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Italian Ph.D. Holders and Mismatch in Education and Skills: Empirical evidence

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Abstract

Ph.D. education is a key element in innovation and the generation of new knowledge. Nevertheless, in Italy, the share of doctoral graduates is still lower than the average for OECD member countries. This paper investigates the effectiveness of doctoral education and the extent to which the Italian labour market properly absorbs the rising flow of Ph.D. holders. The effectiveness is assessed from the twofold perspective of the formal relevance of a Ph.D. qualification in the labour market and the substantial applicability of skills acquired to different occupations inside and outside university. Logit models enable sketches of the main determinants of overeducation and overskilling among Italian Ph.D.'s, whereas log-earnings equations allow assessment of the role of educational and skills mismatches in terms of wage penalties. Oaxaca-Blinder decompositions help analyse some causes of these mismatches. The different patterns of overeducation and overskilling among Ph.D. holders working inside and outside academe lead to different degrees of pay penalties.

1 Introduction

In recent years, the increasing expansion of higher education in Europe (OECD, 2013) has included doctoral education and training (Auriol, 2010). The importance of Ph.D. education - defined as the third stage of higher education by the Bologna Process (1999) - has become more explicit in the EU agenda thanks to the role of such education in contributing to long-run growth and innovation in a knowledge-based economy (Brinkley, 2006; Leadbeater, 1999; Fumasoli et al., 2015). In addition, because they are specifically trained in certain fields of knowledge, doctorate holders are oriented to carry out scientific research that may contribute to social and economic development (Bitusikova, 2010).

Although universities traditionally offer doctoral education, other public and private research-oriented institutions and professional organisations are currently offering Ph.D. programmes with the aim of establishing a European Higher Education Area (EHEA), as called for by the ministers of education and university leaders of 29 countries in the Bologna Process. In the Bologna Seminar titled "*Doctoral Programmes for the European Knowledge Society*" (Salzburg, 3-5 February 2005), European ministers emphasised the importance of research and interdisciplinarity in enhancing the competitiveness of higher education across EU countries. The 2010 Vienna Declaration officially launched

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the EHEA, expressing the need for a worldwide dialogue to explore the role of higher education from a global perspective. In this context, for some years, many governments have been supporting doctorate courses to increase the supply and enrolment of students on the one hand and the performance of such programmes on the other hand. Their specific aim is to attract international talent and to encourage the creation of knowledge in accordance with the principles of internationality, interdisciplinarity and intersectorality (European Commission, 2010). Other specific reforms are intended to widen Ph.D. students' skills and abilities and to favour their transition into the private sector, where they act as agents of creativity and innovation for the benefit of the global society (LERU, 2007). Many strategies have been inspired by the need for doctorate holders to increase their so-called soft skills (e.g., problem solving, interpersonal and leadership skills, and critical reasoning), which enable them to make a difference in the workplace by improving their capacity for management, teamwork, projecting and fund raising. In the near future, in Italy, other reforms will aim to valorise the role of Ph.D. holders in the labour market and to increase actual career opportunities at the highest levels of public administration. In addition, in line with the objective of doctoral degree enhancement, recent school reforms have recognised the advantages for Ph.D. holders in the evaluation of requirements for teaching in high schools, for research grants and for national scientific accreditation.

The upward trend of doctorate courses and programmes concerns the majority of OECD (Organisation for Economic Co-operation and Development) countries. However, although employment opportunities and earnings usually increase with education level (Rehme, 2007; Andersen and wan de Werfhorst, 2010; Castellano and Punzo, 2016), Ph.D. holders are more likely to experience occupational mismatches. The insufficient "absorptive capacity" of the national productive structure (Di Paolo and Mañé, 2013) may mean that the increasing supply of Ph.D. holders is not completely absorbed by the simultaneous creation of academic and research-oriented jobs or that they are mismatched in the labour market (Garcia-Aracil and Van der Velden, 2008; Hakala, 2009; Auriol et al., 2013). Ph.D. holders may be mismatched in the labour market in two respects - education and skills - that, although related, have different analysis and policy implications (Desjardins and Rubenson, 2011). In fact, as argued by the OECD (2013), "more education does not automatically translate into better skills", which is why a joint analysis of education and skills at the individual level is a reliable approach to provide a better comprehensive understanding of the relationship between education and skills mismatches in the labour market.

This paper addresses the outcomes of the doctoral process in Italy, their impact on graduate careers and the adequacy of the competencies developed. It assesses the extent to which the Italian labour market properly absorbs the rising flow of Ph.D.'s and how effectively these degree holders represent key elements for innovation and the generation of new knowledge in the economy. More precisely, our research hypothesis aims to investigate the effectiveness of the doctoral training process from the twofold perspective of the formal relevance of the Ph.D. qualification in the labour market and the substantial applicability of skills acquired for different occupations inside and outside academe. Since the doctoral degree is the highest level of formal education in Italy - it is ranked as the eighth level in the new International Standard Classification of Education (ISCED-2011) - this paper focuses uniquely on upward mismatches in the labour market. It sketches a profile of Ph.D. holders at risk of overeducation and overskilling by examining their main deter-

minants and the amount by which rewards are lower for educationally mismatched workers than for their matched peers. Differences in the probability of experiencing mismatch in education and skills are decomposed into (i) the endowment effect, which captures the share due to differences in employee characteristics, and (ii) the return effect, which is related to the ability of the national system (education vs. labour market) to transform these characteristics into skills and to reward workers differently for the same individual endowments. Finally, the decomposition of the wage gap by groups of doctorate holders allows us to evaluate the contribution of each factor to wage penalties.

This paper is organised as follows. Section 2 describes the conceptual framework of overeducation and overskilling in light of the main theoretical constructs that help explain occupational mismatches. Section 3 analyses the upward trend of Ph.D. education in the Italian educational system. Section 4 addresses the data and some descriptive statistics on well-matched/mismatched Ph.D. holders, whereas Section 5 shows the methodology and the groups of covariates tested. Section 6 discusses the main results, and Section 7 concludes.

2 Occupational Mismatches between Overeducation and Overskilling

In recent years, the growing difficulty in managing the transition from university to work has stimulated an extensive literature on occupational mismatches, especially in terms of overeducation and overskilling. After a doctoral degree is completed, overeducation occurs if this high level of qualification exceeds the requirements to obtain a certain job (Sicherman, 1991; Battu et al., 1999; Dolton and Vignoles, 2000; McGuinnes and Bennet, 2007; Bárcena-Martín et al., 2011). Overskilling occurs when the competencies acquired during the doctoral programme are useless in performing the job (Dolton and Silles, 2008; McGuinnes and Sloane, 2011; Green and Zhu, 2010; Mavromaras et al., 2013). In particular, if the skill levels of overeducated workers are linked to job satisfaction, the genuinely overeducated, who are actually dissatisfied with their occupation, may be distinguished from those who are apparently merely overeducated (Chevalier, 2003).

Researchers have also tried to investigate the potential relationships between overeducation and overskilling. McGuinness and Bennett (2007), for example, studied the extent to which the incidence and impact of overeducation are specific to individuals of particular ability levels, and Allen and Velden (2001) examined the relation between educational and skill mismatches with different effects on wages and other labour market outcomes and concluded that skill mismatches are much better predictors of job satisfaction and job searches than educational mismatches.

However, both dimensions of job mismatch are rarely assessed as regards in terms of doctoral education, which remains an under-researched area compared to undergraduate education. In other words, while increasing attention is being devoted to the matching of education (and skills) level with the job performed for workers with a graduate and undergraduate education, such matching is only marginally assessed for postgraduate workers (i.e., master's degree and Ph.D. holders).

As discussed by Caroleo and Pastore (2017), human capital theory (Leuven and Oost-

erbeek, 2011) and the job competition model (Thurow, 1979) are the main constructs that help explain overeducation. The first approach holds that overeducation is a signal of a lack of the work-related component rather than a waste of human capital. The second model considers excess schooling a consequence of the competition for jobs in the presence of the rigidity of the demand for highly educated labour that leads graduates to accumulate education. The assignment theory (Sattinger, 1993), which attempts to reconcile the two models, holds that overeducation arises because wages are not entirely related to acquired schooling and other personal characteristics (as in the human capital model) or to the nature of the job (as in the job competition model).

Pioneering studies of overeducation and overskilling primarily considered the United States (Freeman, 1976). Subsequent analyses also covered some European countries (Alba-Ramirez, 1993; Dolton and Vignoles, 2000; Büchel et al., 2003; McGuinness, 2003; 2006; McGuinness and Bennett, 2007; Quintini, 2011; Aleksynska and Tritah, 2013; Verhaest and van der Velden, 2013) and other OECD countries (Manacorda and Petrongolo, 2000; McGowan and Andrews, 2015). Much of the research explored the determinants of overeducation from a cross-country perspective with many difficulties due to the lack of comparative data (Leuven and Oosterbeek, 2011; Mavromaras et al., 2013; Sgobbi and Suleman, 2013). Some studies also assessed the impact of a large range of individual characteristics on the "effectiveness of the university degree" in providing a job that matches the individual education and skill levels (Franzini and Raitano, 2012; Cutillo and Di Pietro, 2006). In particular, Manacorda and Petrongolo (2000) showed higher overeducation in the EU than in the USA, with a more dramatic scenario in southern Europe, especially in Italy, where there has also been extensive growth in the human capital supply (Cainarca and Sgobbi, 2009). McGowan and Andrews (2015) found that differences in skill mismatch across OECD countries are related to differences in public policies. Much research has also focused on penalties in earnings and employment prospects (Allen and Velden, 2001; Sloane, 2003; Brynin and Longhi, 2009; Leuven and Oosterbeek, 2011; Franzini and Raitano, 2012). These studies demonstrated that a large share of earning differentials depends on the mismatch between individual skill level and job requirements (McGuinness, 2003) and that the wage penalty for overskilling is lower than that for overeducation (McGuinness and Sloane, 2011). Neumann et al. (2009) found that earnings are associated with the quality of an employer-employee job match and that better-matched workers are usually more productive and receive higher earnings. Nordin et al. (2010), who examined the income penalty for education-occupation mismatches for high-educated workers in Sweden, revealed that for mismatched men, the penalty is approximately twice as large as for their US counterparts, whereas for women, it is approximately the same as for their US peers. Based on the findings of other scholars (Dolado et al., 2002; Ortiz, 2010), overeducated and/or overskilled workers are affected by wage penalties because they do not reach the wage level typically associated with their qualification, with inevitable consequences related to productivity, job satisfaction and psychological strain. More generally, the underutilisation of human capital (Feldman and Turnley, 1995; Feldman, 1996) and inefficiency of public expenditure on education (Groot and Massen van den Brink, 2000; McGuinness, 2006) may cause a waste of resources in the society as a whole.

Doctoral education is still an under-researched area compared to undergraduate education, and issues related to the overeducation and overskilling of Ph.D. holders have

rarely been assessed. One of the main novel elements of this work is that it links research on the forces driving occupational mismatches of Ph.D. recipients to the decomposition of the probability of being overeducated rather than overskilled as well as the contribution of each covariate to the wage gap for specific groups of doctorate holders.

3 The Upward Trend of Ph.D.'s and their Role in the Labour Market

As documented by Eurostat (http://ec.europa.eu/eurostat), in 2004, more than $525\,000$ students were attending a Ph.D. course in EU-25 (approximately 1.15 per 1000 inhabitants), accounting for just 3.3% of tertiary students. In the same year, more than 93,000 Ph.D. students (0.21 per 1000 inhabitants) received their doctoral degree, twice as many as in the United States and six times more than in Japan. In a broader international context, it is worth stressing the constant development of higher education and research systems across OECD countries, where the number of advanced research qualifications has increased by 56% over the period 2000–2012. However, doctorate programmes still represent a small share of all tertiary programmes, even though on average across OECD countries, 1.6% of young people in 2012 were expected to attain the Ph.D. degree over their lifetime, compared to only 1% in 2000 (OECD, 2014) and 1.5% in 2009. In addition to Switzerland (extra-EU), Sweden, Portugal, Finland and Germany showed the highest graduation rates at the doctoral level in 2009 with more than 2.5% of Ph.D. holders, whereas Italy is still below the OECD average (1.6%) but in line with the EU-27 average. The expansion of doctorates from 2000 to 2012 is due partially to the increasing presence of women, who were awarded on average almost half (46%) of the OECD's new doctorate degrees in 2009 (Boarini, 2009; OECD, 2011). However, in 2009, women represented less than 40% of total Ph.D. recipients in most OECD countries (OECD, 2013), and in 2012, they were less likely than men to earn an advanced research qualification (OECD, 2014). Italy shows a tendency to buck the prevailing trend with a higher presence of women in doctorate programmes.

In the 1980s, the high employment rates (93% on average) for doctorate holders in most OECD countries, even greater than those for all tertiary graduates (81%), pointed to the strong attractiveness of Ph.D. graduates as job market candidates, even in times of economic downturn (OECD, 2013). However, in the 2000s, the occupational situation of doctorate recipients has been less favourable. More specifically, in the 2000s, employment rates for Ph.D. holders depend on the field of study (e.g., higher for Ph.D.'s in engineering and social and medical sciences and lower for Ph.D.'s in humanities) and vary considerably across career paths (e.g., the uncertainty of having indefinite contracts is higher for Ph.D. graduates than for all employees). Particularly in Portugal but also in Germany and the Netherlands, Ph.D. recipients, especially in humanities, are in precarious and informal situations in the labour market with temporary and/or part-time contracts or even short-term positions (e.g., postdoctoral positions), which detract from the attractiveness of research careers. Nevertheless, over 90% of working Ph.D.'s are either professionals or managers, especially in the education sector, with significant earnings differentials across OECD countries. However, except for France, whose unemployment rates for Ph.D. re-

cipients were higher than for graduates at a lower level of education (Harfi and Auriol, 2010), employment rates for Ph.D.'s are higher (approximately 3 percentage points) than for other tertiary-level graduates, confirming that employment prospects usually improve with a higher level of education.

4 Data Source: A Preliminary Analysis

Our analysis draws upon the most recent *census data* (2014) from the Istat Survey on Doctorate Holders' Vocational Integration; to be useful to scientists and policy makers, it is based on information that is as up-to-date as possible. We performed the analysis on data from the last edition of the survey, which was conducted between February and July 2014 with doctorate recipients who earned their Ph.D. degree in Italy in 2010. The main objective of the survey is to detect the employment conditions of Ph.D.'s four years after graduation; therefore, 2014 is the year to which the information relates[2]. The survey also collects a large set of data on the subjective opinions of Ph.D.'s about their education and labour market experiences, university-to-work transition process, family background and other personal information. It gains strength by being a *total* survey — the target population is composed of $11\,240$ Ph.D. holders — in which weights allow correction for bias due to potential nonresponses. The survey adopts a mixed approach (Groot and Massen van den Brink, 2000; Desjardins and Rubenson, 2011; Quintini, 2011) to detect occupational mismatches of Ph.D. holders. An objective approach allows the evaluation of matching in education, and a more subjective approach relies on direct questions presented to workers about their perception of mismatch in skills[3].

Among graduates who earned a Ph.D. in 2010 for whom the employment situation was evaluated in 2014, those who are overeducated (anyone whose Ph.D. degree was neither required by law nor useful to the current job) amount to 30.57%. Those who are overskilled (anyone who does not consider the Ph.D. education effectively necessary to perform the current job) have a more significant share that is nearly twice that of the overeducated (60.96%). Doctorate holders who are simultaneously overeducated and overskilled are 29.27% of the total. However, the incidence of mismatched workers who enter a career outside university is higher than that of mismatched workers who continue to work within university: percentages of overeducation are 37.19% outside academe vs. 5.26% inside, whereas percentages of overskilling are 73.02% outside vs. 14.79% inside. This imbalance in mismatches inside and outside academe draws attention to the inability of the private sector to benefit fully from the high potential of individuals who are specifically trained for research. Only 8.46% of Ph.D.'s are still unemployed four years after graduation, and they are prevalently women (62.81% vs. 37.19% men). More than one-fifth of unemployed Ph.D. recipients (22.96%) are waiting to begin a job or remu-

[2] This is the second edition of the census survey on doctorate holders' vocational integration and also includes Ph.D.'s who earned their doctoral degree in 2008. Istat conducted the first edition of the survey between December 2009 and February 2010 with Ph.D.'s who had graduated in 2004 and 2006, with the aim of detecting their employment conditions three and five years after graduation.

[3] The questionnaire envisages two kinds of questions to evaluate the presence of overeducation and/or overskilling. They are, respectively, "Was the Ph.D. degree an explicit requirement to access the current job?" and "In your opinion, is the Ph.D. education effectively necessary to perform the current job?"

nerated training; more than one-third (34.04%) are still looking for a job and one-tenth (10.91%) are seeking a satisfactory job, whereas 10.52% are unable to work for personal reasons. The proportion of individuals who declared they had not yet found a satisfactory job is rather balanced between genders, whereas of those who cited personal reasons that prevented them from working, 90 of 100 are women.

Although overeducation and overskilling are observed exclusively for Ph.D.'s who were employed at the time of the survey, the selection effect arising from this process - due to unobservable individual characteristics that are potentially linked to job search propensity - is not significant; after all, only slightly more than 10% (10.91%) of Ph.D. graduates are unemployed after four years. The different dynamics of overeducation and overskilling that characterise Ph.D. holders' careers inside and outside university justify their separate treatment. However, in Italy, for most Ph.D. graduates, the professional prospect is the academic career for which the doctorate degree is typically recognised or required by law. As illustrated before, working at university produces a greater guarantee of equality because of the more standardised job contracts; for example, there is a lower gender-based pay gap (7.96%) than for Ph.D. graduates who work outside academe (18%) (see Section 6).

In general, doctorate holders who begin a professional career outside university earn, on average, more than others. Overeducation is slightly more frequent for women (34.29%) than for men (26.72%); in detail, 41.09% of women (vs. 32.96% of men) working outside academe are overeducated, and 5.36% of women (vs. 5.15% of men) working inside academe are overeducated.

Outside university, overeducated males earn, on average, even more than females who are well matched in education (Table 1). However, the pay gap — computed as the difference between the mean incomes of overeducated and well-matched Ph.D.'s compared to those who are only well matched — is more severe for men (18.99% vs. 13.85%). Both inside and outside academe, pay differentials are in favour of well-matched Ph.D. holders, meaning that well-matched individuals earn, on average, more than their overeducated counterparts irrespective of the geographical area of the country in which they work.

In terms of the field of study, well-matched individuals in education who work in academe generally earn more than their peers who work outside it. The only exceptions are the Ph.D.'s in humanities and law who, even when they are well matched in education, earn, on average, less than their colleagues in other disciplines. In brief, overeducated Ph.D.'s show some important differences between their mean incomes that are generally in favour of those who undertake a career outside academe. This evidence is partly in line with the majority of other European countries and the United States, where Ph.D. graduates usually receive higher earnings when they do not work as researchers (Auriol, 2010). The largest wage gap (more than 40 percent) exists among doctorate holders who work inside academe in the fields of physical, social and life sciences. In contrast, outside academe, the wage gaps are usually less extensive except for Ph.D.'s in law.

It is worth noting that, except for Ph.D.'s in law, overeducation is generally more severe for the remuneration of doctorate holders who started an academic profession (e.g., their pay gaps are consistently higher than those of their colleagues who work outside academe). In contrast, overskilling more seriously affects the earnings of Ph.D. holders working outside university in several fields except for physical, social and life sci-

Table 1: Mean income of Ph.Ds. (overeducated vs. well-matched in education) by type of career (inside and outside academe) and by other main characteristics

	Academic career			Outside university		
Main characteristics	Overeducated	Well-matched in education	Gap	Overeducated	Well-matched in education	Gap
Gender						
Female	1102	1886	41.57	1418	1646	13.85
Male	1331	2032	34.50	1625	2006	18.99
Geographical area						
North-west	1466	2055	28.66	1591	2007	20.73
North-east	1590	1830	13.11	1549	1861	16.77
Centre	1251	2039	38.65	1523	1844	17.41
South	788	1705	53.78	1434	1594	10.04
Islands		2183		1393	1914	27.22
Field of study						
Physical sciences	1150	2039	43.60	1401	1739	19.44
Life sciences	1263	2141	41.01	1656	1796	7.80
Engineering	1550	2010	22.89	1583	2014	21.40
Humanities		1686		1833	2356	22.20
Economics and Statistics	1700	2132	20.26	1598	1964	18.64
Law	1200	1708	29.74	1177	1814	35.12
Social sciences	1010	1740	41.95	1228	1451	15.37

Source: Authors' elaboration on 2014 census data

ences (Table 2). Therefore, overskilling is widespread, mainly outside academe, where the shares of the overskilled reach 77.66% (vs. 18.06% inside) for women and 68% (vs. 11.91% inside) for men. Particularly in academic professions, the income penalty is higher for mismatched women - overskilled (34.43% vs. 9.05%) or overeducated (41.57% vs. 34.50%). Both inside and outside university, the wage gap due to mismatches in skilling is consistently positive along the entire Italian territory, although it is negligible in the northeast and even negative in the insular regions for Ph.D.'s with an academic career. An anomaly is represented by overskilled workers who achieved their Ph.D. degree in the Isles of Italy and are currently pursuing an academic career: they earn approximately 50% more than their well-matched colleagues.

In terms of the field of study, professions outside academe reward well-matched Ph.D.'s in humanities, economics and statistics, while engineering shows less severe wage gaps between overskilled and well-matched Ph.D.'s. Inside academe, well-matched doctorate holders in social, physical and life sciences have higher rewards than their overskilled colleagues. In the engineering field, mismatched Ph.D.'s who pursue an academic career show an advantage in terms of wages compared with their well-matched peers.

The distributions of mean incomes and wage gaps of Ph.D.'s who are simultaneously overeducated and overskilled are not very different from those of Ph.D.'s who are only overeducated. However, in general, differentials in mean incomes between unmatched workers appear to be larger and the relative wage gaps more severe compared to their peers who are perfectly matched in the labour market (Table 3). Wage differentials across Italian macro regions are even more pronounced. In other words, the wage gaps of mismatched workers in both dimensions (education and skill) are consistently higher than those of their colleagues who are mismatched only in education (Table 1) or in skill (Table 2). The most significant exceptions are the Ph.D.'s who hold a doctorate in law, who appear to be severely penalised if they are only overeducated.

5 Methodology

In the first step, with the aim of understanding the leading determinants underlying overeducation and overskilling (y_i, *manifest* variables) and the probability that these events occur among Ph.D. graduates (y_i^*, *latent* variables) who have been pursuing a career inside or outside academe, maximum likelihood logit models (Allen, 2000), chosen in the sphere of binary response models, are performed. These models are tested on a set of covariates that are grouped as follows: (i) sociodemographic characteristics (gender, cohabiting, children, age at the date of Ph.D. attainment); (ii) family background (father's education level, macroarea of residence); (iii) educational path (final grade at university degree, type of secondary school attended); (iv) doctoral characteristics (mobility from region where the degree was attained, time to earn doctorate, field of study); and (v) doctoral tutorial path (seminars, laboratory activities, schools, experience abroad, teaching). Therefore,

$$y_i^* = \gamma z_i + u_i$$

where γ is the vector of coefficients of the related covariates z_i and u_i is the error terms.

In the second step, to test how overeducation and overskilling affect individual wages, log-earnings functions are tested, also controlling for other factors that are likely to ex-

Table 2: Mean income of Ph.Ds. (overskilled vs. well-matched) by type of career (inside and outside academe) and by other main characteristics

	Academic career			Outside university		
Main characteristics	Overskilled	Well-matched in skills	Gap	Overskilled	Well-matched in skills	Gap
Gender						
Female	1274	1943	34.43	1467	1855	20.92
Male	1839	2022	9.05	1810	2067	12.43
Geographical area						
North-west	1415	2056	31.18	1742	2176	19.94
North-east	1788	1828	2.19	1626	2003	18.82
Centre	1351	2074	34.86	1661	1943	14.51
South	1188	1742	31.80	1498	1667	10.14
Islands	3171	2081	−52.38	1542	2156	28.48
Field of study						
Physical sciences	1487	2064	27.96	1535	1847	16.89
Life sciences	1620	2164	25.14	1649	2046	19.40
Engineering	2121	2000	−6.05	1839	2024	9.14
Humanities	1502	1706	11.96	1966	2825	30.41
Economics and Statistics		2121		1688	2146	21.34
Law	1456	1709	14.80	1426	1775	19.66
Social sciences	1069	1804	40.74	1294	1593	18.77

Source: Authors' elaboration on 2014 census data

Table 3: Mean income of Ph.Ds. (both overeducated and overskilled) by type of career (inside and outside academe) and for well-matched in both education and skill and by other main characteristics

Main characteristics	Academic career			Outside university		
	Overeducated and overskilled	Well-matched in education and skills	Gap	Overeducated and overskilled	Well-matched in education and skills	Gap
Gender						
Female	1102	1943	43.28	1398	1853	24.55
Male	1203	2206	45.47	1624	2095	22.48
Geographical area						
North-west	1250	2059	39.29	1577	2215	28.80
North-east	1590	1828	13.02	1524	1987	23.30
Centre	1187	2078	42.88	1521	1953	22.12
South	788	1742	54.76	1413	1672	15.49
Islands	–	2081	–	1355	2181	37.87
Field of study						
Physical sciences	1150	2064	44.28	1385	1868	25.86
Life sciences	1186	2176	45.50	1640	2051	20.04
Engineering	1550	2000	22.50	1586	2051	22.67
Humanities	–	1706	–	1833	2825	35.12
Economics and Statistics	–	2132	–	1535	2158	28.87
Law	1200	1709	29.78	1177	1775	33.69
Social sciences	1010	1804	44.01	1220	1593	23.41

Source: Authors' elaboration on 2014 census data

plain differences in generating income. Indeed, beyond overeducation or, alternatively, overskilling, a semi-log functional form of earnings equation is performed for other control variables, including the same personal background, family background and doctoral characteristics and the father's profession:

$$\ln W_i = \beta X_i + \epsilon_i$$

where W_i is the personal wage, X_i is the covariates and β the related coefficients, and ϵ_i is the error terms. The comparison between the unconditional (wage is exclusively regressed on overeducation or overskilling) and conditional models (including all the covariates) shows the role played by these mismatches in relation to wages.

In the third step, to analyse in depth the determinants of different outcomes on wages and on the probability of overeducation/overskilling for specific groups of doctorates, the threefold Oaxaca-Blinder (OB) decompositions are performed on both the logit and log-earnings regressions. As argued by Gomulka and Stern (1990), Even and Macpherson (1990), Yun (2004) and Fairlie (1999; 2005), the OB procedure may also be applied to nonlinear regression models. In particular, we perform the extension of the OB procedure developed by Bauer and Sinning (2008) to logit models.

To explore how much of the mean wage gap is accounted for by differences in the predictors, the wage gap is decomposed into three main effects (Winsborough and Dickinson, 1971; Jones and Kelley, 1984; Daymont and Andrisani, 1984):

$$\Delta_j = \left[E\left(X_j\right) - E\left(X_k\right)\right]\beta_k + E\left(X_k\right)'\left(\beta_j - \beta_k\right) + \left[E\left(X_j\right) - E\left(X_k\right)\right]'\left(\beta_j - \beta_k\right) \quad (5.1)$$

The first component (e.g., the difference in the average for each predictor weighted by the slope of the wage earnings equation for the reference group k) represents the share of wage gap that can be explained because of different average characteristics between two subsets of individuals (e.g., males vs. females; northern vs. southern Italy; hard vs. soft subjects[4]; overeducated vs. well matched in education; overskilled vs. well matched in skills). This component is called the endowment effect and reflects the more or less favourable endowment of observable characteristics measured by the explanatory variables for the group of reference compared to each other group. Therefore, the endowment effect measures how much doctorate holders from the jth group would earn differently if they had experienced the same education process as the doctorate holders of the group of reference.

The second component, obtained as difference in the slopes weighted by the average of characteristics of the group of reference, amounts to the proportion of wage gap related to different production processes (that is, the transformation of inputs into educational achievement) between the two groups under consideration. This component is called the return effect and reflects more or less efficiency of the group of reference in producing performance compared to each other group. In other words, the return effect measures how much doctorate holders from the jth group would earn differently if they had the same average characteristics as the doctorate holders of the reference group.

[4] To distinguish the types of field of study in relation to their quantitative content, we grouped physical, life and engineering sciences as hard subjects, and humanity, social, economic and statistic, and law sciences as soft subjects.

The third component, the interaction effect, is the residual part of decomposition and captures the leverage produced by both effects occurring simultaneously. Standard errors of individual components are computed according to Jann (2008), which extends the earlier method developed in Oaxaca and Ransom (1998) to address stochastic regressors.

Regarding probability, Oaxaca and Ransom (1998) proposed a more generalised formulation:

$$\Delta_j = \left[E\left(X_j\right) - E\left(X_k\right)\right]\beta^* + E\left(X_j\right)'\left(\beta_j - \beta^*\right) + E\left(X_k\right)\left(\beta^* - \beta_k\right)$$

where β^* is the weighted average of the coefficient vectors β_j and β_k:

$$\beta^* = \Omega\beta_j + \left(1 - \Omega\right)\beta_k$$

Ω is the weighting matrix and I is the identity matrix. Therefore, for $\Omega = 1$, the weights used are given by coefficients of the so-called advantaged group (the group corresponding to lower probability of being mismatched), whereas for $\Omega = 0$, the weights used are given by coefficients of the disadvantaged group (the group with higher probability). Following this approach, the OB decomposition represents a special case of this generalised equation in which Ω is the null or the identity matrix so that it assumes the general simplified formulation expressed in (5.1).

6 Main Results

Before discussing the main results of our analysis, it is necessary to reflect upon the issue of potential endogeneity that may occur, especially in the case of log-earnings equations. For this reason, we have also controlled for exogeneity that is the orthogonality of the regressors and the disturbance terms of the models. The verification of this assumption is required because in the presence of endogeneity, the use of ordinary least squares (OLS) leads to biased and inconsistent parameters (Nakamura and Nakamura, 1981).

To validate that the OLS model corresponds to our data, the Durbin-Hausman-Wu (DHW) test, which evaluates the consistency of an estimator (OLS) when compared to a less efficient estimator that is already known to be consistent, was conducted (Green, 2012). In particular, the DHW test, which can be used to check for the endogeneity of one or more covariates, compares instrumental variable estimates to OLS estimates and determines whether the errors are correlated (endogenous) or not correlated (not endogenous) with the regressors. The null hypothesis is that they are not, and in this case, the preferred model is OLS. With a p-value of 0.1253, the DHW test is not statistically significant, and the hypothesis that regressors are uncorrelated with the disturbance terms cannot be rejected. Therefore, the OLS models may be considered efficient and consistent. We have also controlled for all the correlations between each regressor with error terms, and the corresponding association indexes are consistently below 0.05.

Table 4 shows the results of the logit models, estimated separately for Ph.D. holders who are pursuing a career inside and outside university. The impact of gender on the probability of being overskilled is higher for Ph.D. holders who work outside universities and consistently favours men. Cohabiting with a partner is associated with a lower probability of overeducation and overskilling but a higher probability of being overskilled

outside university. Younger doctorate holders are less likely to be overeducated and overskilled, whereas living in northern Italy reduces the probability of being overeducated within academic careers and the probability of being overskilled outside university. Most likely, doctorate holders have the highest opportunities for adequate jobs in northern and central Italy. Similarly, doctorate holders who have moved and are currently working outside the region where their doctorate degree was attained are less likely to be both overeducated and overskilled. Surprisingly, a higher final grade increases the probability of being overeducated and overskilled, as does having attended a high or technical school. Regarding the field of study, overeducation is less likely for Ph.D.'s in physical and life sciences, engineering and law outside university and only for Ph.D.'s in physical sciences inside academe.

In general, the qualitative content of Ph.D. courses with respect to schools, seminars, teaching activities and experience abroad improves individual skills, allowing access to job positions that are well matched to the educational background, especially outside academe.

To assess the role played by educational and skill mismatches in wage penalties (Hartog, 2000; McGuinness, 2006), log-earnings equations are estimated in two alternative specifications, including overeducation and overskilling (Table 5). Here, it is important to note that the estimated equations do not control for the classical human capital characteristics, such as the educational level, which is the same for all the employees, and job experience, as workers were analysed four years after they earned the doctorate. In this light, the Ph.D. holders' earnings depend not only on human capital endowment, personal characteristics and parental background but also on the potential existence of overeducation and overskilling. However, both overeducation and overskilling act negatively on personal wages, especially inside university. Pay penalties increase (or at least do not decrease) if the characteristics of doctorate holders are not controlled for (unconditional estimates), suggesting that the covariates included in the model help identify the main causes of mismatched jobs.

Higher rewards are related to male doctorate holders who live in northern and central Italy and who attained the doctorate in any field of study related to social areas (except for humanity sciences inside and outside university and law inside). Generally, having a higher-level family background, proxied by father's educational level and profession, increases the expected wages for careers (e.g., a Ph.D. holder whose father has a medium/high level of education). However, the results denote rather different earnings dynamics between Ph.D. holders who enter careers inside or outside academe.

Regarding the analyses of differences in the probabilities of experiencing mismatch in education and skill (Table 6) as well as differences in wages (Table 7), the estimations from the logit and log-earnings models have been used to decompose these differences through extensions of the threefold OB technique in relation to the most important personal characteristics.

Being female and having earned the doctorate degree in southern Italy increase the probability of being overskilled and overeducated. However, this penalty is close to zero, especially for overeducation, within university, whereas it is more pronounced outside university. For gender, the return effects are more than double the endowment effects, denoting that the majority of this gap is attributable to how personal and doctoral characteristics are rewarded and therefore could include a potential discriminatory component.

Table 4: Determinants of overeducation and overskilling four years after doctorate

	Academic career		Outside university	
	Overeducation	Overskilling	Overeducation	Overskilling
Socio-demographic characteristics				
Gender (1 if male)	−0.15	−2.06	−2.79	−3.79
Cohabiting (1 if living with a partner)	−0.69	−1.78	−0.78	1.23
Children (1 if without)	0.74	0.86	−0.46	−2.06
Age (1 if 30 years or less)	−1.07	−1.88	−2.67	−0.18
Family background				
Father's educational level (ref.: low)				
Medium (secondary school)	−1.97	−2.22	−0.42	0.57
High (university degree)	−0.03	−0.09	−1.19	1.53
Residence area (ref.: South of Italy and Islands)				
North-West	−0.22	−0.85	1.31	−1.85
North-East	−1.03	0.56	0.95	−1.75
Centre	1.03	1.11	−0.86	−1.17
Educational path				
Final grade (ref.: ≤104/110)				
Medium (105-107)	2.17	1.52	8.79	7.38
High (>107)	2.58	3.98	6.10	6.69
Secondary school (ref.: professional)				
High school	11.11	1.11	2.22	2.13
Technical school	10.38	1.56	2.43	2.57
Doctoral characteristics				
Mobility (1 if moved to other region)	−2.47	−3.07	−0.19	−0.31
Time to get doctorate (1 if not on time)	0.21	1.02	0.56	0.58

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	Academic career		Outside university	
	Overeducation	Overskilling	Overeducation	Overskilling
Field of study (ref.: social area)				
Physical sciences	−0.62	0.12	−1.39	−0.17
Life sciences	0.42	0.33	−0.62	0.04
Engineering	0.11	−0.33	−1.10	0.33
Humanities	0.66	0.22	0.41	2.11
Economics and Statistics	0.19	−1.11	0.16	−0.10
Law	–	0.24	−0.25	1.38
Doctoral tutorial path				
Seminars	−0.67	−0.83	−0.03	−1.08
Laboratory activities	1.70	0.07	−2.86	−3.22
Schools	0.19	0.46	−1.53	0.61
Experiences abroad	−0.13	−3.10	−2.10	−3.02
Teaching	−0.11	0.23	−0.97	−0.17
N	567	610	2468	2468
Log likelihood	−140.84	−301.79	−1983	−1738

Source: Authors' elaboration on 2014 census data

Table 5: Determinants of wage-penalty

	Log of net monthly income			
Conditional estimates	Academic career		Outside university	
Overeducation	−0.4697		−0.1573	–
Overskilling		−0.2769	–	−0.1762
Individual characteristics				
Gender (1 if male)	0.0294	0.0123	0.1617	0.1604
Cohabiting (1 if living with a partner)	−0.0379	−0.0525	0.0013	0.0037
Children (1 if without)	0.0466	0.0531	−0.0086	−0.0154
Age (1 if 30 years or less)	0.0129	0.0084	−0.0393	−0.0365
Family background				
Father's educational level (ref.: low)				
Medium (secondary school)	0.0958	0.0897	0.0407	0.0423
High (university degree)	0.1060	0.1079	0.0547	0.0586
Father's profession (ref.: elementary)				
Legislator, senior official and manager	−0.0084	−0.0224	0.0826	0.0883
Expert technician	−0.0119	−0.0388	0.0196	0.0225
Technician	−0.0028	0.0008	−0.0432	−0.0384
Clerk and qualified profession	−0.1736	−0.1547	−0.0319	−0.0166
Skilled operator	0.1212	0.1017	−0.0122	−0.0221
Residence area (ref.: South of Italy)				
North-West	0.0719	0.0487	0.1091	0.1065
North-East	0.0063	0.0184	0.0774	0.0644
Centre	0.0884	0.0764	0.0724	0.0739
Doctoral characteristics				
Mobility (1 if moved to other region)	0.0897	−0.0647	0.0138	0.0530

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	Log of net monthly income			
Conditional estimates	Academic career		Outside university	
Time to get doctorate (1 if not in time)	−0.0591	0.1030	−0.0016	0.0029
Field of study (ref.: social area)				
Physical sciences	0.1582	0.1548	0.0655	0.0778
Life sciences	0.2142	0.2877	0.1313	0.1504
Engineering	0.1365	0.1364	0.1696	0.1851
Humanities	−0.0051	−0.0248	−0.0990	−0.0862
Economics and Statistics	0.1527	0.1229	0.018 01	0.1830
Law	−0.0468	−0.0375	0.3122	0.3311
Constant	7.2215	7.2639	7.1638	7.2252
N	355	355	1297	1297
Adjusted R^2	0.1403	0.1306	0.1785	0.1830
Unconditional estimates				
Overeducation	−0.4636	–	−0.2026	–
Overskilling	–	−0.3009	–	−0.2153

The greater rewards associated with hard sciences are confirmed by the high return effects related to the decomposition of gaps in the probabilities of being overeducated and overskilled, especially outside university. Little differences among these decompositions arise according to the weighting scheme ($\Omega = 0, 1$) as can be seen from the residual part of the decomposition captured by the interaction component.

These results may be a relevant matter in the debate on policy developments to improve the performance of the doctoral process and to offer the labour market workers with the most adequate knowledge. The wage gap decompositions in every case show a high incidence of return effects (Table 7). With the exception of the field of study, the penalties based on the rewards are always higher for Ph.D. holders working outside university, suggesting that the existence of different contractual forms and professional framings allow major subjectivity that can also hide discrimination. The gender wage gap for careers outside university is more than double the corresponding one for academic careers, and outside university, the incidence of the return effect is also double that within university. Conversely, overeducation determines a greater wage gap within university, probably because in this context, it corresponds to administrative and low-paid jobs. Regarding overskilling, surprisingly, those who declare that they suffer from this condition have on average lower endowments than the remaining well-matched doctorate holders.

When we examine the specific contribution of variables to the gap (Table 8), when the groups are identified in relation to gender, the field of study has the most importance in the endowment effect inside and outside university, while mismatch is important only outside university. Demographic variables suggest higher characteristics on average for persons living in southern Italy for all types of career, while with reference to gender and the field of study, higher characteristics exist only for careers outside university.

7 Conclusions

Currently, Ph.D. programmes represent an essential means of development of a knowledge-based economy. Education and research form the so-called knowledge triangle and play a key role in introducing innovation. The creation of new knowledge and advance of economic activities are directly related to the capacity to draw human resources into research. Hence, investing in research and innovation drives the availability of a highly qualified workforce, which is the primary requisite for stimulating economic growth. In Italy, the share of doctoral graduates is still lower than in most European countries; nevertheless, Ph.D.'s obstacles in finding jobs adequate to their skills and competencies, especially outside academe. This problem is relevant because it encourages the "brain drain" and the consequent impoverishment of the country in an economic framework in which the turnover within academia is also obstructed by the scarcity of resources.

In this paper, we proposed an analysis of the occupational outcomes of Italian doctorate holders four years after the completion of their Ph.D. programmes with a special focus on overeducation and overskilling and their potential consequences for wages. Highly diversified scenarios arise in labour conditions and remuneration, especially when we distinguish between doctorate holders' careers within and outside university. These differences suggested that the two situations should be treated separately. However, some of these differences are due to characteristics such as gender, field of study and the geograph-

Table 6: Decomposition of the probability of being overskilled and overeducated for groups of doctorate holders based on gender, geographic area and field of study

	Overeducation		Overskilling	
	Academic career	Outside university	Academic career	Outside university
Gender (ref.: female)				
$\Omega = 1$				
Endowment Effect	0.0010	−0.0217	−0.0143	−0.0191
Return Effect	0.0003	−0.0536	−0.0671	−0.0662
Interaction	−0.0037	−0.0059	0.0199	−0.0113
$\Omega = 0$				
Endowment Effect	−0.0026	−0.0276	0.0056	−0.0304
Return Effect	−0.0034	−0.0595	−0.0472	−0.0775
Interaction	0.0037	0.0059	−0.0199	0.0113
Gap	−0.0024	−0.0812	−0.0615	−0.0966
Area (ref.: South Italy)				
$\Omega = 1$				
Endowment Effect	−0.0059	−0.0293	−0.0317	−0.0115
Return Effect	−0.0029	−0.0207	0.0211	−0.0361
Interaction	−0.0022	0.0151	−0.0145	−0.0012
$\Omega = 0$				
Endowment Effect	−0.0082	−0.0143	−0.0463	−0.0127
Return Effect	−0.0051	−0.0057	0.0065	−0.0373
Interaction	0.0022	−0.0151	0.0145	0.0012
Gap	−0.0110	−0.0350	−0.0252	−0.0488
Field of study (ref.: soft sciences)				
$\Omega = 1$				
Endowment Effect	0.0049	−0.0464	0.0197	−0.0316
Return Effect	0.0101	−0.0653	−0.0157	−0.0861
Interaction	−0.0146	0.0150	−0.0230	0.0081
$\Omega = 0$				
Endowment Effect	−0.0097	−0.0314	−0.0033	−0.0236
Return Effect	−0.0045	−0.0503	−0.0387	−0.0780
Interaction	0.0146	−0.0150	0.0230	−0.0081
Gap	0.0004	−0.0967	−0.0190	−0.1097

Source: Authors' elaboration on 2014 census data

Table 7: Decomposition of the wage gap for groups of doctorate holders based on gender, geographic area, field of study, overeducation and overskilling

	Groups	Mean log income	Gap (1)	Endowment (2)	Return (3)	Interaction (4)	[(3)+(4)]/(1)
Gender	Academic career						
	Males	7.5272	0.0905	0.0509	0.0256	0.0140	0.4376
	Females	7.4367					
	Outside University						
	Males	7.4672	0.2003	0.0419	0.1494	0.0089	0.7903
	Females	7.2669					
Area	Academic career						
	North-Centre	7.5055	0.0833	0.0317	0.0693	−0.0177	0.6194
	South	7.4222					
	Outside university						
	North-Centre	7.3951	0.0951	0.0127	0.0971	−0.0148	0.8654
	South	7.3000					
Field	Academic career						
	Hard science	7.5473	0.2126	0.0119	0.1698	0.0309	0.9440
	Soft science	7.3347					
	Outside university						
	Hard sciences	7.4027	0.1801	0.0480	0.1018	0.0303	0.7335
	Soft sciences	7.2226					

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	Groups	Mean log income	Gap (1)	Endowment (2)	Return (3)	Interaction (4)	[(3)+(4)]/(1)
Overed	Academic career						
	Well matched	7.5073	0.4636	0.2457	0.3613	−0.1433	0.4702
	Overeducated	7.0437					
	Outside university						
	Well matched	7.4342	0.1962	0.0867	0.1133	−0.0038	0.5581
	Overeducated	7.2381					
Oversk	Academic career						
	Well matched	7.5189	0.3009	−0.0643	0.1887	0.1765	1.2137
	Overskilled	7.2180					
	Outside university						
	Well matched	7.5184	0.2097	0.0773	0.1487	−0.0164	0.6309
	Overskilled	7.3088					

Source: Authors' elaboration on 2014 census data

Table 8: Contribution to the wage gap of covariates for groups of doctorate holders based on gender, geographic area and field of study

	Gender			Area			Field of study	
		Inside academe	Outside academe		Inside academe	Outside academe		Inside academe	Outside academe
Log wage									
Prediction_1	Male	7.5272	7.4672	North-Centre	7.5055	7.3951	Hard	7.5473	7.4027
Prediction_2	Female	7.4367	7.2669	South	7.4222	7.3000	Soft	7.3347	7.2226
Gap		0.0905	0.2003		0.0833	0.0951		0.2126	0.1801
Endowment Effect									
Gender		–	–		−0.0010	0.0111		0.0038	0.0240
Demographic		0.0118	−0.0027		−0.0202	−0.0011		0.0097	−0.0095
Geographic		−0.0034	0.0086		–	–		−0.0020	0.0034
Family background		0.0023	−0.0008		0.0328	0.0113		0.0065	0.0001
Time to get		0.0049	−0.0004		0.0040	0.0002		−0.0216	0.0017
Field of study		0.0264	0.0158		0.0021	−0.0134		–	–
Mismatch		0.0088	0.0213		0.0141	0.0047		0.0154	0.0284
Total		0.0509	0.0419		0.0317	0.0127		0.0119	0.0480
Return Effect									
Gender		–	–		0.0079	0.0148		0.0470	−0.0070
Demographic		−0.0798	−0.0083		0.0133	0.0785		−0.0532	0.0110
Geographic		−0.0818	0.0140		–	–		−0.0735	0.0239
Family-background		−0.1218	−0.0634		0.0327	0.0116		0.0738	−0.0350
Time to get		0.0194	0.0090		−0.0280	0.0104		0.0038	−0.0019
Field of study		0.3496	−0.0123		−0.3729	−0.0487		–	–
Mismatch		0.0155	0.0644		0.0170	0.0363		0.0125	0.0431
Constant		−0.0755	0.1461		0.3993	−0.0059		0.1594	0.0677
Total		0.0256	0.1494		0.0693	0.0971		0.1698	0.1018

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	Gender		Area		Field of study	
	Inside academe	Outside academe	Inside academe	Outside academe	Inside academe	Outside academe
Interaction						
Gender	–	–	0.0008	−0.0018	−0.0180	0.0020
Demographic	−0.0007	0.0029	0.0018	−0.0097	−0.0011	0.0198
Geographic	0.0088	−0.0003	-	-	0.0191	0.0024
Family-background	0.0065	0.0019	−0.0361	−0.0132	0.0145	−0.0079
Time to get	−0.0052	0.0007	0.0098	−0.0046	0.0056	−0.0037
Field of study	−0.0125	−0.0005	0.0002	0.0132	–	–
Mismatch	0.0170	0.0042	0.0059	0.0014	0.0107	0.0174
Total	0.0140	0.0089	−0.0177	−0.0148	0.0309	0.0303

Source: Authors' elaboration on 2014 census data (Istat)

ical area where the doctorate degree was earned. In brief, although education and career pathways vary, as do the career trajectories followed after the Ph.D. holders graduate from their doctoral programmes, some common characteristics can be identified.

The persistence of significant mismatches and wage differentials in the occupations reserved for the highest-educated workers could denote the inefficiency of the labour market in acquiring and valorising the available human capital. In particular, the dynamics within the academic career tend to contain the onset of inequalities in skills and wages when the different groups of doctorates are controlled for. Female Ph.D. holders and those who acquired the doctorate degree in southern Italy are more likely to experience both overeducation and overskilling even though the dynamics are different within and outside academe, with greater disparities outside. Furthermore, in assessing the implications for wages, we find that being female incurs more penalties than being overeducated: on average, well-matched women in education earn less than overeducated men. Different patterns are also identified for the rewards reserved for Ph.D.'s in relation to the field of specialisation: humanities and social sciences show the lowest wages, followed by engineering outside university.

As highlighted by the OECD (2014), in Italy, not only are Ph.D.'s often better paid when they do not work as researchers, but inside university, the availability of tenured positions is consistently reduced. This situation favours the growth of less stable types of posts and reduces the attractiveness of research careers due, for example, to the recent freeze of employee turnover or to wage restraints and cuts. Therefore, to stimulate economic growth and produce knowledge and innovation, the challenges for policy makers concern finalising actions to improve the work conditions and attractiveness of research careers, to increase the wages paid for doctoral and postdoctoral fellowships, and to improve in the access of doctorate holders to both academic and no academic employment. In addition, fiscal incentives to attract these highly skilled workers to research could be an efficacious inducement for enterprises to innovate and to promote economic growth.

Our results suggest extending the analysis to a longer period and a more in-depth analysis of some of the characteristics connected to the outcomes for Ph.D. holders, specifically those who have still not found a job, controlling for specific sample selection. Finally, career opportunities within and outside academe should be further investigated to identify the specific professional profiles needed by the labour market that could be enriched by Ph.D. competencies.

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References

[1] Alba-Ramirez, A. (1993): Mismatch in the Spanish labor market: Over-education. *Journal of Human Resources*, **28**, 259–278.

[2] Aleksynska, M. and Tritah A. (2013): Occupation-education mismatch of immigrant workers in Europe: Context and policies. *Economics of Education Review*, **36**, 229–244.

[3] Allen, D. (2000): Social networks and self-employment, *Journal of Socio-Economics*, **29**, 487–501.

[4] Allen, J. and Velden, R. (2001): Educational mismatches versus skill mismatches: Effects on wages, job satisfaction, and on-the-job search. *Oxford Economic Papers*, **53**(3), 434-452.

[5] Andersen, R. and van de Werfhorst, H. G. (2010): Education and occupational status in 14 countries: The role of educational institutions and labour market coordination. *The British Journal of Sociology*, **61**(2), 336–355.

[6] Auriol, L. (2010): Careers of doctorate holders: Employment and mobility patterns. Retrieved from http://dx.doi.org/10.1787/5kmh8phxvvf5-en (13 January 2018).

[7] Auriol, L., Misu, M. and Freeman, R. A. (2013): Careers of doctorate holders: Analysis of labour market and mobility indicators. Retrieved from http://dx.doi.org/10.1787/5k43nxgs289w-en (13 January 2018).

[8] Bárcena-Martín, E., Budría, S. and Moro-Egido, A. I. (2011): Skill mismatches and wages among European university graduates. *Applied Economics Letters*, 8, **15**.

[9] Battu, H., Belfield, C. and Sloane, P. (1999): Overeducation among graduates: A cohort view. *Education Economics*, **7**, 21–38.

[10] Bauer, T. K. and Sinning, M. (2008): An extension of the Blinder-Oaxaca decomposition to nonlinear models. *Advances in Statistical Analysis*, **92**, 197–206.

[11] Bitusikova, A. (2010): Doctoral education in Europe: Trends and perspectives *Communications in Agricultural and Applied Biological Sciences*, **75**(1), 23–27.

[12] Brinkley I. (2006): *Defining the Knowledge Economy*. Retrieved from http://bit.ly/2D7pbgB (13 January 2018).

[13] Büchel, F., De Grip, A. and Mertens, A. (Eds.) (2003): *Overeducation in Europe*. Cheltenham: Edward Elgar.

[14] Brynin, M. and Longhi, S. (2009): Overqualification: Major or minor mismatch? *Economics of Education Review*, **28**, 114–121.

[15] Cainarca, G. C. and Sgobbi, F. (2009): Quanto paga studiare: La relazione fraistruzione e retribuzione in Italia. *Economia Politica*, **26**(1), 53–84.

[16] Caroleo, F. E. and Pastore, F. (2017): Overeducation at a glance. Determinants and wage effects of the educational mismatch based on AlmaLaurea data. Retrieved from http://bit.ly/2FyKXqV (13 January 2018).

[17] Castellano, R. and Punzo G. (2016): Patterns of earnings differentials across three conservative European welfare regimes with alternative education systems. *Journal of Applied Statistics*, **43**(1), 140–168.

[18] Chevalier, A. (2003): Measuring overeducation. *Economica*, **70**(279), 509–531.

[19] Cutillo, A. and Di Pietro, G. (2006): The effects of overeducation on wages in Italy: A bivariate selectivity approach. *International Journal of Manpower*, **27**(2), 143–168.

[20] Daymont, T. N. and Andrisani, P. J. (1984): Job preferences, college major, and the gender gap in earnings. *The Journal of Human Resources*, **19**, 408–428.

[21] Desjardins, R. and Rubenson, K. (2011): An analysis of skill mismatch using direct measures of skill. Retrieved from http://dx.doi.org/10.1787/5kg3nh9h52g5-en (13 january 2018).

[22] Di Paolo, A. and Mańé, F. (2013): Determinants and Consequences of Qualification and Skills mismatch among recent Ph.D. Graduates. Retrieved from http://bit.ly/2AXBXIm (13 January 2018)

[23] Dolado, J. J., Garcĕa-Serrano C. and Jimeno J. F. (2002): Drawing lessons from the boom of temporary jobs in Spain. *The Economic Journal*, **112**(480), 270–295.

[24] Dolton P. and Silles, M. A. (2008): The effects of overeducation in earnings in the graduate labour market. *Economics of Education Review*, **27**(2), 125–139.

[25] Dolton, P. and Vignoles, A. (2000): The incidence and effects of overeducation in the UK graduate labour market. *Economics of Education Review*, **19**, 179–198.

[26] European Commission (2010): Europe 2020 Flagship Initiative Innovation Union. Retrieved from http://bit.ly/1x4k1mk (13 January 2018)

[27] Even, W. E. and Macpherson, D. A. (1990): Plant size and the decline of unionism. *Economics Letters*, **32**, 393–398.

[28] Fairlie, R. W. (1999): The absence of the African-American owned business: An analysis of the dynamics of self-employment. *Journal of Labor Economics*, **17**, 80–108.

[29] Fairlie, R.W. (2005): An extension of the Blinder-Oaxaca decomposition technique to logit and probit models. *Journal of Economic and Social Measurement*, **30**, 305–316.

[30] Feldman, D. C. (1996): The nature, antecedents, and consequences of underemployment. *Journal of Management*, **22**, 385–407.

[31] Feldman D. C. and Turnley W. H. (1995): Underemployment among recent business college graduates. *Journal of Organizational Behavior*, **16**, 691–706.

[32] Franzini, M. and Raitano, M. (2012): Few and underutilized? Overeducation of Italian graduates. In: E. Mandrone E (Ed): *Labour economics: PLUS empirical studies*. Roma: ISFOL.

[33] Freeman, R. B. (1976): *The overeducated American*. New York, NY: Academic Press.

[34] Fumasoli, T., Goastellec, G. and Kehm, B. M. (2015): Introduction: Understanding change in the academic profession through the perceptions of academics and institutional leadership. In T. Fumasoli, G. Goastellec, B. M. Kehm (Eds): *Academic Work and Careers in Europe: Trends, Challenges, Perspectives*, 1–12. Cham: Springer.

[35] Garcia-Aracil, A. and Van der Velden, R. (2008): Competencies for young European higher education graduates: Labor market mismatches and their payoffs. *Higher Education*, **55**, 219–239.

[36] Gomulka, J. and Stern, N. (1990): The employment of married women in the United Kingdom, 1970–1983. *Econometrica*, **57**, 171–199.

[37] Green, W. H. (2000): *Econometric Analysis*. Upper Saddle River: Prentice Hall.

[38] Green, F. and Zhu Y. (2010): Overqualification, job dissatisfaction, and increasing dispersion in the returns to graduate education. *Oxford Economic Papers*, **62**(4), 740–763.

[39] Groot, W. and Massen van den Brink, H. (2000): Overeducation in the labor market: A meta-analysis. *Economics of Education Review*, **19**(2), 149–158.

[40] Hakala, J. (2009): The future of the academic calling? Junior researchers in the entrepreneurial university. *Higher Education*, **57**(2), 173–190.

[41] Harfi, M. and Auriol, L. (2010): The Employability Problems of doctorate Holders: Explaining a "French Exception". Retrieved from http://bit.ly/2r4j4nH (13 January 2018).

[42] Hartog, J. (2000): Over-education and earnings: Where are we, where should we go? *Economics of Education Review*, **19**(2), 131–147.

[43] Jann, B. (2008): Oaxaca: Stata module to compute the Blinder-Oaxaca decomposition. Retrieved from http://bit.ly/2FBmAZZ (13 January 2018).

[44] Jones, F. L. and Kelley, J. (1984): Decomposing differences between groups. A cautionary note on measuring discrimination. *Sociological Methods and Research*, **12**, 323–343.

[45] League of European Research Universities (2007): Doctoral studies in Europe: Excellence in researcher training. Retrieved from http://bit.ly/2mAO8qi (13 January 2018).

[46] Leadbeater, C. (1999): *Living on Thin Air*. London: Penguin.

[47] Leuven, E. and Oosterbeek, H. (2011): Over-education and mismatch in the labor market. In E. Hanushek, S. Machin and L. Woessmann (Eds): *Handbook of the Economics of Education*, 283–326. Amsterdam: Elsevier.

[48] Manacorda, M. and Petrongolo, B. (2000): Skill mismatch and unemployment in OECD countries. *Wirtschaftspolitische Blatter*, **47**(1), 72–82.

[49] Mavromaras, K. G., McGuinness, S., O'Leary, N. C., Sloane, P.J. and Wei, Z. (2013): Job mismatches and labour market outcomes: Panel evidence on university graduates. *Economic Record*, **89**(286), 382–395.

[50] McGowan, M. A. and Andrews, D. (2015): Skill mismatch and public policy in OECD countries. Retrieved from http://bit.ly/2DPqoF0 (13 January 2018).

[51] McGuinness, S. (2006): Overeducation in the labour market. *Journal of Economic Surveys*, **20**(3), 387–418.

[52] McGuinness S. (2003): Graduate over-education as a Sheepskin effect: Evidence from Northern Ireland. *Applied Economics*, **35**, 597–608.

[53] McGuinness S. and Bennett J. (2007): Over-education in the graduate labor market: A quantile regression approach. *Economics of Education Review*, **26**, 521–531.

[54] McGuinness, S. and Bennett J. (2007): Overqualification and the graduate labour market: A quantile regression approach. *Economics of Education Review*, **26**(5), 521–531.

[55] McGuinness, S. and Sloane, P. J. (2011): Labour market mismatch among UK graduates: An analysis using REFLEX data. *Economics of Education Review*, **30**, 130–145.

[56] Nakamura, A. and Nakamura, M. (1981): On the relationships among several specification error test presented by Durbin, Wu, and Hausman. *Econometrica*, **49**(6), 1583–1588.

[57] Neumann, G. R., Olitsky, N. H. and Robbins, S. B. (2009): Job congruence, academic achievement, and earnings. *Labour Economics*, **16**(5), 503–509.

[58] Nordin, M., Persson, I. and Rooth, D. O. (2010): Education-occupation mismatch: Is there an income penalty? *Economics of Education Review*, **29**, 1047–1059.

[59] Oaxaca, R. L. and Ransom, M. (1998): Calculation of approximate variances for wage decomposition differentials. *Journal of Economic and Social Measurement*, **24**, 55–61.

[60] Boarini, R. (2009): Economic Survey of Italy 2009: Towards better schools and more equal opportunities for learning. Retrieved from http://dx.doi.org/10.1787/220864240618 (13 January 2018).

[61] OECD (2011): Building Knowledge. Retrieved from http://dx.doi.org/10.1787/sti_scoreboard-2011-en (13 January 2018).

[62] OECD (2013): Education at a Glance 2013. Retrieved from http://bit.ly/2qYM8wJ (13 January 2018).

[63] Ortiz, L. (2010): Not the right job, but a secure one over-education and temporary employment in France, Italy and Spain. *Work, Employment & Society*, **24**(1), 47–64.

[64] Quintini, G. (2011): Over-qualified and under-skilled: A review of existing literature. Retrieved from http://dx.doi.org/10.1787/5kg58j9d7b6d-en (13 January 2018).

[65] Rehme, G. (2007): Education, economic growth and measured income inequality. *Economica*, **74**, 493–514.

[66] Sicherman, N. (1991): Overeducation in the labor market. *Journal of Labor Economics*, **9**(2), 101–122.

[67] Sloane, P. (2003): Much ado about nothing? What does the overeducation literature really tells us? In Büchel, F., De Grip, A., Mertens, A. (Eds): *Overeducation in Europe*, 11–45. Cheltenham: Edward Elgar.

[68] Thurow, L. (1979): A job-competition model. In M. Piore (Ed): *Unemployment and inflation*, 17–32. White Plains, NY: M. E. Sharpe

[69] Sattinger, M. (1993): Assignment models of the distribution of earnings. *Journal of Economic Literature*, **31**(2), 851–880.

[70] Sgobbi, F. and Suleman, F. (2013): A methodological contribution to measuring skill (mis)match. *The Manchester School*, **81**(3), 420–437.

[71] Verhaest, D. and Van der Velden, R. (2013): Cross-country differences in graduate overeducation. *European Sociological Review*, **29**(3), 642–653.

[72] Yun, M.S. (2004): Decomposing differences in the first moment. *Economics Letters*, **82**, 275–280.

[73] Winsborough, H. H. and Dickinson, P. (1971): Components of negro-white income difference. In E. G. Goldfield (Ed): *Proceedings of the Social Statistics Sections*, 6–8. Washington, DC: American Statistical Association.