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c.MET
Working papers

ISSN: 2281-5023

Was it worth it?
An empirical analysis of over-education among Ph.D. recipients in Italy

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ABSTRACT

This paper aims to provide an empirical examination of factors associated with over-education among Ph.D. graduates in Italy. Our investigation is based on recently released data collected by the Italian National Institute of Statistics by means of interviews with a large sample of Ph.D. recipients, carried out a few years after they obtained their Ph.D. degree. We measured the mismatch between their current job and previous Ph.D. studies using two direct subjective evaluations of over-education, which distinguish between the usefulness of the Ph.D. title to get the current job position and to perform the current work activities. Even if the incidence of over-education varies according to the measurement applied, we found that it is highly widespread among Ph.D. recipients. Our econometric analyses are aimed at identifying factors associated with over-education and are based on the standard probit model and the bivariate probit model with sample selection which allows to control for self selection into employment. Our results show that over-education is significantly correlated with: i) a number of Ph-D. related variables, such as the scientific field of study, having attended courses or visiting periods abroad; ii) some job-related characteristics, such as working in the academia or being mainly involved in research related activities; iii) the channel of access to the job; iv) residential location. This paper contributes to the literature focusing on job-education mismatch by providing, to the best of our knowledge, the first empirical analysis of over-education among Ph.D. recipients in Italy; moreover, it provides some useful insights to evaluate the professional doctoral graduates in Italy.

Keywords: over-education, Ph.D. recipients, self-selection

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c.MET Working paper 02/2013
September 2013

Introduction

In recent years, Ph.D. education and training has gained increasing attention in the European Union (EU) policy agenda (Kehm, 2006). The Lisbon strategy stated the crucial role of scientific research for the development of a competitive knowledge‐based economy in the European area.Being one of the most relevant tools to promote research training and produce new innovation-driving knowledge, Ph.D. programmes are crucial to attain the Lisbon goals.

Contextually, the higher education harmonization process launched by the Bologna Declaration (1999) recognized doctoral studies as the third cycle of higher education (after undergraduate and graduate level): its aim is to provide research-oriented skills together with other competences that may ease Ph.D. recipients' employability within, but also outside, academic institutions.

Stimulated by EU institutions' interest, a number of international organizations have recently started to carry out comparative analyses of structures and organizations of doctoral studies in Europe and in other contexts (see, for example, the UNESCO report edited by Sadlak in 2004 and the one published by the European University Association in 2005).

According to these analyses, over the last 15 years, all European countries have showed a considerable increase in the number of doctoral degrees awarded.

Italy represents an interesting case study in this perspective. According to recent contributions based on official data (Ballarino and Colombo, 2010), the number of Ph.D. graduates per year was about 4,000 in 2000 while it was higher than 10,000 (+150%) only 8 years later, in 2008.

Assuming that all the Ph.D. graduates benefited from high quality training, this increasing trend should be looked at positively, because the growing number of trained researchers heralds the potential development of innovation and technological progress. However, this desirable outcome is possible, only if doctoral graduates are able to find job positions that match their educational profile; otherwise, they accept jobs for which they are over-educated and do not have the opportunity to fully exploit the skills acquired through their Ph.D. studies.

For this reason, the examination of the incidence of over-education among Ph.D. recipients plays a key role in the assessment of Ph.D. programmes' capacity to spread innovation.

Following the seminal contributions by Freeman (1976) and Duncan and Hoffman (1981), over the last 30 years the issue of over-education has been widely analyzed by the economic literature.

On the one hand, scholars provided alternative theories about possible explanations of over-education (McGuinness, 2006); the *human capital model* (Becker, 1964) interprets over-education as a purely temporary mismatch between workers' human capital and firms' technology and states that it does not represent a possible outcome in equilibrium. The *career mobility theory* (Sicherman, 1991) shares the idea of over-education as a temporary phenomenon, but claims that it results from workers' attempt to acquire the right amount of professional experience (occupation specific human capital) that is needed in order to get a job position matched with their educational background. On the contrary, the j*ob competition theory* (Thurow, 1974) looks at over-education as a permanent phenomenon resulting from over investment in education that occurs when individuals have to defend their position in the queue to access job positions.

On the other hand, a number of empirical contributions focused on the consequences of over-education and mostly found that it is associated to wage penalty (Verdugo and Verdugo, 1989; Dolton and Vignoles, 2000; Chevalier, 2003; Dolton and Siles, 2003) and is negatively correlated with job satisfaction and, consequently, to job productivity (Tsang, 1987; Hersch, 1991; Tsang *et al.*, 1991). From the societal point of view, this means that over-education represents a sub-optimal allocation of human capital resources and is potentially harmful for economic development.
This paper uses data collected by the Italian National Institute of Statistics for the first [national] survey of Ph.D. recipients and empirically analyzes individual factors associated to the probability of being over-educated in the workplace in Italy. In other words, this paper aims at identifying the profile of Ph.D. recipients at risk of over-education.

While there are several studies focusing on over-education among Italian graduates (Caroleo and Pastore, 2012; AlmaLaurea 2005; Di Pietro and Urwin 2006; Ordine and Rose, 2009; Ortiz 2010), to the best of our knowledge this is the first paper focusing on over-education among Ph.D. recipients in Italy.

Furthermore, focusing on over-education among Ph.D. recipients, our paper also contributes to the analysis of professional outcomes of doctoral graduates who completed their studies in

Italy. There is a consolidated research tradition on Ph.D. recipients' professional outcomes (see for example Bender and Heywood, 2009 and 2011 for USA; Moguérou, 2002 for a comparison between USA and France; Di Paolo, 2012 for Spain; Lee *et al.*, 2010 for UK; van de Schoot *et al.* 2012, for Netherlands), but there is a surprising lack of research on this topic in Italy; only few papers were published in the past three years and all them use data gathered through local surveys, which cover only one or few national universities (Ballarino and Colombo, 2010; De Quarti *et al.* 2010; D'Agostino and Ghellini, 2011; Campostrini, 2011).

Therefore, the contribution of this paper is two-fold; we provide more evidence to the growing literature concerning individual factors associated to over-education in Italy by means of an analysis focused on particularly highly educated workers and, at the same time, we provide some evidence about Italian Ph.D. recipients' professional outcomes.

The remainder of the paper is organized as follows: section 2 is devoted to the presentation of the data and methodology used in our empirical analysis, section 3 contains a presentation and discussion of our results, while in the final section we conclude with indications for further research.

2. Data and Methodology

We drew our data from the first cross sectional survey of Ph.D. recipients carried out by the Italian National Institute of Statistics (ISTAT) at the end of 2009/beginning of 2010; the survey is based on interviews with 8,814 Ph.D. graduates who obtained their doctoral degree in Italy in 2004 or in 2006[1]. Interviews aimed at collecting respondents' opinions on their Ph.D. experience and their subsequent employment outcomes.

According to McGuinnes (2006), several empirical measurements of over-education may be provided; not surprisingly the incidence of over-education, and the magnitude and significance of its effects may vary according to the measure utilized (Verhaest and Omey, 2010). After analyzing data availability in the ISTAT dataset, we decided to build two alternative indicators of job/education mismatch, both based on direct subjective evaluations (Duncan and Hoffman, 1981; Hartog, 2000) of education-job mismatch.

Our indicators were built according to answers registered for two questions in the survey: i) Was the Ph.D. degree explicitly requested in order to get your present job? (*Per accedere al*

[1] The total number of Ph.D. recipients obtaining their title in 2004 and 2006 is 18,568; 8,443 completed their doctoral studies in 2004 while 10,125 completed them in 2006.

suo attuale lavoro, il titolo di dottore di ricerca era espressamente richiesto?); ii) Is the Ph.D. title actually needed to carry out your job? (*Per svolgere questa attività possedere un titolo di dottore di ricerca è effettivamente necessario?*).

These questions focus on two different aspects of the relationship between the Ph.D. degree and the employment positions of respondents.

The first one asks if the Ph.D degree was a required *to get* the job, and therefore specifically looks at mismatch between education and requirements to obtain the job position (Sicherman, 1991; Chevalier, 2000). Possible answers were: the Ph.D. degree was explicitly requested (1), the Ph.D. degree was not requested but turned out to be useful to get the job (2), the Ph.D. degree was neither requested nor useful to get the job (3). Based on answers to this question, we built a binary dependent variable (labeled OVEREDUCATION) that takes the value of one when respondent picked up answer number 3 and zero otherwise.

The second question explicitly asks about the usefulness of skills and competences acquired during the Ph.D. in performing the current job, compatibly with the "to do" definition of over-education provided by Dolton and Silles (2008). A binary ("no"/"yes") answer was possible. A mismatch between acquired competences and those needed to work may be called over-skilling, therefore, we built a dummy variable that takes the value of one when respondent picked up the answer "no" (OVERSKILLING).

Our empirical model may be represented through the following estimation equation:

$$y_i^* = X_i\beta + \varepsilon_{1i} \qquad [1]$$

Where y_i^* represents over-education/over-skilling of the *i-th* individual, X is a vector of covariates, β is the vector of parameters to be estimated and ε_1 is the error term.

We do not observe y_i^* but a variable y_i :

$$y_i = (y_i^* > 0) \qquad [2]$$

and this binary outcome corresponds to over-education/over-skilling. Assuming that errors are normally distributed, the structure of [1] makes it suitable for estimation as a probit model.

However, given that being over-educated/over-skilled is observable only for those who were employed at the time of the survey, our estimation should to take into account the potential bias arising from this selection process. This happens because some unobservable individual factors may affect the probability of over-education/over-skilling and, at the same time, may be correlated with the propensity to get a job; i.e. [personal] aversion to unemployment risk would have a positive effect on both employment and over-education.

In order to address this problem, we also estimated a bivariate probit model with sample selection (Heckman 1979; van de Ven and van Pragg, 1981). More in detail, the following selection equation was introduced in order to take into account the selection effect:

$$y_i^{select} = (Z_i\lambda + \varepsilon_{2i} > 0) \qquad [3]$$

where y_i^{select} represents the employment condition of the *i-th* individual, taking the value of 1 for employed respondents and 0 otherwise, Z is a vector of covariates, λ is the vector of coefficients to be estimated and ε_2 is the normally distributed error term.

The existence of a statistically significant correlation between the error terms in [1] and [3] ($\text{corr}(\varepsilon_1, \varepsilon_2) = \rho \neq 0$) indicates that unobserved factors jointly affect the probability of employment and over-education and therefore the selection equation has to be considered in order to obtain unbiased estimates. Otherwise, $\rho = 0$ would indicate that ε_1 and ε_2 are independent and therefore the probit estimation of model [1] would give consistent results.

The covariates included in X were broken down into three categories:

- socio demographic variables: they include gender (dummy variable labeled FEMALE), age at completion of Ph.D. (AGE), one dummy identifying those who are married and another for having at least one child (CHILDREN). Finally, the variable PARENTSEDUCATION controls for parents' highest educational level, which may be a good proxy of Ph.D. graduates' access to family networks as a resource for finding a job (Cutillo and Di Pietro, 2005).

- Variables related to the Ph.D. completed and to previous educational performances: they include one proxy for individual unobservable abilities such as final grade obtained at the end of the Master's degree (DEGREE_GRADE), one dummy taking the value of one for

those who were able to complete their Ph.D. in three years, i.e. average ideal institutional length (NOEXTRAYEAR); furthermore, we added one variable identifying the Ph.D. sector of studies (SPECIALIZATION) and the year of completion of Ph.D., which, according to our data availability, might be 2004 or 2006 (YEAR). Two dummies were introduced to control for the attendance of courses during the Ph.D. and the completion of a visiting period abroad during the Ph.D. (COURSES and VISITING respectively). Finally, we intended to introduce dummies identifying the university where the Ph.D. title was obtained, in order to control for unobserved heterogeneity in Ph.D. courses' quality. Unfortunately, data about the university where respondents have attended their Ph.D. is not provided in the original dataset for privacy protection. Instead, we decided to introduce dummies identifying the province where the Ph.D. course was attended.

- Job-related variables: one dummy controls for informal access to the actual job position (INFORMALACCESS), taking the value of one for those who were helped in finding their job by family, friends or their professors at University; the variable we labeled ACADEMIC identifies those who work in the academic sector or in publicly financed research centers; R&D measures how much the actual job position is based on research and development activities. Finally, SELFEMP controls for the self employment status (SELFEMPL), while OPENENDED takes the value of one only for those who have an open-ended (permanent) contract.

Moreover, we introduced one variable (MACROREGION) to control for respondent's place of residence (North West, North East, Centre, South of Italy or any other country abroad) and account for unobserved heterogeneity in context (economic development, unemployment, features of the economy, etc.).

The bivariate probit with sample selection estimation procedure requires the Z vector in equation [3] to include covariates that can be legitimately excluded from X in equation [1].
Finding a variable that does not affect over-education but affects employment is rather hard. Previous papers studying over-education at university graduates level used variables such as: having a loan for accommodation (Croce and Ghignoni, 2011), number of members in the household (Devillanova, 2011), marital status (Ramos, 2011). Unfortunately, the first two variables were not available in our dataset while the third one seemed to be unconvincing,

because being married may constrain individuals' spatial mobility and therefore limit job search and cause over-education (Verhaest and Omey, 2010).
We decided to follow Quintano *et al* (2008) and used a variable indicating whether Ph.D. recipients still live in their parental home; we assume that those who still live with their parents have low motivation to find a job because are protected?/sustained by their families, while this variable may not have any influence on over-education, once we have controlled for other factors.

In addition, the vector Z also includes all the socio demographic variables and the variables related to the Ph.D. course and previous educational performances that we included in the X vector in equation [1].

All our variables are fully described in tab. 1 where some basic descriptive statistics are also provided.

[TABLE 1 HERE]

Results

A very high rate of employment is registered among the doctoral recipients in the sample; at the time of the interview about 93% of survey's respondents declared to be employed. Not surprisingly, universities and other publicly funded research centers represent the main source of employment (about 46% of the total sample). About 39% of respondents held a permanent job position, while 19% are self-employed.

Only 19% of respondents declare to be overeducated, that is to say their Ph.D. title was neither requested nor useful to get their job. The percentage of over-skilled respondents, that is to say those who declared that skills and competences acquired during their Ph.D. were not useful in performing their job, is sensibly higher: 46%. While this difference is commonly found in studies focusing on over-education and over-skilling among university graduates (Caroleo and Pastore, 2012), in this case it may be partially explained by the fact that the question related to over-education registers a high number of missing values (about 28%); that could mean that some people had difficulty in answering, perhaps because they were not able to indicate if their Ph.D. title was de facto useful to get their job position. Instead, no missing was registered for the question related to over-skilling.

Over-education and over-skilling are positively, but not highly, correlated (0.43). Only 1,025 respondents (about 12% of the working respondents' sample) declared themselves to be at the same time overeducated and over-skilled.

Table 2 shows the estimated coefficient of the probability of being over-educated (the dependent variable here is OVEREDUCATION); both probit estimates and estimates calculated via bivariate probit with sample selection are reported.

[TABLE 2 HERE]

Looking at the first column of table 2, the probit estimates suggest that socio-demographic variables do not play a relevant role in explaining the over-education status; *ceteris paribus*, the age at completion of Ph.D., being female or married and having children are not statistically associated with uselessness of the Ph.D. to get the current job. Among this group of variables, only parents' highest educational attainment is found to be significant; in more detail, our results reveal that having better educated parents is associated with a higher probability of over-education. This result may be surprising given the well-known immobile social structure of Italy (Checchi, 2010), where familiar background is usually found to represent a relevant factor of working success. At least part of the effect of better familiar background on over-education is probably through familiar networks that ease the [immediate] search for a job position, where the Ph.D. degree is not formally needed. This effect is partially caught by the INFORMALACCESS variable that is discussed below and partially by these covariates measuring familiar background.

Ph.D.-related variables show interesting results. First, once we control for other covariates, the Ph.D. field of study (SPECIALIZATION) seems to be barely significant (the reference category here is Industrial and IT Engineering). Only Biology and Medicine turned out to be significantly and positively associated with over-education. The result for Medicine is not surprising since holding a Ph.D. in the medical field is poorly enhanced in Italy (i.e. it is less important than having completed a specialization school which allows junior doctors to apply for job positions in public hospitals) and is partially useful only to those who decide to continue their professional career in the research/academic environment. The result for Biology, instead, is quite surprising and reveals a particular difficulty for biologists to get a job matched with their Ph.D. title.

Secondly, having attended specific courses (COURSES) or completed visiting periods abroad (VISITING) is negatively associated with uselessness of the Ph.D. to get the current job.

According to this result, courses and visiting periods abroad may be considered as further experience that increases specific competences and, consequently, ease the search for a job position matched with one's educational background. Moreover, together with province dummies which were included but not reported because of space constraints, these variables control for the quality of the Ph.D. course attended. In this perspective, our results suggest that people who experienced better Ph.D. courses have a higher probability to get a job for which their educational title represents a formal or substantial requirement.

A positive and significant coefficient is found for the dummy that identifies those who obtained the Ph.D. in 2006 (YEAR, the reference category is 2004). Compatibly with the *career mobility theory*, this result suggests that over-education may be a temporary status, because those who obtained their Ph.D. later show a higher probability of experiencing over-education, when compared with those who completed their studies in 2004.
Finally, the grade obtained at the end of the Master's Degree (DEGREE_GRADE) and the dummy identifying those who completed their Ph.D. in time (NOEXTRATIME) are not significant.

All our job-related controls show significant results, revealing that they play a major role in influencing the probability of over-education.
Looking at employment positions, those who work as self-employed (SELFEMPLOYED) are more inclined to declare themselves as overeducated, probably because they did not take advantage of their Ph.D. title to start their professional activity. Quite surprisingly, instead, holding a permanent job position (OPENENDED_CONTRACT) is associated with higher probability of over-education. These results suggest that a trade-off between employment stability and proper job-education matching may be at work here.
Working in the academic sector or in publicly funded research centers (ACADEMIC) is significantly negatively associated to self-reported over-education and the same is found for having a job mainly or at least partially based on Research & Revelopment activities (R&D). Of course, these results are not surprising at all. On the one hand, the Ph.D. title represents a substantial requirement for any academic career; on the other hand, the skills acquired during the Ph.D. studies are mainly research-oriented, therefore holding a Ph.D. is a preferential title for working in R&D divisions of private companies. This result is particularly interesting, because, as a consequence of the remarkable increase in the number of doctoral degrees awarded Italy over last 15 years, the academic sector cannot represent anymore the unique

destination for Ph.D. recipients like it was in the past (Ballarino and Colombo, 2010). Indeed, the increase in Ph.D.s awarded "has been more than proportional with respect to the overall expansion of Italian universities" (Ballarino and Colombo, 2010, p. 152) and the same can be said of other European countries, where the number of doctoral recipients who seek employment opportunities in the labor market outside university and research has increased, too (Kehm, 2006).

When looking at channels used to gain access to the current job position, we found that informal channels (INFORMALACCESS), such as friends', family's and university networks, increase the probability of being over-educated. Therefore, though personal networks may ease the search for a job, there is a significant trade-off between this effortlessness and job-education matching.

Also, our residential dummies show interesting results. Compared with living abroad, living in all the Italian macro-regions is associated to a higher probability of over-education. This result may suggest that foreign countries' labor markets offer higher chances of appropriate occupation. At the same time, reverse causality may be at work here, because the choice of moving abroad may be determined [only] by having found an appropriate job.

Looking at column 2 in table 2, the results obtained by the bivariate probit models with sample selection are substantially the same of those calculated in the probit model; the ρ coefficient measuring the correlation between ε_1 in equation [1] and ε_2 in equation [3] is negative, but it is not statistically significant; therefore, our probit estimates does not seem to be severely affected by the sample selection bias.
However, the selection equation (table 2, column 3) shows interesting results. More in detail, we found that being female, having children and being older when completing the Ph.D. negatively affect the probability of employment compatibly. All scientific sectors offer minor probability of employment than Industrial Engineering (which is the reference category), while completing the Ph.D. within three years and having carried out a visiting period abroad both have a positive effect. Not surprisingly, a negative effect is associated to living in the South of Italy, where the labor market is sensibly depressed. Moreover, it is worth noting that, as expected, our selection variable (LIVES_WITH_PARENTS) is negatively and significantly correlated with having a job.

Table 3 reports the results we obtained when using the dependent variable that measures over-skilling (OVERSKILLING). The same set of covariates as before is used. Like in table 2, both probit estimates and estimates calculated with bivariate probit with sample selection are reported. Also in this case, LIVES_WITH_PARENTS is used as selection variable in the bivariate probit with sample selection model. The ρ coefficient measuring the correlation between errors in the selection and in the outcome equation is positive but, again, not significant; this suggests that our probit estimates lead to unbiased results.

[TABLE 3 HERE]

No substantial difference with the results obtained in table 2 is found, with few exceptions; PARENTSEDUCATION is not significant, while it was significant in tab.1. This may mean that having better familiar background may exert some influence on the probability of finding a job for which the Ph.D. degree is not formally needed, but this does not imply finding a job where Ph.D. skills are useless.

SELFEMPLOYED is found to be negatively correlated with OVERSKILLING while it was positively correlated with OVEREDUCATION. This result highlights that skills and competences acquired through doctoral studies are significantly useful, when carrying on self employed professional careers, while, obviously, they are not useless in order to get a self-employment working position.

Looking at Ph.D. fields, Chemistry and Agricultural Science/Veterinary are found to affect positively and significantly the probability of OVERSKILLING, together with Medicine and Biology, which were found to be significant also in tab.1. While having a Ph.D. in the scientific field is generally found to be correlated with higher probability of employment (see the selection equation column 3 of tab.3), some scientific fields are significantly associated with over-skilling, while no significant association is found with having a Ph.D. in the social sciences and humanities.

Conclusions

Ph.D. programmes provide training for researchers and thus represent an essential tool in developing the European knowledge economy fostered by the Lisbon agenda. The analysis of the professional outcomes of Ph.D. recipients represents a useful tool in order to evaluate the [general] outcome of Ph.D. programmes and their impact on the society.

This paper proposed an empirical analysis of over-education among Ph.D. graduates who completed their doctoral studies in Italy. Data were gathered through a national survey of Ph.D. recipients, which includes some questions about respondents' self assessment of their own over-education.

We found that a relevant part of Ph.D. recipients (19%) did not benefit from the Ph.D. title in order to get their present job and a even higher percentage (46%) does not consider the skills and competences acquired through the Ph.D. useful to carry out their present job.

Looking at robust correlations between over-education and individual characteristics we found that, consistently with the research-oriented characterization of Ph.D. programmes, over-education is negatively associated to working in the academic sector and, other things being equal, to being involved mostly in R&D activities.

Some characteristics of the Ph.D. programme completed seem to make a difference: i.e. having attended courses and having completed visiting periods abroad are negatively associated with over-education. Somewhat surprisingly, while having a Ph.D. in the scientific field is generally correlated with a higher probability of employment, some scientific areas (Medicine and Biology, above all) are positively associated with over-education.
Moreover, informal access to the labor market and family background also seem to play a role, being positively correlated with over-education. Finally, residing in Italy is significantly associated to over-education, if compared to reside abroad.
This analysis contributes to unveiling the problems that Ph.D. recipients face when looking for a job position matching their skills. Moreover, it provides some useful insights to identify Ph.D. recipients who are more exposed to the risk of over-education. In this sense, this paper represents a first step towards a more detailed assessment of the organization and outcomes of Ph.D. programmes in Italy.

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Label	Description	Obs	Mean	Std. Dev.
OVEREDUCATION	dummy =1 for those declaring that	5923	0.191	0.393
OVERSKILLING	dummy =1 for those declaring that	8201	0.449	0.497
EMPLOYED	dummy=1 for employed	8814	0.930	0.254
FEMALE	dummy = 1 for female	8814	0.537	0.498
AGE	age at completion of Ph.D.			
	less than 30	8814	0.282	0.450
	30	8814	0.150	0.357
	31	8814	0.138	0.345
	32	8814	0.108	0.310
	33 or more	8814	0.319	0.466
MARRIED	dummy=1 for married /living together	8814	0.606	0.488
CHILDREN	dummy=1 for having at least one child	8814	0.365	0.481
YEAR	year of Ph.D. completion			
	2004	8814	0.445	0.497
	2006	8814	0.554	0.497
DEGREE_GRADE	Degree final grade			
	66-90	8814	0.003	0.059
	91-100	8814	0.051	0.220
	101-105	8814	0.107	0.310
	106-109	8814	0.129	0.335
	110	8814	0.708	0.454
NOEXTRATIME	dummy=1 for those who did not require extra regular years to complete thei Ph.D.	8814	0.898	0.302
SPECIALIZATION	Ph.D. specializaiton			
	Mathematics and Informatics	8814	0.035	0.183
	Physics	8814	0.053	0.225
	Chemistry	8814	0.064	0.245
	Earth sciences	8814	0.031	0.174
	Biology	8814	0.123	0.329
	Medicine	8814	0.090	0.287
	Agricultural sciences & veterinary	8814	0.080	0.271
	Civil engineering & Architecture	8814	0.091	0.287
	Industrial & IT engineering	8814		
	Philology & Literature	8814	0.102	0.302
	History - Philosophy	8814	0.096	0.294
	Law	8814	0.076	0.265
	Economics & Statistics	8814	0.064	0.245
	Political and Social sciences	8814	0.032	0.177
COURSES	dummy=1 for those who attended courses during their Ph.D.	8814	0.807	0.394
VISITING	dummy=1 for those who made a visiting period in foreign universities during their Ph.D.	8814	0.292	0.455
PARENTSEDUCATION	parents' highest educational level			
	junior high school or less	8814	0.249	0.432
	high school	8814	0.349	0.476
	degree or more	8814	0.401	0.490
SELFEMPLOYED	dummy= for selfemployed	8201	0.136	0.343
INFORMALACCES	dummy=1 for those who found their job thank to informal channels (family, friends, professors, etc.)	8201	0.283	0.450
OPENENDED_CONTRACT		8814	0.395	0.489
MACROREGION	macro region of residence			
	North-west	8814	0.209	0.406
	North-East	8814	0.165	0.371
	Centre	8814	0.244	0.429
	South and Islands	8814	0.317	0.465
	Abroad	8814	0.062	0.242
ACADEMIC	dummy =1 for those working in the academic sector or in public research centers	8201	0.462	0.498
R&D	Does your job imply carrying out R&D activities?			
	mainly	8201	0.491	0.499
	partially	8201	0.491	0.499
	not at all	8201	0.258	0.438
LIVES_WITH_PARENTS	dummy=1 for those who live with their original family	8814	0.138	0.344

Tab. 1: Description of variables and summary statistics

	Probit estimates		bivariate probit with sample selection			
			overeducation equation [a]		employment equation [b]	
	coeff	s.e.	coeff	s.e.	coeff	s.e.
Socio demographic variables						
FEMALE	-0.00164	(0.05)	-0.00160	(0.05)	-0.186***	(0.05)
AGE						
30	0.0330	(0.07)	0.0330	(0.07)	-0.0606	(0.07)
31	0.0544	(0.07)	0.0545	(0.07)	-0.0980	(0.08)
32	0.0976	(0.08)	0.0975	(0.08)	-0.00631	(0.09)
33 or more	0.0349	(0.06)	0.0350	(0.07)	-0.195***	(0.07)
MARRIED	0.0186	(0.05)	0.0186	(0.06)	0.0586	(0.07)
CHILDREN	-0.0139	(0.06)	-0.0139	(0.06)	-0.223***	(0.06)
PARENTSEDUCATION						
high school	0.159***	(0.06)	0.159***	(0.06)	0.0134	(0.06)
degree or more	0.103*	(0.06)	0.103*	(0.06)	0.0942	(0.06)
Ph.D. and previous educational performances						
YEAR						
2006	0.0921**	(0.05)	0.0921*	(0.05)	-0.169***	(0.05)
DEGREE_GRADE						
91-100	0.217	(0.34)	0.217	(0.34)	0.0924	(0.37)
101-105	0.0763	(0.34)	0.0763	(0.34)	0.0388	(0.36)
106-109	0.175	(0.33)	0.175	(0.33)	0.0875	(0.35)
110	0.0907	(0.33)	0.0907	(0.33)	0.159	(0.35)
NOEXTRATIME	0.0331	(0.08)	0.0331	(0.08)	0.131*	(0.08)
COURSES	-0.136**	(0.06)	-0.136**	(0.06)	-0.0503	(0.06)
VISITING	-0.148***	(0.05)	-0.148***	(0.05)	0.147***	(0.05)
SPECIALIZATION						
Mathematics and Informatics	-0.128	(0.17)	-0.128	(0.17)	-0.489***	(0.19)
Physics	0.0453	(0.15)	0.0453	(0.15)	-0.422**	(0.18)
Chemistry	0.0964	(0.13)	0.0965	(0.13)	-0.604***	(0.17)
Earth sciences	0.246	(0.15)	0.246	(0.15)	-0.502***	(0.19)
Biology	0.223**	(0.11)	0.223*	(0.12)	-0.536***	(0.16)
Medicine	0.306**	(0.12)	0.306**	(0.12)	-0.455***	(0.17)
Agricultural sciences & veterinary	0.181	(0.12)	0.181	(0.13)	-0.526***	(0.17)
Civil engineering & Architecture	0.0427	(0.12)	0.0427	(0.13)	-0.464***	(0.17)
Philology & Literature	0.0753	(0.12)	0.0754	(0.13)	-0.737***	(0.16)
History - Philosophy	0.0968	(0.12)	0.0970	(0.13)	-0.824***	(0.16)
Law	0.139	(0.13)	0.139	(0.13)	-0.595***	(0.17)
Economics & Statistics	-0.210	(0.14)	-0.210	(0.14)	-0.232	(0.18)
Political and Social sciences	0.197	(0.16)	0.197	(0.17)	-0.759***	(0.18)
Job-related controls						
SELFEMPLOYED	0.492***	(0.08)	0.492***	(0.08)		
INFORMALACCES	0.352***	(0.05)	0.352***	(0.05)		
OPENENDED_CONTRACT	0.318***	(0.05)	0.318***	(0.05)		
ACADEMIC	-0.673***	(0.06)	-0.673***	(0.06)		
R&D						
mainly	-0.947***	(0.06)	-0.947***	(0.06)		
partially	-0.373***	(0.05)	-0.373***	(0.05)		
Residence						
MACROREGION						
North-west	0.470***	(0.13)	0.470***	(0.13)	-0.0159	(0.13)
North-East	0.461***	(0.14)	0.461***	(0.14)	0.0464	(0.13)
Centre	0.446***	(0.13)	0.446***	(0.13)	-0.112	(0.12)
South and Islands	0.485***	(0.13)	0.485***	(0.13)	-0.230*	(0.12)
Selection variable						
LIVES_WITH_PARENTS					-0.397***	(0.07)
University provinces dummies	*Yes*		*Yes*		*Yes*	
Oss.	5922		6536			
log likelihood	-2100.33		-3963.25			
Pseudo R2	0.27					
LR chi2	1583.66		1123.82			
PR>chi2	0.00		0.00			
BIC	4947.69		9419.96			
artrho			-.00062 (0.27)			

Tab. 2: overeducation equation with and without correction for sample selection. The dependent variable is OVEREDUCATION. *Notes:* *** 1% significance level; ** 5% significance level; * significance level. [a] the dependent variable is OVEREDUCATION; [b] the dependent variable is EMPLOYED

	Probit estimates		bivariate probit with sample selection			
			overeducation equation [a]		employment equation [b]	
	coeff	s.e.	coeff	s.e.	coeff	s.e.
Socio demographic variables						
FEMALE	0.0511	(0.03)	0.0497	(0.04)	-0.205***	(0.05)
AGE						
30	0.0806	(0.05)	0.0804	(0.05)	-0.0367	(0.07)
31	0.0540	(0.06)	0.0536	(0.06)	-0.0679	(0.07)
32	0.0324	(0.06)	0.0327	(0.06)	0.0250	(0.08)
33 or more	-0.0569	(0.05)	-0.0571	(0.05)	-0.0530	(0.06)
MARRIED	-0.103**	(0.04)	-0.101**	(0.04)	0.0850	(0.06)
CHILDREN	0.0653	(0.04)	0.0643	(0.04)	-0.176***	(0.06)
PARENTSEDUCATION						
high school	0.0444	(0.04)	0.0445	(0.04)	0.0113	(0.05)
degree or more	0.0290	(0.04)	0.0298	(0.04)	0.102*	(0.06)
Ph.D. and previous educational performances						
YEAR						
2006	0.00420	(0.03)	0.00347	(0.03)	-0.108**	(0.04)
DEGREE_GRADE						
91-100	0.172	(0.27)	0.173	(0.27)	0.207	(0.34)
101-105	0.0993	(0.27)	0.100	(0.27)	0.125	(0.33)
106-109	0.128	(0.27)	0.129	(0.27)	0.142	(0.33)
110	0.0672	(0.27)	0.0689	(0.27)	0.241	(0.33)
NOEXTRATIME	-0.0604	(0.06)	-0.0600	(0.06)	0.0594	(0.07)
COURSES	-0.129***	(0.04)	-0.129***	(0.04)	-0.0374	(0.06)
VISITING	-0.0918**	(0.04)	-0.0911**	(0.04)	0.0946*	(0.05)
SPECIALIZATION						
Mathematics and Informatics	0.0307	(0.12)	0.0287	(0.12)	-0.496***	(0.18)
Physics	0.0122	(0.10)	0.0103	(0.10)	-0.440**	(0.17)
Chemistry	0.164*	(0.09)	0.162*	(0.10)	-0.628***	(0.16)
Earth sciences	0.154	(0.11)	0.151	(0.12)	-0.545***	(0.18)
Biology	0.158*	(0.08)	0.156*	(0.09)	-0.569***	(0.15)
Medicine	0.172*	(0.09)	0.171*	(0.09)	-0.407***	(0.16)
Agricultural sciences & veterinary	0.232**	(0.09)	0.230**	(0.09)	-0.529***	(0.16)
Civil engineering & Architecture	0.0905	(0.09)	0.0894	(0.09)	-0.343**	(0.16)
Philology & Literature	0.0603	(0.09)	0.0567	(0.09)	-0.690***	(0.15)
History - Philosophy	-0.0311	(0.09)	-0.0352	(0.09)	-0.766***	(0.15)
Law	-0.0494	(0.09)	-0.0514	(0.09)	-0.469***	(0.16)
Economics & Statistics	-0.0443	(0.09)	-0.0451	(0.09)	-0.225	(0.17)
Political and Social sciences	0.0316	(0.12)	0.0278	(0.12)	-0.748***	(0.17)
Job-related controls						
SELFEMPLOYED	-0.177***	(0.06)	-0.177***	(0.06)		
INFORMALACCES	0.144***	(0.04)	0.144***	(0.04)		
OPENENDED_CONTRACT	-0.0134	(0.04)	-0.0134	(0.04)		
ACADEMIC	-0.939***	(0.04)	-0.939***	(0.04)		
R&D						
mainly	-1.228***	(0.05)	-1.227***	(0.05)		
partially	-0.523***	(0.05)	-0.523***	(0.05)		
Residence						
MACROREGION						
North-west	0.473***	(0.09)	0.473***	(0.09)	0.0517	(0.13)
North-East	0.466***	(0.09)	0.466***	(0.09)	0.125	(0.13)
Centre	0.468***	(0.09)	0.468***	(0.09)	-0.0169	(0.12)
South and Islands	0.375***	(0.09)	0.373***	(0.09)	-0.130	(0.12)
Selection variable						
LIVES_WITH_PARENTS					-0.387***	(0.07)
University provinces dummies	*Yes*		*Yes*		*Yes*	
Oss.	8200		8814 uncensored -8200 censored			
log likelihood	-3921.63		-5987.49			
Pseudo R2	0.30					
LR chi2	3439.38		2717.46			
PR>chi2	0.00		0.00			
BIC	8618.28		13519.28			
artrho			0.0311 (0.25)			

Tab. 3: over-skilling equation with and without correction for sample selection. Coefficients and standard errors (in parentheses) *Notes:* *** 1% significance level; ** 5% significance level; * significance level. [a] the dependent variable is OVERSKILLING; [b] the dependent variable is EMPLOYED