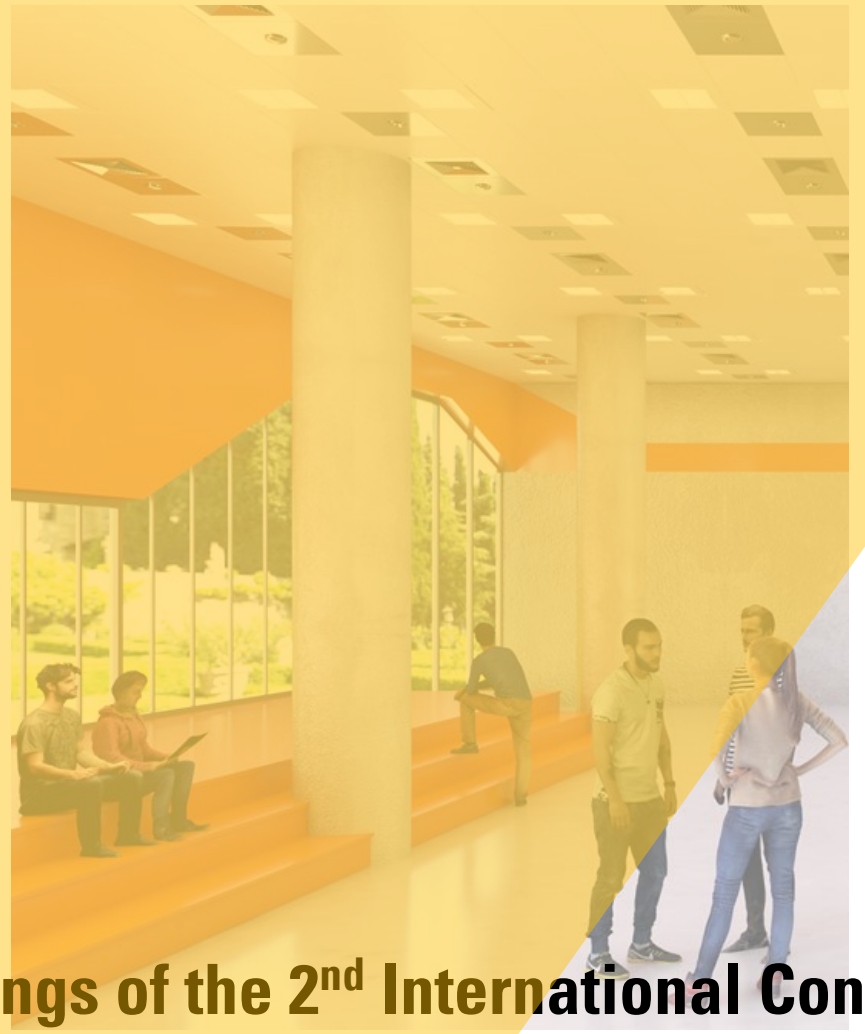

Proceedings of the 2nd International Conference of the Journal Scuola Democratica

REINVENTING EDUCATION

VOLUME II

Learning with New Technologies, Equality and Inclusion

ASSOCIAZIONE "PER SCUOLA DEMOCRATICA"

Proceedings of the 2nd International Conference of the Journal Scuola Democratica

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VOLUME II

Learning with New Technologies, Equality and Inclusion

ASSOCIAZIONE "PER SCUOLA DEMOCRATICA"
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Title **Proceedings of the Second International Conference of the Journal "Scuola Democratica" – Reinventing Education VOLUME II Learning with New Technologies, Equality and Inclusion**

This volume contains papers presented in the First International Conference of the Journal "Scuola Democratica" which took place at the University of Cagliari on 5-8 June 2019. The aim of the Conference was to bring together researchers, decision makers and educators from all around the world to investigate the concepts of "education" in a "post-democracy" era, the latter being a set of conditions under which scholars are called to face and counteract new forms of authoritarian democracy.

Populisms, racisms, discriminations and nationalisms have burst and spread on the international scene, translated and mobilized by sovereigntist political movements. Nourished by neo-liberalism and inflated by technocratic systems of governance these regressive forms of post-democracy are shaping historical challenges to the realms of education and culture: it is on this ground, and not only on the political and economic spheres, that decisive issues are at stake. These challenges are both tangible and intangible, and call into question the modern ideas of justice, equality and democracy, throughout four key dimensions of the educational function, all of which intersected by antinomies and uncertainties: ethical-political socialization, differences, inclusion, innovation.

The Conference has been an opportunity to present and discuss empirical and theoretical works from a variety of disciplines and fields covering education and thus promoting a trans- and inter-disciplinary discussion on urgent topics; to foster debates among experts and professionals; to diffuse research findings all over international scientific networks and practitioners' mainstreams; to launch further strategies and networking alliances on local, national and international scale; to provide a new space for debate and evidences to educational policies. In this framework, more than 600 participants, including academics, educators, university students, had the opportunity to engage in a productive and fruitful dialogue based on researches, analyses and critics, most of which have been published in this volume in their full version.

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Gender Differences in Work and Life Paths among PhD Holders in Italy

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ABSTRACT: *The present paper follows in the wake of previous works that have shown changes and stability regarding female educational and working participation in STEM. Our previous analyzes (De Vita, Giancola, 2017, 2021), have shown several solid evidence. First, we could observe how the paths (both study and work) in STEM are formed at a very early age (with important implications for policies aimed at reduction in gender inequalities). We then saw that the gender variable does not act autonomously but acts combined with the social background, creating further differentiation effects «within» the STEM areas. Finally, we have been able to observe that having a high degree in STEM has a relative protective effect for women (in terms of positioning in the labor market) but that a still substantial salary differential persists. In this paper, using the latest ISTAT data produced as part of the survey on the professional insertion of PhD's holders, we will focus on the observation of the previously estimated trends (female participation and differentiation «within» STEM) after graduation at higher level in the education system. The survey (whose data were published in 2019 and refer to the cohorts of PhD's holders who obtained the title in 2012 or 2014, interviewed in 2018) allows precise comparability, a feature that makes the previously listed analyzes possible. Starting from the database, a specific focus will then be directed to the «University-work transition», developing a differential analysis with respect to gender and ascriptive factors. The basic idea is to estimate the factors that most produce gender differences with respect to employment and income size, with a specific focus on the STEM field. Another aspect of interest is to investigate parenthood, having as a control parameter other data on compatible populations (by age and survey period). The paper therefore aims to investigate continuities and discontinuities but also to investigate specific thematic aspects that allow a more in-depth and detailed analysis of social mechanisms and dynamics with respect to differences and inequalities at the highest level of education and in the following life and work paths.*

KEYWORDS: *Higher education, PhD, Gender differences, Economic return of education, Parenting*

1. Overview and Research questions

This paper is part of a more general reflection on the presence of women in STEM (Science, Technology, Engineering and Mathematics) careers. In recent years, the national and international debate has highlighted important changes, alongside the persistence of several mechanisms of inequality (Smith, 2011; Bilimoria, Lord, 2014; De Vita, Giancola, 2017; De Vita, Giancola, 2021). Beside a progressive growth in the presence of women, both in training and in the labor market, women continue to face significant barriers first relate to the distinction between the hard and life sciences, second to the quality of employment in terms of social protections, income and career paths. Against this backdrop, and by distinguish between life sciences and hard sciences, the basic idea is to estimate first gender differences in STEM fields related to occupational conditions and income. Second we have delved into the variables related to parenthood, and especially the presence of children, having as a control parameter other data on compatible populations (by age and survey period). The aim is to analyze whether and to what extent the presence of children impacts in the life and work paths for men and women at the highest level of education.

2. Data and Methods

With respect to the cognitive purposes illustrated, we used data from the survey «Job placement of PhDs» carried out by ISTAT (released in June 2019). The survey concerns those who have earned a doctorate, with the aim of detecting their employment status a few years after receiving their doctorate. The survey of PhDs covered two cohorts, i.e., those who received their Ph.D. degrees in years 2012 and 2014. The survey (conducted in year 2018), therefore, captured employment status six and four years after the degree and, unlike the other surveys in the system, which are sample-based, covered all PhDs in the two cohorts.

The database produced by the survey includes a great deal of information such as: results of the educational pathway; opinions on the PhD experience; insertion in the world of work; mobility experiences, especially towards other countries; family situation of the PhD, both that of origin and that at the time of the interview.

The analyses performed were, in a first step, exploratory in nature. In this step, the different presence of men and women in the various scientific fields covered by the doctoral programs and the single gender distribution of the respondents by doctoral field were analysed. In the next step, after recoding by merging doctoral research fields, we proceeded to analyse wage differentials between men and women, then interacting the parenting variable (having or not having children). The elaboration was carried out through a multi-strata ANOVA (analysis of variance) procedure Finally, based on the recorded evidence, we moved

on to develop a set of regression models (OLS, *without* and *with* interaction effects between the doctoral field and the presence of children) in order to estimate the effects of variables assumed to be independent with respect to employment status and income.

3. Explorative results: the persistence of gender inequalities

Quite consistent with the results of other research, the feminization of STEM fields follows an uneven trend. As evident from table 1 if we look at the distribution of men and women among the various disciplines we can see how, with reference to the STEM fields, that women are mainly present in medicine and biology while men in industrial and informatics engineering. It is confirmed therefore a kind of model of association between gender and academic sector that affects not only the opposition between humanist and scientific disciplines, but also the one between technical knowledge and relational knowledge, or knowledge linked to the dimension of care as provided for example by medicine and life sciences (Barone, 2011; Barone 2010; Triventi 2010). The trend is also evident if we look at the gender differences (on the right in table 1) within each discipline. The gap is indeed important in industrial and informatics engineering, but also in mathematics and physics. This confirms an ongoing process of feminization, with some areas in which women outnumber men, long standing process in the humanities, and others in which the presence of women is still absolutely marginal.

TAB. 1. *Doctoral area by gender (% of row and column)*

PhD area	*Males*	*Females*	*Total*
Mathematics and Computer Science	5,1%	1,9%	3,4%
Physical Sciences	6,6%	2,5%	4,4%
Chemical Sciences	4,3%	5,4%	4,9%
Earth Sciences	2,5%	2,3%	2,4%
Biological Sciences	7,6%	11,7%	9,8%
Medical Sciences	11,5%	18,6%	15,2%
Agricultural and Veterinary Sciences	5,8%	5,7%	5,8%
Civil Engineering and Architecture	8,0%	7,3%	7,6%

PhD area	*Males*	*Females*	*Total*
Mathematics and Computer Science	70,6%	29,4%	100,0%
Physical Sciences	70,3%	29,7%	100,0%
Chemical Sciences	41,8%	58,2%	100,0%
Earth Sciences	48,4%	51,6%	100,0%
Biological Sciences	36,8%	63,2%	100,0%
Medical Sciences	35,5%	64,5%	100,0%
Agricultural and Veterinary Sciences	47,4%	52,6%	100,0%
Civil Engineering and Architecture	49,2%	50,8%	100,0%

Industrial and Information Engineering	18,5%	5,9%	11,8%	Industrial and Information Engineering	73,6%	26,4%	100,0%
Ancient, philological-literary and historical-artistic sciences	7,0%	12,2%	9,7%	Ancient, philological-literary and historical-artistic sciences	33,9%	66,1%	100,0%
Historical, philosophical, pedagogical and psychological sciences	7,4%	10,0%	8,8%	Historical, philosophical, pedagogical and psychological sciences	39,6%	60,4%	100,0%
Legal sciences	7,3%	7,2%	7,2%	Legal sciences	47,3%	52,7%	100,0%
Economics and Statistics	5,4%	5,4%	5,4%	Economics and Statistics	47,2%	52,8%	100,0%
Political and Social Sciences	3,2%	3,8%	3,5%	Political and Social Sciences	42,6%	57,4%	100,0%
Total	100%	100%	100%	*Total*	47,1%	52,9%	100,0%

This non-homogeneity of STEM disciplines, characterized by different processes of gender expansion, suggested for further elaboration to distinguish the STEM fields by grouping them into two subgroups. As can be seen from tab 2 we have the hard STEM (Physical Sciences; Mathematical and Computer Sciences; Industrial and Information Engineering; Civil Engineering and Architecture) and STEM life sciences (Chemical Sciences; Earth Sciences; Biological Sciences; Agricultural and Veterinary Sciences; Medical Sciences).

TAB. 2. *Regrouping of PhD areas*

Physical Sciences	*Hard STEM*
Mathematical and Computer Sciences	
Industrial and Information Engineering	
Civil Engineering and Architecture	
Chemical Sciences	*STEM Life sciences*
Earth Sciences	
Biological Sciences	
Agricultural and Veterinary Sciences	
Medical Sciences	
Ancient, Philological, Literary and Historical-Artistic Sciences	*Other sectors*
Legal sciences	
Economics and Statistics	
Political and Social Sciences	
Historical, Philosophical, Pedagogical and Psychological Sciences	

Compared to employment status, having a STEM PhD increases the possibility of being employed for both men and women. As we can see in the table 3, STEM gives an advantage over other disciplines and in STEM life there are no differences between men and women, which in any case are small even in hard STEM. So the competitive advantage of these types of paths is fully confirmed by our data. While a high education for females is always associated with a greater competitive advantage in the labor market, STEM disciplines amplify this advantage much more than for males. As shown in the table in non-stem disciplines the gap between men and women in terms of employment is higher as well as female unemployment is higher.

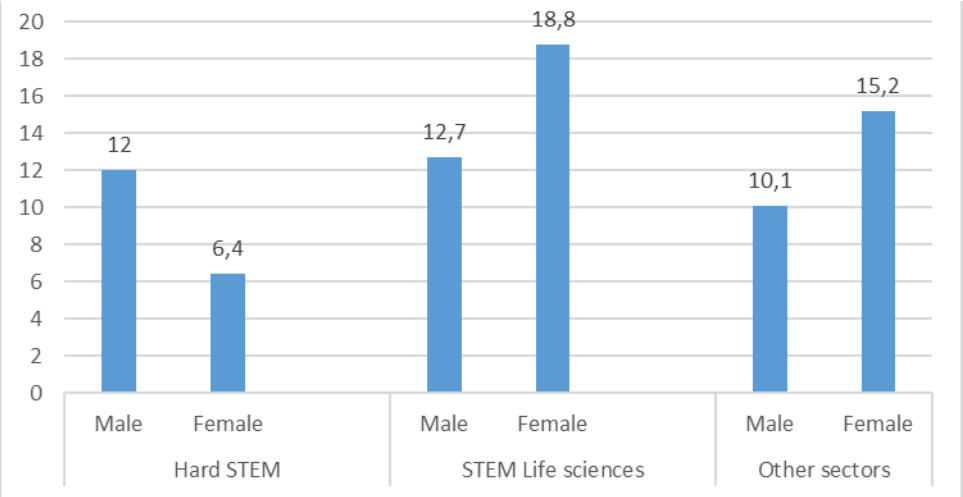
TAB. 3. *Employment status by gender and by PhD area*

			Other sectors	*STEM Life sciences*	*Hard STEM*	*Total*
Males	Work situation	*Currently working*	78,6%	87,1%	88,0%	84,9%
		Currently working, in more than one occupation	15,1%	9,2%	8,8%	10,8%
		Unemployed	6,3%	3,7%	3,2%	4,3%
	Total		100,0%	100,0%	100,0%	100,0%
Females	Work situation	*Currently working*	75,6%	87,1%	84,5%	82,2%
		Currently working, in more than one occupation	15,0%	5,7%	11,0%	10,2%
		Unemployed	9,4%	7,2%	4,5%	7,6%
	Total		100,0%	100,0%	100,0%	100,0%
Total	Work situation	*Currently working*	76,8%	87,1%	86,8%	83,5%
		Currently working, in more than one occupation	15,1%	7,0%	9,6%	10,5%
		Unemployed	8,1%	5,8%	3,6%	6,0%
	Total		100,0%	100,0%	100,0%	100,0%

The data on transition to parenthood for PhD Holders in STEM fields are already showing important element of difficulties. Data from our elaboration on «Popolazione e famiglia, data warehouse ISTAT» showing that the share of women with children in Italy in the equivalent age group in higher compared to women in STEM fields are significantly higher. In

the same age rank of sample of PhD Holders, the female population have one child between the 27.1% (lower age bound) and 26.2% (upper age bound) of cases and more than one child (includes the previous one) between 50.3% and 46.6%. As evident in Fig. 1, in hard stem the presence of children is the lowest compared to all the other areas. Interesting to point out, while the likelihood of having children in hard STEM fields remains more or less in line with other fields for men, it drops dramatically for women, with a difference of more than 12 percentage points compared to STEM life sciences. This perhaps is linked to the organizational structure that characterizes companies operating in hard STEM. If, indeed, is more common for women in life STEM to be employed in the public sector, companies operating in the hard STEM adopt organizational models that are more growth- and competitiveness-oriented, with limited attention to family friendly policies (Cech, Blair-Loy, 2019). Moreover, the presence of a corporate culture that tends to delegitimize reproductive choices also encourages the creation of a sort of «stigma» linked, for example, to the use of leave, part-time work, etc., and a motherhood penalty (England, Budig 2001) viewed as a manifestation of less effort, commitment to work and productivity.

FIG. 1. *Children presence by PhD Area*



4. Gender and PhD field: from differences to inequalities

As described in the methodology section, after the descriptive analyses, we moved on to the development of a set of multivariate models based on multiple linear regression. In the model reported in Tab. 4, we estimated the weight that variables referring to doctoral area, gender, and age group have in predicting positive employment outcomes. Doctoral pathways pertaining to life sciences and hard STEM sciences were included as independent variables, using as a reference category the one including all other doctoral pathways. The other independent

variables are age groups, with the reference category being those born before 1978, and gender, using «men» as the reference category.

TAB. 4. *Determinants of employment status (dependent variable employed vs. unemployed/inactive)*

STEM Life sciences	0,044
Hard STEM	0,064
ref.cat. Other sectors	-
age group=1979-1982	0,00*
age group=1983-1984	0,026
age group=1985	0,034
ref.cat. 1978 or older	-
Female	-0,061
ref.cat. Male	-

* Not sign. / Coeff. >0,0,5

As can be seen from the model, compared to doctoral paths that can be placed in non-STEM areas, STEM paths have a stronger weight in determining the employment outcome; specifically, it is possible to observe an advantage resulting from having faced a doctoral path in hard STEM disciplines compared to those belonging to the STEM life sciences area. With reference to gender, however, what emerges is the disadvantage for women, which then determines a negative impact in the employment outcome, net of other variables used in the model. Generally speaking, it is possible to say that doctorates in STEM disciplines, once obtained, constitute an advantage in entering the labor market, being able to guarantee greater possibilities of finding employment at the end of the course of study, compared to doctorates obtained in non-STEM disciplines.

TAB. 5. *Determinants of employment status (dependent variable employed vs. unemployed/inactive). Split model by gender with interaction PhD Sector with children presence*

	Male	Female
age group=1979-1982	0,040	-0,024*
age group=1983-1984	0,069	0,013
age group=1985	0,071	0,029
ref.cat. 1978 or older	-	-
Hard STEM – Children presence	0,045	-0,039
STEM Life sciences – Children	0,060	0,022

presence		
Other sectors – Children presence	0,024	0,012
All PhD without Children	-	-

* Not sign. / Coeff. >0,0,5

In Tab. 5, divided by gender, the impacts on the employment outcome of the independent variables referred to age groups and the presence of children among male and female PhDs were evaluated, using as a reference category those who have obtained a doctoral degree and at the same time do not have children. What emerges is that the presence of children among female PhDs in hard Stem has a negative impact in terms of employment, while for male PhDs in the same area the presence of children has a positive impact. Both positive are, instead, the impacts related to the presence of children among those who have obtained a doctorate in the area of life sciences, even if the advantage is greater for men than for women. The presence of children among STEM PhDs does not appear to represent a disadvantage with respect to employment outcomes, although for women the effects of having children tend to weaken the overall advantage that a doctoral degree in STEM disciplines (as reported in Table 4) provides. Young age – with respect to the groups considered in our study – has a positive impact on both sexes; although with greater weight for men, being born after 1978, in fact, represents an advantage for the employment outcome.

In Table 6 we reported the average salary between men and women with respect to the presence or absence of children. Without initially going into the division by PhD area, the presence of children represents a disadvantage in terms of salary for women, with an average loss of salary on a monthly basis of about 61 euros. This disadvantage, on the other hand, is not recorded for men; in fact, on average, male PhDs tend to have a higher average monthly salary when children are present. Delving deeper into doctoral areas, however, while there remains a gender wage difference, it is interesting to note what happens when children are present. Among female PhDs in non-Stem areas and those in Hard Stem areas, the presence of children represents a disadvantage in terms of salary, with an average monthly loss of salary of about 166 and 115 euros, respectively. The opposite case occurs among PhDs in life sciences, where the presence of children increases, on average, the monthly salary by about 100 euros. Overall, the presence of children tends to exacerbate what is the wage differential between men and women, with a more pronounced disadvantage among women with doctoral degrees in stem disciplines than those with doctoral degrees in non-Stem fields.

TAB. 6. *Determinants of income (ANOVA by PhD Field, Gender, Children presence)*

	Total Overall		*Hard STEM*		*Stem_Life sciences*		*Other sectors*	
	Total Monthly Income		Total Monthly Income		Total Monthly Income		Total Monthly Income	
		Mean		Mean		Mean		Mean
No children	Male	2171,9	Male	2212,2	Male	2183,8	Male	2119,9
	Female	*1766,9*	*Female*	*1808,3*	*Female*	*1782*	*Female*	*1710,5*
	Total	1963,7	Total	1995,1	Total	1981,1	Total	1915,2
With children	Male	2325,3	Male	2343,1	Male	2527,8	Male	2105
	Female	*1705,9*	*Female*	*1692,6*	*Female*	*1881,4*	*Female*	*1543,8*
	Total	2020,2	Total	2104,2	Total	2132	Total	1824,4
Average income loss Female with children		-61,04		-115,77		99,37		-166,71

In Tab. 7, the dependent variable used is income, with the intent of analysing the weight that age, being female versus being male, and doctoral area crossed with the presence of children have in determining income. Being a woman continues to represent a disadvantage in terms of earnings; the negative value reported in the table indicates the persistence of a wage gap. Having children, together with having earned a doctorate in the area of life sciences, has a positive impact on income, even greater than having earned a degree in the hard Stem field together with the presence of children. Of lesser impact, however, is the question of age, with values that do not reveal particular differences on an age basis.

TAB. 7. *Determinants of income (OLS regression) – Explorative model*

age group = 1979-1982	-0,021
age group = 1983-1984	-0,014 *
age group = 1985	0,03
female_vs_male	**-0,202**

hard stem w/children	0,022
life sciences stem w/children	0,074
other sectors w/children	0,015 **

* Not sign. / Coeff. >0,0,5

Dividing the model by gender (Tab. 8), on the other hand, we can see the positive impact on income that obtaining a PhD in the Stem area has for both sexes. In the case of women, a doctorate in the life sciences has an even higher positive impact than for men in income composition, while the hard Stem area has a higher weight for men than for women. Finally, having children has a different impact by gender: for men it has a positive impact on income, while for women – albeit slightly – it has a negative impact. In the specific, this result tends to be in line with what was discussed earlier (Tab. 6), with a penalization that affects the average income for women in case of presence of children.

TAB. 8. *Split model by gender with interaction PhD Sector with children presence*

Males

age group =1979-1982	0,006**
age group =1983-1984	0,017*
age =1985	0,049
Phd Area life sciences stem	0,066
Phd area = hard stem	0,091
presence of children	0,114

Females

age group =1979-1982	-0,063
age group =1983-1984	-0,072
age =1985	-0,018*
Phd Area life sciences stem	**0,082**
Phd area = hard stem	**0,054**
presence of children	**-0,011**

* Not sign. / Coeff. >0,0,5

In this last model, of econometric type, the objective is to detect those variables that affect positively and negatively in determining the income. The value of the constant (803.916) represents the average salary – in euros – of PhDs net of the variables included in the model. Having obtained a PhD degree in Stem areas represents an advantage in terms of salary, with the life sciences managing to guarantee a slightly higher economic treatment than the Hard Stem. In addition, the results show that doctoral degrees in STEM disciplines tend, albeit partially, to narrow the gender-reported wage gap. In fact, treating gender as an endogenous variable, being female has a negative effect on income, with an average monthly pay differential of around 373 euros.
In the model discussed here, what seems to weigh most heavily in determining income is contract type. In fact, net of the other variables, it is possible to observe how strong the contractual differentiation is, with

the type of contract assuming primary importance on the composition of income. Having a permanent contract guarantees a higher salary than other forms of contract, with an average difference of around 260 euros between the latter and the fixed-term contract. Finally, the presence of children, while not weighing heavily on income, has an impact on the composition quantifiable at around 70 euros per month.

TAB. 9. *Determinants of income (OLS regression) – Overall model*

	Non-standardized coefficients	Beta standard	Sign.
(Constant)	803,916		0,000
isco_1	1061,577	0,121	0,000
isco_2	549,113	0,103	0,000
Work for a Public Administration or private	74,307	0,033	0,000
STEM Life sciences	193,002	0,086	0,000
Hard STEM	163,198	0,067	0,000
Female vs Male	-373,251	-0,171	0,000
Permanent	832,864	0,376	0,000
Fixed Term	570,327	0,213	0,000
Self employed	680,618	0,202	0,000
Post-doc	432,660	0,156	0,000
Children vs No children	70,362	0,031	0,000

Concluding remarks

The data show, comparatively, the stabilization of female presence in STEM areas. Having a PhD in STEM fields increases the chance of being employed, fosters career paths, and helps to reduce the wage gap. Inequalities, however, remains when looking at job quality. As seen, the wage gap increases in the hard sciences, with the presence of children, and in non-standard occupations. Important, still with respect to income, is the protective effect offered by the possibility, proper to the life STEM, of working in the public administration or in the teaching profession. The data therefore point to the need to develop policies that are not focused only on the supply side. In recent years, several programs have been promoted to increase the presence of women in STEM disciplines. Outreach efforts, scholarships and incentives have been made available to increase women's enrollment in STEM courses. While these programs are very important these policies do not, however, affect structural

inequalities. What seems to be needed instead are demand policies, aimed therefore at reshaping mechanisms and practices for job assessment. What the data presented highlights is the persistent presence of inequalities that continue to constrain the quality of work, especially for women. Looking at the data is still present the remuneration effects that imply that the market offers different pay for men and women for the same qualification as well as penalties related to the presence of children are still important.

In conclusion, years of research based on different sources and methodologies clearly show us how the presence of women in the world of education has progressively grown, overtaking that of men (Fornari, Giancola, 2009). This growth and stabilization, however, is configured as a sort of differential expansion: women enroll and graduate at a higher rate than men, but it is clear that there is a gender bias with respect to the subjects studied (De Vita, Giancola, 2017). This is also reflected, as we have seen, in the choice of doctoral fields. With regard to the labor market, the persistence of a gap in terms of both employment and income even for the highest level of education, such as the doctorate, as well as underlining that the labor market continues to evaluate and pay men and women differently for the same qualifications, also suggests the need to rethink the practices and mechanisms of recruitment and career progression. Given the same level of education, in the case analyzed here the PhD, there are several factors that reinforce the gender wage gap to the disadvantage of women, especially on the side of labor demand and in the lack of policies to support parenting and reconciliation (as also showed at international level by McGivney, 2004 and Carbone and Cahn 2012). These shortcomings seem to penalize women above all, despite the fact that having a doctorate (especially if in the STEM area) partly mitigates them. Although the picture still presents many shadows, even from the data presented, it is clear that the presence of women, especially in some of the STEM disciplines, is now an established phenomenon and that this presence should be further encouraged and supported in view of greater social equity and a more efficient use of human capital, both male and female.

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