Doctoral education and employment in the regions: the case of Catalonia

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ABSTRACT
Even though the doctoral degree was originally designed for an academic career, there is an increasingly important labour market for doctorate holders outside academia, mainly because of a shortage of job opportunities within it. Doctoral degrees are granted only by universities; thus, universities are the only suppliers of the doctoral workforce to the labour market. Understanding the needs of non-academic employers is thus crucial if universities are to adapt their doctoral education curriculum. Many studies have analyzed labour markets for doctorate holders at national and transnational scales, but few studies focus on the regional scale. The present study explores regional data for Catalonia in Spain on the employment situation of doctorate holders in order to define the characteristics of the regional, non-academic labour market for doctorate holders. Descriptive statistics suggest a high retention rate of doctorate holders within the region and a large part of doctorate holders (two-thirds) having a job that does not require a doctoral degree. This study highlights the existence of a skills mismatch that might be linked to the preference for a better paid or more stable job, or to the lack of development of skills that represent added value in the eyes of employers. These characteristics can be formulated as hypotheses to be tested in further qualitative or quantitative studies. They have several implications for universities, non-academic employers and regional policy-makers, such as the need to work on the valorization of the doctoral degree in the non-academic labour market.

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INTRODUCTION
On the one hand, doctoral education overlaps both of the core missions of universities: education and research. Since doctoral students often produce a high percentage of a university’s research results (Enders, 2002), the doctoral education curriculum of a university is important not only for its internal functioning but also for its contribution to the development of its country (Thune, 2009). The growing trend for doctorate holders to find employment outside academia (Auriol, Misu, & Freeman, 2013; Garcia-Quevedo, Mas-Verdú, & Polo-Otero, 2012; Neumann &
Tan, 2011), which is mainly due to a shortage of career opportunities within it (Etmanski, Walters, & Zarifa, 2017), is evidence of such a contribution to national development. On the other hand, different strands of literature on regional development show that universities are key players in their regions, such as in regional innovation systems (Asheim & Isaksen, 2002; Cooke, Uranga, & Etxebarria, 1997), or triple helix systems (Leydesdorff & Etzkowitz, 2001). In practice, the European Commission, for instance, supports the development of entrepreneurial universities to enhance regional development, through the HEInnovate project in collaboration with the Organisation for Economic Co-operation and Development (OECD) (HEInnovate, 2018). Universities are also involved in the design and implementation of Smart Specialisation Strategies (S3) in the European Union (EU) (Fonseca, 2018).

Doctoral education seems to be a potential tool for universities to take part in regional development. Most previous studies provide national or transnational analyses of the labour market for doctorate holders outside academia (Metcalfe, 2006; Neumann & Tan, 2011; Thune et al., 2012), but few focus on the integration of doctorate holders into the non-academic labour market at the regional level, or on non-academic regional employers’ needs for doctoral skills, which are skills acquired during doctoral studies. What are the characteristics of the labour market for doctorate holders at the regional scale?

The following study explores regional data for Catalonia, Spain, on the employment situation of doctorate holders in order to define the characteristics of the regional non-academic labour market they face. Even though the population of doctoral students and doctorate holders is not homogeneous (Bienkowska, Klofsten, & Rasmussen, 2016), and the population of regional employers is not homogeneous either, it is important for universities to understand the most prominent needs of diverse regional employers in order to be able to meet these needs by adapting the education curriculum. Comparing the situations of doctorate holders who use their doctoral degree in their job and those who do not enables the observation of features characterizing doctoral education and employment situations at the regional scale. The study contributes to the literature dealing with the role played by universities in the development of their regions, as well as to the literature on doctorate holders’ integration into the labour market. It binds together these two fields of study by focusing on an analysis at the regional scale, and on the doctoral education curriculum as a tool for universities to influence regional development, using data provided by the Agency for the Quality of the University System in Catalonia (AQU). The study gives way to a better understanding of doctoral education and doctoral employment in order to monitor regional development better. For instance, it reveals that two-thirds of the observed population has a job that does not require a doctoral degree, suggesting that doctorate holders may renounce the use of their degree in order to find employment.

The paper is structured as follows. The following section reviews the literature dealing with the labour market for doctorate holders, over-education and the reform of doctoral education. The methodology and the case study are then presented, complete with a description of the analyzed data. The analyses and definition of characteristics are detailed in the discussion, which is followed by the conclusions.

**LITERATURE REVIEW**

The labour market for doctorate holders

*The non-academic labour market for doctorate holders*

Even though the doctoral degree was originally designed for an academic career, there is an increasingly important labour market for doctorate holders outside academia. Statistics on the labour market for doctorate holders as a whole at national and transnational scales show that there is an increasing demand for doctorate holders in non-academic organizations (Auriol et al., 2013; Garcia-Quevedo et al., 2012; Neumann & Tan, 2011). Using a collection of data from OECD countries, Auriol et al. (2013, p. 6) observe that ‘although the higher education
sector is the main sector of employment for doctorates, demand for doctorates is apparent across other sectors of the economy. This trend, sometimes referred to as ‘too many PhD graduates’ (Larson, Ghaffarzadegan, & Xue, 2014), can be observed in countries where innovation and research systems are well developed, but not where these systems are still being developed, such as Portugal (Santos, Horta, & Heitor, 2016). Etmanski et al. (2017) reveal that fewer than 15% of doctoral graduates obtain a professorship in Canada, while in Australia, Neumann and Tan (2011) find that ‘only one-quarter of all doctoral graduates are initially employed in academic positions on completion of their PhD’ (p. 609).

The increasing importance of the non-academic labour market for doctorate holders is due to several ‘pull’ and ‘push’ factors (Bloch, Graversen, & Pedersen, 2015). Push factors stem from the demand side of the labour market, for example, the availability of jobs, within or outside academia. A determining characteristic of the academic labour market is the bottleneck in the availability of academic positions, which leads to the postdoctoral workforce forming a queue for tenure-track positions (Andalib, Ghaffarzadegan, & Larson, 2018). Another characteristic is the increasing need within private companies for a doctoral workforce: according to Herrera and Nieto (2013), companies need such a workforce in order to access scientific knowledge, to resolve previous failures in innovation activities and to find innovation partners and external research and development (R&D) funding more easily.

Pull factors stem from the supply side of the labour market. They can be the individual preferences of doctorate holders for employment, in form (e.g., type of contract) or in content (e.g., job responsibilities). Many authors focus on these pull factors (Cruz-Castro & Sanz-Menéndez, 2005; Roach & Sauermann, 2010; Sauermann & Roach, 2012). Roach and Sauermann (2017), for instance, find that many doctoral students realize during their doctoral training that they do not want to work in academia, but this change of mind is not primarily related to the lack of job opportunities. Pull factors can also be derived from the characteristics of doctoral education, such as the type of funding for the thesis (Mangematin, 2000), the number of publications (Mangematin, Mandran, & Crozet, 2000), or support for academic entrepreneurship, mobility and collaboration with the private sector (Bienkowska et al., 2016).

The regional labour market for doctorate holders

The geographical dimension of doctorate holders’ employment situation depends on both pull and push factors. Stephan, Sumell, Black, and Adams (2004), focusing on the choice of geographical location of doctorate holders in STEM (Science, Technology, Engineering and Mathematics disciplines) who are hired in the private sector in the United States, observed that ‘many states fail to capture the economic development advantages that come from training a skilled workforce’ (p. 1). More recently, Zolas et al. (2015) found that US doctoral graduates in STEM tend to spread nationally, including those who are hired by the private sector. However, a small proportion of these doctoral graduates find employment near the university in which they received their doctoral education. Zolas et al.’s results make one think that the choice of geographical location by doctorate holders might be unpredictable because the labour market for them is international (Auriol et al., 2013). There is a need to investigate the determinants for the choice of geographical location by doctorate recipients after graduation.

Thus, there seems to be both demand and supply for a doctoral workforce, not only at national and international scales but also at the regional scale. However, the majority of all studies on the labour market for doctorate holders focus on national (Thune et al., 2012) or transnational labour markets, such as the UK (Metcalf, 2006). Djelic (2008) assesses that ‘the markets for doctoral training and for doctors are really regional, not even national’ (p. 55), but the regionality of this labour market still seems under-researched. Nevertheless, it seems to be of prime importance for universities since they are suppliers of the workforce (including the doctoral workforce) to their regions.
Over-education and labour market mismatch

However, it appears that a large proportion of doctorate holders employed outside academia are over-educated or over-skilled. The European Centre for the Development of Vocational Training (Cedefop) (2016) predicts that more and more highly educated workers will work in jobs requiring a lower level of education, a figure that is expected to reach 14% of the employed population in Europe by 2025. To make up for this skill mismatch, employers tend to favour a higher level of experience (Kulkarni, Lengnick-Hall, & Martinez, 2015). This mismatch has consequences for the employment situation of doctorate holders, and especially for wages (Allen & Van der Velden, 2001; Gaeta, Lubrano Lavadera, & Pastore, 2016). Studies show that geographical mobility and entrepreneurship are possible solutions for doctorate holders to find more suitable employment, thus reducing this mismatch (Ghosh & Grassi, 2017; Stenard & Sauerermann, 2016). In both solutions, the geographical dimension of the employment situation seems important. Geographical mobility can be a solution for a doctorate holder to find suitable employment elsewhere, no matter what the location. Alternatively, becoming self-employed can be a solution for a doctorate holder to design their own job while staying in their home region.

The adaptation of doctoral education for non-academic employability

Universities are the only suppliers of a doctoral workforce. They have the ability and the responsibility to adapt their doctoral education curriculum to ensure the employability of their graduates, even if this is not their first priority; in other words, to meet the needs of both academic and non-academic employers. Nyquist (2002) calls for a revision of doctoral education in the United States, highlighting the fact that the skills expected from doctorate holders have evolved considerably because of increased employment in non-academic sectors as well as increased expectations from society. Thune et al. (2012) suggest three criteria for assessing the quality of a doctoral education system, including the relevance of doctoral education throughout the country.

A reform of doctoral education, sometimes conducted in collaboration with the private sector, has already begun (Metcalfe, 2006). Roberts’ (2018) systematic literature review qualifies industrial involvement in doctoral education as ‘best practice’ (p. 7), in line with Assbring and Nuur’s (2017) concept of collaborative doctoral education. Transferable skills seem to be the added value for doctoral education in the eyes of non-academic employers; what they value the most (Kyvik & Olsen, 2012). These skills are usable both in research- and non-research-intensive positions (Sinche et al., 2017). The teaching of transferable skills is becoming standardized. However, ‘there appears to be no consensus regarding which transferable skills are most needed at different career stages’ (OECD, 2012, p. 34). Several lists and categories of skills to develop as a researcher have been published by expert groups (LERU, 2016; UAB, 2017; Vitae, 2011), but few academic studies report empirical evidence for what kind of skills should be mastered by doctorate holders.

Nevertheless, a university needs to be competitive. It needs to be attractive for doctoral students and doctoral graduates’ employers at the regional, national and international levels. It seems possible that the standardization of doctoral education reduces the ability of a university to stand out in the doctoral education market. However, there are transferable skills that cannot be formalized (Durette, Fournier, & Lafon, 2016), and as such they can be transmitted only thanks to different types of proximities (Boschma, 2005), including geographical and social, which are those of a region. The transmission of these non-formalizable transferable skills might be the opportunity for a university to distinguish itself from the others in the doctoral education market, and in this case, embeddedness in its region is of prime importance.

METHODOLOGY

This study explores the need for a doctoral workforce in the regions, with a focus on the specific case of the Spanish region of Catalonia. It is based on a descriptive statistical investigation of
databases on doctorate holders and employers in this region. The populations studied are doctorate holders with Spanish nationality who graduated from a Catalan university, and regional employers.

Case study overview
The choice of studying Catalonia is justified by the following reasons: although Catalonia is not the region including the Spanish capital, Madrid, it does concentrate a large part of the population and the economic activity of Spain. This makes Catalonia both a provincial region and, paradoxically, quite central as well. It is one of the autonomous communities in Spain where cultural and institutional autonomy is the most prized. The recent (2017) referendum in favour of Catalan independence, declared illegal by the Spanish government, showed a real concern from the local population regarding the autonomy of the region. Catalonia thus seems to be a very specific region (see Appendix A).

Yet, it can also be seen as globally attractive, and not only for tourism (see Appendix A): Barcelona is one of the most innovative cities in the world (2think now, 2017). Catalonia also concentrates a large part of the higher education of Spain: with its 12 universities, the region ranks second in the number of universities after the region of Madrid (14 universities) and just above Andalusia (11 universities) (CRUE, 2018). The percentage of people employed and researchers is slightly higher in Catalonia than the national mean: in 2015, 50.20% of the Catalan population was employed, 0.85% of whom were researchers; while on average, 46.40% of the Spanish population had a job in 2015, 0.68% of whom were researchers (Idescat, 2017a, 2017b).

In addition, the AQU makes it possible to conduct such a study because it records relevant data and makes it available to researchers on request.

Method
Since the aim of this study is to be exploratory, descriptive statistics were chosen as the method. Descriptive statistics are already provided in reports of the AQU Catalunya (2017a, 2017b) and can also be consulted online (EUC dades, 2018), but those presented in this study are complementary: they have a narrower focus on the employed part of the population and combine two separate AQU databases, thus linking information from the supply side (doctoral graduates) and the demand side (employers). The aim of the study is to define characteristics that can be formulated as hypotheses to be tested in further research, whether qualitative or quantitative. Having a clear overview of the collected data will enable the definition of characteristics. Descriptive statistics were thus chosen because they are the method designed to fulfil such an objective (Goos, 2015). The descriptive statistics provided here present distributions of the sample for a variety of features, in particular a variety of types of skills.

The observed databases are collected from the AQU. After having consulted its 2017 report on the integration of doctoral graduates in the labour market (AQU Catalunya, 2017a), and its 2014 report (AQU Catalunya, 2014) on the opinion of companies on the competences of recent graduates, agreements were filled in and signed with the agency to gain access to its databases, which were built from their data collection campaigns of 2008, 2011, 2014 and 2017 for doctoral graduates (database 1) and from 2014 for employers (database 2). The databases, as well as a catalogue of variables, were downloaded and converted into readable Excel formats. The databases were then explored with the use of Tableau software, a tool for data visualization, which allows Excel files to be used as data sources. The correctness of the data was verified by reproducing some figures displayed in both the 2017 (AQU Catalunya, 2017a) and 2014 (AQU Catalunya, 2014) reports, before producing further statistics.

Comparing the two databases triggers some methodological problems. The first regards the difference in dates between the sets of data being compared. For the analysis of database 1, the focus is generally on 2017, while the available data from database 2 are from 2014. A solution
could have been to focus on the 2014 data from database 1. However, another problem is that there is no possibility to create a link between the two databases, for example, between employed doctorate holders and their employer. Since the establishment of such a correspondence is not possible, the difference in dates does not seem so problematic after all, and priority was given to the data collected most recently. A three years’ difference is not a very large time lapse in the context of doctoral education: it corresponds to the minimal threshold of a period of doctoral studies. Changes might happen during this period, but it does not seem long enough to observe a potential revolution in doctoral education.

Another issue triggered by the composition of the population of database 2 is the fact that the sample might not be representative of the Catalan labour market: small and medium-sized enterprises (SMEs) are overrepresented in the sample of the AQU. However, 99% of Catalan companies are small and medium-sized companies with fewer than 50 employees (IDESCAT, 2017c); thus, the fact that SMEs are overrepresented in database 2 does not seem abnormal.

Limitations
This study has several limitations. It does not consider the population of doctorate holders with non-Spanish nationality who obtained their doctoral degree from a Catalan university, or those with Spanish nationality who obtained their doctoral degree outside Catalonia. It would be interesting to see whether adding these populations would have any influence on the retention and attraction of doctorate holders in Catalonia, as well as whether the type of skills that are looked for by Catalan employers would be modified. Moreover, the database anonymizes the universities where respondents received their doctoral degree, which means it is not possible to observe whether there are any differences in the provision of doctoral skills to the regional labour market due to the function of universities. Employers are anonymized as well, preventing links between the two databases analyzed. Additionally, observations that aim to compare doctorate holders whose jobs require a doctoral degree and those whose jobs require a specific non-doctoral degree are based on the hypothesis that elements of doctoral studies, as well as job offers’ characteristics, are known by both parties (the doctorate holder and the employer) at the moment of the decision to offer employment and to accept the job – which has not been verified. The ‘needs of society’, which are mentioned in the preface of the 2017 report (AQU Catalunya, 2017a, p. 7), seem also to be quite narrow, to the extent that they represent private and public universities, research institutes and companies only – no other type of organization is evoked (if there are, they are assimilated into companies). Finally, another limitation is that it is not specified in database 2 whether or not recent graduates hired by respondents’ companies are doctorate holders.

DATA
The integration of doctoral graduates into the labour market
The database ‘Doctors integrada (2008–2017)’ (database 1) provided by the AQU is a collection of data recorded by 11 Catalan universities and two affiliated centres of physical education that are members of the agency (see Appendix A). These higher education institutes (HEIs) are anonymized in the database. The population of respondents is composed of 4943 (out of a total population of 8060) doctorate holders with Spanish nationality who graduated from one of the universities on the list five years before data collection (1358 out of a total population of 2545 for the 2017 survey). Database 1 comprises data recorded during four periods of data collection through a series of telephone interviews: in 2008, 2011, 2014 and 2017. Data are broadcast by the agency to the general public through reports written in Catalan – the most recent is the 2017 report (AQU Catalunya, 2017a). These reports also contain data on doctorate holders with non-Spanish nationality who graduated from one of the Catalan HEIs (for the 2017 survey,
they number 1243) – however, these data are not accessible outside the agency, so it was not possible to apply the following analyses to this population.

In 2017, the population of respondents consists of 1358 doctorate holders who obtained their doctoral degrees during the academic years 2011–12 or 2012–13. The sample is quite representative of the different disciplines (Figure 1). It does not comprise any industrial doctorates, since the programme was launched in Catalonia in 2012; thus the first graduations took place in 2015 (GenCat, 2018). The interviews lasted on average 16.5 min, and the sample represents 54% of the total population of Spanish doctoral graduates from Catalan universities (2545 persons in total for the 2017 survey). The report from the AQU does not mention any bias in the selection of the sample. Respondents seem to have been randomly selected from the roll of graduates of AQU partner universities (see Table B1 in Appendix B). However, a sampling selection bias could still exist since the representation rate is not equal to 100%. The bias could be triggered by logistical problems such as loss of contact information for alumni, or by the refusal of alumni to take part in the survey, because they are too busy at the moment of data collection or have negative feelings about their doctoral education or employment situation, for example.

The questionnaire used to collect these data is available in AQU Catalunya (2017b). It has 76 questions divided into 10 information blocks (see Table C1 in Appendix C). Database 1 contains 222 variables in total, including all the survey variables that are still used, newly used and no longer used by the agency. A total of 190 variables are direct results from the answers recorded during the interviews; 32 variables are calculated by the agency to interpret the data (Figure 2).

The opinion of companies on recent graduates’ competences

The database ‘Ocupadors’ (database 2) provided by the AQU is a collection of data gathered in 2014 from employers of recent university graduates (both companies and self-employed) with establishments located in Catalonia (whether or not their headquarters) in 2014. Companies from the following areas have been excluded: public administration, education, culture and research, and health and social assistance. These exclusions were made in order to follow the method used by the agency itself: these employment sectors were the object of specific, more complete surveys. This exclusion is not expected to have an important influence on the findings since only 110 lines from the database were excluded. The population of respondents is composed of 1325 (out of a total population of 16,757, a representation of 8%) Catalan companies that are listed in the exchange portfolios of the Catalan universities and in the directory of Catalan companies ACICSA 2014. Data are broadcast by the agency to the general public through reports written in Catalan – the most recent is the 2014 report (AQU Catalunya, 2014).

<table>
<thead>
<tr>
<th>Database 1</th>
<th>Database 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Doctors integrada (2017)</td>
</tr>
<tr>
<td>Number of observations</td>
<td>1,358</td>
</tr>
<tr>
<td>Representation rate</td>
<td>54% of doctoral graduates</td>
</tr>
</tbody>
</table>

Figure 2. Representativeness of databases.
The questionnaire used to collect these data is available in AQU Catalunya (2014). It has 76 questions divided into 10 information blocks, resulting in 149 variables in total (see Table C1 in Appendix C).

**DISCUSSION**

AQU report 2017 presents a figure on the employment of Catalan doctorate holders (AQU Catalunya, 2017a, p. 13), showing a good employment rate for this population (94% in 2017). This figure is high for the labour market, all the more so for Catalonia and Spain. This figure confirms the interest of the case to understand better doctoral education and doctoral employment in a region. The focus from now on will be on Spanish doctorate holders who graduated from a Catalan university and stayed in Catalonia after graduation in order to work; this corresponds to the total population mentioned henceforth. This focus enables the observation of the regional needs for skills that have been answered by Catalan universities through their doctoral education curriculum.

**The retention of doctorate recipients in Catalonia**

Overall, 94% of the doctorate holders with Spanish nationality who graduated from a Catalan university have a job in 2017 (AQU Catalunya, 2017a, p. 13). It seems that doctorate holders have skills that are valued in the labour market: 59% of them have a job with functions specific to a doctoral level of education, and this is quite homogeneous among the disciplines (Figure 3). In order to determine if there are needs for doctoral skills at the regional scale, it seems relevant to observe whether or not doctorate holders graduating from a Catalan university find employment in Catalonia. This also enables the observation of whether Catalan universities take part in regional development by providing a workforce for the regional labour market.

**Universities’ provision of a doctoral workforce for the regional labour market**

Catalan universities have an influence on the Catalan regional labour market through the provision of a doctoral workforce. Catalan universities manage to retain the skills they attract and develop during doctoral studies, and to spread these skills into the region after graduation, even outside academia. A geographical visualization of the places of residence of the population (Figure 4) indeed shows a real concentration in Spain and, within Spain, in Catalonia: 82% of the total population lives in Catalonia. It also seems that the proportion of the population staying to work in Catalonia decreased from 2008 to 2014 but is now reaching a peak, at 84% of the total population in 2017. Thus, the retention of doctorate holders with Spanish nationality in the region of Catalonia seems globally successful. Such a high retention rate of doctorate recipients in Catalonia suggests that universities provide a doctoral workforce for the regional labour market.

Catalan universities may have an influence outside Catalonia as well, since the vast majority of the doctorate holders who live outside Catalonia in 2017 claim to have a high general satisfaction with their doctoral studies, by giving a grade equal to 5/7 or above in the survey.

However, such a high level of employment among the population of doctorate holders makes one wonder whether doctorate holders are hired for a job that really corresponds to their level of education.

**The requirement for a doctoral degree in employment**

Even if doctorate recipients from Catalan universities go on to find employment in Catalonia, it seems that the majority of them do not use their doctoral degree or their doctoral level of education in their jobs. In 2017, only 32% of working doctorate holders in Catalonia had a job that required a doctoral degree. This ratio has been decreasing since 2011. On the other hand, 50% of
working doctorate holders have a job that requires a specific non-doctoral degree. Two-thirds of the observed population experience a mismatch between their professional position and their level of education, suggesting that doctorate holders may renounce the use of their doctoral degree in order to find employment. This requirement for doctoral degree in the recruitment process varies quite a lot depending on the discipline, showing the heterogeneity of the population of doctorate holders. However, this heterogeneity is not the focus of this study: the focus is instead the general trend and characteristics of the labour market for doctorate holders in regions (Figure 5).

This trend is not necessarily linked to dissatisfaction with doctoral education. Globally, both types of doctorate holders (those whose jobs require a doctoral degree and those who do not) express a high level of satisfaction with their doctoral studies and a potential desire to repeat

**Figure 3.** Match between the skills acquired and the job (from AQU Catalunya, 2017a, p. 14)
**Figure 4.** The residential locations of respondents in Spain.

**Figure 5.** The difference in requirement for doctoral degree depending on discipline.
such studies, although those whose jobs do not require a doctoral degree show a slightly lower level of satisfaction (80% against 85% would repeat their doctoral studies; 88% against 92% give a grade of 4/7 or higher to express their general satisfaction with their doctoral studies). Moreover, even when a doctoral degree is not required, some jobs call for a doctoral education. In the total population, more than 50% have a job whose functions correspond to a doctoral level of education. This ratio reaches 90% for doctorate holders whose jobs require a doctoral degree.

The low percentage of doctorate holders whose jobs require a doctoral degree seems rather counter-intuitive and triggers many questions; especially: do the skills needed in Catalonia really correspond to a doctoral level of education, or can they be acquired at a lower level of education? In that case, does having a doctoral degree bring any added value to the labour market?

The valorization of higher education degrees by regional employers outside academia

In spite of the diversity in activities and organizational configurations, regional employers who took part in the agency’s survey seem to have quite homogeneous needs for higher education skills. Companies hiring recent graduates are the focus of the analysis since they can rate their satisfaction with these graduates’ skills. In database 2, employers rate the importance they give and the satisfaction they assess regarding the skills of the recent graduates they have hired. Globally, similar trends and distributions of the ratings can be observed between employers valorizing doctoral degrees and employers valorizing other degrees (master’s and specific degrees).

The valorization of the doctoral degree by regional employers seems marginal compared with other university degrees but it does nevertheless exist. In database 2, 10% of the sample valorizes the doctoral degree as important in the recruitment process, while 34% valorizes the master’s degree instead and 86% a specific degree. The majority of respondents valorizing the doctoral degree also valorize both the master’s and the specific degree. One respondent only valorizes the doctoral degree and not the other degrees in the recruitment process; it is thus difficult to look for any distinguishing features between the doctoral degree and the other degrees. However, in database 1, more doctorate holders from category A received a promotion in their job upon receiving their doctoral degree than from category B, and this trend is even more noticeable when comparing jobs in the private and public sectors: 33% of category A received a promotion in the public sector against 13% in the private sector; while 19% of category B received a promotion in the public sector against 14% in the private sector. These analyses seem to show that the doctoral degree does not present any added value for regional employers outside academia, compared with the master’s degree and specific degrees, suggesting that non-academic regional employers do not grasp the added value of the doctoral degree compared with other higher education degrees.

We observed that the majority of Spanish doctorate holders who graduated from Catalan universities choose to stay in Catalonia to live and work, but also that a large proportion of them (two-thirds) do not use their doctoral degree or education in their jobs. It seems possible that the choice of a geographical location in Catalonia is a priority for most doctorate holders, to such an extent that they may renounce using their doctoral degree and accept a job requiring a lower level of education in order to stay in the region. This prioritization is not measured in the agency’s databases. The following analysis will instead explore whether the choice of geographical location in Catalonia is linked to the availability of jobs requiring skills specifically developed during doctoral studies (henceforth, doctoral skills) or to other preferences of doctorate holders, such as a preference for stability offered by a certain type of contract. To be able to make this exploration, it seems relevant to distinguish doctorate holders using their doctoral degree in their jobs from those who do not. The following descriptive statistics compare two categories of doctorate holders: category A, doctorate holders whose jobs require a doctoral degree, and category B, doctorate holders whose jobs require a specific non-doctoral degree such as an engineering degree (Figure 6).
Characteristics of doctoral employment in the region

The following descriptive statistics aim to explore which characteristics of employment in Catalonia might be valued by doctorate holders by comparing these characteristics for the two types of employed doctorate holders in Catalonia: categories A and B.

Using the doctoral degree seems more common when working in academia or in research-intensive positions outside academia. In contrast, the doctoral degree does not seem suitable for non–research-intensive positions, such as managerial or technical positions. The majority of doctorate holders from category A work in public universities (40% of the population in 2017, 39% of doctorate holders in experimental sciences and technical areas in 2017) – the second most important regional employers for them are research institutes (30% of the total population in 2017, 33% of doctorate holders in experimental sciences and technical areas in 2017), while companies, as well as other organizations, come third (23% of the total population in 2017, 23% of doctorate holders in experimental sciences and technical areas in 2017). The majority of doctorate holders in category B work in companies and other organizations (58% in 2017, 48% of doctorate holders in experimental sciences and technical areas in 2017), in public universities (24% in 2017, 32% of doctorate holders in experimental sciences and technical areas in 2017) and in research institutes (14% in 2017, 20% of doctorate holders in experimental sciences and technical areas in 2017). There are some noticeable differences between categories A and B regarding the functions of their jobs. In
2017, more doctorate holders from category B have managerial functions than from category A (28% against 21%), or teaching functions (52% against 44%), or technical functions (20% against 11%). However, doctorate holders from category A work much more in R&D functions than those from category B: 87% against 55%.

Positions requiring a doctoral degree seem less stable, more uncertain and with lower salaries than those that do not require such a degree. Most workers in category A tend to have temporary jobs, with only one-third having a fixed contract. In contrast, doctorate holders in category B seem to have more stable jobs, with 60% of them having a fixed contract, and 52% in experimental sciences and technical areas. They also have a slightly more important part of doctorate holders working autonomously, so as self-employed: 9% in all disciplines, 6% in experimental sciences and technical areas. However, the length of contracts for category A seem greater than for the other category of doctorate holders: most of them last more than one year, whereas the majority of contracts in category B last between six and twelve months. This difference in length may be due to the difference in mission: shorter consulting missions versus involvement in one stage of a research project. Doctorate holders in category B tend to earn a higher salary than doctorate holders in category A: 44% of category B earns more than €30,000, against 37% in category A (24% of category B earns more than €40,000 against 9% in category A).

To sum up, there seem to be some characteristics of employment, such as the type of contract or job functions, that distinguish categories A and B of doctorate holders in Catalonia, suggesting that the choices of doctorate holders to renounce the use of their doctoral degree and stay in Catalonia are linked to a preference for a non-research-intensive position or to a more stable or better paid position.

Relevance of doctoral skills for employment in the region

The following statistics aim to explore which characteristics of doctoral studies might have enabled doctoral recipients to develop skills that are valued by Catalan employers by comparing these characteristics for the two categories, A and B, of employed doctorate holders in Catalonia.

Being able to work in teams, and on empirical problems, are skills that seem to make a doctoral education valued by regional employers. A difference can be seen between categories A and B in the type of work conducted during the thesis: a greater proportion of category B graduates worked independently during their thesis than from category A. This trend is noticeable in the whole population (83% of category A worked in a research group, against 54% for category B), but even more so in the focus on doctorate holders in experimental sciences and technical areas (86% of category A worked in a research group, against 69% for category B). Monographs are still the most common type of thesis in Catalonia, but this was more important for category B (75% of the population in 2017, against 63% for category A), even in experimental sciences and technical areas (same proportion). However, even though empirical theses are most common in the whole population, for both category A (79%) and category B (69%), it seems that there is a greater proportion of the total population of category B who did not write an empirical thesis (29.5% against 20%).

Being able to work in an international environment is also a skill that seems to make doctoral education valued by regional employers. For category A, English was the language used to write the thesis in the majority of cases (47% of this population in all disciplines in 2017, and the same percentage for those in experimental sciences and technical areas). This is not the case for category B: the most-used language is Spanish (42% of this population in all disciplines in 2017, and the same percentage for those in experimental sciences and technical areas). There seems to be a noticeable difference between the two categories of doctorate holders, regarding geographical mobility during doctoral studies: doctorate holders from category A seem significantly more mobile geographically, especially through experience abroad, than doctorate holders from category B, both for all disciplines (62% against 38% had mobility abroad) and for experimental sciences and technical areas (66% against 47% had mobility abroad).
To sum up, some characteristics of doctoral studies seem to distinguish categories A and B. These distinguishing characteristics might have helped doctorate recipients to develop particular skills during their doctoral studies – such as the ability to work in research groups or geographical mobility – that are valued by regional employers. These particular skills might compose the added value of the doctoral degree in their eyes as well. This suggests that the choice of doctorate holders to renounce the use of their doctoral degree and stay in Catalonia is linked to a lack of development of skills that provide the added value of a doctoral degree in the eyes of regional non-academic employers, such as the ability to work in teams or in an international environment (Figure 7).

**CONCLUSIONS**

This study is partly in line with the findings of Di Paolo and Mañé (2016), who conducted a quantitative analysis of the 2011 data from database 1. They argue that ‘overall, the problem of mismatch among PhD graduates is closely related to the demand-side constraints of the labour market’ (p. 432), such as the economic sector of the employer. However, the descriptive statistics conducted on the 2017 data of the same database, combined with database 2, suggest that the supply side of the labour market also plays a role in the mismatch, to the extent that the doctoral degree does not seem to offer any added value for regional employers.

This study of the Catalan case contributes to both the literature on doctoral education and regional development and to policy-making in other regions: it helps one better understand

<table>
<thead>
<tr>
<th>Category</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
<td>Doctorate holders whose jobs require a doctoral degree</td>
<td>Doctoral holders whose jobs require a specific non-doctoral degree (e.g. engineering degree)</td>
</tr>
<tr>
<td><strong>Representation rate in the 2017 sample</strong></td>
<td>32%</td>
<td>50%</td>
</tr>
</tbody>
</table>

**Figure 7.** Summary of key figures on database ‘Doctors Integrada’ (database 1).
the employment of doctoral workforce in regions in order to monitor better regional development. The main finding of the study is that doctorate holders may renounce to the use of their doctoral degree to find employment in the region: two-thirds of the observed population have not used their doctoral degree to obtain employment. Database 2 seems to show that there is a great interest among both regional employers and universities to match the skills of recent graduates with the needs of the labour market, while database 1 seems to show an increasing awareness by universities and the region of the importance of doctorate holders’ integration into the labour market. There is a possibility that regional employers are not really aware of what a doctoral degree and doctoral education consist of. Making sure that regional employers have a better understanding of a doctoral education and its advantages, collecting their specific needs and involving them in the building of the doctoral curriculum, could be a way for universities to better meet their needs. This implies developing and deepening university–industry linkages. The Catalan region is already acting in this sense through the implementation of the industrial doctorate – but similar programmes could be considered for sectors other than industry. This study also highlights the activities of the AQU for the integration of doctorate holders into the labour market, which can be inspiring. Another policy implication could be for the region and universities to analyze in more depth why most doctorate holders seem to prefer not to use their doctoral degree to find better suited employment in their region; for instance, the stability of employment and salary conditions, and try to improve these issues in the labour market, both within and outside academia.

Further research could test the hypotheses formulated from the characteristics defined in this study and explore whether the choice to stay in the region is the cause or the consequence of the observed employment situations. It could also explore whether the choice of geographical location is linked to the geographical origin of the doctorate holder, or to other characteristics, such as his/her age or work experience preceding the doctoral studies. Such explanations could reveal underlying constraints, for example, those implied by family obligations or by the economic situation of a region.

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**APPENDIX A: BRIEF PRESENTATION OF CATALONIA (SPAIN)**

Catalonia is one of the 19 autonomous communities that constitute Spain, corresponding to the NUTS-2 level of classification of European regions. It is situated in the north-east of the country, next to France (see Figure 1). It comprises 42 regions itself (NUTS-3), and has more than 7.5 million inhabitants (GenCat, 2019). Catalonia is the richest autonomous community...

![Figure A1. Map of the Spanish autonomous communities. Source: Adapted from https://www.cartograf.fr/pays/img/espagne/carte_espagne_regions_villes_provinces_espagnol.jpg.](https://www.cartograf.fr/pays/img/espagne/carte_espagne_regions_villes_provinces_espagnol.jpg)
in Spain with a gross domestic product (GDP) of €223 million in 2017 (INE, 2018). It is also a dynamic region within the European Union: Barcelona is the 13th most innovative city in the world in the Innovation Cities™ Index for 2016–17 (2think now, 2017), and fifth in Europe; in addition, it has been one of the Four Motors for Europe since 1988 (4motors, 2019).

In recent years, Catalan politics have been prevalent in the international news, especially at the end of 2017 when a referendum was organized, with a majority in favour of independence of the region. This referendum was declared illegal by the Spanish government and the Catalan leaders were sued. The reasons for this referendum are rooted in the cancellation in 2010 of the reinforced autonomy of Catalonia that had been implemented in 2006. In 2010, a consultation of the Catalan population showed a strong will for independence, but did not result in any legal change. In 2015, for the first time, independentists from different political parties won the majority in the Catalan parliament. They are those who organized the referendum in 2017 (adapted from Le Monde, 2017).

APPENDIX B

Table B1. Participating universities in AQU Catalunya

<table>
<thead>
<tr>
<th>University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universitat de Barcelona (UB)</td>
</tr>
<tr>
<td>Universitat Autònoma de Barcelona (UAB)</td>
</tr>
<tr>
<td>Universitat Politècnica de Catalunya (UPC)</td>
</tr>
<tr>
<td>Universitat Pompeu Fabra (UPF)</td>
</tr>
<tr>
<td>Universitat de Girona (UdG)</td>
</tr>
<tr>
<td>Universitat de Lleida (UdL)</td>
</tr>
<tr>
<td>Universitat Rovira i Virgili (URV)</td>
</tr>
<tr>
<td>Universitat Oberta de Catalunya (UOC)</td>
</tr>
<tr>
<td>Universitat Internacional de Catalunya (UIC)</td>
</tr>
<tr>
<td>Universitat de Vic – Universitat Central de Catalunya (UVic-UCC)</td>
</tr>
<tr>
<td>Universitat Abat Oliba CEU (UAO CEU)</td>
</tr>
<tr>
<td>Institut Nacional d’Educació Física de Catalunya (adscrit a la UB)</td>
</tr>
<tr>
<td>Institut Nacional d’Educació Física de Catalunya (adscrit a la UdL)</td>
</tr>
</tbody>
</table>

APPENDIX C

Table C1. Description of the databases and data collections

<table>
<thead>
<tr>
<th>Name</th>
<th>Doctors integrada, 2008–17</th>
<th>Ocupadors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer</td>
<td>Catalan universities</td>
<td>Catalan universities</td>
</tr>
<tr>
<td>Distributor</td>
<td>AQU Catalunya</td>
<td>AQU Catalunya</td>
</tr>
<tr>
<td>Brief description</td>
<td>Data on professional insertion of doctorate holders from Catalan universities</td>
<td>Data on the opinion of employers on the skills of recent graduates</td>
</tr>
<tr>
<td>Unit of analysis</td>
<td>Doctorate holder</td>
<td>Employer</td>
</tr>
<tr>
<td>Observations</td>
<td>4943</td>
<td>1325</td>
</tr>
<tr>
<td>Method</td>
<td>Telephone interviews</td>
<td>Telephone interviews and online surveys</td>
</tr>
</tbody>
</table>

(Continued)
### Table C1. Continued.

<table>
<thead>
<tr>
<th>Information blocks</th>
<th>Doctors integrada, 2008–17</th>
<th>Ocupadors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
<td></td>
<td>Identification of the company: information on the number of employees, private or public organization, location of headquarters, field of activity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Process of employment: information on the recruitment of recent graduates, the importance of the type of diploma, studies abroad, the prestige of the university, etc.</td>
</tr>
<tr>
<td>Academic data: respondent is asked about pre-doctoral and doctoral studies</td>
<td></td>
<td>Competences: information and satisfaction grades for a list of skills of recent graduates</td>
</tr>
<tr>
<td>Current employment situation and employment history: respondent is asked about employment experience after graduation</td>
<td></td>
<td>Collaboration with universities: information on the type of collaboration with universities, on what could improve the skills of recent graduates</td>
</tr>
<tr>
<td>Satisfaction with doctoral studies: respondent is asked to give a score from 1 (very negative) to 7 (very positive) to assess several aspects of their doctoral studies</td>
<td></td>
<td>Company strategy: information on in-company training for recent graduates, human resources practices</td>
</tr>
<tr>
<td>Current/previous job: respondent is asked about whether or not their job requires a doctoral degree, and about characteristics of their employment</td>
<td></td>
<td>Reasons for not having employed recent graduates</td>
</tr>
<tr>
<td>Assessment of satisfaction in relation to the current job: respondent is asked to give a score from 1 (not satisfied at all) to 7 (very satisfied) to assess their satisfaction with their current employment situation</td>
<td></td>
<td>Data on the respondent: position in the company, survey by email or phone, etc.</td>
</tr>
<tr>
<td>Mobility: respondent is asked about mobility during their doctoral and postdoctoral experiences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact of doctoral studies on their current job</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessment of the training received: respondent is asked to give a score from 1 (very low) to 7 (very high) to assess the valorization of the training received during their doctoral studies, for instance, regarding document management, planning, networking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socioeconomic status: respondent is asked about the level of education and jobs of their parents</td>
<td></td>
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<tr>
<td>In case of unemployment: respondent is asked whether or not they are looking for a job</td>
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</tbody>
</table>