OVER-EDUCATION AND THE GREAT RECESSION. THE CASE OF ITALIAN PH.D GRADUATES

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1. Introduction

The emergence and consolidation of the so-called knowledge economy has strengthened the importance of high levels of education. Accordingly, we observed a growing interest toward the role and function of Ph.D programs in providing high skilled human capital (EUA, 2005), available also to fulfill job requirements and carry on occupations outside academia.

Notwithstanding, it become clear that over-education may be an issue also at the level of Ph.D holders (Bender and Heywood, 2011; Di Paolo and Manè, 2016). The topic has received attention also in Italy where several papers analyzed which factors can influence the qualification and skill mismatch among Ph.D holders and the possible impact of the mismatch in terms of wages and job satisfaction (Gaeta, 2015; Ermini *et al*., 2017; Ghosh and Grassi, 2020; Gaeta *et al.*, 2022; Cintio, 2022). At the same time, while a growing number of scholars studied the relationship between over-education and cyclical economic fluctuations (Croce and Ghignoni, 2012; Cockx and Ghirelli, 2016; Liu *et al.*, 2016); Altonji *et al.*, 2016). However, such a strand of literature has not yet focused on Ph.D graduates. Indeed, given the polarization and strategic and opportunistic upskilling and under-employment induced by downturns (Modestino *et al.*, 2016, 2020; Beaudry *et al.*, 2016; Hershbein and Kahn, 2018), the crisis may have affected the professional outcomes of both low and high-educated individuals.

Within this context, this paper adds to the existing literature by assessing the effect of the recent structural financial and economic crisis on overeducation in the labour market of the most skilled workers, i.e. Ph.D graduates. We adopt three different proxies to take the recession effect into account and, as a novelty, we examine the nexus between over-education and regional resilience. Finally, we contribute to improve evidence on the situation of Italian Ph.D graduates by using data on four cohorts of Italian Ph.D recipients surveyed from 2004 to 2010 by the Italian National Institute of Statistics (hereafter ISTAT).

Our main results show that the Great Recession increased the risk of over-skilling. Working in R&D based occupations, both within academia or other sectors of the

economy, reduces the detrimental effect of the economic crisis on over-education in general. The remainder of the paper proceeds as follows. Section 2 presents data and the econometric approach. Section 3 discusses the results of the empirical analysis as to the impact of the Great Recession on over-education. Concluding remarks are made in Section 4.

2. Empirical strategy

2.1. Data and over-education measure

Data for the present study come from two cross-sectional surveys on the professional outcomes of Italian Ph.D graduates carried out by ISTAT in 2009 – that surveyed those who obtained a doctoral degree in Italy in 2004 and 2006 (12964 respondents out of 18568 graduates) – and 2014 – directed to graduates awarded the doctoral title in 2008 and 2010 (16322 respondents out of 22469). The surveys collected information on four main issues: personal details and education; job and job search; mobility; family-related characteristics.

Following Ermini *et al.* (2017), we adopted a subjective approach based on Ph.D graduates' self-assessment to measure over-education in terms of *over-skilling;* this variable is used as dependent variables in the empirical analysis. It is defined as a dummy variable equals to one when respondents reported that the skills and competences acquired during the Ph.D were not useful to carry out the job, and equals to zero otherwise. In our ISTAT sample, only slightly above 50% of Ph.Ds (13633 out of 27189 valid responses) declared to be not over-skilled showing that in Italy over-skilling is a crucial concern also for the most educated workers. Interestingly, over-skilling is less relevant for those holding academia positions or R&D jobs (i.e., about 13500 individuals in our sample) as these workers declare to be mismatched with percentages equal, respectively, to 10% and 15.7%.

2.2. Econometric approach

To investigate the relationship between over-education (OE) and the Great Recession (GR), we estimated the following model:

$$OS = \alpha + \beta GR + X\gamma + \varepsilon \quad (1)$$

where the dependent variable OS, a *Nx1* vector, is over-skilling for each respondent $i = 1 \ldots N$ and it is a dummy variable equals to one when workers reported to be over-skilled, and zero otherwise, as described in section 2.1. *GR* is a *Nx1* vector collecting proxy for the Great Recession computed for each respondent *i;* it is measured using three different indicators, denoted as *crisis, varVA* and *resilience,* that are punctually outlined in section 2.3. X is the *NxK* matrix of *K* control variables, which includes potential determinants of OS, for any *i*. In this analysis, we included three different

categories of control variables in the main equation: socio-demographic information, Ph.D features and job attributes. The parameters β (a scalar) and γ *(vector Kx1)* are the estimated coefficients of GR and *K* control variables, respectively. Finally, ε is the usual *Nx1* vector of individual error term. All the dependent and independent variables introduced above are briefly defined in Table 2, which also reports the relevant summary statistics.

Since the dependent variable has a binary outcome $OS_i \in (0,1)$ for each respondent *i*, i.e. it is equals to one when workers are over-educated and zero otherwise, equation (1) can be estimated by a probit model[1]. Given a set of regressors[2] w_i, our goal is to describe $Pr(OS_i = 1|w_i)$ through a function of the form $Pr(OS_i = 1|w_i) = F(w_i'\delta)$, where $F(\cdot)$ is assumed to be normal. Indeed, as a binary outcome model, we give the probit model a latent variable interpretation, by assuming that the variable OS_i is linked to an unobserved variable OS_i^* according to the following equations:

$$OS_i^* = (w_i'\delta) + e_i \text{ where } e_i \sim F(\cdot) \quad (2)$$

$$OS_i = \{1 \;\; if\; OS_i^* > 0 \;\; 0 \;\; otherwise \quad (3)$$

Moreover, as the probability of being over-educated was assessed only for those respondents employed at the time of the survey, our sample represents a non-random selection of potential observations. Ignoring this selection into the labour market by using a simple probit model could produce biased estimates of the determinants of the risk of over-education that can be corrected by estimating a probit model with sample selection (Heckman, 1979). Accordingly, assuming that the dependent variable is observed if (and only if) OS_i^{select} =1 and it is unobserved otherwise, we have the selection equation specifying the probability for the respondent to be employed as a function of some covariates z_i:

$$OS_i^{select} = z_i'\lambda + u_i > 0 \quad (4)$$

This approach yielded consistent, asymptotically efficient estimates for all parameters in the model when the correlation through the error terms of the main probit equation of determinants of over-education and the probit selection equation of the probability of being employed, i.e., e_i and u_i, was other than zero, making results from the standard probit techniques of Equation (3) biased.

As regards the selection equation adopted to correct for potential sample selection, we follow Ermini *et al.* (2017) in the choice of valid excluded instruments

[1] See Gaeta (2015) and Ermini *et al*. (2017) for applications in a similar context.

[2] For simplicity of notation, we indicate a unique matrix W of variables; it includes our key variable *GR* and all the other controls included in X as illustrated in equation (1).

to perform probit with selection, i.e. marital status (*married*) and children (*children*), both interacted with the variable *female*.[3] Additionally, socio-demographic information, Ph.D-related features and the variable on the area of residence were included among the regressors of the employment status in the selection equation (see Table 2 for descriptive statistics).

2.3. Great Recession measures

The main purpose of our analysis is to assess the impact of the Great Recession on the risk of over-skilling among Ph.D recipients. It may well happen that downturns have a more painful impact on middle-skilled workers, who also suffer from the competition of those high-skilled workers who take middle- and low-skilled jobs – an occurrence usually denoted as 'upskilling'. As a consequence, over-skilling among high- skilled workers may easily emerge in a slack (polarized) labour market. Indeed, as shown in Table 1, our data indicate that the incidence of over-skilling has increased substantially during the crisis.

As to measurement issues, as a main proxy for the Great Recession we generated *crisis*, a dummy variable that assumes value one if Ph.D graduates were awarded their degree during the economic crisis, i.e. from 2008 onwards, and zero otherwise. This variable captures global discontinuity in the economic system due to adverse fluctuations and the related economic contraction. According to our sample, this cut-off distinguishes respondents to the first ISTAT survey (graduated in 2004 and 2006) from respondents to the second one (graduated in 2008 and 2010).

Table 1 – *Over-education before and after the crisis (%).*

		Before the crisis	After the crisis	Total
Over-skilling	No	54.7	46.5	50.1
	Yes	45.3	53.5	49.9
	Total	100.0	100.0	100.0

Authors' elaboration ISTAT 2009, 2014

Moreover, under the assumption that the crisis resulted in a general slowdown of growth and a decline in the values of the main economic indicators, we elaborated two further indicators to depict the behavior of a worsening local labour market that, before and after the economic crisis, operated in significantly different economic conditions and with different opportunities for the newcomer Ph.D holders.[4] Accordingly, as a second indicator of the Great Recession, we approximated the crisis of labour market prospects by computing the variation of the value added

[3] See Ermini *et al*. (2017) for more details and a richer set of literature references.

[4] The mean values of the two variables computed before and after the crisis signal a deterioration of the labor market's performance in the post-recession period. Indeed, tests of the difference between the two periods' means returned to being statistically significant. Results are available on request.

(*varVA*) registered in the provincial job area of a worker who entered the labour market as a Ph.D holder before and after the crisis, as follows:

$$varVA_{k,p} = \frac{VA^{p}_{k,t(k)} - VA^{p}_{k,t(k)-1}}{VA^{p}_{k,t(k)-1}} \quad (5)$$

Where *VA* indicates Value Added, k = 2004, 2006, 2008, 2010, i.e. the cohort of graduates, p = 1, 2...110, i.e. the Italian province where the job is located and t(k) the relevant year to compute the variation across two points of time as a function of k such that

$t(k) = \{2007\ if\ k = 2004, 2006\ 2011\ if\ k = 2008, 2010$.[5] Higher values of *varVA* denote a lower exposure to the economic crisis pointing out the growth of value added across the two points of time.

Table 2 – *Variables and summary statistics.*

Variable (label)	Description	Obs	Mean	Std. Dev.
DEPENDENT VARIABLES				
Over-skilling (oversk)	dummy=1 if over-skilled	27189	0.499	0.500
Employment (employm)	dummy=1 if employed	29286	0.928	0.258
KEY REGRESSORS				
Great Recession (crisis)	dummy=1 if awarded during Great Recession	29286	0.557	0.497
Value Added variation (varVA)	Provincial variation of Value Added	24446	0.029	0.022
Provincial Economic Resilience (resilience)	Provincial labour market economic resilience	24264	-0.341	2.669
SOCIO-DEMOGRAPHIC VARIABLES				
Gender (female)	dummy=1 if female	29286	0.521	0.500
Citizenship (ita citizenship)	dummy=1 if Italian	29286	0.984	0.126
Marital status (married)	dummy=1 if married or living together	29286	0.523	0.499
Children (children)	dummy=1 if having at least one child	29286	0.377	0.485
Parents' educational level (parents edu i)	1: junior high school diploma or lower*	29286	0.253	0.435
	2: high school or post-high school diploma	29286	0.378	0.485
	3: degree or post-graduate	29286	0.369	0.483

[5] Great recession hit Italy mainly during 2008. Thus, we assumed that those who attained the title in 2004 and 2006 have been exposed to pre-crisis labour market scenario that ended in t(k)=2007; on the contrary, cohorts who get the Ph.D title in 2008 and 2010 faced a post crisis labour market setting that endured (at least) until t(k)=2011. This reasoning has been applied for computing variations of value added and resilience indicators (see Equation 5 and 6, respectively).

Table 2 – *Variables and summary statistics (continue).*

Variable (label)	Description	Obs	Mean	Std. Dev.
Parents class (parents class i)	Parents' highest social class: 1: bourgeoisie*	29286	0.301	0.459
	2: middle class	29286	0.4	0.490
	3: petite bourgeoisie	29286	0.17	0.376
	4: working class	29286	0.101	0.301
	5: other	29286	0.027	0.164
Province of residence before University	categorical variable, province of residence	29286	n.a.	n.a.
Ph.D-RELATED VARIABLES				
Recent cohort(s) (recent cohort)	dummy=1 if most recent cohort of graduates	29286	0.536	0.499
Age at graduation (Ph.D age)	dummy=1 if 29 (or younger)	29286	0.284	0.451
Visiting abroad (visiting abroad)	dummy=1 if visiting abroad for at least 1 month	29286	0.35	0.477
Ph.D Study field (study field)	- Hard Sciences	29286	0.257	0.437
	- Medicine	29286	0.143	0.350
	- Agriculture and Veterinary Sciences	29286	0.067	0.250
	- Technical Sciences	29286	0.191	0.393
	- Economics and Statistics*	29286	0.059	0.236
	- Law	29286	0.072	0.259
	- Socio-political Sciences and Humanities	29286	0.21	0.407
Province of Ph.D University	categorical variable, Ph.D University province	29286	n.a.	n.a.
JOB-RELATED VARIABLES				
Self-employment (selfemployed)	dummy=1 if self-employed	27189	0.138	0.345
Informal access (informal access)	dummy=1 if informal channels to find job	27189	0.078	0.267
Academic (academic)	dummy=1 if academic sector	27189	0.342	0.474
R&D (R&D)	dummy=1 if R&D prevalent in job	27189	0.431	0.495
Part time (part time i)	0: Full-time*	27189	0.895	0.306
	1:Part-time, no full-time opportunities	27189	0.063	0.244
	2: Part-time, voluntary	27189	0.041	0.199
Job experience- numbers (jobexp i)	0: No job started before Ph.D completion*	27189	0.317	0.465
	1: One job started after Ph.D completion	27189	0.299	0.458
	2: More than one job after Ph.D completion	27189	0.384	0.486
Sector (sector i)	Sector: 1: Industry*	27189	0.084	0.278
	2: Service	27189	0.897	0.303
	3: Agriculture	27189	0.018	0.134

** denotes the reference category in the estimation*

Finally, according to Martin (2012), differences in the region's sensitivity to economic fluctuations can be observed because of its economic resilience. We built on the concept of resilience to elaborate a measure of regional difference in employment opportunities. We basically compared employment's variation in a

territorial region relative to the national one, before and after the crisis. By so doing, we were able to assess if the crisis had worsened the capacity of the labour market to give workers an occupation. For the post-recession, this measure corresponds to the economic resilience described by Martin (2012). In fact, the impact of the crisis depends on the real exposure of the local labor market to the fluctuation and on its capacity to restructure economically in response to a crisis. To our knowledge, the nexus between territorial economic resilience in the broad sense and over-education has not yet received attention. Actually, labour markets more resilient to crisis can offer more opportunities for skill-job matching because they are better able to drive transformation of a given geographical area, to retain manufacturing, and to innovate a high-tech economy. Accordingly, we used *resilience* as an additional proxy of the intensity of the crisis. Thus, we computed:

$$resilience_{k,p} = \frac{\frac{\Delta E^p}{E^p} - \frac{\Delta E^N}{E^N}}{\left|\frac{\Delta E^N}{E^N}\right|} \quad (6)$$

where E stands for employment, $\frac{\Delta E}{E}$ is the employment variation; $\frac{\Delta E^p}{E^p} = \frac{E^p_{k,t(k)} - E^p_{k,t(k)-2}}{E^p_{k,t(k)-2}}$; k = 2004, 2006, 2008, 2010; $t(k) = \{2007\ if\ k = 2004, 2006\ 2011\ if\ k = 2008, 2010$; p = 1, 2...110 is the province of job location and N=Italy.[6] Values of resilience above zero indicate the greater resistance of the province to economic shocks compared to the nation. In contrast, values less than zero indicate a decreased ability to cope with a recessionary period compared to the national average.

3. Results and discussion

This section presents the empirical results of our econometric analysis. As the coefficients of the selection term were statistically different from zero, we relied on the estimates of the probit models with sample selection. Accordingly, Table 3 reports the results of the main model of determinants of over-skilling (columns **(**1**)**, **(**3**)** and **(**5**)**) and the results of the employment selection equation (columns **(**2**)**, **(**4**)** and **(**6**)**). For the sake of space, we only show results for the proxies for the Great Recession (*crisis*, *varVA* and *resilience*) and those of the excluding instruments.[7]

[6] When using employment as a measure to evaluate the state of the local labour market, we adopted a temporal lag larger than the one assumed to evaluate changes in value added, given that the employment level reacts slowly to variations in local economic conditions: that is, employment effects are more persistent.

[7] Full estimates are available upon request.

The variables chosen as instruments in the selection equation are significant and show the expected sign: having children and being married increase the probability of getting a job, denoting a relatively higher urgency to provide family sustenance. However, when also the gender variable is taken into account, a disadvantage for women emerges: being a woman with children or being a married woman reduces the probability of being employed, confirming our theoretical predictions. Notably, the coefficient of the dummy crisis shows a negative and significant sign confirming our expectation that during a recession the opportunities to find a job are relatively scarce and being unemployed is more likely. Overall, the results of the whole selection model appear to be fairly stable across all the estimated specifications.

Table 3 – *Over-skilling before and after the crisis.*

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	oversk	empl_sel	oversk	empl_sel	oversk	empl_sel
Key regressors:						
Crisis	0.113***	-0.118***		-0.168***		-0.183***
	[0.018]	[0.026]		[0.024]		[0.024]
varVA			-1.410***			
			[0.414]			
Resilience					-0.006*	
					[0.003]	
Excluding instruments:						
Children		0.202***		0.219***		0.218***
		[0.052]		[0.053]		[0.053]
female*children		-0.373***		-0.375***		-0.373***
		[0.061]		[0.062]		[0.061]
Married		0.281***		0.276***		0.273***
		[0.045]		[0.046]		[0.046]
female*married		-0.260***		-0.237***		-0.229***
		[0.056]		[0.056]		[0.056]
Observations	27189	29286	24446	29286	24264	29286
Wald test rho=0 (p-value)		43.35 (0.000)		26.42 (0.000)		18.12 (0.000)

*Rob. std. errors in brackets. *** p<0.01, ** p<0.05, * p<0.1 All estimates include: constant, socio-demographic variables, Ph.D related variables and job related variables (see Table 4).*

Focusing on the main model of over-skilling determinants, it emerges that the coefficient of *crisis*, which is the main proxy for the Great Recession, is positive and significant. This result suggests that the Great Recession has reduced the probability of Ph.D-holders to find the job most appropriate for their skills. The risk of over-skilling is more likely during a downturn. In column (3) we report the estimated coefficient of *varVA*. The correlation between this variable and over-skilling is negative, suggesting that as the index grows - signalling that the area is less hit by the crisis - over-skilling is less likely. This reinforces the belief that recessions do not offer opportunities for adequate job matching. We then assess the predictive power of the variable *resilience* in column (5). As the coefficient is negative and

statistically, even if weakly, significant, we can conclude that Ph.D-holders working in areas with a higher level of market potential were at less risk of over-skilling. Overall, the above evidence validates the hypothesis that the Great Recession brought about a deterioration of professional outcomes also in terms of over-skilling determining a waste of human capital as a possible outcome.

In an attempt to account for the heterogeneous impact of the crisis across job characteristics of our sample of Ph.D-holders, we extended the empirical model in the columns (1)-(3)-(5). Hence, we interacted the *crisis* dummy with *academic* and *R&D*: that is, those variables that best capture the worker's taste for science, which corresponds to the primary vocational attitude of academically-trained Ph.D students. We expected that being occupied in such sectors could protect the workers from the negative effect of the economic fluctuation because these high-skilled jobs are at less risk of downskilling. Moreover, the highly qualified human capital holding such jobs can be a key factor in relieving an economic crisis. Economic resilience of a region hinges on the capacity to maintain and to booster the territorial competitiveness by branching into related or entirely new paths of development (Martin and Sunley, 2015). It entails restructuring and reorienting human and capital resources, a task that high human capital employed in knowledge and technology-led sectors can more easily perform. We report the estimates of interest of the main model of over-skilling in Table 4. The results are in line with our expectations of negative coefficients of the interaction terms. For those who worked in academia or in R&D based occupations the Ph.D title proves to be worthy to avoid over-skilling also in risky economic conditions such those related to downturns.

Table 4 – *Over-skilling and the Great Recession in R&D-based occupation.*

Dependent Variable: Over-skilling	**Coeff**	**Std. error**
crisis	0.323***	[0.026]
academic	-0.852***	[0.031]
Crisis•academic	-0.324***	[0.043]
R&D	-0.930***	[0.028]
crisis•R&D	-0.342***	[0.038]
Observations	27189	

**** p<0.01, ** p<0.05, * p<0.1 Estimates include: constant, socio-demographic variables, Ph.D related variables and job related variables (see Table 4) and an employment selection equation; the operator • denotes the interaction term between crisis with the variables academic and R&D.*

As regards other drivers of over-education not reported in the table, socio-demographic variables do not seem to affect significantly the probability of being over-educated. Surprisingly, the family of origin of doctoral graduates does not influence over-education. International exposure emerges as a key aspect of a Ph.D course, because spending a study period abroad proves to be the characteristic that most affects a successful job matching. Moreover, the risk of over-education is not

equally distributed across fields of study since Ph.D graduates in Humanities are more likely to be mismatched than peers graduated in Economics or Science and Technology. Overall, a strong result of this paper, is that job characteristics are the main drivers of the risk of mis-match among Ph.D-holders. Besides a prominent protective effect induced by working in a university or a R&D-based center, we point out that self-employers or workers in the manufacturing sector are at a greater risk of over-education.

4. Concluding comments

In this paper we have sought to shed light on the impact of the Great Recession on over-education. We have focused on Italian Ph.D-holders, graduated from 2004 to 2010, using surveys carried out by ISTAT (2009, 2014). Our estimates revealed a striking impact of the Great Recession. This effect emerged when the incidence of the crisis was measured both by using a crude dummy and when we adopted more refined indicators that explicitly took account of economic performance at provincial level, such as value added growth, and the local labour market's resilience. As expected, our findings show that the impact of the crisis is less pronounced when labour markets are more resilient. Moreover, the effect of downturns on over-skilling is less marked among Ph.Ds working in academia or R&D activities. These findings prompt several considerations.

First, closer attention should be paid by economic studies to the phenomenon of over-skilling which, although it is becoming increasingly widespread, costly, and persistent - and even more so during downturns – is still overlooked. Second, indicators of the state of the labour market should also include the important dimension of over-education in order to avoid underestimating its real costs, especially during recessions. Third, the sensitivity of over-skilling to economic fluctuations calls for economic policies designed not only to promote employment but also to favor job matching and to integrate Ph.D-holders into the process of producing and distributing goods and services. Indeed, human capital is a key factor in developing regional resilience, which is itself an effective strategy to deal with economic fluctuations and to cope with cyclical variations. Finally, our evidence seems to confirm that the Italian Ph.D is still based on a research-oriented educational pattern, since working in academia or in research-based sectors provides the most successful matching. In this regard, our evidence highlights the need for more incisive policy actions promoting a more applicable type of knowledge which might be more valuable outside the pure research sectors and academia. Hopefully, this should produce successful outcomes also among self-employed workers, who, according to our results, appear to be at a disadvantage.

Acknowledgements

We thank participants to LVIII Sieds Conference held at LUMSA (Palermo) for helpful comments. The authors alone are responsible for the views expressed in this paper and the publication does not constitute an endorsement by the institutions with which the authors are affiliated of the opinions expressed in it.

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SUMMARY

The paper evaluates the impact of the Great Recession on Ph.D over-skilling using data drawn from four annual cohorts of Ph.D graduates surveyed by the Italian National Institute of Statistics. The results show that over-skilling is positively associated with the Great Recession. However, it has an heterogeneous impact across job characteristics, as being occupied within academia or R&D-related sectors protect the workers from the negative effects of the economic fluctuation.

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