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Precariousness and Gender Asymmetries Among Early Career Researchers: A Focus on STEM Fields in the Italian Academia

Rossella Bozzon, Annalisa Murgia, Paola Villa

1. Introduction

Over the last twenty years, scientific careers have been profoundly modified by the broad process of transforming tertiary education systems in Europe, which has pushed the organisational and scientific culture of universities and research institutions in the direction of a culture of enterprise, new public management and marketisation. Such transformations have profoundly changed the academic landscape and the working conditions in the scientific sphere, increasing levels of uncertainty and instability. What seems to persist, however, is the existence of relevant gender asymmetries, which continue to characterise scientific careers despite the growing presence of women in the early stages of academic positions.

This work aims at analysing the interrelation between the precarisation of the early stages of scientific careers and the (re)production of gender asymmetries in career advancement strategies, in the light of the neoliberal paradigm which has marked the Italian university system (and the wider labour market). Our main concern is to understand how growing levels of job instability influence (fe)male career chances and strategies within or outside academia, paying attention to the mechanisms which impede or favour the exclusion from academic career paths. The attention will focus on STEM disciplines, where women are still heavily underrepresented and on which most part of the debate and the political initiatives aimed at promoting gender equality in research has been catalysed (Bozzon et al. 2015; EC 2012).

After reconstructing the debates on the precarisation of scientific careers and gender asymmetries in career development in the Italian academic context, we discuss the methodological tools adopted in our research. Firstly, we illustrate the statistical analysis of PhD holders' working conditions at the national level, with a specific focus on STEM disciplines. Secondly, PhD holders' working conditions are also explored from a subjective point of view, by showing the results of a qualitative organisational case study conducted in an Italian STEM department. Therefore, attention is paid to gender differences, and especially to job in/security, career strategies and future prospects of male and female researchers at the very beginning of the scientific career.

2. Growing precariousness in early career development...

Over the last decade, the Italian academic system has been deeply modified by a comprehensive reorganisation started in 2005 with the Moratti reform (Law n. 230/2005) and completed in 2010 by the Gelmini reform (Law n. 240/2010). These reforms recast the internal organisation of Italian public universities as well as the academic staff recruitment, selection and career advancement procedures, introducing a strong flexibilisation of the early career stages¹. Moreover, they went hand in hand with consistent financial restrictions to the university/research system and a strong limitation of the turnover rules which have produced a serious contraction of the permanent teaching staff (down by 18% between 2008 and 2014) and the rise in number and relevance of unstable research positions with limited career prospects. This dynamic is more visible in the case of the STEM fields of study. In fact, while almost 23% of the university research staff had a non-permanent position in 2013, such proportion reached 33% in the case of STEM disciplines (Bozzon et al. 2016). These new temporary positions are composed mainly by postdocs, that are independent from the turnover rules imposed by the reform and connected to the ability of each scientific institution to attract external research funding. Thus, the faster growth in the STEM fields is (also) a consequence of the higher resources from the private sector and public selections (mainly European funding) invested in these scientific areas.

With regard to individual professional trajectories, the main consequence of the reform of the university system has been an increase in the instability of scientific careers, especially at the early stages, fuelled not only by fixed-term contracts, but also by the increased pace of work, by the constant exposure to assessment procedures dependent on production and efficiency standards which are often founded on a merely quantitative basis, as well as the uncertain access to resources that can give continuity to the course of one's own research (Toscano et al. 2014; Peroni et al. 2015). The rise in instability in working conditions has brought with it an increased perception of instability and vulnerability in scientific careers. Indeed, researchers are forced to fulfil growing demands for scientific productivity, competitiveness, mobility, and fundraising ability in order to enhance their current and future career prospects (Busso and Rivetti 2015; Ferri and

¹ The current academic recruitment process accounts for 3 positions after completing a PhD: a) up to 6 years as a postdoc; b) up to 5 years as a fixed term assistant professor (RTD-a); c) followed by 3 years as a tenure assistant professor (RTD-b). At the end of the tenure track, and after receiving the national scientific qualification, an RTD-b can be called as associate professor with a permanent position.

Murgia 2017). The lack of research funding or the non-renewal of research contracts seem to be the most important reasons motivating individuals to leave research (Ajello et al. 2008). The limited time span of postdoc grants negatively affects the chances to meet the expected research performance and the quality of the scientific productivity. The need to constantly find a new job before the current position expires overlaps with fundamental research and writing activities (Toscano et al. 2014). Moreover, unexpected events in the private sphere (health problems, childbirth) reduce one's dedication to job activities (Peterson et al. 2012; Falcinelli and Guglielmi 2014). In this context, the limited availability (often the lack) of social policy supports and unemployment provisions target non-standard job positions and early career stages, as well as the limited development of policies that explicitly target the promotion of gender equality in academia (but also in the wider labour market) contribute to the increase in the vulnerability of unstable researchers in the Italian context (Bozzon et al. 2016).

3. ... and the persistence of gender asymmetries in career development

The literature on gender inequalities in academia and the debate on the *leaky pipeline* phenomenon show that the number of women leaving the scientific career path continues to regularly be higher than the number of men doing so. The consequence of this differential leaking along the career path is to create a sex-based filter that removes one sex from the stream and allows the other to reach the end of the pipeline in a logic of cumulative disadvantages over time (Alper 1993; Blickenstaff 2005).

In the Italian context, even though women outnumber men among graduate students, and the total number of female researchers in the labour market has been increasing over time (De Vita and Giancola, in this Special Issue), in 2014 female researchers represented only 35% of researchers employed in Italy, an increase of only two percent points since 2005 (EC 2016)². Career advancements for women are slower than for men and this trend has remained more or less stable over time in the academic system (EC 2016; Frattini and Rossi 2012; Palomba and Menniti 2001). The gender gap increases over the career levels and is particularly striking when considering top positions. The situation is quite critical in the case of the STEM disciplines where female full professors were only 17% in 2013, four percentage points under the national average (Bozzon et al. 2016)

² Estimate based on Eurostat data [rd_p_persocc]. Last update October 2016.

The majority of the dispersion of women along the career path is generally linked to two main sets of factors: the gender gap in scientific productivity, and life/work interferences mainly with regard to parenthood choices (EC 2012).

With respect to the first factor, many studies show that women continue to suffer from a systematically reduced scientific productivity (D'Amico et al. 2011; Lissoni et al. 2011). Some explain this disadvantage as women having a greater tendency to risk aversion in competitive contexts (Pautasso 2015). Other interpretations, shifting the question from the individual to the organisational level, explain the reduced female production as the consequence of a systematic devaluation of female abilities (re)produced by a series of gender stereotypes which proliferate in scientific contexts (Bocchiaro and Boca 2002; Palomba 2008). In doing so, they obstruct and delegitimise women's scientific activity and their recognition among the relevant professional network (Xie and Shauman 2003). Such devaluation often already begins in the recruitment phase, continues over time with career promotions and influences the way in which the scientific evaluation processes are constructed (Addis 2008; Falcinelli and Guglielmi 2012).

The second set of factors look at how gender roles and gender cultures contribute to modulating and differentiating both the expectations and the career prospects of men and women, influencing their career strategies and opportunities generally to women's disadvantage. The ambivalent role of the parenthood in career development has received particular attention (Forster 2001; Blackwell and Glover 2008). Several studies have highlighted the negative impact of maternity on women's career access and prospects in academic contexts, in contrast to men, who usually benefit from such family events (Ledin et al. 2007; Xie and Schauman 2003). In this perspective, motherhood and career achievements often emerge as mutually exclusive experiences. In fact, investment in spheres of life other than work, such as the family, looking after care activities, is interpreted as a limitation on total dedication to the academic career (Gaio Santos and Cabral-Cardoso 2008; Lind 2008). However, if on the one hand, female scientists are more often unmarried and childless than their male colleagues (and than women in general), on the other, there is no proof that childless women benefit from greater career opportunities, and there are no univocal conclusions on the role of parenthood on scientific productivity (Palomba 2008). At the same time, studies on the motivations of those who left academic careers (Preston 2004) indicate that while men make their decision with reference to their work (dissatisfaction at how much they earn and the lack of career prospects), women resort to more complex answers, in which they highlight the difficulty to balance career and family in environments which are not gender-friendly.

4. Research questions

Given the framework outlined this far, the main purpose of this article is to create a meeting point between the debate on the precarisation of academic professions and that on the (re)production of gender asymmetries in academic careers. The analyses focus on the career dynamics in STEM fields, where the consequences of the job precarisation introduced by the last university reform are more visible, and where the scientific debate and the political efforts aimed at improving gender balance in research has been concentrated (EC 2012).

At the professional level, the period following the completion of a PhD is the stage of the career most affected by the process of precarisation of working conditions and, at the same time, the presence of a more intense pace at work and geographical mobility. At the private level, however, these years coincide with a period of life, which more than the others, is marked by great expectations and pressures in the domestic and reproductive spheres. Therefore, we are interested in understanding how the growing instability and uncertainty that permeate academic systems and scientific careers intersect the mechanisms that reproduce gender (dis)advantages in career development. What are the career chances of male and female PhD holders in a context of growing uncertainty and competition for resources to carry out a research career? How do early stages researchers' perceptions of job instability and job insecurity influence their career strategies and how do they differ between men and women? And how do they influence the mechanisms that reproduce gender differences in career development? These are the research questions which leads the analyses presented in this article.

5. Methodology

The analyses proposed in this work are based on quantitative as well as qualitative sources. While the quantitative part focuses on the conditions of PhD holders' careers at a national level, the qualitative part allows us to look more in depth at the interaction between objective and subjective dimensions. Despite the diverse nature of the data used, they share the same time frame: they focus on career trajectories between 2008 and 2014, a period of great changes in the regulation of the Italian academic system.

From a quantitative point of view, we compare men and women's working conditions four and six years after the completion of a PhD, considering their personal and professional characteristics. Attention is paid to the comparison of

the career situation between those working in research at university or in the private or public sector and those who have moved to other sectors. The analyses are based on the *Doctorate Holders' Vocational Integration* survey, carried out by Istat in 2014 on PhD holders who obtained their PhD title in 2008 and 2010 in the Italian university system³. More specifically, the sample selection includes PhD holders in STEM fields: mathematics, physics and computer science; geology, chemistry and biology; civil engineering and architecture; industrial and information engineering. The final sample counts 3,501 PhD holders in 2008 (1,971 men and 1,530 women) and 3,792 PhD holders in 2010 (2,114 men and 1,678 women).

The analyses are organised into two parts. The first compares gender differences in working conditions within and outside the academic and scientific sectors, four and six years after completing a PhD. In the second part, the focus is shifted to the career opportunities of those who are still employed in research positions, with the aim to understand how aspects concerning the quality of scientific careers, as well as some aspects concerning the private sphere, are linked to having a tenured position in the research market.

The qualitative analysis is instead based on an organisational case study, conducted within the framework of the European project GARCIA⁴, focused on gender differences in the early phases of the scientific career in seven European universities/research centres⁵. Concerning the Italian case, the research was carried out in a STEM department at a medium-sized university, situated in the North of the country. From September 2014 to March 2015, 20 biographical interviews (Merrill and West 2009) were conducted with early career researchers who had had a postdoc contract with the studied STEM department between 2010 and 2013. Therefore, in terms of time frame, the group of the interviewees largely overlaps with that of the PhD holders analysed by the ISTAT study.

Considering the characteristics of the interviewees further, the first significant piece of information concerns their average age, which was 35.6 at the time of the interviews. This means that the 'early stages of academic careers' are more often to be understood in relation to the academic hierarchy rather than regarding the researchers' professional experience. The second relevant information concerns their parenthood status. Among the interviewees – 11 men and 9 women – only

³ <http://www.istat.it/it/archivio/8555>

⁴ The project GARCIA - Gendering the Academy and Research: combating Career Instability and Asymmetries – has been financed for the period 2014–2017 within the call Science in Society of the FP7 Programme of the European Commission (Grant Agreement n. 611737).

⁵ The countries involved in the GARCIA project are: Italy, Belgium, the Netherlands, Iceland, Switzerland, Slovenia and Austria.

very few had children and there were no women with children who still worked in academia.

During the interviews, two different timescales were explored: the first looked at their biographical and professional trajectories and their expectations for the future; the second, however, focused on their daily lives, looking therefore at the ways in which work and other life realms are intertwined. The interviews lasted between 50 minutes and two hours and a half, and were wholly recorded and then transcribed. The collected material has undergone a content analysis and was codified using the software Atlas.ti.

The next two paragraphs are dedicated to the presentation of the research results. Firstly, we shall illustrate gender differences in job in/security as well as in career prospects (within and outside academia) of STEM PhD holders at the national level. Secondly, we shall discuss – on the basis of the qualitative organisational case study – the main mechanisms underpinning gender asymmetries, conceptualising job in/security both from an “objective” as well as from a “subjective” point of view.

6. The quantitative analysis: Job conditions of male and female PhD holders

Starting out from the classic distinction between those who work and those who do not, the tab.1 shows that PhD holders in STEM disciplines are rarely jobless. On average, only 5.4% of PhD holders in 2008 and 6.9% of PhD holders in 2010 were unemployed six and four years after completing a PhD respectively. At the same time, the typical gender differences about professional chances are immediately visible: despite we are comparing men and women with higher qualifications, women are more often jobless than men.

[qui tab 1]

If we only take into consideration those PhD holders who are employed, the distribution of men and women in professional sectors shows that the average of those working in the research environment – made up of the sum of universities and public and private research institutions – is at almost 54% and 49%, four years and six years after completing a PhD respectively. There are no noticeable differences between men and women neither in the percentage of those employed in “other sectors” nor in the distribution of men and women in the three research sectors (tab. 2).

[qui tab 2]

The gender gap becomes visible, however, when the conditions of contracts are looked at in more detail in the various sectors⁶. Such disaggregation highlights two interesting aspects related to the process of precarisation (tab. 3). The first concerns the proportion of individuals who have temporary work contracts in the various sectors. The university is the sector in which the majority of individuals working in unstable working conditions can be found. In the case of the cohort 2010, 81.6% of women and 71.1% of men employed in academia were working in atypical positions four years after completing a PhD. The percentages of the 2008 cohort are lower: 49.4% of men and 69% of women were working with non-standard contracts six years after completing a PhD. It is important to note that, in the case of Italian academia atypical positions mainly coincide with postdoc research grants, which are nearly excluded from social protection, including unemployment benefits (Bozzon et al. 2015). In other research sectors, whether they are public or private, the security of employment relations is often much higher than in the academic sector, even if women's disadvantages remain unchanged: 63% of women from the 2010 cohort and 50.3% of women from the 2008 cohort have temporary contracts, in comparison with 50.3% and 45.4% of men in the two respective cohorts.

[qui tab 3]

On the other hand, permanent contracts make up a scarce part of conditions documented at university, where slightly more than one employee in ten benefits from these contract conditions, four years after completing a PhD, and one in four, six years after completing a PhD. The number of workers with permanent contracts is higher among those who work in "Other sectors". In this case, 48.3% of PhD holders from the 2010 cohort and 55.3% of PhD holders from the 2008 cohort are employed with permanent contracts. The fact that many are leaving research sectors seems thus to be compensated by a higher employment stability.

The second aspect linked to the process of precarisation of careers concerns gender differences in working conditions. It is more common to find PhD holders employed with atypical contracts or fixed-term contracts among women than men in all the sectors which were studied. The gap between men and women is, however, particularly high in the case of those working at university, where the

⁶ In these analyses, given the low number of those working in the private research sector, it was preferable to join the category with those who conduct research in the public sector (different from the university).

difference between women and men in atypical positions is 10 percentage points for the 2010 cohort and even 20 percentage points for those from the 2008 cohort.

To complete the picture of PhD holders' working conditions, we considered two further indicators which take into account the quality of positions in relation to the doctoral degree and the level of satisfaction with future career prospects.

The comparison between men and women employed in "other sectors" confirms that the PhD is hardly recognised outside of academic and research contexts (Bonatesta et al. 2014) (Tab 4). Academia remains in fact the environment in which doctoral degrees are most frequently asked for formally to fill professional positions. For those who work in other sectors, only in 10% of the cases having a PhD has been necessary to fill the position, and in about 80% of cases it is labelled as being either unnecessary or useless. Women more often than men claim to be overqualified for the jobs in which they work.

[qui tab 4]

Finally, looking at the level of career prospects satisfaction, the table 5 summarises this satisfaction as being greatly influenced by working conditions and the sector in which one is employed. The general trend is that those who have an atypical working position are generally less satisfied. In particular, levels of satisfaction seem to be significantly lower among atypical workers at university, whose average level, when measured on a scale of one to ten, remains at a level just above four in comparison with the level of satisfaction of those with fixed positions which was closer to six. In addition, the dependent fixed-term positions outline different patterns according to the sector. In the case of the university sector, these positions correspond to positions of assistant professors, regular members of the academic teaching staff and those closer to achieving a tenure position in academia, the ideal destination of scientific careers. Thus, it is hardly surprising that their levels of satisfaction are similar to those who are already full or associate professors. The case is different in other sectors, where those who have a dependent fixed-term contract have a level of satisfaction which is close to those who have other non-standard jobs. Although they are not shown on the table, in this case the disaggregation by sex does not show relevant gender differences.

[qui tab. 5 1]

In a nutshell, the picture that emerges shows that, although the university sector remains the environment in which PhD holders are most often in demand, at the

same time, it is the context that offers worse and less well protected working conditions. Those who leave the research sector often do so at the expense of being able to carry out a job suitable for the PhD they obtained, in favour of more secure and better guaranteed working conditions. At the same time, working conditions tend to be less advantageous for female PhD holders in terms of insertion in the career, conditions of the employment contract or the coherence of the work with the PhD obtained.

Placing the focus exclusively on those who are working at university and in research, it is possible to compare the chances for men and women to be employed in a teaching/research standard position (with permanent and fixed-term dependent contracts) *versus* those employed with non-standard positions (postdoc grants, occasional or temporary research collaborations), controlling for some indicators which take into account the quality of life and research paths four and six years after completing a PhD. Given the low percentage of those conducting their activities as self-employed in these sectors, we have decided to omit this category from the analyses.

To conduct the analyses on STEM PhD holders who are employed in academia or research, logit regression models were estimated. The control variables considered in the analyses were organised into four relevant areas:

- 1) the characteristics of current working positions and the information about previous experiences in the research environment between the end of the PhD and the current job: a) the sector of work, b) the country in which one works; c) and the fact of having benefited from a postdoc research grant, excluding the current grant if still underway;

- 2) the scientific productivity in the postdoctoral period, separated in two indicators: a) a rough indicator of the average annual scientific productivity based on the sum of all the published research products (articles, chapters in books, book reviews, proceedings) between the end of the PhD and the time of the interview, divided by the number of years since completing a PhD; b) and the number of won research projects after the PhD;

- 3) the quality of the PhD course measured in comparison with a) the field of study; b) having completed the PhD in the expected amount of time; c) and having spent a period of at least three months abroad during one's PhD;

- 4) the socio-demographic and domestic characteristics such as a) sex, b) age, c) living with a partner, d) and having child(ren) at the moment of the interview.

The results of the logit regressions are shown in the table 6, where the estimated values (beta), the connected confidence intervals, and average marginal effects (dy/dx) are reported⁷.

The main result is that women have more chances than man to be employed in precarious research positions even if the scientific course, the productivity and the personal sphere are controlled. The gender gap is larger for the 2008 cohort of PhD holders, six years after completing a PhD, for which women chances of being employed in a standard research position are 12% lower than men. In the case of the 2010 cohort, the marginal effect for women is -5% (tab 6).

[qui tab 6]

There are fields of study for which it is easier to be employed in a standard research position four or six years after completing a PhD. It is the case of who has a PhD in industrial engineering and information technology. Working outside the university sector and abroad show a positive relation with a permanent job, further proof that who works in these contexts finds more protected working conditions than in the Italian academic context.

Furthermore, there is a positive relation between scientific productivity and having a standard research job. However, given the nature of the data, it is not possible to clarify the direction of the relationship, namely if it is either a greater productivity that allows one to reach better positions, or whether, on the contrary, it is having a job which is more secure that allows for a better productivity. Nevertheless, studying the predicted probabilities on having a standard position in research for men and for women per the average annual scientific production shows an interesting trend. Figure 2 shows how for men from the 2008 cohort a rise in the number of publications makes working in a structured position more likely. On contrary, in the case of women the probability of being in a standard position is systematically lower and does not increase significantly despite rises in productivity. The same exercise repeated with the 2010 cohort highlights a positive relationship between productivity and employment in a permanent job, but the differences between the two sexes are negligible. Although on average women are less productive than men⁸, the criteria for measuring career development seem to count in different ways for men and women in the process of professional consolidation, despite having the same number of publications.

⁷ The descriptive statistics of the variables included in the models are collected in an appendix available on request to the authors.

⁸ According to our scientific productivity indicator, on average women of the cohort 2008 have 4,9 annual publications after PhD graduation while men have 6.2 annual publication. In the case of the cohort 2010 women have 5.1 annual publications and men 6.4.

[qui fig 1]

Finally, the two indicators regarding the private sphere, having children and living with a partner at the time of the interview, show a positive association with being employed in permanent positions. It is not possible to clarify the direction of this relationship in this case either. As a rule, in the Italian context, and more generally in contexts with low levels of welfare protection, the relationship between professional uncertainty and family transitions often leads to postponing the latter (Barbieri et al. 2015). The result found could thus reflect the fact that among those employed in more stable positions, it is more common to find individuals who have had the possibility to put into practice projects related to families and parenthood.

7. The qualitative analysis: Job in/security in the narratives of male and female PhD holders

In the light of the findings of the quantitative analysis, and after having analysed the collected biographical narratives, in this contribution we shall re-interpret the results of the organisational case study conducted in a STEM department in Northern Italy, by constructing a dialogue between the macro and micro approaches used in our research. More precisely, the experiences of the STEM PhD holders we interviewed during the GARCIA project have been classified by taking into consideration both the dimensions of ‘objective’ and ‘subjective’ job in/security (De Witte and Naswall 2003). With this purpose, two different axes of the ‘job in/security’ meaning have been crossed: the first based on the type of employment contract, and so on objective in/security, the second based on the subjective representations of the interviewees. Therefore, the extremes of the first – horizontal – axis are *employment insecurity* (i.e. an unstable employment situation, which results in a non-tenured position at university or in a temporary contract in the private sector), and *employment security* (i.e. a full time and open-ended contract). On the vertical axis are instead arranged the subjective representations of the interviewees about job in/security. More precisely, we conceptualised the ‘subjective job insecurity’ in terms of feeling under pressure – in the professional sphere as well as in private life – and about career prospects. The main objective of the qualitative analyses is then to investigate not only the type of contracts under which the interviewed PhD holders are employed, but also in which ways they perceive their job position and their career prospects, in the

university or in the company in which they were working at the moment of the interview. In analysing the relations between objective and subjective in/security, particular attention is reserved to gender differences and to the articulation of different life realms in the experiences of STEM PhD holders. As mentioned above, the interviews were realised with PhD holders who worked as postdocs in the studied STEM department between 2010 and 2013. At the moment of the interviews, conducted between the end of 2014 and the beginning of 2015, some of them were still working in the same department, some moved to another university (in Italy or abroad), and some were working in a private company.

Starting from the analyses of ‘objective job insecurity’, a first result is the evidence that none of the interviewees, at the time the research was conducted, had obtained a permanent position or a tenure-track position at an Italian university. The trajectories of those who chose to move to another country after the postdoc, show instead a higher level of stability. It is above all those who return to their own country of origin who find it easier to obtain a permanent position as assistant or associate professor. In the same way, among those people who, after a postdoc in the studied department, moved to the private sector, only one had a fixed-term contract. Therefore, the security/insecurity axis, in terms of employment contract, seems to polarise those who try to stay in the Italian academic system and must accept an unstable position (quadrants *a* and *b*), and those who decide to work in academia abroad or move to the private sector, who are able to obtain a job stability (quadrants *c* and *d*). Thus, also the qualitative analysis confirms that the time needed for career stabilisation is very long in Italian academia (with very few positions available) and that it takes less time in other countries and in the private sector.

Moving beyond the analysis of the working arrangements, a more accurate interpretation of these findings can be provided by combining the structural element of the employment contract with the subjective dimension of the job in/security’s self-representations. The way in which the “objective job in/security” is combined with the “subjective job in/security” leads to different positionings, described in the light of the observed gender differences among interviewees.

[qui fig 2]

In the *quadrant (a)*, we find early career researchers who are employed as fixed-term assistant professors at an Italian university, but don’t perceive themselves in a precarious or risky situation concerning their working conditions, sharing therefore the feeling of ‘subjective job security’. The interviewees who find themselves in this position, despite the insecurity of the job, seem to be

certain that they will soon obtain a stable position in the STEM department in which they work, and in which they had previously worked as postdocs. However, among the stories which could be placed in this quadrant, we found relevant gender differences in the perception of the future, not so much in terms of professional perspectives, but rather about prospects in family life.

“My aim is to become an associate professor, because I have the qualifications. On the basis of my C.V. I would expect to obtain a position as associate professor [...]. There are some firm reference points which are quite obvious, what I mean by that is that with a daughter on the way I doubt I will be moving from here soon. Obviously, it depends on various things: whether I pass a public examination here, or whether I pass it somewhere else and have to move. But my aim is to obtain a position as an associate professor in Italian academia, this is more or less my goal” [Man, STEM dept. RTD-A].

“My work here is going well, really, [...] I know that if I continue to work like that I will have what I expect for my work life, I don't have any doubt on that, but if I work like that... If I stop working, I know that I will lose something. [...] To have a relaxed mind I will wait until I will become associate professor. And then I would like to have a baby, so let's see.” [Woman, STEM dept. RTD-A].

Both interviewees seem to be sure about the fact that in the future they will continue to work at the STEM department in which they are employed as fixed-term assistant professors, even though their contract does not oblige the university in any ways with respect to a possible renewal of the contract or the stabilisation of their position. However, competition and the pace of work seem to affect male and female PhD holders in different ways, especially in the balance between work life and private life. All interviewees who could be placed in *quadrant (a)* believed to have good career development prospects and told us that their pace of work is very intense, and they often continue to work even in the evening or at the weekend. However, men do not see parenthood as a hindrance to their own professional path, also because they seem to reproduce a work-life balance model based on a somewhat traditional gender culture. On the other hand, the only woman interviewed who declared not to have doubts about her own academic future described starting one's own family as an obstacle to the development of an academic career. This perception then results in a postponement of motherhood, due to concerns about the disruption of work that this would cause (Ferri et al. 2016). Therefore, motherhood is perceived by the interviewees as a problematic event at the individual level, and maternity still does not seem to find citizenship in Italian academia, which reproduces an organisational model based on the *long*

hours' culture (Currie et al. 2000), imposing a pace of work which makes difficult to spend time on other life realms, mainly care activities (Gaio Santos and Cabral-Cardoso 2008).

If we continue to focus on those who have a temporary employment contract, and are therefore affected by 'objective job insecurity', in *quadrant (b)* we can again find individuals who work in Italian academia, but who not only have an unstable employment contract, but also feel like being in an insecure situation from a subjective point of view, believing not to have good career prospects. Indeed, while the assistant professors described before have a fixed-term contract and are considered as part of the standard teaching staff at the university, the interviewees in *quadrant (b)* are employed as postdocs. Beyond the distinctions related to working arrangements, the subjective job insecurity shared by the interviewees in this group is connected to the lack of hope in continuing their career in the Italian academia. This sense of insecurity is nevertheless experienced in very different ways by men and women who, despite both believing not to have professional prospects, enact different career strategies. On the one hand, most men working as postdocs are planning to go abroad to achieve their aim to remain at university. On the other hand, most women wish to continue to do research, but they are not willing to leave the country.

“The situation is the same as it is in all the rest of Italy: there's no money and there are no investments. It's not the criteria which are the problem. The problem is very simple: if you don't invest, you can put whatever criteria you want. It's a matter of funds, not criteria. I can't complain because as metrics they're okay. [...] It's very simple, I have to move in a place where the government invests in research” [Man, STEM dept. postdoc].

“In the future I see myself doing research. I'd like to stay here, but I know that there are very few chances. [...] I don't have a plan yet... I have some directions, but I don't want to have a career at any price... I don't know, maybe it's because I'm not very competitive. I am an ambitious person, I want to follow my objectives and if I believe in an idea, I try to take it forward, but I'm not here to attract attention... [...] Yes, I think competitiveness and showing off is a problem, that is to say that I think there is a substantial difference between men and women in principle” [Woman, STEM dept. postdoc].

In looking at gender differences, another interesting aspect is the fact that men tend to attribute the low probability of continuing to do research to the lack of resources in the Italian academic system, but without recruitment and assessment criteria being called into question. Among the women, a recurring theme in the interviews is that the principal characteristic for an academic career in Italy is not

so much meeting the formal criteria of selection, but rather the ability to attract attention in the department in which one works, something that men seem to be more able to do than women.

After having analysed how the ‘objective job insecurity’ is intertwined in some cases with the subjective job security – it is mainly the case of fixed-term assistant professors – and in some others with a subjective perception of job insecurity – it is mainly the case of postdocs – we shall now focus on how the ‘objective job security’ is interlaced with the subjective representations. This means to pay attention to the stories of those who have an open-ended employment contract, and to illustrate the positionings of both those who feel secure also from a subjective point of view, and of those who, on the other hand, despite a permanent position, feel to be in a fragile position.

Among those who believe to have attained security, we found firstly the interviewees who obtained a permanent position in the academic field in their country of origin. However, in *quadrant (c)*, there are above all those interviewees who decided to move to the private sector, in order to obtain a permanent position and specially to continue doing research with a less frenetic work pace and higher salaries than those at universities.

“I applied for a job at *** because basically there was no chance of staying at the *** [STEM department]. So, I could either remain there with a totally precarious post without any stability or guarantees, or look for another job but one still linked to research.” [Woman, former STEM dept. postdoc].

“I didn’t have any chance of staying there. Actually, for the last six months I looked around for a job. I tried to write proposals for the European Commission or something like that, but I was not lucky at that time and found nothing. When I was offered a chance to enter this institution with a more stable contract, I accepted it” [Man, former STEM dept. postdoc].

From the stories of those who went to work in the private sector, it would seem that there are no relevant gender differences. However, they resurface when one analyses the interviewees’ reasons for deciding to leave academia. Among men there are some who underline how problematic becoming a parent in the university environment is, and others who, even earlier, when they were working as postdoc, could easily balance work and private life. Among the women with children who left university, the interviewees’ stories are instead more homogenous and refer to a pace of work that is difficult to manage when working in a company, but that would have been impossible to sustain in the academic context.

“I realized that the work I was doing would have been hard to reconcile with

family life and especially with having children [...]. I and my wife had two difficult lives because we were both doing research. We weren't Superman or Wonder-woman. So, this would have also limited the possibility of managing any future children" [Man, former STEM dept. postdoc].

"During that period, I didn't work after six thirty or seven in the evening. I might work after seven if I had a deadline. [...] At the weekends, we went into the mountains with friends, and I found a bit of time for myself ... I checked my emails on Monday [...] but the salaries are definitely different in the academic and the private sectors, and then after a year in a company I understood that I want to have something more stable" [Man, former STEM dept. postdoc].

"I can't work more because my body won't let me. If the girl falls asleep at nine, say, I can't work in the evening because I just can't stand it psychologically, I can't concentrate anymore, I'm tired [...] It's difficult, even now. But if you have a permanent contract you feel so much better, you feel different. If I had had a postdoc, I would have felt much worse. When I became pregnant I told my boss, I told everyone and they all said: "Yes, okay, we understand everything, don't worry, it's fine." But afterwards, once you have a child, if you want to get back on track, you have to go back to work three months after giving birth, and for me that was difficult [...] But then I caught up again. At *** [STEM department] it would have been impossible" [Woman, former STEM dept. postdoc].

Academia is therefore described, once again, as an organisational context that does not allow periods of interruption, which would slow down the activities required by the department. Male and female interviewees in this quadrant share what we have defined a 'subjective job security', since both are positive with respect to future professional developments within the company they work for. However, work-life balance remains more complicated for women than for men, who are, furthermore, employed in managerial positions from the outset, which is not the case for the women we interviewed.

Finally, the fourth and last *quadrant (d)* should collect the stories of those who have a stable job but, despite this, feel to be in a vulnerable position – here defined as 'subjective job insecurity' – because of the limited possibilities of career development, or because they are doing a job they are overqualified for. Among the interviews that we carried out, only one story can be included in this quadrant. In this case, the interviewee obtained an open-ended employment contract, but she claimed not to be able to use the skills acquired along the academic path, so that the obtained PhD was not valued in her profession.

"Everything I've done since the doctorate, I could easily not have done at all. Even my degree is too much compared with what I do now in my job, because to be *** you don't need the skills acquired with a PhD, not even the skills acquired at the master level [...]. Let's say that I'm not satisfied

with my job, if I consider it on the basis of my curriculum and my previous professional experience” [Woman, former STEM dept. postdoc].

The only story which can be placed in *quadrant (d)* – maybe not by chance about a woman – represents a case of professional deskilling, which was forcedly accepted by the interviewee in exchange for a greater stability in her employment contract with the aim, moreover, to start a family. This last quadrant, even if populated only by an interview, is, however, particularly interesting; it sheds light on the importance of the identity dimension in the researchers’ work, as it shows the difficulties experienced in managing a failed professional ambition. The sense of insecurity, therefore, is strongly linked to the employment instability – what we defined ‘objective job insecurity’ – but also to the fact that one feels fragile from a subjective point of view, both on the labour market and in the private life.

8. *Discussion and conclusions*

In this final section, we intend to discuss the convergence points of the quantitative analysis of the STEM PhD holders’ working conditions, in relation to the research results of the qualitative organisational case study, conducted on the same target group within a STEM department at a university in Northern Italy. This has allowed us to study not only objective factors concerning employment (in)security (permanent vs. temporary positions), but also the subjective representations of the (in)securities that mark the career trajectories and the future prospects of the STEM PhD holders. More precisely, our interest was focused on how the growing instability and uncertainty in the academic system intersect the mechanisms that reproduce gender dis-advantages in scientific careers.

The first element to be pointed out is that – for early career researchers who obtained their PhD in Italy – Italian universities represent the part of the research market which offers the worst conditions with regard to employment contracts and in which it takes the longest to obtain a tenured position. What both the national data and the interviews reveal, therefore, is something that was already highlighted in previous works on the Italian academic context (Toscano et al. 2014), namely that the process of precarisation is affecting the university landscape and more and more limiting early career researchers’ access to academia. Postdoc grants – the type of contract most frequently used among temporary contracts in academia – represent the emblem of the process of precarisation, since they are not recognised by the Italian legislation as a proper employment and are excluded even from unemployment benefits (Bellè et al. 2015). It is then hardly surprising that both the quantitative as well as the

qualitative analyses show the high level of dissatisfaction among those who work in these positions about future career possibilities and the little trust they have concerning their opportunities to continue their academic path in Italy. The analyses also converge on the career strategies put in place to limit the conditions of ‘objective job insecurity’: (i) finding a research position at a foreign university; (ii) moving to the private research sector; (iii) leaving the research sector.

From a gender perspective, the data confirm that women have greater difficulties in obtaining stable working conditions, both when they continue doing research and when they leave scientific careers. At the same time, they seem to be less willing than men to geographical mobility aimed at finding more stable working conditions. The result is that, on the one hand, women employed in scientific careers in Italy remain in insecure positions for longer periods than men, independently of their performance. If for men scientific productivity means an increase in work opportunities, this does not seem to be the case for women. On the other hand, those women who leave the research environment are exposed to greater risks of devaluation of their skills, finding themselves to be in temporary or underqualified positions more often than men. Moreover, the analysis conducted within the qualitative case study shows that leaving the Italian academia – either to continue doing research or to move to the private sector – is counterbalanced by daily working conditions which are more sustainable in terms of the work/life balance. From this perspective, differently from the majority of men, who are principally looking for greater employment security and an improvement in their own financial situation, women who leave academia seem to be mainly interested in working conditions that are more sustainable and less intrusive on the private sphere, also because of the persistence of relevant gender asymmetries within the couple.

In conclusion, our research shows that the structural lack of tenured positions is not the only crucial element for those leaving their scientific careers within Italian academia. In fact, another one is also the job insecurity experienced subjectively, closely linked to the organisational model, based on the long hours’ culture, in which the acceleration of the pace of work and the requirement to be constantly available do not leave room, above all for women, for other life realms. Such a situation is, moreover, reinforced by the social context, based on a rather traditional gender culture, as well as by a limited development of policies that promote work-life balance and gender equality in workplaces. In such a context, the mechanisms that favour the creation of gender differences in work opportunities continue to be reinforced by – and continue to reinforce – an ideal career model, based once more on an anachronistic, traditional and masculine biographical trajectory, in which motherhood does not find any place, and in

which women remain marginalised, even those who adhere to such a career model. The career strategies of the female early career researchers (in STEM fields of study) within Italian academia consists in fact in remaining in the system and postponing or refusing to make decisions in the private life, in an effort not to compromise their own scientific activity and their own visibility in the academic network, indispensable features for a successful career development. On the other hand, males' strategies seem to be more proactive and mobile, mainly free from the conditions of the family sphere, and to adhere to the criteria for the assessment of merit, also because they are still built around the figure of the *homo academicus*. Thus, the current precarisation of academic careers concerns both male and female early career researchers, but does not seem to scratch and/or undermine the organisational culture in the Italian universities which remains based on a traditional gender model resistant to change.

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