


Misusing our talent? Overeducation, overskilling and skill underutilisation among Spanish PhD graduates

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Abstract

The ‘knowledge economy’ is said to depend increasingly on capacities for innovation, knowledge-generation and complex problem-solving – capacities attributed to university graduates with research degrees. To what extent, however, is the labour market absorbing and fully utilising these capabilities? Drawing on data from a recent cohort of PhD graduates, we examine the correlates and consequences of qualification and skills mismatch. We show that job characteristics such as economic sector and main work activity play a fundamental and direct role in explaining the phenomenon of mismatch, experienced as overeducation and overskilling. Academic attributes operate mostly indirectly in explaining this mismatch, since their effect loses importance once we control for job-related characteristics. We detected a significant earnings penalty for those who are both overeducated and overskilled. Being mismatched reduces satisfaction with the job as a whole and with non-monetary aspects of the job, especially for those whose skills are underutilised. Overall, the problem of mismatch among PhD graduates is closely related to the demand-side constraints of the labour market. Increasing the number of adequate jobs and broadening the job skills that PhD students acquire during training should be explored as possible responses.

JEL Codes: I20, J24, J28, J31

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Doctors, earnings, graduate attributes, graduate employment, job satisfaction, overeducation, overskilling, skill underutilisation

Introduction

In recent decades, we have witnessed the emergence and consolidation of the so-called knowledge economy, in which economic success does not critically depend on natural resources, physical capital and low-skill labour but rather on the effective utilisation of intangible assets such as knowledge, skills and innovative potential. In this new economic paradigm, there is growing consensus that PhD holders have a strategic role in the success of firms and nations (European University Association (EUA), 2007). PhD recipients represent a key element for innovation and the generation of new knowledge because of their ability to solve complex problems (Stephan et al., 2004). They produce the most up-to-date scientific knowledge (through basic research), and they bring their capabilities to firms, where they help to transform scientific inventions into new market products (Herrera et al., 2010). In addition, employing PhD holders helps firms to cooperate with universities and to create external networks with the scientific community, which often is the only way to access forms of knowledge that are mainly tacit in nature (García-Quevedo et al., 2012).

In recognition of the importance of ensuring an adequate supply of highly educated workers, many countries have expanded and reformed their doctoral programmes (Park, 2007). The number of doctoral degrees awarded in Organisation for Economic Co-operation and Development (OECD) countries has increased dramatically in recent decades (Auriol, 2010). Moreover, extensive reforms have changed the definition, organisation and evaluation of doctoral programmes (Kehm, 2007).

Nevertheless, the growing number of PhD holders has raised concerns about the negative consequences of their possible misallocation in the labour market, especially in view of recent signs of saturation in the academic job market (especially in some European countries). Indeed, the figures obtained for several OECD countries, from the Careers of Doctorate Holders (CDH) survey, highlights that a non-negligible share of PhD holders ends up in jobs unrelated to their PhD or below their qualification level (Auriol, 2010). Recent reports indicate that job-education mismatch is a widespread, persistent problem (Pouliakas, 2013), which generates considerable individual and societal costs. Considering the importance of PhD holders for the economy, the high cost of doctoral education and the high levels of public funding received by doctoral students, the potential inefficiencies due to job-education mismatches are much higher for PhD recipients than for other educational groups. Unfortunately, while the literature about mismatch among university graduates is rather extensive, the research for PhD holders is still in its infancy, mainly due to data restrictions.

Drawing on data for a recent cohort of graduates from public universities in Catalonia (Spain), this article contributes by adding empirical evidence to the debate on the importance, correlates and consequences of labour market mismatch among PhD holders. In line with the recent literature on university graduates, we consider two different

dimensions of mismatch: on the one hand, we rely on information about qualification requirements for the current job, and define PhD holders as overeducated if their PhD was not a prerequisite for being recruited. On the other hand, we also exploit information about the skills that are required to perform the current job, and classify individuals as overskilled if they state that the skills they possess are not necessary in the workplace.¹

Our article expands current empirical evidence along several lines. First, we discuss the correlates of overskilling and overeducation and show how specific academic features that characterise the development of the PhD thesis represent indirect conditioning factors. Existing literature mostly focuses on job-related variables and does not inform about potential indirect effects of academic characteristics.

Second, we provide evidence of the different (negative) impacts of overeducation and overskilling on earnings. Furthermore, we show that their detrimental effects are specially pronounced when they are combined. While these results have been showed in the related literature of university graduates, to the best of our knowledge, we provide novel evidence for doctorate holders.

Third, we analyse the effect of overeducation and overskilling on job satisfaction. We confirm that mismatch is harmful for job satisfaction among PhDs and expand the analysis by considering the effect of both forms of mismatch on satisfaction with different facets of the job. This additional piece of evidence is indeed relevant, since mismatch seems to have a different effect on monetary and non-monetary aspects of the job – an issue that cannot be appreciated by considering overall job satisfaction alone (as done in previous articles).

The rest of this article is organised as follows. In the section ‘Related research’, we review the relevant literature. Section ‘Data and descriptive statistics’ presents the data, and section ‘The correlates of qualification and skills mismatch’ illustrates the factors conditioning mismatch among PhD graduates. In the section ‘Were mismatched doctors penalised?’ we explore the consequences of mismatch in terms of earnings (‘Mismatch and earnings’) and job satisfaction (‘Mismatch and job satisfaction’). Finally, the section ‘Conclusion’ summarises the evidence and provides interpretations and policy implications of the results.

Related research

The literature on labour market mismatch is quite extensive (Leuven and Oosterbeek, 2011; Pouliakas, 2013). The well-established conclusions emerging from this literature highlight that mismatched workers endure wage penalties and have lower job satisfaction, higher turnover and absenteeism, and lower participation in training. For employers, costs associated with qualification and skills mismatch may take the form of higher recruitment costs, lower productivity and lower product quality.

Much of the existing research is based on the concept of educational or qualification mismatch, which is defined using educational credentials as a reference point (Carroll and Tani, 2013; McGuinness and Bennett, 2007). More and more authors, however, are using measures of deficits/surpluses in skills or competences (Green and McIntosh, 2007; McGuinness and Sloane, 2011; Mavromaras et al., 2010). The resulting evidence suggests that, quite unexpectedly, educational and skills mismatches are not strongly

correlated, indicating that they are distinct empirical phenomena that need to be studied separately. The literature reports negative wage effects stemming from both forms of mismatch, with an increasingly robust evidence that the worst situation is to be over-skilled *and* overeducated.

Several articles (Green and Zhu, 2010; McGuinness and Sloane, 2011; Mavromaras et al., 2013) have analysed the impact of qualification and skills mismatch on job satisfaction. Examining the impact of mismatch on job satisfaction along with earnings is especially relevant because it can reveal whether or not this represents a voluntary status. Workers, for instance, may forego higher wages in favour of other, more satisfying, job attributes, such as job security or work–life balance. Therefore, several authors argued that finding negative effects of mismatch on earnings but positive effects on satisfaction would be suggestive of an intended choice of being mismatched. On the contrary, obtaining negative impacts of mismatch on both satisfaction and earnings indicates that being mismatched is driven by constraints in the labour market. The results of this incipient literature show that, in general, mismatch represents an involuntary situation (i.e. it has a negative effect on both labour market outcomes). Moreover, qualification mismatch per se is not strongly correlated with job satisfaction, whereas underutilisation of acquired skills has more serious consequences, particularly when accompanied by educational mismatch.

Doctoral education has attracted increasing attention in specialised academic journals in recent years, as well as among national and international policy management spheres (EUA, 2010). However, the evidence on the labour market situation of PhD holders, while growing, is still quite limited. More importantly, very few articles have focused on the determinants and the effects of job-education mismatch specifically among PhD holders. Regarding the determinants of mismatch, drawing on data from the US Survey of Doctoral Recipients (SDR), Bender and Heywood (2009) stress the importance of employment sector and work activity as determinant of having a job related to the PhD. In a subsequent article, Bender and Heywood (2011) exploited the panel structure of the SDR data and found that job changes from the academia to business or government increase the likelihood of mismatch, but mostly at the early stage of the career. On the contrary, the main activity carried out in the workplace affects mismatch also in advanced phases of the working life of PhD graduates. However, both articles are silent about the potential role of academic attributes, which could indeed act as determinants of mismatch either directly or indirectly (through their effect on job characteristics). More recently, Gaeta (2015) analysed overeducation and overskilling among Italian PhD graduates, confirming the importance of sector and work activity as conditioning factors of both forms of mismatch. He also included dummies for on-time PhD completion, attending extra courses and pre-doctoral mobility as controls, and found that the latter two variables negatively correlate with mismatch. We consider that examining the effect of academic characteristic is of special importance, since it captures individual heterogeneity in human capital accumulation that is not fully accounted for PhD programme controls. For this reason, our models contain a large list of academic attributes that could affect mismatch. Moreover, we implement a stepwise inclusion of control variables, which enables analysing the extent to which academic characteristics affect mismatch indirectly because of their effect on job-related controls that in turn determine the risk of being mismatched in the labour market.

The evidence about the effect of mismatch among PhD holders is also limited. Bender and Heywood (2009, 2011) estimated the wage penalties due to job–education mismatch among US PhD holders. They show that having a job that is not related to the PhD has a negative impact on earnings, which is robust to the inclusion of individual fixed effects. Moreover, in the second article, they also performed separate estimates of the wage penalty associated with mismatch by field of study and at different career stages, and found worse effects for those with a PhD in Hard Sciences and, to a lesser extent, in Social Sciences, as well as for those at an advanced stage of their career.

Canal Domínguez and Rodríguez Gutiérrez (2013) studied wage differences by area of study and employment sector among Spanish PhD holders. Although job mismatch was not their specific focus, they included variables capturing job–PhD relatedness and qualification requirements as controls. The results suggest that working in a job that requires higher education levels (post-doctoral, PhD, graduate or undergraduate) is associated with higher earnings, relative to occupations that do not require higher education qualifications, especially outside the academic sector.

Regarding job satisfaction, Bender and Heywood (2006) analysed gender differences in job satisfaction among US PhDs across sector (again using SDR data). They also controlled for a proxy of job–PhD relatedness and found that being in occupations closely related to the PhD improves job satisfaction in all sectors (academy, government and business) and for both males and females. Consistent results have been presented in the analysis of job satisfaction of their subsequent work specifically focused on mismatch among PhDs (Bender and Heywood, 2009). Since their dependent variable refers to overall job satisfaction, they are unable to examine whether or not mismatch has a different effect on satisfaction with different facets of employment, such as monetary and non-monetary elements.

Overall, to the best of our knowledge, this is the first article providing novel evidence about the impact of overeducation and overskilling on two key labour market outcomes of recent PhDs: earnings and job satisfaction.

Data and descriptive statistics

Our article is based on data from a recent cohort of PhD graduates from public universities in Catalonia, Spain. The number of PhDs awarded by Catalan universities increased from 968 during the 1997–1998 academic year to 1781 in 2010–2011 (an increase of 84%). As can be seen in Figure 1, the increase in doctoral awards in Catalonia has followed the same general tendency observed for Spain as a whole.

The rising flow of PhD holders in recent decades, however, has not caused a major supply shock in the Spanish labour market. In 2011, the doctoral graduation rate was just 1.1% of the population in the reference age cohort, considerably below the OECD mean of 1.6% and just slightly up from the rate of 0.9% reported for Spain in 2011 (OECD, 2013: 94). In 2009, there were 6.7 doctorate holders per thousand population aged 25–64 years in Spain, contrasting with 14 in Germany, 13.5 in the United States and 7.6 in Finland (OECD, 2013: 96).

The data used in the empirical analysis in the present study come from a 2011 survey on the early labour market experiences of PhD holders, implemented by the Quality

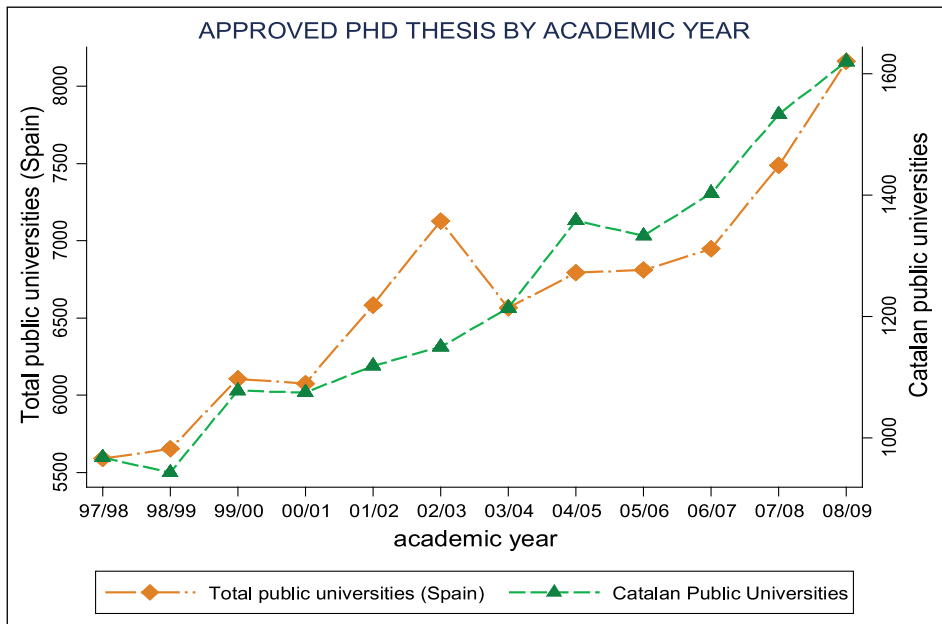


Figure 1. PhD theses approved in Spain and Catalonia between 1997–1998 and 2008–2009. Source: Spanish National Statistical Institute (INE).

Assurance Agency for the Catalan University System (AQU).² The target population consisted of all Spanish-born individuals who completed a PhD in one of the seven Catalan public universities in 2006 or 2007. The entire population was composed of 1824 individuals and 1225 answered the questionnaire, which corresponds to a fairly high response rate of 67.2%. Graduates were contacted 4 years after PhD completion. Therefore, our analysis concerns the short-term mismatch situation of our sample of PhD holders. It could be argued that analysing this early period in the professional careers of PhD graduates may be misleading as they are still adjusting to a situation that may evolve towards a better match. While theoretically this would appear to be likely, the scant evidence available suggests that the incidence and the negative effects of mismatch on earnings of US PhDs are more pronounced among those in late careers, but are also present among recent PhD graduates (Bender and Heywood, 2011), which makes our early career analysis particularly interesting.

The dataset contains basic socio-demographic data, information on academic attributes and the doctoral programme followed, as well as detailed information on current employment. We restricted the sample to those individuals who were in a full-time job at the time of the survey and were aged 40 years or younger when they started their PhD.³

The main variables of interest are those concerning the job (mis)match status of PhD holders, taken from two specific questions from the AQU survey. In the first question, respondents were asked about the educational entry requirements for their current job. Four possibilities were considered: (1) a PhD degree, (2) a specific undergraduate degree (i.e. the degree held by the individual), (3) any undergraduate degree, and (4) no

Table 1. Cross-tabulation of qualification and skills mismatch.

		PhD qualification required		Total
		No	Yes	
PhD skills necessary	No	260 25.95%	16 1.60%	276 27.54%
	Yes	275 27.45%	451 45%	726 72.46%
	Total	535 53.40%	467 46.60%	1002 100%

qualification requirements. In the second question, respondents were asked whether their PhD-specific skills were necessary in their current job. In this article, we adopt an approach similar to that of Dolton and Silles (2008). We classify individuals as overeducated if they stated that their PhD was not necessary for securing their current job and as overskilled if they considered that the skills acquired with the PhD are not necessary for performing the job.⁴ Table 1 shows the marginal and joint distribution of these two distinct dimensions of mismatch.

The data indicate that just over 72% of individuals in our sample were adequately matched in terms of skills and that just 53% were adequately matched in terms of education. These figures reflect a considerable level of overeducation and overskilling in our cohort of doctors. It is difficult to validate these data due to a lack of comparable information, but they are quite similar to results reported for Spain by Auriol (2010) and Canal Domínguez and Rodríguez Gutiérrez (2013).

Cross-tabulation of education and skills mismatch measures shows that the probability of being well-matched in terms of skills was significantly higher for PhD graduates in occupations that required a PhD, meaning that these two distinct facets of (mis)match are likely to be interrelated. Indeed, the correlation between the two mismatch indicators is 0.51, which is well above the correlation indicated in articles using similar mismatch measures for college graduates. Looking at the extremes, 45% of our sample can be considered adequately education/skill-matched, while 26% were in jobs that seemed to require neither a PhD degree nor the skills acquired during doctoral studies (overeducated and overskilled).

What were the characteristics of our graduates? Did mismatch status reflect differences in observed individual, academic and labour market characteristics?⁵ Overall, it appears that mismatch status was clearly related to the academic and professional profile of the individual. Well-matched PhD holders were more likely to be younger males with a clear academic orientation, as they were more represented among those who developed their PhD thesis within a research group and completed the doctorate in at most 6 years. They also tended to have shorter job tenure and were more inclined to work in academia, research institutes or private firms doing research and development (R&D) work. The profile of graduates who were both overskilled and overeducated was similar but they had a significantly longer tenure and were more likely to have started working as adjunct professors or research assistants at a university before completing their PhD. It is

interesting to note that strongly mismatched graduates were more likely to work either in the government or private sector.

The risk of mismatch also varied markedly across different types of PhD programmes. PhD graduates in the areas of humanities and social sciences were generally less likely to be well-matched, while the opposite was observed for PhD holders in hard sciences. The evidence for the area of health points out that mismatch was an important problem among PhD graduates in these fields, especially for those holding a PhD in Medicine. The incidence of mismatch was moderate among PhDs in technical studies, with the exception of Architecture.

Table A2 in the Appendix also reports descriptive information about potential wage and job satisfaction penalties associated with mismatch status. With respect to raw differences in gross annual earnings, adequately matched doctors were slightly more represented in the modal category (between €30,000 and €40,000). Interestingly, graduates earning more than €50,000 (the top-coding category) were significantly more likely to be mismatched, particularly in terms of skills. This is possibly related to the fact that a higher proportion of these graduates worked in the better paid private sector. The survey also provided information about perceived satisfaction. On average, job satisfaction was rather high (5.7 on a 1–7 scale) and the respondents were especially satisfied with promotion opportunities, but less happy with job content and pay. As expected, those who were overeducated and even more so those who were overskilled were significantly less satisfied with the match between their skills and the work they were doing.

The correlates of qualification and skills mismatch

In this section, we examine the variables conditioning mismatch. We estimated two Seemingly Unrelated Bivariate Probit equations that model the probability of being overskilled and of being overeducated. This allowed us to check for significant differences in the conditional association between the explanatory variables and each of the two types of mismatch. Table 2 shows the average changes in the predicted probabilities for four different specifications of the two equations. The baseline specification (1) contains socio-demographic variables, academic credentials and indicators for pre- and post-doctoral mobility. Model (2) adds the type and region of work, model (3) job attributes, and model (4) information on the main activities performed at work.⁶ This stepwise inclusion of controls was designed to observe whether and how academic and job-related attributes separately affect the likelihood of being overeducated and/or overskilled. Additionally, each model contains fixed PhD-type and university effects to capture factors shared by graduates with similar PhDs across the seven universities. As expected, the estimated correlation between the residuals of the two equations was positive and significant in all cases, pointing to the presence of common unobserved determinants of overskilling and overeducation.

Two immediate points emerge from the results of our analysis. First, the effect of academic attributes seems to be mainly indirect, since it loses importance once we control for the full set of work characteristics. Second, the stepwise inclusion of different groups of regressors did not generate striking changes in the estimated coefficients as we moved from one model to the next in terms of direction and statistical significance,

Table 2. Probabilities of overqualification/overeducation – average marginal effects from Bivariate Probit models.

	ΔPr (Overeducation)				ΔPr (Overqualification)			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Socio-demographic variables								
Female	0.057** (0.023)	0.042* (0.022)	0.045** (0.022)	0.054*** (0.018)	0.034 (0.039)	0.025 (0.032)	0.010 (0.029)	0.030 (0.030)
Age/10	-0.016 (0.050)	0.017 (0.038)	0.022 (0.041)	0.037 (0.040)	0.025 (0.063)	0.034 (0.057)	-0.146*** (0.038)	-0.143*** (0.039)
Academic variables								
Time between bachelor completion and PhD enrolment/10	0.033 (0.056)	0.015 (0.042)	0.014 (0.040)	-0.008 (0.042)	0.086 (0.072)	0.068 (0.065)	0.099** (0.042)	0.092** (0.038)
PhD funding: research fellowship				reference category				
PhD funding: teaching or research during PhD	-0.010 (0.044)	0.074** (0.033)	0.053* (0.032)	0.023 (0.031)	0.100* (0.055)	0.137*** (0.049)	0.041 (0.039)	0.032 (0.038)
PhD funding: work related to PhD	0.089** (0.041)	-0.017 (0.029)	-0.011 (0.030)	-0.030 (0.033)	0.128** (0.051)	0.051 (0.046)	0.040 (0.037)	0.026 (0.038)
PhD funding: work not related to PhD/other situations	0.156** (0.069)	0.051 (0.062)	0.051 (0.064)	-0.015 (0.055)	0.216*** (0.048)	0.162*** (0.047)	0.146*** (0.039)	0.148*** (0.034)
PhD duration > 6 years	0.015 (0.045)	0.006 (0.033)	-0.001 (0.032)	-0.019 (0.030)	0.047 (0.041)	0.035 (0.040)	0.023 (0.027)	0.023 (0.029)
PhD thesis within a research group	-0.073* (0.037)	-0.021 (0.030)	-0.013 (0.031)	0.004 (0.025)	-0.149*** (0.032)	-0.108*** (0.029)	-0.066** (0.033)	-0.056** (0.027)
Pre- and post-doctoral mobility								
No pre-doctoral mobility				reference category				
Pre-doctoral mobility in national institutions	-0.076* (0.045)	-0.066** (0.033)	-0.041 (0.028)	-0.052* (0.027)	-0.024 (0.057)	0.004 (0.048)	0.010 (0.036)	0.010 (0.034)
Pre-doctoral mobility in foreign institutions	-0.055* (0.032)	-0.019 (0.022)	-0.019 (0.020)	-0.013 (0.025)	-0.088*** (0.034)	-0.047* (0.028)	-0.032 (0.021)	-0.027 (0.025)
No post-doctoral mobility				reference category				
Post-doctoral mobility in national institutions	-0.241*** (0.046)	-0.123** (0.051)	-0.133*** (0.050)	-0.116** (0.046)	-0.226*** (0.056)	-0.135*** (0.049)	-0.065 (0.049)	-0.067 (0.044)
Post-doctoral mobility in foreign institutions	-0.266*** (0.025)	-0.117*** (0.027)	-0.117*** (0.029)	-0.085*** (0.030)	-0.276*** (0.030)	-0.133*** (0.028)	-0.070** (0.029)	-0.065** (0.028)
Type of work								
University				reference category				
Research institute		0.044 (0.032)	0.012 (0.036)	0.035 (0.034)		-0.016 (0.039)	0.065** (0.029)	0.078*** (0.027)
Public sector		0.515*** (0.034)	0.490*** (0.042)	0.303*** (0.054)		0.359*** (0.036)	0.406*** (0.024)	0.277*** (0.043)
Private sector		0.395*** (0.040)	0.351*** (0.040)	0.223*** (0.045)		0.221*** (0.033)	0.255*** (0.034)	0.137*** (0.039)
Working region								
Barcelona province				reference category				
Elsewhere in Spain		-0.011 (0.027)	-0.023 (0.026)	-0.029 (0.019)		-0.031 (0.026)	-0.009 (0.023)	-0.015 (0.024)
Outside Spain		-0.142*** (0.048)	-0.141*** (0.046)	-0.107** (0.051)		-0.214*** (0.035)	-0.123*** (0.034)	-0.083** (0.040)
Job attributes								
Current job tenure (in years/10)			-0.015 (0.028)	-0.021 (0.027)			0.570*** (0.055)	0.541*** (0.055)
Permanent contract			0.016 (0.028)	-0.006 (0.025)			-0.041* (0.024)	-0.045** (0.019)

(Continued)

Table 2. (Continued)

	ΔPr (Overeducation)				ΔPr (Overqualification)			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
# Workers ≤ 50				reference category				
51 ≤ # Workers ≤ 250			0.046 (0.038)	0.052* (0.032)			-0.048* (0.029)	-0.062** (0.029)
251 ≤ # Workers ≤ 500			-0.120*** (0.037)	-0.125*** (0.030)			-0.129*** (0.045)	-0.137*** (0.045)
# Workers > 500			-0.028 (0.037)	-0.012 (0.032)			-0.043 (0.027)	-0.039 (0.026)
Main activities (outside university; non-exclusive)								
Management				0.045** (0.023)				0.018 (0.021)
R&D				-0.295*** (0.039)				-0.240*** (0.032)
Technical support				0.066*** (0.023)				0.116*** (0.028)
Teaching				0.013 (0.023)				0.037 (0.034)
Health care				0.071* (0.038)				0.076 (0.097)

All the estimations include fixed effects for PhD type and university (not shown). Standard errors (in parenthesis) are clustered at the PhD programme level. The average marginal effects for indicator variables are average discrete changes in the predicted probabilities.

***Significant at 1%; **significant at 5%; *significant at 10%.

meaning that the general picture of the conditioning factors of mismatch among PhD holders in our series remained largely unchanged.

Female graduates were more likely (around 5 percentage points (p.p) higher) to be overskilled than male graduates with similar characteristics, but we did not observe any gender differences in terms of overeducation. This finding could be a cause for concern as it might mean that while the formal process of accessing the labour market is similar for men and women, there may be subsequent (discriminatory) filtering of women into jobs or tasks requiring fewer skills. Age appeared to be unrelated with overskilling, whereas it had a negative effect on overeducation only when job characteristics were controlled for (probably reflecting cohort effects in education requirements).

Academic experience variables were divided into three groups: source of PhD funding, academic attributes that characterise PhD studies and research mobility. Ideally, these variables would capture the quality of training received and, therefore, signal the best doctoral graduates, who, in a normal, well-functioning labour market, should be better matched.⁷ However, if PhD programmes are, at least to some extent, designed to attract and channel students into the academic profession, these variables could also be capturing a sorting process into specific labour markets. The coefficients estimated show that the academic experience has a modest impact on the probability of being over-skilled, but are markedly relevant for explaining the probability of being overeducated.

Funding one’s PhD through any of the three main mechanisms analysed did not seem to be associated with dramatic differences in mismatch status. It should be noted, however, that scholarships were generally associated with a lower incidence of

both overeducation and overskilling, but this beneficial effect tended to be lost once job characteristics were controlled for. This means, at least to some extent, that individual profiles simply affect occupational choices, which, in turn, determine the chances of being mismatched or not. For the small group of students working in jobs unrelated to their PhDs during their doctoral studies (about 4% of the sample), we observed a higher risk of being affected by both forms of mismatch. These students might represent the least able students (those unable to secure a more favourable way of funding their PhD), but it is also possible that their desire to obtain a PhD was driven more by a 'consumption' motivation than by academic/professional goals.

The results for academic attributes capturing individual performance indicate that PhD duration had no impact on the probability of being mismatched. However, working in a research group while pursuing one's PhD favoured access to jobs requiring a PhD degree, but its positive effect on the likelihood of the acquired skills being fully utilised disappeared after controlling for employment sector. This observation clearly points to the value of using research infrastructures as a stepping stone towards an academic career requiring a PhD.

Pre-doctoral research mobility and, most notably, post-doctoral mobility in national or international institutions decrease the probability of being mismatched by about 25 p.p. (relative to no post-doctoral mobility). Mobility experiences allow acquiring productive skills and personal maturity that most likely are rather difficult to reproduce in the student's own institution during the regular training period. Moreover, research mobility, particularly after completing a PhD might also have a positive impact on job quality resulting from increased networking opportunities. This is indeed confirmed by the fact that although the size of the effect of research mobility diminishes after controlling for job-related variables, it still remains important (especially for overskilling).

Moving to the results obtained in the models where job-related variables are included as additional covariates, we must stress that the employment sector was of fundamental importance for explaining the likelihood of being overeducated and, in particular, of being overskilled. Working in the private sector and even more so in the public sector (i.e. government, public administration and other public non-academic institutions) substantially increased the chances of being mismatched and, even though this penalty was reduced after controlling for the main activities at work, it remained sizeable and significant. On the contrary, those who worked in research institutes were not more likely to be overskilled and were just slightly more likely to be overeducated when job attributes and main activities were maintained constant. These results are remarkable, especially considering that working outside an academic-research environment has a very large impact on the probability of being overskilled. They suggest that the problem of mismatch among PhD holders is not just related to a lack of recognition of the PhD credential outside the university (i.e. overeducation), but also point to a more fundamental problem related to a clear underutilisation of skills by many employers.

The estimates of work location suggest that working outside Spain was associated with a lower probability of being mismatched. This could reflect either positive sorting of PhD holders who migrated after completing their PhD or a higher supply of suitable jobs in destinations to which Spanish PhD graduates were likely to migrate, namely,

Northern Europe and the United States. The estimated marginal effects for the additional job-related controls highlighted a sizeable positive effect of job tenure on overeducation. This result might be explained by the cohort nature of our data and also perhaps by the fact that some graduates in our sample may have started their current job before completing their PhD. However, seniority seemed to be unrelated to the likelihood of overskilling. In our sample, those with a permanent contract were slightly more likely to be adequately matched in terms of qualifications than others. In agreement with evidence reported for college graduates, we found that working in a medium–large firm (250–500 workers) had a beneficial effect on the probability of being adequately matched.

Finally, model (4) controlled for the main activities at work for those employed in non-university settings. Therefore, the effect of these variables in this model has to be interpreted as the impact of job task variation once the ‘average’ effect of employment sector has been controlled for. As expected, working in R&D reduced the likelihood of being mismatched in a consistent way for both indicators. This means that working outside a university per se was not synonymous with mismatch. Rather, the higher risk of being mismatched depended on whether or not PhD skills were utilised in (non-academic) jobs. In other words, working outside academia, but in a research-related job, would compensate for the higher average likelihood of mismatch among private and public sector workers. This was also confirmed by the positive conditional relationship of performing technical support tasks on both forms of mismatch, as well as the increased likelihood of those working in management and health care being mismatched. However, this last point should not be interpreted in terms of having ‘too many skills’ but rather in terms of having skills that are not useful for a particular job.

Overall, our results confirm the crucial importance of key job characteristics such as employment sector and job-tasks as conditioning factors of mismatch among PhD recipients, as highlighted by Bender and Heywood (2009, 2011) and Gaeta (2015). However, we have underscored the impact of academic variables on the probability of suffering some form of mismatch. These variables appeared to operate indirectly (although not exclusively so), since their effect on mismatch was mediated by job characteristics. That is, academic attributes affected the kind of job PhD holders obtained after completing their studies, which in turn determined the chances of being or not being mismatched in the labour market.

Were mismatched doctors penalised?

Mismatch and earnings

In this section, we examine the potential labour market penalty associated with job mismatch in our cohort of recent doctors. We estimated an extended earnings equation that includes several academic attributes and job characteristics as control variables, following an ‘assignment’ view of the labour market in which both individual human capital and academic and job characteristics determine earnings.

Table 3 shows the estimates from the augmented earnings regression.⁸ Following Mavromaras et al. (2013), we included the four job match statuses in our model: adequately matched, overskilled, overeducated, and overskilled and overeducated. Our

Table 3. Mismatch and annual gross earnings (in logs) – Interval Regression.

Dependent variable: ln(annual earnings)	Coeff.	s.e.
Mismatch variables		
Adequately matched (PhD and skills required)		reference category
Overskilled but NOT Overeducated	-0.037	0.089
Overeducated but NOT Overskilled	-0.035	0.028
Overeducated and Overskilled	-0.121	0.043***
Socio-demographic variables		
Female	-0.113	0.021***
(Age at the job entry)/10	0.124	0.043***
Academic variables		
Time between bachelor completion and PhD enrolment/10	-0.089	0.047*
PhD funding: research fellowship		reference category
PhD funding: teaching or research	0.003	0.033
PhD funding: work related to PhD	0.049	0.037
PhD funding: work unrelated to PhD or other situations	-0.061	0.065
PhD duration > 6 years	-0.072	0.036**
Type of work		
University		reference category
Research institute	0.022	0.032
Public sector	0.065	0.047
Private sector	0.140	0.043***
Working region		
Barcelona province		reference category
Elsewhere in Spain	-0.037	0.028
Outside Spain	0.184	0.032***
Job attributes		
Current job tenure (in years/10)	0.172	0.040***
Permanent contract	0.172	0.028***
# Workers ≤ 50		reference category
51 ≤ # Workers ≤ 250	0.055	0.046
251 ≤ # Workers ≤ 500	0.159	0.051***
# Workers > 500	0.149	0.039***
Main activities (outside university; non-exclusive)		
Management	0.112	0.022***
R&D	0.018	0.035
Technical support	-0.011	0.028
Teaching	-0.022	0.027
Health care	0.250	0.057***
PhD type		
Geography and Demographics	-0.183	0.089**
History. Philosophy and Arts	-0.140	0.054**
Language. Linguistics and Literature	-0.221	0.051***
Economics and related fields	0.131	0.062**

(Continued)

Table 3. (Continued)

Dependent variable: ln(annual earnings)	Coeff.	s.e.
Law and related Fields	0.071	<i>0.098</i>
Sociology, Political Sciences and Communication	-0.191	<i>0.079**</i>
Pedagogy and Education	-0.060	<i>0.065</i>
Psychology	0.090	<i>0.069</i>
Chemistry	0.072	<i>0.031**</i>
Biology	reference category	
Environmental Studies	0.030	<i>0.043</i>
Mathematics	0.045	<i>0.051</i>
Physics	0.016	<i>0.075</i>
Medicine	0.090	<i>0.041**</i>
Pharmacy	0.033	<i>0.067</i>
Veterinary	0.066	<i>0.094</i>
Architecture	-0.127	<i>0.139</i>
Civil, Nautical and Aeronautical Engineering	0.100	<i>0.078</i>
Production Engineering	0.083	<i>0.050*</i>
Computers and Information Engineering	0.159	<i>0.041***</i>
Agricultural Engineering	0.007	<i>0.119</i>
University	reference category	
University of Barcelona (UB)	reference category	
Autonomous University of Barcelona (UAB)	0.001	<i>0.023</i>
Polytechnic University of Catalonia (UPC)	0.045	<i>0.043</i>
Pompeu Fabra University (UPF)	0.159	<i>0.050***</i>
University of Lleida (UdL)	-0.004	<i>0.053</i>
University of Girona (UdG)	-0.030	<i>0.058</i>
Rovira i Virgili University (URV)	-0.008	<i>0.059</i>
Constant	9.663	<i>0.144***</i>
Pseudo R ²	0.315	
Number of observations	937	

Robust standard errors in italics.

***Significant at 1%; **significant at 5%; *significant at 10%.

results indicate that being overskilled or overeducated was not statistically associated with earnings, suggesting that PhD recipients in these two categories did not earn less than their adequately matched counterparts. On the contrary, compared to well-matched graduates, those who were both overeducated and overskilled faced a wage penalty of about 12%. These results are similar to those obtained for college graduates. Even though we used a different measure of mismatch, our results are also consistent with findings obtained by Bender and Heywood (2009, 2011) for US PhD holders, as well as with the evidence for Spain reported by Canal Domínguez and Rodríguez Gutiérrez (2013). This might be taken as further evidence that unless accompanied by a certain degree of skills mismatch, overeducation does not have a detrimental effect on job match among PhD graduates.

The estimates of the control variables in our model are quite standard and are just briefly discussed. The results show a significant *ceteris paribus* gender difference in annual earnings in favour of male doctors. As expected, earnings rose with age at job entry and job tenure and graduates who obtained their PhD while working in a job related to their studies earned more, reflecting human capital accumulation through experience. However, a longer time between finishing college and starting one's PhD studies had a negative effect. Moreover, graduates who took more than 6 years to finish their PhD studies endured a wage penalty.

There was a sizeable positive earnings differential in favour of PhD holders working in the private sector compared to the university sector, but no significant differences were detected among those working in research institutes or in the public sector. The public sector dummy coefficient is however significantly higher and statistically different from zero when main activities at work are excluded from the model,⁹ suggesting that PhD recipients who worked in the public sector earned more than those who worked in a university only if they performed certain activities that were better remunerated, such as management and health care work.

As expected, we also found positive earnings returns to having a permanent contract and working in medium–large firms. Moreover, PhD recipients who performed management and health-related tasks were better paid than others. The estimates from the PhD-type fixed effects revealed that those with a PhD in biology earn more than those who studied humanities, sociology, political science or communication, but less than those who studied economics, business, chemistry, medicine or computer and information engineering.

Mismatch and job satisfaction

In this section, we analyse the conditional association between job mismatch and job satisfaction. We consider perceived overall job satisfaction as an aggregate indicator of all relevant aspects of the job. Moreover, we also analyse perceived satisfaction with four distinct facets of the job, namely, promotion opportunities, earnings, job content and job-skills match. Running separate regressions for overall satisfaction and job-domains satisfaction would provide a better insight into the channel through which mismatch affects the level of utility derived from the job. Given the ordinal nature of the variables in question, we applied the standard Ordered Probit approach.

Table 4 shows the marginal effect of each mismatch indicator on the probability of being very satisfied (the highest category) with the job as a whole and with each job domain.¹⁰ It appears that mismatched PhD holders are not less satisfied with earnings and career prospects than their well-matched peers. However, being mismatched is significantly associated with a lower probability of being very satisfied with job content and job-skills match, two domains that reflect intrinsic and non-monetary aspects of the job. Specifically, graduates in the overeducated category are less satisfied with job content and job-skills match, although educational requirements per se appear to have a lower impact on job satisfaction than skills utilisation. Indeed, skills underutilisation makes PhD holders significantly less likely to be very satisfied with job content and job-skills match. Moreover, the satisfaction loss for being both overeducated and overskilled is

Table 4. Mismatch and job satisfaction.

	Marginal effect	s.e.
Promotion opportunities		
Adequately matched (PhD and skills required)		reference category
Overskilled but NOT Overeducated	-0.061	<i>0.039</i>
Overeducated but NOT Overskilled	-0.012	<i>0.021</i>
Overeducated and Overskilled	-0.039	<i>0.025</i>
Earnings		
Adequately matched (PhD and skills required)		reference category
Overskilled but NOT Overeducated	-0.026	<i>0.028</i>
Overeducated but NOT Overskilled	0.009	<i>0.015</i>
Overeducated and Overskilled	-0.013	<i>0.018</i>
Job content		
Adequately matched (PhD and skills required)		reference category
Overskilled but NOT Overeducated	-0.264	<i>0.095***</i>
Overeducated but NOT Overskilled	-0.068	<i>0.037*</i>
Overeducated and Overskilled	-0.222	<i>0.042***</i>
Job-skills match		
Adequately matched (PhD and skills required)		reference category
Overskilled but NOT Overeducated	-0.257	<i>0.041***</i>
Overeducated but NOT Overskilled	-0.101	<i>0.032***</i>
Overeducated and Overskilled	-0.282	<i>0.028***</i>
Overall job satisfaction		
Adequately matched (PhD and skills required)		reference category
Overskilled but NOT Overeducated	-0.159	<i>0.047***</i>
Overeducated but NOT Overskilled	-0.045	<i>0.029</i>
Overeducated and Overskilled	-0.103	<i>0.031***</i>

Average marginal effects on the probability of being very satisfied obtained from Ordered Probit models. Each model includes controls for gender, age, time between bachelor completion and PhD enrolment, PhD funding, PhD duration >6 years, PhD-type and university fixed effects, type of job, job location, current job tenure, permanent contract, firm size, main activities and annual earnings categories (complete estimates are reported in Table 3A in the Appendix). Robust standard errors in italics.

***Significant at 1%; **significant at 5%; *significant at 10%.

very similar to that associated with being overskilled only, indicating that underutilisation of skills is significantly more damaging to job satisfaction than disregard of the attained qualification.

A more general view of the relationship between job mismatch and job satisfaction among PhD holders can be obtained from the estimates of the overall satisfaction equation. Overall job satisfaction represents an aggregate of job domain satisfaction and very probably includes additional domains to the four we considered (Van Praag and Ferrer-i-Carbonell, 2007). Consistent with the results for job content and job-skill match satisfaction, being overeducated has only a modest negative effect on satisfaction with the job as a whole (which is imprecisely estimated). By contrast, job satisfaction is significantly lower when overeducation and overskilling are combined and is lower still among PhD

graduates who are overskilled but not overeducated (although this estimate is less precise because of the few observations in this category). It might be that overeducated doctors enjoy other features of their job that would compensate for underutilisation of skills (compensating differentials). Alternatively, it is possible that the requirement of a PhD to get the job might have falsely raised the graduate's expectations regarding the need for his or her skills. Whatever the case, our results are in line with those of Bender and Heywood (2006, 2009), indicating that mismatch reduces job satisfaction. Our analysis of job-domains satisfaction reveals that most of the effect of mismatch is due to the lack of suitable non-monetary job characteristics, rather than monetary aspects. In conclusion, it is possible to claim that overskilling is unlikely to be voluntary.

Conclusion

Analysing job mismatch among Spanish PhD holders, we drew on data from a recent cohort of PhD graduates from the public university of Catalonia (Spain). Following the recent literature on job mismatch among highly educated workers, we have distinguished between two forms of mismatch: education mismatch and skills mismatch. Overall, our analysis reveals a worrisome situation in which a non-negligible proportion of recent PhD graduates face involuntary mismatch associated with a significant penalty in terms of job satisfaction and, in the most severe case, earnings.

Our results show that these phenomena of overeducation and overskilling are quite closely correlated. This indicates that employers' recruitment and promotion strategies are quite closely aligned with actual job content, reflecting a clear understanding of what can be accomplished by a PhD graduate. The PhD job market is segmented into, on the one hand, jobs at universities and research institutes where graduates' credentials and skills are recognised and largely used, and, on the other hand, jobs in the public and private sectors where this is not so much the case. The main conditional correlates of job mismatch are the sector of employment and the activities performed within the sector, which are in turn affected by PhD holders' academic attributes. It is important to stress that the problem of mismatch is more closely related to the skills requirements of the job rather than to employment in a private firm or the public sector. In other words, job mismatch, especially in terms of overskilling, seems to be more sensitive to the demand side than the supply side of the labour market.

We also investigated the impact of mismatch on earnings and job satisfaction. As in the case of college graduates, PhD holders face a severe wage penalty only when they are both overeducated and overskilled. They show a high level of job dissatisfaction mostly related to non-monetary elements (reflecting intrinsic job quality). Those who are either overeducated or overskilled are, at least partly, compensated by higher earnings, but this does not offset the lack of relevant non-monetary aspects of the job that are highly valuable for PhD holders. Our results show that it is the extent to which new doctors can exploit their 'scientific' knowledge (i.e. their research potential) in the workplace what determines job satisfaction.

The sector of employment plays an important role in determining earnings. A private sector job commands a sizeable wage premium, casting doubts on the claim that PhD holders do not have skills required to be productive outside the academic world. It seems,

however, that a certain number of graduates working in private companies (and to some extent in government and other public sector jobs) undertake tasks that are more closely related to management than to R&D. Despite their higher earnings, these graduates feel that their skills are being misused – which is reflected in the job satisfaction analysis. This apparent contradiction could be explained by the fact that PhDs’ ‘high taste for science’ is not fulfilled in their jobs (Agarwal and Ohyama, 2013; Roach and Sauermann, 2010; Stern, 2004).

We consider that our results can be interpreted within the broader discussion of the availability of adequate jobs for the increasing number of PhD holders entering the labour market. The growing influx of graduates may not have been adequately absorbed by a labour market that, on the one hand, is creating fewer academic and research jobs and, on the other, has long been incapable of effectively channelling new graduates into suitable jobs in industry, private business or in the public sector. This does not mean, however, that new PhD graduates lack the skills to be successful in positions with a clear research and innovation content outside the academic world. In addition, there are signs that these graduates, when placed in middle- and top-management positions, can be a key asset. Unfortunately, there seems to be a misalignment between the skills acquired during the completion of a PhD and those required in management positions.

The results presented in this article call for a new set of policies aimed at reforming supply and demand conditions. From the demand perspective, it is clear that Spanish firms must continue to transform their structures and incorporate more R&D activities to increase their competitiveness. However, in addition to fostering such changes, more attention should be given to promoting collaboration between the business world and universities, through initiatives such as joint research projects, research spin-offs and co-training of graduates. From the supply perspective, there is a need for policies aimed at developing what has been called a ‘new skills agenda’, with horizontal and transferable skills such as managerial, organisational, leadership and teamwork skills that are transferable to a range of career paths, within and beyond research (Lee et al., 2010; Mangematin, 2000).

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Notes

1. The European Centre for the Development of Vocational Training (Cedefop) (2010) provides clear-cut definitions and discusses the differences between overeducation and overskilling. McGuinness and Sloane (2011) argue that overeducation relies on comparing a proxy measure of individual skills (educational attainment) with a proxy measure of the skill content of the job (job entry requirements). However, overskilling allows for a more direct comparison of the individual's accumulated skills, whether they relate to formal education, on-the-job training or perceived innate ability, with the actual skill requirement of the job in question. Indeed, the literature to date suggests that there is a less than a perfect correlation between overeducation and overskilling and that both phenomena tend to have quite distinct implications for workers.
2. See <http://www.aqu.cat/insercio/index.html#.Uqs8htGA3mR> for details of the survey.
3. Only 3% of the sample was not working at the time of the survey. However, we estimated models controlling for the self-selection into employment and it didn't change any result.
4. This classification also resembles the one used by Mavromaras et al. (2013), except for the fact that they considered a statistical definition of overeducation (based on modal schooling within occupations).
5. Table A1 in the Appendix deploys a complete description of explanatory variables used in this article selected using existing empirical works (e.g. Bender and Heywood, 2009, 2011; Canal Domínguez and Rodríguez Gutiérrez, 2013; Mangematin, 2000).
6. The various categories were not mutually exclusive in the sense that individuals might perform more than one activity. Moreover, this information is reported only for individuals who worked outside the university.
7. We cannot rule out the presence of self-selection of the best students into specific situations. Nevertheless, fixed effects for PhD programme and university should capture part of the training quality dimension.
8. Notice that we retained only those academic attributes that were directly related to human capital accumulation. Moreover, we included age at job entry rather than current age to better proxy for previous labour market experience.
9. These additional results are not shown, but are available upon request.
10. Complete results were quite standard and are not discussed for brevity reasons (but are reported in Table A3 in the Appendix). Notice that we also included earnings categories dummies as additional regressors in satisfaction equations.

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