

PhD graduates in Spain: does it pay to study it abroad?

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Abstract

An important decision when applying for a PhD is whether to study for a degree in the home country or abroad. In this paper, we investigate the returns to studying for a PhD abroad for Spanish PhD graduates. Using the 2019 Spanish University Graduate Placement Survey, we analyze how completing a PhD partially or fully abroad impacts wages and the likelihood of labor mismatch during the first years after PhD. We find that most of the positive effects of studying abroad occur when people decide to live and work abroad after their PhD. Our results suggest that the lack of adequate jobs for PhD holders in Spain generates a brain drain. Nevertheless, we observe some positive wage returns to study abroad among those that remain in Spain.

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1. Introduction

There is extensive literature on international student mobility at the undergraduate and master's levels. Empirical evidence indicates that studying abroad increases the likelihood of working abroad after graduation (Knutson et al., 2024, Oosterbeek and Webbink, 2011, Parey and Waldinger, 2011). This dynamic can contribute to brain drain if countries fail to attract foreign talent to offset the outflow of domestic graduates. This paper addresses a relatively underexplored yet increasingly relevant dimension: the international mobility of PhD students. Drawing on recent data from Spain, we examine the impact of studying abroad during doctoral training on two key labor market outcomes—wages and the likelihood of overeducation. These outcomes embody two main aspects of the job: pecuniary rewards and quality of the job in terms of its alignment with the education level. Overeducation is particularly important since we are studying PhDs, that is workers with highest possible levels of education. Underutilization of their human capital would be particularly wasteful and frustrating for them compared to undergraduates or even master's graduates.

Studying for a PhD abroad may improve labor market outcomes through several mechanisms. International experience can enhance academic and professional networks (Melin, 2004), expose individuals to diverse research environments, and foster the development of transferable skills such as adaptability and cross-cultural communication improving their curricula (Woolley et al., 2008).

Spain presents a particularly relevant case for examining the international mobility of PhD students due to its persistently high youth unemployment, widespread overeducation (Caparros-Ruiz, 2019), and segmented labor market (Bentolila et al., 2022). The Spanish labor market is characterized by a dual structure in which a small share of workers has stable, well-protected permanent contracts, while a large proportion, especially young individuals, are sentenced to temporary or precarious employment. This segmentation poses substantial barriers to stable career progression and contributes to the underutilization of advanced qualifications (Bentolila et al., 2022). Such labor market situation pushes many of the young professionals to look for better working conditions abroad, in more industrialized countries where their capacities could be fully employed and rewarded. This dynamic contributes to a brain drain among PhD holders (Cattaneo et al., 2018).

Our findings show that international mobility during PhD studies is associated with higher wages and better job matches, particularly for those who remain abroad after graduation. The wage premium and labor match quality improvement associated with PhD studies mobility mostly disappear if we consider those who do not emigrate. This suggests that the Spanish labor market does not provide adequate opportunities for highly trained individuals. This raises important concerns about the potential for brain drain. However, we also find a modest wage premium for internationally mobile PhDs who return to work in Spain.

This study contributes to the growing literature on PhD careers (Bender & Heywood, 2011; Canal-Domínguez & Wall, 2013; Di Paolo, 2016; Gaeta et al., 2021), which, like our work, focuses mainly

on wages and job match quality. However, unlike previous research that relied on regional subsamples or older data (e.g., Di Paolo, 2016; Caparros-Ruiz, 2019), we use the 2019 Spanish University Graduate Placement Survey, a nationally representative dataset, to provide updated evidence on the labor market outcomes of PhD graduates. Our empirical specification includes controls for fields of study (Cañibano et al., 2020, Laudel and Bielick, 2019), firm characteristics (Garcia-Quevedo et al., 2012) and academic versus industry employment (Canal-Domínguez and Wall, 2013). Moreover, our sample is particularly well-suited to assess the incentives for a possible brain drain of Spanish PhDs, as it includes recent PhD graduates at the early stages of their careers (Marini, 2022, Cañibano et al., 2020).

The rest of the paper is organized as follows. Next section discusses related literature. Section 3 describes the data and explains the econometric specifications used in the analysis. Section 4 presents and discusses the estimation results. Finally, section 5 concludes.

2. Literature review

There is a large body of research on the careers of doctorate holders. Sarrico (2022) and Hancock (2023), among others, highlight an unprecedented increase in the production of PhDs due to their crucial role as innovators in the knowledge economy. Accordingly, an increasing number of PhD graduates are expected to pursue careers outside academia as knowledge creators (Hancock, 2023) contributing to the growing importance of understanding both the adequacy and availability of employment opportunities for PhD holders.

Over the last decades, the careers of PhDs have attracted a lot of research focus paying particular attention to their wages (Canal Domínguez and Rodríguez Gutiérrez, 2013, Canal-Domínguez and Wall, 2013, Schwabe, 2011, Gaeta et al., 2022) and job match quality (Bender and Heywood, 2009, Gaeta, 2015, Gaeta et al., 2021, Ermini et al., 2017). For instance, in a recent study, Cultrera et al. (2025) show that between 20 and 33% of PhD graduates across OECD countries experience job mismatch in terms of overeducation and associated with it wage opportunity cost.

Another strand of research has focused on the qualitative aspects of PhD careers, such as field of study and international mobility (Laudel and Bielick, 2019, Cañibano et al., 2020). Two main conclusions arise. First, the type and length of international mobility matter. Cañibano et al. (2020) show that early career mobility is more likely to lead to long-term settlement abroad, while mid-career mobility is associated to short-term stays abroad. Their study confirms the earlier observations by Laudel (2005) who demonstrated that elite researchers move abroad before they become elite.

Second, the field of research significantly influences mobility patterns. Cañibano et al. (2011) analyzed the CVs of researchers residing in Andalusia (Spain) and concluded that doctors in social sciences and humanities were much more internationally mobile than their peers in sciences or health. Similarly, Laudel and Bielick (2019) observed that history graduates were more mobile than their physics or biology peers. There are also marked wage differences associated with different study fields

(Canal Domínguez and Rodríguez Gutiérrez, 2013, Caparros-Ruiz, 2019). Graduates in humanities and arts as well as graduates in social sciences secure higher wages in academia, while engineers and medical doctors earn higher wages outside of university.

Consequently, the international mobility is regarded as a positive aspect in a PhD career, often associated with prestigious academic and professional experiences (Woolley et al., 2008, Melin, 2004). A few papers study the labor outcomes of PhDs related to mobility. A first group of papers considers the effect of international mobility during PhD studies on job match. Ermini et al. (2017) and Gaeta (2015) use the Italian PhD national survey and find that having visiting periods abroad during PhD studies significantly reduces the likelihood of overeducation. Similarly, Di Paolo and Mañé (2016) study the mismatch of PhD graduates from public universities in Catalonia, Spain and find that both pre- and post-doctoral mobility reduce overeducation and skill mismatch of PhD graduates, although post-doctoral mobility has a stronger effect.

Other papers examine the effect of having a postdoctoral stay abroad on wages and job match quality. Caparros-Ruiz (2019), using the 2009 Spanish data, shows a positive effect of migration on wages and job match quality of PhDs even after controlling for endogeneity as the most talented or wealthier individuals may select into international experience in their PhD studies. Similarly, Di Cintio and Grassi (2016) use Italian data on PhDs from 2009 and find a positive wage effect when controlling for endogeneity of the mobility decision. In line with these findings, Dias Lopes and Hancock (2024) analyze data for the UK and find a significantly positive effect of international mobility on wage of early career movers. They name it a “mover’s advantage” after Grogger and Hanson (2015) and Holding et al. (2024) who identify a similar effect on large samples of PhD migrants to the US.

A negative migration balance of highly skilled individuals is often referred to as “brain drain” (Docquier and Rapoport, 2012). PhDs migrate abroad for a variety of reasons, but labor market conditions often play a decisive role. Moreover, domestic labor markets may struggle to attract similarly skilled foreign talent, resulting in a net outflow of highly educated workers. Cattaneo et al. (2018), using Italian data, show that lack of adequate jobs and low pay drive many PhD graduates to move abroad. Di Cintio and Grassi (2017) reach similar conclusions, identifying wage differentials as the main motivation for migration abroad. Güngör and Tansel (2014) point towards PhD brain drain from Turkey partly due to economic instability and partly due to political reasons. Indirectly, Santos et al. (2016) point towards possible brain drain of PhDs in Portugal and the need to consider policies to attract and retain PhD holders. In a recent paper Marini (2022) shows that the Italian brain drain happens mostly during the PhD studies, reinforcing our argument that looking at the PhD students’ mobility may be the key to identification of possible brain drain incentives. Highly skilled individuals who cannot secure good enough jobs in terms of pay and other characteristics in their home country may feel pushed to move abroad in search of better opportunities. Furthermore, due to information asymmetries employers in receiving countries like the US, UK, Germany or France may be better at determining the true ability of foreign PhDs and thus attract them more easily to their job offers

(Kwok and Leland, 1982). Auriol et al. (2013) and Grogger and Hanson (2015) provide evidence of a global increasing trend in the migration of skilled scientists towards the US, where they tend to outperform their peers who remain in their home countries mainly due to higher prestige and better productivity of US universities (Holding et al., 2024). Despite these contributions, the existent evidence of possible PhDs brain drain is scarce.

This paper seeks to fill this gap by analyzing recent data from Spain, providing evidence that young PhDs face strong incentives to migrate abroad, leading towards the brain drain phenomenon. Using 2019 Spanish University Graduate Placement Survey we show that studying abroad improves wages and job match, but benefits are mainly for those living abroad, indicating a lack of adequate PhD jobs in Spain. Our results although limited to Spain should be a warning to the whole Southern Europe (Spain, Italy, Portugal where there is similar evidence). Previously, research has concentrated on the brain drain from the developing countries to the US. However, it becomes all the more evident that there may be brain drain from the developed countries such as Spain, Italy or Portugal because of better opportunities elsewhere (US, UK...) (Cattaneo et al., 2018, Santos et al., 2016, Holding et al., 2024). Therefore, despite the local character of our findings their message is fairly universal for a good part of Europe which cannot compete with prestige or wages with US or British markets which enjoy better academia-industry connections and invest more in R&D.

Our results contribute to the understanding of PhD mobility and PhD careers in a number of ways. First, using a sample of young PhD graduates we show that where PhD studies are conducted is crucial for future labor market prospects. Similarly to other papers, we show that international mobility during PhD studies is related to higher wages and lower overeducation, mainly if an individual decides to stay abroad (Marini, 2022, Cattaneo et al., 2018). Among those graduates living in Spain only individuals who completed their entire PhD abroad experience a wage premium. Thus, we show that there are clear incentives for the young doctoral graduates in Spain to move abroad, who, as we showed earlier, are the most likely group to migrate and not return (Cañibano et al., 2020). Second, we show that having studied partially abroad and partially in Spain during the PhD has a wage penalty for researchers who decide to return to Spain. This may be a signal of inbreeding recently mentioned by Cattaneo et al. (2018) in the Italian context. As young researchers go for a period abroad, their local social ties weaken. This leads to the situation where they fall out of the hiring queue in their home institutions or local industry and have to rebuild their social ties after returning to Spain. It is particularly troubling as Spain is known for its dual labor market. Spanish youth face a small amount of well-paid, stable and matching jobs and a large pools of precarious employment arrangements (Bentolila et al., 2022).

Third, while other studies only looked at the mobility in some selected fields of study (Cañibano et al., 2020, Laudel and Bielick, 2019), our sample entails all fields available in Spain aggregated to 5 major categories: Humanities and arts, Sciences, Social sciences, Engineering and architecture, and Health.

Furthermore, we control for the occupation choice by PhDs. Research on PhD careers has traditionally distinguished between academic versus industry employment (Canal-Domínguez and Wall, 2013, Agarwal and Ohyama, 2013). Results from this research indicate that PhDs who exhibit “taste for science” tend to look for academic employment, while others value more industrial implications of their doctoral training. Academic employment, while providing higher job satisfaction, tends to pay worse wages than industry. Thus, controlling for academic versus industry employment is also an important issue to be addressed.

Lastly, our models control for the size of the firm as the majority of PhDs in our sample work outside of academia. Garcia-Quevedo et al. (2012) show non-linear relationship between firm size and likelihood of employment of a PhD. Small and large firms are more likely to employ doctoral graduates than medium size enterprises.

3. Data and econometric specifications

3.1 Data

We use the Survey on the Labor Insertion of University Graduates 2019 (EILU 2019 by the Spanish acronym). EILU provides information on the transition of university graduates to the labor market. The survey conducted in 2019 consists of a representative sample of bachelor’s and master’s graduates of the 2013-2014 academic year at Spanish universities. Individuals are asked about their current labor situation, further studies attained, several characteristics of their study path, mobility experiences, and working experience. The total sample consists of approximately 32,000 bachelor graduates and 12,000 master’s degree holders. Around 3.5% of these individuals completed a PhD between 2014 and 2019. We use this PhD sample in our analysis. We pool the bachelor’s and master’s graduates’ samples and cluster standard errors by the sample of origin in all estimations. We exclude part-time workers and all observations with missing values. The final sample consists of 1090 PhD graduates, of which 930 have full-time employment in 2019.

We study the determinants of wage and the education-job match of PhD graduates, with special emphasis on the effect of international mobility experiences during PhD studies. The wage is reported in wage bands. For the overeducation variable, we use the information reported by respondents on whether their job requires a PhD. We consider individuals overeducated if they consider that their job does not require a PhD. This type of subjective variable has been extensively used in the literature to describe overeducation (Gaeta, 2015, McGuinness et al., 2018, Capsada-Munsech, 2019).² The main independent variable is the place of the PhD studies, which has three options: only in Spain, partially abroad, or fully abroad. It is crucial for understanding how the place of PhD completion

² Unfortunately, we do not have information on other types of mismatches, such as skills or field mismatch. The survey questions on skills and field mismatch only refer to the match between the studies finished in 2013/2014 (bachelor or master) and the current job.

affects early market outcomes of young doctors (Marini, 2022). The other independent variables used in the analysis are demographic characteristics, fields of study and job and firm characteristics. A detailed definition of all variables used is presented in Table A1 in the Appendix.

As regards ability and family of origin economic status, we proxy them with scholarships that graduates enjoyed during their previous studies. In the absence of better measures of ability and family economic background, scholarships are imperfect but a relevant indicator. Information on scholarships is not common in most databases. We have information on whether the individual enjoyed a scholarship during the studies completed in 2013/2014. The general scholarship requires a low family income/wealth level and passing a minimum number of credits every year (the minimum varies per field of study). It covers the enrolment fee for everyone plus some amount depending on the family income. The excellence scholarship depends on academic achievement and is independent of family income. It is a lump sum amount associated with high GPA (usually above 8 over 10). Around 8% of PhD holders have enjoyed some excellence scholarships in their previous studies versus 4% of non-PhD holders. In contrast, a general scholarship is more common among non-PhD holders than among PhD holders. We use the scholarship variables in our inverse probability weighting (IPW) strategy to correct for possible selection of wealthier or more gifted individuals into PhD studies abroad.

The first three columns in Table 1 present the descriptive statistics of the raw data where individuals are grouped by the place of PhD studies. Most of the PhD graduates of our sample studied fully in Spain (56%), while around one third (35,7%) studied partially abroad, and only 8.6% studied fully abroad. Those that studied PhD abroad tend to be younger, doing a PhD in Sciences, they previously studied in a public university, 18% of them enjoyed a scholarship of excellence and close to 43% had an international exchange experience in their previous studies. Moreover, most of them have a father with a tertiary education, close to 70% have at least one parent with a tertiary education. They are very likely to live abroad (70% of the sample). In contrast, those that studied the PhD fully in Spain are older, only close to 6% of them had a scholarship of excellence in their previous studies, around one third of them has a father with tertiary education, and 45% of them have at least one parent with tertiary education. Among those that study partially abroad, we observe that around half are females, they are younger than those who stayed in Spain, they studied Sciences and Engineering mostly, around 11% of them got a scholarship of excellence in the previous studies, and around 31% obtained the general scholarship, a slightly larger share compared to the other two groups. The parental background is similar to the one of those who studied fully in Spain and worse than the one of those who studied fully abroad.

When it comes to differences in wages and overeducation among the three groups, we can see a clear pattern, particularly while comparing studies abroad fully vs partly or fully in Spain. While those who studied fully in Spain, or partly abroad earn mostly between 1000 and 1999€ per month, those who studied their PhD fully abroad are more likely to earn above 2499€. Also, the overeducation declines almost linearly between having completed PhD only in Spain (57% overeducated), through studies

shared between Spain and abroad (47% overeducated) and finishing on those who completed their PhD work fully abroad (36% overeducated). It is also clear from this descriptive view that PhD abroad commands higher wages and decreases the threat of overeducation for PhD graduates.³ The rest of Table 1 provides the means of the variables weighted by IPW, stabilized IPW and truncated IPW. Weighting by the inverse probability of treatment improves the balance of the sample for most covariates.

Insert Table 1 about here

3.2 Econometric specification

We independently estimate the wage equation and the probability of being overeducated. We cluster standard errors by the sample of origin (undergraduate and master) in all estimations. The wage equation is estimated using an interval regression model as wages are reported in wage bands. The coefficients inform us about the effect of each variable on the wage of individuals, which refers to the monthly wage after taxes. The estimated wage equation is the following:

$$wage_i = X_i\beta + \gamma_P PM_i + \gamma_F FM_i + \epsilon_i$$

where wage indicates the wage interval, PM is a dummy indicating whether the PhD was done partially abroad, and FM is a dummy indicating if the PhD was done fully abroad. Vector X includes demographic characteristics such as gender, age group, partnership status, and a proxy for ability—whether the individual received an excellence scholarship in previous studies. Additionally, vector X incorporates the field of study of the PhD to account for differences in labor market opportunities, whether prior studies were completed at a public university, and job characteristics such as academic employment, contract permanence, firm size, and whether the individual resides abroad. Both fields of study as well as career stage when mobility happens have been previously shown to be determinant for the international mobility of PhDs and subsequently affect their labor market outcomes (Laudel and Bielick, 2019). Furthermore, it is well known that permanent contracts and larger firms are associated with higher wages. Finally, we also control for academic employment, which has been shown by previous studies to provide higher job satisfaction despite lower pay (Di Paolo, 2016). Additionally, we also add a dummy indicating whether the individual is from the Bachelor or Master sample. A detailed definition of the variables is available in Table A1 in the Appendix.

The overeducation probability is estimated using a probit model. The variables used are the same as in the wage equation.

$$P(Overeducation_i|X) = \Phi(X_i\beta + \gamma_P PM_i + \gamma_F FM_i)$$

³ Unfortunately, we cannot control for price differences across countries as we do not know the countries of residence for all individuals.

In both cases, the inverse probability weighting is applied along with an equation controlling for selection into employment. The exclusion restriction in the selection equation is the education of the father. Parental education is often used as an exclusion restriction variable in employment selection equations (Lemke and Rischall, 2003, Ashenfelter and Zimmerman, 1997). Despite the criticism received in the literature, we are able to use father's education as it satisfies the assumptions of the selection models (Heckman, 1979). It is correlated and significant in the selection equation, but at the same time uncorrelated with the residuals of the wage model (Card, 2001).⁴ Additionally, the rationale for using this variable as a selection restriction is grounded in the literature on intergenerational transmission of human capital. It has been shown that the education of parents is crucial at the early educational transitions (primary, secondary...) shaping opportunities and aspirations but loses its importance at later stages such as master or PhD (Wilson, 2001). Results are robust to this specification and do not change when the estimation has no selection equation.

The key independent variable of interest is the place of the PhD studies, which has three options: Spain, partially abroad, or fully abroad. Since the decision to study for the PhD abroad is not exogenous, we use inverse probability weighting (IPW) to balance the samples (Austin and Stuart, 2015, Hirano et al., 2003). Balancing the sample in terms of the chances of studying entirely in Spain, versus partially or fully abroad reduces the endogeneity bias and allows for better comparisons between these outcomes. Following the standard methodology, we use a multinomial logistic estimation to predict the probability to study for the PhD in Spain, partially abroad, or fully abroad. We consider individual characteristics, prior educational background, and family background to influence the decision to pursue a PhD abroad. The independent variables include gender, sample indicator (undergraduate and master), age group, characteristics of previous studies (such as whether the university was public or private and the field of study), family background measured by parental education and receipt of a general scholarship, and ability, proxied by the receipt of an excellence scholarship. Results of this auxiliary regression are reported in Table A2 in the Online Appendix. We use this multinomial estimation to compute the weights as the inverse probability of the treatment received. Since some predicted probabilities to study for the PhD abroad are very low, the weights for some individuals become very large and increase the variability of the estimated treatment effect. We propose two approaches to mitigate this problem. First, we use stabilized or normalized weights, which consists of multiplying the inverse probability of treatment by the marginal probability of each treatment and control group in the overall sample (Austin and Stuart, 2015). Second, we truncate the inverse probability weights to account for the low probability scores instead of using the stabilized weights (truncated IPW). We set the inverse probability weights to the 99% level for those that have a higher weight. This only affects 11 individuals that studied fully abroad.

⁴ The pairwise correlation of father's education and the residual of wage equation (taken at the midpoint of wage bands) is close to zero in for all education levels of the father. The same results are observed for overeducation equation residuals and father's education.

The variable of interest in both the wage and the overeducation equations is where individuals did their PhD. We argue that by using the inverse probability weighting for treatment, where the treatment is the PhD place, results can be interpreted as causal (Huber, 2014).

4. Results

4.1 Wage equations

Table 2 provides the main estimated coefficients of the wage interval regression estimations for the different weighting strategies. The upper panel reports the results when using IPW, the middle panel reports the results when using stabilized IPW, and the bottom panel reports the results when using truncated IPW. The coefficients can be interpreted as in a linear OLS estimation. All equations also include other controls and selection into employment. Column (1) reports the results when using the whole sample. Column (2) adds the control whether individuals are currently living abroad. Finally, in column (3) the sample is restricted to those currently living in Spain. The full estimation results, including the rest of the covariates, are reported in Tables A3-A5 in the Online Appendix.

Results are robust to the different weighting approaches used. Studying for the PhD abroad increases wages above 300€ monthly (see column (1) in Table 2). Our main results corroborate the consensus in the literature that international mobility increases wages of PhDs. In our case, mobility refers to the place of doing the PhD. We also see that once we control for living abroad, the wage premium of studying abroad disappears. This happens because doing PhD abroad increases the likelihood of living abroad. Since both factors are strongly correlated only the strongest one prevails in the wage estimation. In the decision whether to live abroad, wages are an important determinant (Cattaneo et al., 2018). Young PhDs who are at the beginning of their careers have often lower family responsibilities and lower opportunity cost of migrating abroad than established researchers (Cañibano et al., 2020). It is thus at this point that incentives to move find the most fertile ground and the role of wage differences is the highest. Low wages at home are thus a push factor for young PhDs to move abroad. In a recent paper for Italy, Marini (2022) observes that bad labor prospects push recent PhDs to consider mobility abroad which frequently leads to brain drain.

In column (3) of Table 2 we restrict the sample to those living in Spain. We see that having studied PhD abroad has a wage premium that ranges between 50 and 100 euros monthly depending on the weighting approach. Therefore, we observe positive returns to doing a PhD fully abroad, independently whether the individual stays abroad or returns to Spain.⁵ In contrast, partially studying a PhD abroad has a negative impact on wages for those living in Spain. This could be due to adaptation costs slowing study progress or hindering the creation of a strong network in Spain, affecting job prospects. Individuals who decide to study abroad for some time may weaken their local social networks and thus hamper their chances for a good job once they return from their research

⁵ The difference between the wage premium for studying abroad between columns 1 and 3 may be attributed to the fact that graduates earn much higher nominal wages abroad.

period abroad. Unfortunately, the length of the stay abroad is unknown to us, so we are not able to verify this tentative explanation empirically.

The coefficients of the rest of the variables have the expected sign and do not change much across estimations (see Tables A3-A5 in the Online Appendix). There is a gender wage gap of around 140 euros monthly on average. Experience is rewarded positively as indicated by the positive age coefficients. PhD graduates in Health Science and Engineering earn above 200 euros monthly more than in Social Sciences. Having an academic job, which is defined as working as a teacher in a job that requires a PhD in the education sector, has a wage penalty of around 200 euros monthly. Finally, having a permanent contract is associated with a wage premium. Small firms seem to be the most rewarding employers for our sample of PhDs. A tentative explanation would be that large firms in Spain have too rigid structures to fully appreciate the disruptive and innovative knowledge of PhD graduates. This result partly confirms the findings of Garcia-Quevedo et al. (2012). Further research might be required to fully disentangle the relationship between firm size and PhD wages.

Insert Table 2 about here

4.2 Overeducation among PhD holders

In this section, we analyze the quality of the current job in terms of the match between the education acquired (PhD) and the required education in the job. For example, PhD holders that follow an academic career are clearly in a matched job, as the PhD is required in this occupation by definition. We consider as overeducated those PhDs that perform jobs which do not require a PhD, according to the information provided by the respondent.

Table 3 presents the marginal effects of the probit estimation where the dependent variable is whether the individual is overeducated. As before, the upper panel reports the results when using IPW, the middle panel reports the results when using stabilized IPW, and the bottom panel reports the results when using truncated IPW. The model strategy is the same as in the case of wages. Estimation (1) uses the whole sample, estimation (2) adds the control whether individuals live abroad, and estimation (3) restricts the sample to those living in Spain. Full estimation results are available in Tables A6-A8 in the Online Appendix.

In estimation (1) doing the PhD fully abroad reduces the probability of overeducation by around 12 percentage points. However, when we control for living abroad in estimation (2), the effect of studying abroad becomes statistically insignificant, while living abroad reduces the probability of overeducation by around 30 percentage points. These results suggest that there is a lack of PhD level jobs in Spain, which may lead to a brain drain problem (similarly as detected by Cattaneo et al. (2018) for Italy), especially combined with the results from the previous analysis that jobs abroad command higher wages. When we restrict the sample to people living in Spain (estimation 3), results reveal no significant effect of studying abroad on the probability of overeducation. These findings challenge

earlier literature that identified international study experience as a key factor in improving job match outcomes for PhDs. Thus, we can say that studying abroad which has been identified by previous papers to be beneficial in job search for PhDs does not play any important role nowadays in avoiding overeducation in Spain. In the current Spanish context, studying abroad no longer appears to offer protection against overeducation for those who return. This is a particularly concerning development, as it represents yet another push factor encouraging young PhD holders to seek employment abroad, thereby exacerbating the brain drain of highly educated Spanish professionals.

The results for the rest of the variables are provided in Tables A6-A8 in the Online Appendix. Having a partner increases the likelihood of overeducation. Having a PhD from a STEM field reduces the likelihood of overeducation. Those individuals that graduated from a master's degree in 2013-2014 are less likely to be overeducated. They are more likely to have finished the PhD earlier and therefore had more time to look for an adequate job. Larger firms are more likely to offer matching jobs to PhDs. Permanent contract, instead, is positively correlated with overeducation of PhDs in our sample. Similar result has been found for undergraduate students who trade their match for job stability (Ortiz, 2010).

Insert Table 3 about here

5. Conclusions

In this paper, we focus on the effect of doing a PhD partially or fully abroad on wages and education-job match in 2019. We find that PhD graduates who did their PhD abroad get a significant wage premium of around 300 euros monthly. We also find evidence that studying for a PhD abroad reduces the probability of being overeducated. However, the effects of higher wage and lower likelihood of mismatch wane when we restrict the sample to the doctors who decided to live in Spain. Their wage premium drops to 45-90€ and they are not less likely than the rest of PhDs to become overeducated. Conversely, doctorate graduates living abroad have a much lower probability of being overeducated and tend to have higher wages.

This brings awareness about the difficulty of attracting back the talent that went to study abroad. The lack of adequate jobs and low wages compared to other countries makes it difficult to retain and attract talent in Spain resulting in brain drain described recently in Italy (Cattaneo et al., 2018, Marini, 2022) among others. Spanish labor market is characterized by high duality where only a small group of graduates enjoy stable working conditions with adequate jobs and competitive pay, while others are marginalized in badly paid, precarious jobs, which do not match their education levels. In such a market being a PhD is particularly complicated (Bentolila et al., 2022). If undergraduate and master's workers cannot secure good jobs, then PhDs are even more fragile, as most often their doctoral degrees are equally treated as those of master's or undergraduate in jobs outside of academia. In such

circumstances, their matches peril and their wages drop. On top of that, if they are just starting their careers and so have a low opportunity cost of migrating abroad (Cañibano et al., 2020, Marini, 2022) then we have a perfect incentive mix to push them to other countries creating idoneous conditions for a brain drain. Our results show that it is more attractive for Spanish PhD students to study and work abroad.

Spain needs to create more adequate and well-paid graduate jobs for PhDs. Currently, PhD graduates face limited and underpaid academic positions or uncertain industry opportunities (Sarrico, 2022). Spain should implement strategies to attract highly skilled PhDs into matching and well-paid industry and academic jobs. A good example may be industrial doctorates promoted nowadays in Spain. Their aim is to link directly PhD studies with the necessities of real business. In the Spanish case most of the PhD studies are funded by public scholarships, so retaining this human capital is important. In other word the Spanish government is paying for the education of PhD graduates but then does not provide policies to offer them adequate job opportunities.

This analysis has at least two limitations. One is the lack of data on host countries, that would allow us to better understand the advantages of living and working abroad. The other is the sample size, which is too small to let us disentangle the heterogeneity of mobility impact on labor outcomes across fields of study.

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Table 1. Descriptive statistics.

	Raw data			IPW			Stabilized IPW			Truncated IPW		
	0	1	2	0	1	2	0	1	2	0	1	2
Wage =<700 Euro	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00
Wage 700-999 Euro	0.05	0.03	0.02	0.05	0.04	0.04	0.05	0.04	0.04	0.05	0.04	0.04
Wage 1000-1499 Euro	0.28	0.35	0.14	0.32	0.35	0.13	0.32	0.35	0.13	0.32	0.35	0.14
Wage 1500-1999 Euro	0.32	0.32	0.23	0.31	0.29	0.43	0.31	0.29	0.43	0.31	0.29	0.39
Wage 2000-2499 Euro	0.18	0.14	0.19	0.17	0.16	0.07	0.17	0.16	0.07	0.17	0.16	0.08
Wage 2500-2999 Euro	0.08	0.08	0.21	0.08	0.09	0.19	0.08	0.09	0.19	0.08	0.09	0.19
Wage =>3000 Euro	0.08	0.08	0.20	0.07	0.07	0.14	0.07	0.07	0.14	0.07	0.07	0.15
Overeducated	0.57	0.47	0.36	0.55	0.51	0.39	0.55	0.51	0.39	0.55	0.51	0.39
Female	0.42	0.53	0.47	0.46	0.44	0.41	0.46	0.44	0.41	0.46	0.44	0.44
Partner	0.53	0.43	0.47	0.50	0.45	0.55	0.50	0.45	0.55	0.50	0.45	0.53
Age bands=<30	0.40	0.57	0.61	0.48	0.46	0.36	0.48	0.46	0.36	0.48	0.46	0.43
Age bands=30-34	0.29	0.35	0.30	0.31	0.31	0.36	0.31	0.31	0.36	0.31	0.31	0.32
Age bands=>34	0.31	0.08	0.10	0.21	0.23	0.28	0.21	0.23	0.28	0.21	0.23	0.26
PhD Field of Study:												
Arts and Others	0.13	0.08	0.10	0.10	0.10	0.05	0.10	0.10	0.05	0.10	0.10	0.06
Science	0.25	0.39	0.51	0.30	0.35	0.39	0.30	0.35	0.39	0.30	0.35	0.40
Social Sciences	0.16	0.11	0.05	0.14	0.13	0.21	0.14	0.13	0.21	0.14	0.13	0.17
Engineering & Architecture	0.18	0.24	0.16	0.20	0.21	0.14	0.20	0.21	0.14	0.20	0.21	0.16
Health Science	0.29	0.17	0.18	0.26	0.22	0.21	0.26	0.22	0.21	0.26	0.22	0.21
Characteristics of previous studies												
Public university	0.85	0.90	0.91	0.87	0.87	0.91	0.87	0.87	0.91	0.87	0.87	0.90
Master sample	0.74	0.72	0.53	0.72	0.70	0.79	0.72	0.70	0.79	0.72	0.70	0.76
Excellence Scholarship	0.06	0.11	0.18	0.09	0.09	0.06	0.09	0.09	0.06	0.09	0.09	0.07
General Scholarship	0.27	0.31	0.26	0.29	0.31	0.33	0.29	0.31	0.33	0.29	0.31	0.31
Study abroad previously	0.07	0.14	0.43	0.13	0.13	0.09	0.13	0.13	0.09	0.13	0.13	0.11
Father's education:												
At most low secondary	0.36	0.33	0.24	0.33	0.33	0.43	0.33	0.33	0.43	0.33	0.33	0.37
Higher secondary	0.29	0.29	0.22	0.31	0.30	0.20	0.31	0.30	0.20	0.31	0.30	0.21
Tertiary education	0.35	0.38	0.53	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.42
Parents education:												
None has tertiary education	0.55	0.50	0.32	0.51	0.53	0.56	0.51	0.53	0.56	0.51	0.53	0.48
One parent with tertiary	0.21	0.26	0.29	0.24	0.23	0.18	0.24	0.23	0.18	0.24	0.23	0.22
Both with tertiary educ	0.24	0.25	0.39	0.25	0.25	0.26	0.25	0.25	0.26	0.25	0.25	0.29
Living abroad	0.06	0.17	0.70	0.07	0.15	0.51	0.07	0.15	0.51	0.07	0.15	0.51
Academic job	0.14	0.15	0.17	0.14	0.13	0.14	0.14	0.13	0.14	0.14	0.13	0.12
Firm size < 50	0.21	0.15	0.21	0.21	0.15	0.33	0.21	0.15	0.33	0.21	0.15	0.27
Firm size 50-249	0.18	0.20	0.18	0.16	0.16	0.18	0.16	0.16	0.18	0.16	0.16	0.22
Firm size 250+	0.62	0.66	0.61	0.62	0.69	0.50	0.62	0.69	0.50	0.62	0.69	0.52
Observations	607	389	94									

Group classification: PhD place (0-Spain; 1-Partially abroad; 2-Only Abroad).

Table 2. Wage equations estimations.

	(1)	(2)	(3)
IPW	All	All	Living in Spain
PhD place: Spain & Abroad	17.528 (47.982)	-41.586** (20.165)	-92.161*** (5.221)
PhD place: Only Abroad	312.726*** (18.076)	-22.760 (63.520)	42.903*** (8.831)
Living abroad		735.917*** (15.725)	
Total Observations	1090	1090	921
Employed individuals	930	930	773
Stabilized IPW	All	All	Living in Spain
PhD place: Spain & Abroad	23.663 (59.661)	-47.056 (39.199)	-66.392*** (16.476)
PhD place: Only Abroad	305.345*** (1.911)	-48.550 (123.056)	93.698*** (18.620)
Living abroad		818.637*** (68.831)	
Total Observations	1090	1090	921
Employed individuals	930	930	773
Truncated IPW	All	All	Living in Spain
PhD place: Spain & Abroad	27.048 (46.873)	-39.643** (18.776)	-83.514*** (4.561)
PhD place: Only Abroad	334.327*** (28.389)	-7.783 (60.266)	45.088*** (4.797)
Living abroad		760.396*** (5.480)	
Total Observations	1090	1090	921
Employed individuals	930	930	773

IPW: Inverse probability weighting. Interval regression estimation with selection into employment. Dependent variable: wage interval. Independent variables: Female, Partner, Age: 30-34, Age:>34, Excellence scholarship, Field of Study (Arts, Science, Engineering & architecture, Health Science), Public university, Academic job, Master database, Permanent contract, Firm size (50-249, 250+), PhD place (Spain & abroad, Only abroad), Living abroad.

Table 3. Overeducation

IPW	(1) All	(2) All	(3) Living in Spain
PhD place: Spain & Abroad	-0.031* (0.017)	-0.004 (0.030)	-0.027 (0.023)
PhD place: Only Abroad	-0.144*** (0.039)	0.014 (0.067)	0.014 (0.050)
Living abroad		-0.339*** (0.018)	
Total Observations	1090	1090	921
Employed individuals	930	930	773
Stabilized weights	All	All	Living in Spain
PhD place: Spain & Abroad	-0.032 (0.019)	-0.006 (0.027)	-0.026 (0.031)
PhD place: Only Abroad	-0.125*** (0.026)	0.006 (0.068)	0.036 (0.070)
Living abroad		-0.311*** (0.009)	
Total Observations	1090	1090	921
Employed individuals	930	930	773
Truncated	All	All	Living in Spain
PhD place: Spain & Abroad	-0.039** (0.018)	-0.014 (0.029)	-0.032 (0.026)
PhD place: Only Abroad	-0.129*** (0.036)	0.007 (0.070)	-0.001 (0.055)
Living abroad		-0.297*** (0.012)	
Total Observations	1090	1090	921
Employed individuals	930	930	773

IPW: Inverse probability weighting. Probit estimation with selection into employment. Dependent variable: overeducation. Independent variables: Female, Partner, Age: 30-34, Age:>34, Excellence scholarship, Field of Study (Arts, Science, Engineering & architecture, Health Science), Public university, Master database, Permanent contract, Firm size (50-249, 250+), PhD place (Spain & abroad, Only abroad), Living abroad.

APPENDIX

Table A1. Definition of variables

Female	Dummy with value 1 if the individual is female, 0 otherwise.
Partner	Dummy with value 1 if the individual lives with a partner, 0 otherwise.
Age group	Three age groups: <30, 30-34, >34
Father's education	Three categories: At most low secondary, Higher secondary or vocational education, University education.
Parent's education	Three categories: No parent has tertiary education, either father or mother has tertiary education, both parents have tertiary education.
PhD field	Field of study of PhD. It has five categories: Arts and others; Science; Social Sciences; Engineering & Architecture; Health Science.
PhD place	Place of studying for the PhD. It has three categories: Spain, Spain and abroad, only abroad.
Master sample	Dummy with value 1 if the individual graduated from a master's degree in 2014, 0 if the individual graduated from an undergraduate degree in 2014.
Excellence scholarship	Dummy with value 1 if the individual got an excellence scholarship during in the studies finished in the academic year 2013/2014. Given to those with high academic achievement.
General scholarship	Dummy with value 1 if the individual got a general scholarship during the studies finished in the academic year 2013/2014. Given to those with low family income.
Exchange	Dummy with value 1 if the individual had an international ERASMUS experience during the studies finished in the academic year 2013/2014.
Public university	Whether the individual graduated in 2014 from a public university (either bachelor or master studies).
Wage bands	Monthly wage after taxes. This variable has seven categories: <700€, 700–999€, 1000-1499€, 1500-1999€, 2000-2499€, 2500-2999€, >3000€.
Overeducated	Dummy with value 1 if the individual reports that the level of education most adequate for present job is at most a master's degree, 0 otherwise.
Academic	Dummy with value 1 if the individual is a teacher in a job that requires a PhD in the education sector, 0 otherwise.
Permanent	Dummy with value 1 if the individual has a permanent contract, 0 otherwise.
Firm size	Three categories: less than 50 employees, between 50 and 249 employees, 250 or more employees.
Live abroad	Dummy with value 1 if the individual currently lives abroad, 0 otherwise.