the last years, the debate on gender inequality in the university environment has been investigated by numerous studies in different contexts. Despite the steady growth in the number of women in tertiary education and PhDs, there is a persistence of gender imbalance in the academic sector. The latest European report on the situation of women in academia (European Commission 2019) shows that, in 2016, women made up 40% of associate professors and only 24% of full professors, highlighting a wider gap in Science, Technology, Engineering and Mathematics - STEM. Furthermore, according to the same report, women were under-represented in scientific articles authorship. In Italy, the most recent MIUR analyses (2020) follow the same direction.
The scarce presence of women in managerial positions and leadership roles, known as vertical segregation or *glass ceiling*, has been investigated in numerous studies (Pyke, 2013; Solera and Musumeci, 2017; Roberto, Rey, Maglio, Agliata, 2020), as well as horizontal segregation in specific disciplinary areas, in particular Social Sciences and Humanities - SSH (Sattari and Sandefur, 2019): the more stable the position, the larger the gap. Several studies have focused on the issue of access to permanent positions and on the path from early career stages to professorship. Analyses of the phenomenon of the *leaky pipeline* (Monroe and Chiu, 2010) and entrapment in the labyrinth (Picardi, 2020) indicate that, more often, women remain in precarious conditions, to be then expelled from the academic sector (Murgia and Poggio, 2018).
This chapter will examine the gender productivity gap with a focus on the generational issue. After introducing the determinants of the gender gap in scientific productivity and the changes in the Italian academic system, occurred over the last decades and exacerbated in the last years by the establishment of the *publish or perish* culture, we will show how the data collected in 2015-2016 could provide some valuable evidence on these themes, even more important today.

2. Neoliberal Academia and the Determinants of the Gender Gap in Scientific Productivity

In recent decades, relevant transformations have taken place in the academic organisational culture. A neoliberal organisational culture model, rooted in public universities as well as in other domains of society, appears to be hegemon on the international scene. The framework of the so-called *New Public Management* - which has institutionalised temporary contracts and is based on the centrality of the performance - identified competitiveness as a principle and the pressure to publish as the norm (Thomas and Davies, 2002; Poggio, 2018; De Coster and Zanoni, 2019; Ivancheva, Lynch and Keating, 2019).

Numerous studies have highlighted how the pillar of this model, the concept of *excellence*, has deep consequences on work-life balance and life planning, especially for women and above all for mothers (Probert, 2005; Rafnsdóttir and Heijstra, 2013; see also the special issue edited by Dubois-Shaik and Fusulier, 2017). This neoliberal organisational framework affects academic scientific productivity and needs to be investigated in a gender perspective (Stack, 2004; Fox, 2005; Mairesse, Pezzoni and Visentin, 2019).

The conceptualisation of *excellence* as neutral and quantifiable (Rees, 2011; Van den Brink and Benschop, 2012) is defined not only nor primarily by the evaluation of the quality of the research, but mostly by the quantification of published products, namely productivity, and the measurement of citations through bibliometric indicators. As the next paragraphs will explain, the procedures for quantifying productivity are now consolidated practices in Italy, in the form of processes to achieve the National Scientific Qualification and measurements on the basis of the Evaluation of the Quality of the Research. The number of research products, even before qualitative assessment, is what determines whether or not an author can access the path for obtaining the NSQ, the first step towards being able to apply for permanent positions. Therefore, dimensions strongly affected by gender imbalance such as evaluation, recruitment and career advancement, are also directly conditioned by the number of publications, the quantification of products. Undoubtedly, an analysis of productivity from a gender perspective is therefore relevant (Aiston and Jung, 2015).

Research productivity, assessed through bibliometric indicators to quantify the quantity and quality of research output, plays a crucial role towards gaining success in the NSQ. This system reinforces the *publish or perish* academic culture: if researchers do not publish enough, they are destined to perish - and often those who perish are women (Weisshaar, 2017), pressured out like droplets in a *leaky pipeline* (Monroe and Chiu, 2010; Filandri and Pasqua, 2019), especially in STEM area (Sattari, Sandefur, 2019).

Numerous studies underline that the gender productivity gap is present in many contexts, but most of these studies, especially in Italy, show empirical evidence taken either in very specific disciplinary sectors and contexts (D'Amico, Vermigli, Canetto, 2011; Akbaritabar, Casnici adn Squazzoni, 2018) or in sectors in which researchers are evaluated by bibliometric indicators (Abramo, D'Angelo and Caprasecca, 2009; Madison, and Fahlman, 2020). In the latter, the evaluation is based on the measurement of citations, using databases that do not allow to study this gap by keeping control over many of the factors that could influence it.

International literature shows a systematic relationship between scientific productivity and gender: women publish less than men, especially in high-impact journals, and are less cited (Stack, 2004; Fox, 2005; Abramo, D'Angelo and Caprasecca, 2009; Hunter and Leahey, 2010; Aiston and Jung, 2015; Abramo, D'Angelo and Di Costa, 2018). The few studies that do not highlight significant gender differences have been conducted on small populations with very specific characteristics (Mayer and Rathman, 2018).

To explain the differences in productivity between individuals, some hypotheses have been formulated in the scientific literature, taking into consideration various factors: personal, cultural and organisational or contextual.

On the one hand, some of the factors considered in the scientific debate were the role of gender bias, distortion, assessment errors in decision-making processes, often unconscious, connected to gender stereotypes and prejudices (Helmer et al., 2017).
On the other hand, the literature shows how gender bias also influences decision-making processes for women themselves, who tend to propose fewer articles than men, especially to prestigious journals, and to apply less frequently than their male colleagues for high-ranking positions (Bosak and Sczesny, 2008; De Paola, Ponzo and Scoppa, 2017; 2018), instead dedicating more time to tasks that do not influence their career, such as service work (Guarino and Borden, 2017; Lynch et al., 2020).
Furthermore, the *homophily hypothesis* (Murray et al., 2019) notes how the frequently male-dominated composition of editorial committees and evaluation commissions (Addis and Villa, 2003) tends to penalise women, due to the unconscious preference for people of the same gender in the evaluation process (De Paola and Scoppa, 2015).
Many studies have emphasised that the organisational context and the professional environment are also crucial for scientific productivity. Networking in particular increases the chances of publishing (Lee and Bozeman, 2005), and several surveys have shown that men more often join, or lead, research groups (Van den Brink and Benschop, 2014).
Some of the gender policies implemented by universities to frame imbalance as well as to create networks among academic women are worth mentioning, from the Gender Budgeting to Gender Equality Plans and Gender Action Plans (Bozzon, Murgia and Poggio, 2016), to the different gender practices in *networking* and *mentoring* (Poggio, 2016; Picardi and Agodi, 2020).
Finally, it is very interesting to note that some analyses show that the gender productivity gap appears to narrow for younger generations (Van Arensbergen, Van der Weijden and Van den Besselaar, 2012), even if it is a matter of fact that the phenomenon persists over time (Van den Besselaar and Sandstrom, 2016). This change in the new generations of academics is contemporary with the last period of the neoliberal turn and could be linked with the expansion of this organisational culture. The *publish or perish* principle influences the scientific productivity gap: female academics, just like their male colleagues, are pressured into publishing, today more than ever.

3. The Productivity of Italian Academics: Squeezed Between Scarce Resources and High Pressure to Publish

In Italy, the allocation of funding is intertwined with scientific productivity - and influences a range of inequality determinants. Established in 2004, the Evaluation of the Quality of Research system assesses universities and researchers' quality of research mainly through peer evaluation. The results are used for the allocation of the Ordinary Financing Funding reward shares. Therefore, the productivity of every researcher and professor contributes towards the university receiving funding, creating a vitious circle in which universities located in more affluent areas are often allocated greater funding than others.
What is more important, this increases the North-South divide. RES Foundation's 2015 Report underlined that the distribution of ordinary public funding widened the gap between the universities of the North and the universities of the Centre-South: the latter have lost 12%, with peaks of over 20% in the Islands, against a 4,3% loss for universities in the North (RES Foundation 2015).
In the Italian academic system, recruitment procedures, employment conditions and salaries in public universities are instituted by national laws and reforms. The salaries of permanent academic staff only vary according to their level and seniority. Each professor specialises in a research field: the National University Council defined 383 disciplinary-scientific sectors, regrouped into 14 areas. Any job vacancy is associated with one of these sectors, and applicants are evaluated by a commission of professors working in the same field.

Researchers and professors can only be hired through public tenders, which should guarantee a) public advertisement of the vacancy, b) objectivity in the selection criteria (and in the selection of the selective committee), and c) transparency in the selection process. Accountability should theoretically guarantee total fairness in this process, but more often than not proves to be a *veil of Maya* that covers the reality of a neoliberal governance, in which inequalities are still present because of the persistence of a (white, middle-aged) "masculine professional norm", which women (or other categories) fail to actually fully adhere to (De Coster and Zanoni, 2019).
From the point of view of the allocation of resources, it is due noting that the Italian university system has suffered significant funding and personnel cuts in the last decades, especially academic staff. Italy recorded a -14,4% funding decrease in real terms for tertiary education from 2008 to 2018, a figure higher than both the economic decline and the decline in student numbers. The European University Association's Public Funding Observatory Report of 2019-20 underlines that, in the period 2008-2018, the cuts implemented were not compensated by the overall investments, and the funding has stabilised at a very low level (European University Association 2020).
The funding cuts caused a significant contraction in the number of both tenured and fixed-term positions, from academic year 2007-2008 to 2017-2018 the report shows a decrease of -17% in academic staff and -26% in non-academic staff, in the face of a decrease of only -8,5% in university students. In absolute numbers, the decrease equals 21.643 units, from 130.481 to 108.838 people employed as academic staff in Italian public universities (European University Association 2020). In addition to this, it is to be highlighted that the Italian public investments in Research and Development are also modest.
Furthermore, since the Gelmini Reform in 2010 (L. 240/2010), the recruitment process has been organised through the National Scientific Qualification, a necessary requirement for accessing associate and full professorships, therefore making it mandatory for researchers to gain this qualification to apply for permanent positions. As a matter of fact, this Reform stressed the importance of the quantity of publications already in the early career stages.
Each round of the NSQ procedure uses medians to calculate the average quantity of publications produced by all the Italian academics working in the same field. To gain a tenured position in an Italian university, researchers need to publish a minimum quantity of papers, essays and monographs to reach these medians and obtain the qualification; then they can apply for a public tender for a permanent position.
Today, the *publish or perish* principle is a fact: the pressure to publish is strong, and the quantity of products, especially journal articles, determines the work of academics and university funding (Van Dalen, 2021). This pressure affects academics' productivity, increasing the number of publications (but what about the quality of the research?) and getting academics to start discussing the issue, especially in the STEM area (Génova and De la Vara, 2019). In an academic system characterised by funding cuts, such as the Italian one, the competitiveness and pressure are at all-time highs.

4. An Analysis of the Gender Productivity Gap in the Italian Academia

In this paragraph, we want to give an empirical picture of the relationship between gender and scientific productivity in Italy starting from the hypothesis, maintained by the literature just examined, that a productivity gender gap exists, and women publish on average less than men, even net of some of those factors that research shows to be important determinants of productivity. In addition to this research aim, we are questioning another aspect that some recent contributions have highlighted (Van Arensbergen, Van der Weijden and Van den Besselaar, 2012): we wonder whether the gender productivity gap is more limited in younger generations of scholars than in older ones.

To answer our questions, we used data from a sample survey of 5.123 Italian academics working in all the Italian public universities, carried out between the end of 2015 and the beginning of 2016[3]. These data prove extremely useful since, in addition to being collected on a national and statistically representative sample of academics from all disciplines, it allowed us to look at scientific productivity on at least two types of publications, which constitute the two products of *excellence* in the two macro areas, STEM and SSH.

Respondents were asked to indicate the number of contributions (articles or essays) in scientific journals or volumes and the number of monographs they published in the last five years. In this way, the two cardinal scientific productivity variables worked as our two dependent variables. The only correction made to these variables in the post-detection phase was the re-coding of missing value to zero, in case there was at least one of the answers to the questions about scientific products. In the case of missing answers to all questions, the cases were excluded from the analysis. The responses of academics who appeared to be outliers were not deleted. Using different identifying methods for outliers[4], we analysed their consistency, distribution, and possible determinants. In particular, the fact that the group of academics identified as outliers had on average almost twice as many research collaborators as the others, has seriously questioned the hypothesis that the number of publications declared was incorrect, since it means that they are academics who can count on important resources, both human and financial, elements that assume and favour high productivity at the same time. With this in mind, we therefore preferred to include the variable of the number of collaborators among the control ones and follow a conservative approach of the respondents' statement. In addition to the number of collaborators in the five years prior to the interview (sum of the number of PhD students and research fellows), the other control variables that we included in the multivariate models, to control the relationship between scientific productivity and gender, were: age in years; academic position (full professor, associate professor, researcher); disciplinary area (as considered at sampling stage); geographical area where the university is located (as considered at the sampling stage); the size of the university, classified on the basis of the number of students enrolled (small, up to 10.000 students; medium, 10.001 to 20.000 students; large, 20.001 to 40.000 students; mega, with more than 40.000 students).

Among the respondents, men were 56,4% and women were 39,4%; we excluded those who did not indicate sex (4,2%)[5] from the analysis. In the whole academic population, without distinction of role, disciplinary area or age, women's scientific productivity is lower than men’s in terms of the average number of monographs and, more markedly, the average number of articles and essays[6]. In the five years prior to the interview, men published on average 1,4 monographs and 23,3 essays or articles, whereas women respectively on average 1,2 and 17.

The average level of scientific productivity varies according to different career stages, so those in a higher position have published more than those in an intermediate or initial stage, and, since women in high positions are fewer than men, gender differences are to be considered within each stage. The productivity gap between men and women remains in all academic positions only with regard to the

[3] Data come from the survey on third mission activities of Italian academics carried out as part of the PRIN 2011 Project "University, Innovation and Economies Regional". The sample was randomly extracted from the list of names of professors and researchers in the role as of 31 December 2013 provided by the MIUR and was stratified according to two criteria: the disciplinary area of teaching and the geographical location of the university of reference. The disciplinary area has been aggregated into 7 distinct categories on the basis of the scientific-disciplinary sectors: Humanities and the Arts; Engineering and Architecture; Social and Behavioral Sciences; Business, Economics and Law; Mathematics, Physics and Natural Sciences; Agricultural and Veterinary Sciences; Health Sciences. The geographical area of location of the university of reference has been classified in 5 macro-regions on the basis of ISTAT: North West, North East, Centre, South, and Islands. The distribution of the actual sample (response rate of 34,2%) was proportional to the reference population not only for the two stratification variables, but also for other relevant characteristics, such as gender and academic role.

[4] Specifically, we have used the method of *Range* added interquartile of the value +3 and the method of standardized values (with threshold value +3 to identify those excess extremes); in both cases we operated within the 14 CUN areas.

[5] Although not stratified by gender, the actual sample was distributed proportionally by gender to the population of researchers and professors in service in 2015 (MIUR data) both at the overall level and within the role and within the disciplinary areas.

[6] For reasons of space and not to burden reading of the chapter, the calculations relating to the total sample - both bivariate, both multivariate – are not included in the text; are available on request to authors.

productivity measured by the number of articles or essays, while with regard to monographs, gender differences remain only in early career stages (tab. 1). Moreover, when it comes to monographs, women appear on average less productive than men only in the macro-area of SSH, where this kind of product is more relevant towards one's career, while in the STEM area the differences do not appear great enough to be significant. In both macro-subject areas, however, women report significantly fewer articles and essays (tab. 2).

Tab. 1. Analysis of variance of scientific productivity by gender within academic roles.

		Men	*Women*	*Total*		
		Average (Std. Dev.)	*Average (Std. Dev.)*	*Average (Std. Dev.)*	*F-test*	*Sig.*
Researcher	Monographs	1,3 (3,3)	1,1 (2)	1,2 (2,7)	5,045	,025
	Articles or essays	20,2 (36,2)	15 (23,7)	17,4 (30,2)	14,361	<,001
Associate Professor	Monographs	1,3 (2,5)	1,3 (2,3)	1,3 (2,4)	0,088	,767
	Articles or essays	22,9 (30.7)	18,5 (18,6)	21,1 (26,5)	13,567	<,001
Full Professor	Monographs	1.5 (2.6)	1,4 (2)	1,5 (2,4)	0,596	,440
	Articles or essays	27,2 (37,6)	21,2 (28,6)	25,3 (35,1)	7,532	,006

Tab. 2. Analysis of variance of scientific productivity by gender within the two macro-disciplinary areas.

		Men	*Women*	*Total*		
		Average (Std. Dev.)	*Average (Std. Dev.)*	*Average (Std. Dev.)*	*F-test*	*Sig.*
SSH	Monographs	1,7 (2,5)	1,5 (1,9)	1,6 (2,2)	5,165	,023
	Articles or essays	15,3 (14)	12,5 (9,8)	13,9 (12,1)	23,702	<,001
STEM	Monographs	1,2 (2,9)	1,1 (2,3)	1,2 (2,7)	3,001	,083
	Articles or essays	26,6 (39,5)	20,5 (28,1)	24,2 (35,5)	23,608	<,001

Tab.3. Analysis of variance of scientific productivity by gender within the two age groups.

		Men	*Women*	*Total*		
		Average (Std. Dev.)	*Average (Std. Dev.)*	*Average (Std. Dev.)*	*F-test*	*Sig.*
Up to 45	Monographs	1,5 (3,5)	1,3 (2,4)	1,4 (3,1)	1,925	,166
	Articles or essays	22,8 (30,7)	18,5 (29,4)	20,9 (30,2)	7,331	,007
Over 45	Monographs	1,3 (2,4)	1,2 (2,1)	1,3 (2,3)	2,175	,140
	Articles or essays	23,5 (35,8)	16,8 (19,7)	20,6 (30,2)	43,627	<,001

Finally, we observed the gender productivity gap within two age groups – up to 45 years of age and over 45 years of age – to test the generational hypothesis. The choice to divide the sample into these two age groups was mainly determined by methodological reasons. On the one hand, the need to have an adequate number of cases for each category of each variable included in subsequent multivariate models, required limiting the segmentation of the sample, since a small number of women could affect the significance of the relationship. On the other hand, the literature shows that if there is a decrease in the productivity gap, this concerns the younger generations. So, there was no reason to hypothesise that further division into several age groups could be useful.

tab. 3 shows scientific productivity for men and women within the two age groups. On the one hand, the analysis of variance reveals that the gap in the average number of monographs is not significantly different between men and women in either generation. On the other hand, the gap in journal articles persists even among younger scholars, though narrowing comparing to that of over-45s, due to a higher average number of articles and essays published by young women and a lower number published by young men.

As already shown in these preliminary analyses, the association between gender, productivity and other explanatory factors is evident. In fact, our independent variable, gender, is not equally distributed within the subject areas and academic positions and, overall, when taking into account the whole sample, women are on average younger than men (with an average age of 50,6 years, as against an average age of 52,1 years for men), and moreover they can count on fewer research collaborators (on average 1,4 as against 1,7) that, as mentioned above, constitutes a factor significantly associated with higher scientific productivity.

In order to consider the complexity of all the factors, it is therefore necessary to use multivariate models to estimate the average differences in productivity between men and women, while taking into account all the other potentially influential available elements.

The two negative binomial regression models (one for each productivity indicator, monographs and articles) show that, when all control variables are considered (in particular the academic role, the disciplinary area and the number of research collaborators), the differences between male and female productivities are reduced: they become non-significant as far as monographs are concerned, and greatly decrease for articles and essays (the estimated marginal difference decreases from +6,3 to +3,6)[7].

Our initial hypothesis therefore finds a first feedback, which reveals the existence of a gender productivity gap in the Italian academia in favour of men. However, this gap does not seem to be significantly wide on all product types: women and men, for the same age, academic position, disciplinary area, number of collaborators and contextual characteristics, publish on average a similar number of monographs. The gap exists for articles and essays, although the factors considered relevant have been kept under control. These are the products on which the literature on gender inequalities in scientific productivity has mostly focused. Several hypotheses have been put forward to explain this gap.

One of the most interesting for this dimension of productivity is the one that calls into question *gender biases* and prejudices, often unconscious, that condition, with different mechanisms, both men and women and the decision-making processes they are involved in. On the one hand, these biases make women less likely to send proposals for contributions to scientific journals (Helmer et al., 2017); on the other hand, together with the phenomenon of *homophily* (Murray et al., 2019), these biases penalise women in the *peer review* and selection processes because the editorial committees are often composed by male professors (Addis and Villa, 2003).

To answer the second research question on the evolution of the gender productivity gap in generational terms, we used the same repeated model for the two types of scientific product, within the two age groups and into the two disciplinary macro-areas, STEM and SSH. In tab. 3 we have observed how the gender gap appears to be reduced in new generations of scholars because of processes having taken place in recent years which led to the affirmation of the *New Public Management* also in the Italian academia.

The establishment of this neoliberal organisational culture and of the *publish or perish* principle, together with, perhaps, a greater presence of women in academia, seems to limit the action of unconscious gender biases and homophily that are mentioned in the scientific literature among the main determinants of the gender productivity gap. Dividing the analysis by macro-area also has the advantage of showing whether the assumed minor gender productivity gap of new generations of academics is similar in STEM and SSH, or whether the generational change affects one disciplinary area more than the other.[8]

[7] In the model conducted on the entire sample, we inserted among the control variables the disciplinary area recoded in 7 categories. In subsequent analyses, we used the macro area of STEM disciplines and the macro area SSH disciplines to differentiate the models; the others control variables are the same as the other models: age, position, number of collaborators, geographical area and size of the university of reference.

[8] In models, although conducted separately for macro-areas, disciplinary areas that refer to the macro reference area have been included as control variables. This analysis strategy has made it possible to minimise the effect of outliers on normality assumption of the residuals required by the model used.

The results of the multivariate analysis show that the gender productivity gap in SSH (tab. 4) is significant for over-45s both in terms of monographs and articles and essays published in scientific journals and volumes, while for the group of younger academics the gap concerns only the latter dimension of productivity. Other factors being equal, young women publish the same number of monographs, but fewer articles than young men. Indeed, the gender gap related to articles seems to be greater among younger academics than among over-45s.

Tab. 4. Negative binomial regression models on scientific productivity in SSH disciplines for two age groups (Coefficients)

	Monographs		Articles and essays	
	Over 45	Up to 45	Over 45	Up to 45
Intercept	0,66	2,805***	3,763***	3,693***
Men	0,212**	0,036	0,184***	0,193**
Women (Ref.)	0	0	0	0
Assistant Professor	-0,216	-0,648*	-0,508***	-0,401*
Associate Professor	-0,045	-0,49	-0,271***	-0,195
Full Professor (Ref.)	0	0	0	0
Business, Economics and Law	-0,177	-0,272*	-0,184**	-0,075
Humanities and Arts	-0,257**	-0,386**	0,087	-0,011
Social and Behavioural Sciences (Ref.)	0	0	0	0
University location: North	0,066	-0,17	0,145**	-0,104
University location: Centre	0,218*	0,077	0,173**	-0,067
University location: South and Islands (Ref.)	0	0	0	0
University size: Small	0,014	-0,434*	-0,066	-0,143
University size: Medium	-0,062	0,019	-0,051	-0,016
University size: Large	0,025	0,087	0,064	-0,007
University size: Mega (Ref.)	0	0	0	0
Age (years)	-0,004	-0,039*	-0,023***	-0,019
N. collaborators	0,017*	0,025*	0,04***	0,034***
(Negative Binomial)	0,713	0,515	0,45	0,344
Women-Men (Marginal differences)	-0,34**	-0,062	-2,221***	-3,094***
Sig.	<,001	<,001	,000	<,001
N	1094	532	1094	532

**p-value<0,05 **p-value<0,01 ***p-value<0,001*

Looking at the STEM area, we can observe a different dynamic (tab. 5). The scientific productivity measured by the number of monographs does not differ between men and women in the younger group, nor does in the older one. On the contrary, the gender productivity gap regarding the number of articles is significant among older academics, even with other factors being equal, and disappears completely among scholars up to 45 years of age. The neoliberal culture linked with the publish or perish principle seems to be more pressing in the STEM area than in SSH, especially regarding scientific productivity in journal articles (Génova and De la Vara, 2019). This could be the determinant of an increase in the scientific productivity of younger women, even leading to a closure of the gender productivity gap for the younger in the STEM area, and for journal articles specifically, as the study results show.

Tab. 5. Negative binomial regression models on scientific productivity in STEM disciplines for two age groups (Coefficients)

	Monographs		Articles and essays	
	Over 45	Up to 45	Over 45	Up to 45
Intercept	0,646	3,508**	4,775***	5,837***
Men	-0,006	0,27	0,261***	0,088
Women (Ref.)	0b	0b	0b	0b
Assistant Professor	-0,255*	-0,371	-0,638***	-0,72**
Associate Professor	-0,142	-0,266	-0,281***	-0,458
Full Professor (Ref.)	0b	0b	0b	0b
Mathematics, Physical and Life sciences	-0,333**	-0,577**	-0,055	0,172
Architecture and Engineering	0,142	-0,303	-0,273***	-0,055
Agriculture and Veterinary	-0,028	-0,09	-0,283***	-0,046
Health (Ref.)	0b	0b	0b	0b
University location: North	-0,078	-0,313*	0,113*	-0,13*
University location: Centre	-0,223*	-0,198	0,11*	-0,11
University location: South and Islands (Ref.)	0b	0b	0b	0b
University size: Small	-0,221	0,073	-0,325***	-0,254*
University size: Medium	-0,269**	-0,25	-0,218***	0,119
University size: Large	-0,581***	-0,285	-0,167***	-0,048
University size: Mega (Ref.)	0b	0b	0b	0b
Age (years)	-0,004	-0,067**	-0,027***	-0,052***
N. collaborators	0,026***	0,049***	0,021***	0,019**
(Negative Binomial)	1,65	2,56	0,715	0,61
Women-Men (Marginal differences)	0,006	-0,401	-4,961***	-2,491
Sig.	,000	<,001	,000	<,001
N	2290	914	2290	914

**p-value<0,05 **p-value<0,01 ***p-value<0,001*

5. Conclusive Remarks and Future Challenges

This essay investigates the gender gap in scientific productivity in Italy, in order to provide a picture of the disadvantage women face in academic career advancement, already present before the Covid-19 pandemic.

The data used come from a national sample survey conducted in 2015-2016 which makes it possible to observe the relationship between gender and productivity on a large representative sample of academic staff from all subject areas and on different types of publications: monographs, essays and articles.

The results show that women have, on average, a lower scientific productivity in journal articles and essays, even when considering personal, academic and contextual characteristics. The gap is articulated differently in macro areas: the gender productivity gap tends to be greater in the SSH areas

than that existing in the STEM disciplines. The main determining factors highlighted in this essay and previously underlined in the literature are gender bias, prejudices and gender stereotypes, even unconscious ones, often internalised by women themselves, which affect decisions and choices made by all social actors, also in academia. Moreover, the homophily hypothesis is taken into account.
Furthermore, we analysed two age groups of academics: up to-45s and over-45s, in order to observe if the gender productivity gap would have been smaller in the younger group, as some recent studies indicate. The results show that, comparing the two age groups' performances, the gender productivity gap among academics of a young age actually seems to have been bridged in the STEM area, perhaps due to the publish or perish principle being extremely pressing in this field (Génova and De la Vara, 2019). On the contrary, in the SSH area the gap is still significant for up to-45s, and even increases when it comes to publishing articles and essays.
Nevertheless, the persistence of profound gender inequalities in promotions and career advancements in the STEM area remains evidence underlined in the scientific literature (Sattari and Sandefur, 2019). Actually, in the academic sector, the few women who are successful in building a career are those who reach the male standards of the absolutely and inherently gendered social construct of academic *excellence* (Rees, 2011; Van den Brink and Benschop, 2012).
However, this study presents limitations. In fact, even if the data used allows for the study of the phenomenon on the entire Italian academic body and with different productivity measures, it does not takes into account important control variables, such as presence of children, use of parental leave and others of a more aptitudinal nature, which could be allowed to test hypotheses and propose more robust interpretations.
Despite these limitations, the evidence obtained is of particular relevance, since it provides an articulated picture of the gender imbalance on the measurable productivity dimension, a key factor for recruitment and advancement in the academic career today. These results are even more relevant if we consider that they offer empirical evidence on the pre-pandemic situation and will therefore be useful, in the future, in order to understand the possible effects of the current situation, still to be observed and analysed.
Reconciliation difficulties for workers of this sector seem to have worsened following the Covid-19 pandemic. The closure of schools and childcare services, together with the widespread implementation of remote working (Carreri and Dordoni, 2020), have decreased their productivity (Minello, Martucci and Manzo, 2020). Therefore, we deem it even more important today to be able to have a precise picture of the existing disparities, also with a view to trying to reduce the imbalances by implementing gendered practices and policies (Poggio, 2016; Picardi and Agodi, 2020).
Having scientific evidence of the gender disparity in scientific productivity that already existed then is even more relevant today following the health crisis, the restriction of mobility and the closure of schools caused by the pandemic. In fact, thanks to the results of this analysis, it will be possible in future research to compare the situation of 2015-2016 with the post-pandemic one.

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