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DOCTORS' PROFESSIONAL FUTURE: UNIVERSITY ACTIVITY VS. WORKING AT FIRM. THE SPANISH CASE

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Abstract
This paper analyzes the determining factors weighted by people with doctoral education when choosing their professional careers. As for the Spanish case, the analysis of such group of workers has been traditionally excluded from the empiric studies. On one hand, the lack of databases made it difficult to see their actual professional situation, and on the other, a professional career at the University was understood as this group's innate purpose. The growing demand of qualified professionals in general, and particularly of those with a science training has prompted the developed countries to carry out some research on how to fit third-level training cycle with labour market needs. This group of workers' labour conditions analysis allows assessing whether the current doctoral education programs satisfy labour market needs. The estimation of a multinomial logit model reveals the different determining factors when choosing a professional career depending on the area of knowledge. Personal characteristics, such as age, training, the area of knowledge or job as well as the expected wages become fundamental factors when determining doctors' professional future.

Key Words: New education policies, PhD, research fields, professional career, labour market.

Classification JEL: I21, I23, J24

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1.- Introduction

Why does an individual decide to become a doctor? What returns does he expect from such investment and how is it related to the actual return? Is it worthy for a country to increase the number of people with a PhD? According to Kehm (2007), European doctoral education is undergoing a very rigorous analysis and adapting itself to the new education policies. In this sense, 1999 Bologna Declaration meant to build up a Higher Educational European Space, or 2000 Lisbon Strategy designed to create a European Area for Research and Innovation, have prompted decisive changes in how Third-cycle education has been traditionally regarded.

The current concept of doctoral education is quite different from its initial concept (Noble, 1994 and Clark, 1995). At the beginning, in order to get a PhD, a person should prove to have the necessary skills to teach at the university. However, welfare state expansion and the development of public university education from the sixties onwards meant a change on how university ultimate target was perceived. It became then a place not only for education but also for research. The most immediate consequence was the emergence of a practical learning in research (Ben-David, 1992; Jamieson and Naidoo, 2007). At the same time, research learning turns, from then on, into a need for all students willing to become university teachers or researchers. These will create a new group of students to be considered the elite of the university world.

Since then, the University is not only pressured by the socioeconomic changes but also by its own organizational ones which has caused and triggered a transformation in the meaning of the “PhD title” and its assessment in the labour market. So, as Enders

(2004) and Kehm (2007) point out, labour market's request of doctors has been increased remarkably due to several reasons. Among them, we may stand out, on one hand, the fact that nowadays to be a PhD graduate has become a necessary requirement (a "must") for those researchers who want to develop a university career, and on the other, public and private firm's need to recruit more individuals with research experience. This makes the PhD graduate very attractive for their training process.

Spanish university is really aware of such changes. In fact, Perotti (2007) says that Spain is a unique case as for how quickly its university has undergone changes, and so how it has completely broken with the previous model. However, this author considers that in order to clearly understand this process, both socioeconomic related-changes factors (university admission rules, overcrowded classrooms) and those academic ones must be analyzed individually. It is particularly important to assess the contents of the programs arose from such changes as well as the opinions of those students taken such programs so as to be able to make the right decisions to adapt them to the changing European university.

In this sense, the first and second university education cycles (Graduate and Bachelor) have undergone several analyses in our country (see Sánchez, 1996; Mora *et al*., 2000; Mora and Vidal, 2000). Nevertheless, doctoral education has been traditionally excluded from research mainly due to the lack of databases gathering specific information of such university cycle. In fact, papers such as that of Buela-Casals and Castro (2008) look into the development of doctoral education in Spain from a quantitative perspective generating lists of Spanish universities according to the number of high-quality PhD's.

As the lack of information problem is not exclusive of our country, but it is also present in the rest of the European countries, the EU has backed up some surveys on this training cycle by passing Regulation 753/2004 on science and technology which defines the framework to generate statistics about PhD graduate workers. By applying this regulation the National Statistics Institute (INE) carried out in 2008 "2006 Survey on Human Resources in Science and Technology", which means an exhaustive study on Doctors who obtained their degree between 1990 and 2006 at any Spanish university either public or private.

This paper is meant to outline the basic characteristics of such group of individuals by analysing the information gathered in such survey. The final target is to know those determining factors when choosing a professional career. In particular, it is devoted to analyze whether there is a clear tendency of PhD graduates to change a professional career at the university when facing of private or public firms' labour market working chances.

This information proves to be fundamental within the framework of changes undergone by the Spanish university, not only regarding the structure of the PhD's programs, but also their own generation. These changes will undoubtedly have effects on Doctoral education.

2.- Changes in the PhD model

2.1. Problems derived for PhD traditional meaning

Many papers have been devoted to the changes undergone by the university in the recent years (see Abbot, 2001; Naidóo, 2003; Naidoo and Jaimeson, 2005). According to them, on one hand, the university has basically changed from being a training place for a selected group of people, to face massification (overcrowding?) problems in some cases. And on the other hand, it has turned from being a knowledge generating institution into become an institution meant to pass on the necessary knowledge to train people to deal with their daily working difficulties (Gibbons *et al*., 1994).

As Jamieson y Naidoo (2007) point out, it would be surprising to expect doctoral education to be unaware of such changes. The excess supply of people (oferta en economía es supply. Tiene ahora significado la frase?) with higher education has motivated their value "to be devaluated" in the labour market, and this has caused the need to incorporate an extra "requirement" with master and doctoral education. The difference between them would be that the former implies that the student has a great command of some knowledge, whereas the latter proves the student is able to innovate in the area of knowledge.

In the case of doctoral education, Enders (2004) and Kehm (2005) consider that worldwide demand increased 30% in the nineties. This increase in the number of students taking this level of training has forced a change in the way of teaching it, from a learning process constantly supervised by certain tutors to a mixed model where the

training responsibility is assumed by the institution and supervision is shared with the tutors (Kehm, 2007). Besides, such massification (overcrowding?) has also caused problems when assessing candidates' research skills as well as their interest in following an academic career. In this case, the solutions proposed by the system are either to design a selection exam or to carry out a selection process during the doctoral education period.

Such changes have not only affected the way PhD works but also its content. National governments show a growing interest to know the return of university research funds because the university is regarded as an institution whose targets are closely related to firms, where the efficiency and the economies of scale become more important day by day and where the students are considered as good's consumer (education). All this within an international framework where there is a great competition to have the most qualified labour force available (Brooks and Heiland, 2007).

National and supranational institutions (for example, European Commission), have established a definition of PhD appropriate to society's need to obtain a quicker return and an application of the knowledge achieved at the university, and for such reason they have boosted a more practical university research also more related to the non-university world (Häyrinen-Alestalo and Peltola, 2006). The remarkable growth in the number of doctoral candidates and in the variety of research fields both in Europe and in US has raised the professional university career as a less accessible labour option for students who in turn decide to look for a job outside the university. Nowadays, within this context, the traditional doctoral education directed to university teaching proves not to be enough (Crosier *et al.*, 2007)

This idea is also pointed out by Jamieson and Naidoo (2007), who state the emergence of two new doctoral models from labour market pressures. On one hand, the so called American doctoral model developed by more than 30 US universities and supported by their government would be a variation of the traditional model in which in order to get the PhD title a research work must be carried out and defended in front of the committee. Besides, this new model is more focused on student's learning process so that first, the lack of knowledge in the research area might be rectified, and second the student should be given knowledge in research theories and methodologies beyond his specialized area of studies. On the other hand, there is another model related to the growing number of professionals taking doctoral studies especially in US, Australia or UK. In this case, besides carrying out a research work and defending it in front of a committee, also the doctoral candidate does a research closely related to solve a particular problem considered vital for a given profession.

2.2. Future doctoral education guidance

Both 1999 Bologna Declaration and 2000 Lisbon Strategy have commonly considered as strategic the supply of the highest possible qualified human resources in order to reach the greatest economic and technological growth. However, at European level, there is a great current concern on what is considered a poor number of researchers. The causes could be found in a decreasing interest among students to join certain science research fields, as well as European Union difficulties to keep the most brilliant researchers (Moguérou, 2005).

As to show how important this problem is for European Union's economic development, the European University Association, in its 2008 Trends V report, within the European Higher Education Trends project, points out in its first paragraph that the European Union is concerned for PhD employment. And for this reason, it supports a model that fosters the relation between the university and the firms (public and private) in such a way that university career is not presented as the only option for PhD. In this sense and as it was previously mentioned, it is meant to promote doctoral education among professionals outside the university world.

Summing up, two underlying tendencies can be distinguished in the identification of reform targets and in the analysis of the tools and models used for its putting into practice. On one hand, doctoral education and research training can not be considered to be devoted just to an unselfish search of knowledge. The creation of new knowledge has become a basic strategic resource for developed economies and so it begins to be treated as a good. As it is considered such an important resource, it can not be left in the hands of teachers and departments, and it becomes a component part when formulating national or even supranational policies. On the other hand, the remarkable growing number of PhD graduates will cause looking for employment outside the academic institutions a challenge in itself. Such employment is in turn necessary for that qualified labour force to boost economic growth and innovation. However, for such jobs, research training directed to academic teaching is not considered enough, so it would be necessary to carry out some changes in doctoral education (Kehm, 2007).

Facing the forthcoming changes in the doctoral programs as a result of their being oriented towards the labour market outside the university, it is fundamental to analyze

which parts of the current model must be reviewed and which ones work properly regarding the final targets. So, the following section will describe the content of the survey carried out by the INE directed to PhD graduates by any Spanish university in order to obtain the most accurate image of the success of the current Spanish doctoral education programs.

3.- Which is the actual status of Doctors in Spain?

As it has been stated in the introduction, "2006 Survey on Human Resources in Science and Technology", represents an exhaustive study of doctors who obtained their title between 1990 and 2006 at any public or private Spanish university. The statistic unit of the survey is a doctor under 70's [1]. The total amount of selected individuals is 17,000, being the final total sample population 12,625. As for the time framework, the survey took as basic reference year 2006, although some other periods were included according to the theme areas into which the survey was divided. Finally, survey's content has been divided into different areas providing information about the personal characteristics of the interviewees, areas of research, labour status, international, national and sector mobility, scientist output, subjective assessment of their deciding on taking research training, as well as wages characteristics.

Regarding the personal characteristics of the interviewees, 45.2% were women, while sample average age was 41 years old. The most frequent age was 38 years (749 cases

[1] The problem lies on the fact that there is no national directory including all the individuals who have a Doctor title. So, INE had to recall the information from every University through the Consejo Superior de Universidades. To gather such information individually implied several problems as some of those universities do not have the lists, while others present heterogeneous lists in relation to their seniority, being most of them quite recent.

that is 6% of the sample); this figure should be considered low given that the target group corresponds to those with the highest training profile in this country.

Interviewees' distribution by great areas of knowledge reveals that three of those areas gathered most of the remarks: natural sciences (29.2%), health (22.6%) and social sciences (20.8%). They three sum up almost 73% of the total interviewees. Far behind we see humanities (14%), engineering and technology (9.6%), and agriculture science (4%). So, science areas are predominant over the humanities ones.

In relation to the year the titles were obtained, the fact that doctor databases are new determines the results, as 54% of the individuals got the title after year 2000. Despite this bias, there is a growing tendency in the number of new doctors since 1990. This data follows the observed international behaviour that changes its tendency in 2003 though (sobra?). This fact could be caused by students' decreasing interest in joining the research field of some science areas (maybe due to the greatest job opportunities granted to bachelors by labour markets at that time), and also by European Union's difficulty to keep back the most outstanding researchers (Moguérou, 2005). In the particular case of Spain, the most remarkable falls between 2003 and 2006 corresponded to social sciences and humanities (47% and 44% respectively).

Once the PhD title is obtained, to join to labour market does not seem to be very complicated as by December 31st ,2006, the activity rate was very high, placed at 96.5%, quite above the rate standing for the whole of the Spanish labour market. Unemployed were 2% and inactive 1.5%.

As for the main activity of the firm they work for, almost half of the PhD graduates (48.3%) do it so in higher education institutions, being health and hospital-related activities the second most frequent activity with 16.4%. A 10% was devoted to natural science and technical research and development activities. In line with these figures, 44% of the surveyed PhD graduates work as university teachers, 18.3% as doctors and related professions (except nursery). The remaining professions are heterogeneously distributed being always below 10%. So, taking into account that 44% confirm to be working for higher education institutions and 36% in the Public Administration, it can be stated that almost 80% of the surveyed belonged to the public sector. 14.8% is to be found at private firms while the others work for non-profit institutions. Such data are consistent with the observed European labour market tendency to require research-trained individuals (both public and private firms) as more than half of PhD graduates do not work at education institutions. On the other hand, despite the increasing professional tendency towards jobs outside the university, to be a university teacher is the most predominant activity. Therefore, education institutions seem to be the most frequent activity for doctors.

There are some differences if we take into account the area of knowledge. To be a teacher is the most frequent activity in the two areas of knowledge, but it is 20% higher in the case of humanities, particularly 42.5% of doctors of science are teachers whereas 62.7% in the case of humanities. So, there is a clear tendency among doctors of humanities to choose a traditional university career while doctors in science tend to follow a professional career outside the university. Moreover, there is an outstanding educational vocation among doctors of humanities because if all the possible professional options in the education field are summed up, the interviewees are more

than 78%. On the other side, doctors of science distribution among the diverse professional options is much more disperse as more than 34% are found at research institutions and in health and hospital-related activities.

As far as labour relation is concerned, the vast majority of the interviewees (94%) work full-time and with permanent contract (72%). However, temporality rates do not differ from the ones observed for the labour market as a whole, and this has become particularly worrying especially as we see that hardly 12% of such temporal workers belong to the private sector. This means that, the problem of temporality among doctors is located in the public sector, mainly in higher education where half of the temporal workers are located.

As far as earning levels, information is divided into intervals. As we can see in Table AI, there are clear differences in relation to earnings the labour market establishes for research training where the most favoured ones are those working at health areas. Just on the opposite side, humanities, agriculture sciences and nature sciences are placed, whereas engineering and technology and social sciences are just in the middle.

(TABLE AI)

To sum up, these data present some interesting features. First, there is an increasing tendency to train new doctors although it has slowed down during the last years of the survey. This tendency reflects labour market's need for highly qualified labour force to which both men and women are equally incorporated. In the second place, the commonest professional choice is university teacher following the academic tradition for this type of training. However, universities are no longer the most popular option for

doctors of science, as more than half of them work at non university-related institutions. This fact will go hand in hand with firms' growing demand of doctors. Finally, there seems to be a difference in wage level depending on a doctor's area of knowledge, and such difference favours science studies.

Based on these conclusions, the following section develops an econometric model directed to analyze the factors determining the choice of the professional activity that the surveyed doctors confirm to be developing and to what an extend they can be explained by an Economic Theory. Besides, this model will also take into account that the choice might vary depending on the area of knowledge the individual has been trained on.

3.- The econometric model

The analysis of the factors determining the decision-making of individuals when facing various options can be done by different discrete choice models. The advantage of these models vs. traditional econometrics is that the former allows modelling qualitative variables by using discrete variable own techniques. Depending on the number of alternatives included in the endogenous variable, dummy answer models are distinguished from multiple choices or answer models. Depending on the function used for estimating the probability there is the lineal truncated probability model, the Logit model and the Probit model. As for whether the alternatives of the endogenous variable are exclusive or add ordinal information, it is distinguished between non-ordered data model and ordered data model. Among the former, and following that whether the

covariates do refer to sample specific aspects or to the alternatives to choose, the multinominal models and the conditional ones are differentiated.

In this paper it has been decided to use a multiple choice model that can be applied when the endogenous variable to be modelized is a discrete variable ("podemos decir: cuando la variable endógena es discreta…", y nos evitamos el término modelizar) with different possible alternatives for answer. These models might be designed according to the random utility assuming that the individuals are rational agents with accurate information facing a number of alternatives linked to a certain utility. In fact, from the researcher point of view such utility is not noticed directly. It is splitted (divided?) into two component parts, a observable $U_{ij}^{'}$ that will depend on a certain amount of measurable qualities for each individual and option and a random μ_{ij}. A common formulation is the additive random utility model:

$$U_{ij} = U_{ij}^{'} + \mu_{ij} \quad j = 1,..., J \tag{1}$$

where U_{ij} is the utility that alternative j provides to the i^{th} individual, and J is the number of available alternatives. An individual will always choose the alternative that provides him with the greatest utility so if i^{th} individual chooses alternative j, it is because it provides the highest level of utility (U_{ij}):

$$U_{ij} > U_{ik} \Leftrightarrow U_{ij}^{'} - U_{ij}^{'} \geq \mu_{ik} - \mu_{ij} \; \forall k \neq j, \quad k = 1,..., J \tag{2}$$

The observed decision reveals which alternative provides the greatest utility, but not its utilities which are not noticeable (observables, observadas??). As the random component is not known exactly, therefore it is not possible to determine for certain if (2) is fulfilled, then it must change to a probabilistic framework where the multiple choice models are found. These models are classified into two main groups if the endogenous variable alternatives can be ordered (ordered data model) or not (non-ordered data model).

This paper is based on data that follow the non-ordered data multiple choice models whose general specification is summarized in the following expression:

$$(Y_i = j) = \frac{e^{\beta' Z_{ij}}}{\sum_{j=0}^{J} e^{\beta' Z_{ij}}} \qquad (3)$$

where Z_{ij} stands for model covariates' matrix. There are two types of such explanatory variables:

- Variables containing individual's specific data, so their value remains in every alternative. These variables are known as characteristics.
- Variables containing specific data of the alternatives to choose and so they vary both among individuals and among alternatives. These are called the qualities of the alternative.

Starting from this general specification and taking into account that explicative variables referring to characteristics or attributes are included in the model, it is decided

to use multinominal logit models for the first case and conditional logit models for the second.

The data provided by the survey follow the first case as the explanatory variables values diverge for each individual but they remain constant for every alternative. So, the variable's influence on each alternative cannot be identified unless a dummy variable interacting with each alternative is incorporated. In order to avoid singularity problems, the number of dummy variables in the model will be equal to the number of alternatives minus one *(J-1)*.

A multinominal logit formulation is stated in the following equation:

$$\text{Prob}(Y_i = j) = \frac{e^{\beta_j' x_I}}{\sum_{j=0}^{J-1} e^{\beta_J' x_I}} \qquad (4)$$

where *j* stands for the index associated to each alternative and ranges from 0 to *(J-1)*. The parameters' vector has attached a sub index related to the precise analyzed alternative. The estimated equations provide a set of probabilities for each alternative that an individual *i* with individual characteristics X_i may choose.

In the multinominal logit model there is an indeterminacy when trying to estimate the value of the parameters. In order to solve this problem, a model will be normalized by taking the paremeters value zero when being with the alternative zero($\beta_0 = 0$).

The resulting probabilities are:

$$\text{Prob}(Y_i = j) = \frac{e^{\beta_j' x_I}}{1 + \sum_{j=0}^{J-1} e^{\beta_J' x_I}} \qquad j = 1,2,...,(J-1) \qquad (5)$$

$$\text{Prob}\,(Y_i = 0) = \frac{1}{1 + \sum_{j=0}^{J-1} e^{\beta_j' x_I}} \qquad j = 0 \qquad (6)$$

Where

$$\sum_{j=0}^{J-1} P_j = 1 \qquad (7)$$

In this paper the selection to be analyzed refers to the different professional alternatives chosen by doctors. This selection is expected to be mainly conditioned by the area of knowledge in which the doctor has specialized as training is presented as the fundamental factor of an individual's human capital and therefore it will be a dominant key factor when choosing a professional career.

The data contained in the survey prove that the individuals have chosen among 27 professional activities according to their classification stated by the National Classification of Occupations ISCO-88. If we also consider that such selection must be determined by the area of knowledge in which the doctor has done his training (the survey distinguishes up to 47 fields or areas of knowledge according to UNESCO), the number of possible options for the doctor to choose is great enough so as to prevent the results to be analyzed.

For such reason, options have been reduced to four. As 44% of the interviewee work as university teacher it has been decided to divide professional selections into two groups: university teacher and other professional activities. As for the academic training area,

the survey distinguishes between science and humanities teachers in order to contrast whether there is effectively a different professional projection for technical than for social sciences training[2].

As for the variables influencing in the selection of a professional career, they can be divided into three groups: personal characteristics, training and research and job characteristics. Worker earnings are to be found within this last group of variables. Given that it is not possible to identify whether a person's earning is the consequence of his professional choice, or rather the professional choice was done based on the expected earnings, a Mincerian wage equation was estimated to avoid the likelihood of endogeneity and following Labour Economy traditional specifications

$$LnW = X\beta + u \tag{8}$$

where LnW stands for wage logarithm, X is the characteristics vector, β is a parameter vector and u the random errors distributed independently in a normal way with 0 average and variance $\sigma_u^2(0,\sigma)$. The estimated salaries are recovered and entered into the multinomial logit lately.

As wages information is given at intervals, an estimation method by intervals will be used, in which the dependent variable of any individual i is placed within an interval. Following Stewart (1983), if the wages of any individual i is placed at interval k_i

$$A_{k-1} \leq LnW_i \leq A_k$$

[2] The following fields are included within the sciences area: natural sciences, engineering and technology, health sciences, agriculture sciences and within social sciences, there are economy, and business administration. The rest of doctors in social sciences are included into the humanities group together with the humanities proper ones.

where A_{k-1} and A_k are the lower and upper interval limits respectively. Observed sample's probability function is

$$L = \sum_{k=1}^{K} \sum_{i \in k} \log \left[F\left(\frac{A_k - X_i \beta_i}{\sigma} \right) - F\left(\frac{A_{k-1} - X_i \beta_i}{\sigma} \right) \right] \qquad (9)$$

where K are the observed wage intervals and F is the accumulative distribution function. The maximization of L allows obtaining consistent estimations for β and σ.

4.- Results

This section presents the results of the estimations carried out on the basis of the econometric model developed above.

4.1. Descriptive statistics

Table AII contains the descriptive statistics for the variables used in the estimations[3]. As it can be seen, there are some substantial differences in such variables' values as they take into account doctor's area of knowledge as well as his professional activity. So, as far as personal characteristics, the percentage of men is always higher among doctors of sciences than of humanities (this is normal given the traditional male profile in such activities), and the average age is always higher among the humanities workers.

As it was predicted, science output is higher as for university teachers as their scientific output is determinant for both their professional careers and in their earnings. The

[3] Their definitions will be stated in Table BI of Appendix B.

number of published papers is higher as for doctors of science while the number of published books is higher in the case of doctors of humanities.

Regarding job characteristics, the vast majority of teachers work for public universities, which shows how little interest private university does rise among Spanish doctors. There are remarkable differences regarding the suitability of doctoral studies to the job achieved depending on the activity developed. Around 80% of university teachers find this suitability quite high while the highest percentage among those who are not teachers correspond to doctors of science with 45%. These figures reveal that doctoral education is still focused on the university world mainly, so when being outside this world, workers find it difficult to put their knowledge into practice either because workers do not find a job related to their area of knowledge or because their training level is not required. In this sense, the variable that tries to measure the existence of over education (the minimum level of studies required for a job) detects the lack of suitability between their studies and job requirements especially in case of doctors who are not university teachers. Around 60% of university teachers consider PhD title as the minimum necessary qualification. However, this percentage should not be considered quite high since this is the minimum requirement to develop a professional career within the university. As for those devoted to other activities, the percentages are slightly lower between 18% for doctors of sciences and 7% for doctors of humanities.

Finally, in relation to earnings, Table AII shows eight wage intervals proposed by the survey and the percentage of workers for each of them. When dividing the sample between sciences and humanities, we see that, as a whole, wages level is higher for

doctors of sciences, and such differences remains even when dividing the sample between university teachers and other type of doctors.

(TABLE AII)

4.2. Results

According to the econometric model presented, process first step is the estimation of the wages equation in order to correct wages endogeneity. Table BII of the AppendixB shows the expected results following the human capital theory and the descriptive statistics mentioned in the previous section.

The estimated wages are recovered and included within the multinominal logit independent variable group. Results are in Table AIII and marginal effects in Table AIV Following the results container in the latter table, it can be observed within the personal characteristics that by increasing the average age of doctors, the likelihood of choosing any science area is reduced while the chances of selecting a humanities area rise. Such result seems logic as in the last decades a very important scientific development has taken place in the science area which has caused an increasing demand for professionals trained in such knowledge area. In relation to sex, it does not have a clear effect on neither the selection of the area of knowledge nor the professional career.

In relation to training and research, doctoral education procedures and methodology are quite different for the science than for the humanities areas. This is because any delay to obtain the PhD title in science is negatively valued (even though it is not statistically significant for university teachers) while it is positively valued in the humanities area for any professional activity.

As for doctors of humanities, to take post-doc education does not exert a positive effect on the chances of developing any type of professional career. As for doctors of sciences, a positive effect is just observed when choosing a job outside the university. Both results indicate the insufficient development of this research option and its little value in the labour market.

Scientific output has clearly different effects depending on the area of knowledge. Publishing books has a positive effect on the development of any professional activity in the case of doctors of humanities and obviously it is greater among university teachers. As for doctors of science, the negative effect is higher among non-university teachers and while being no relevant among university teachers. Opposite to this, publishing papers is much more related to the area of sciences as it has a positive effect on any job (greater in the case of university teachers) but having a negative effect on the case of doctors of humanities. Finally, international mobility does not affect the development of a professional career.

Regarding job characteristics, working for the public sector favours the likelihood of becoming a university teacher Vs any other professional option. But the negative effect of a full-time job and of the worked hours on the chances of developing a professional career at the university will show that working at the university is compatible with other professional activities outside the university. These should be regarded as complementary to the main activity (university teaching and research) and as the natural and expected link between the university and the scientific and business worlds. Among university non-teacher doctors the positive effect of both variables is greater in the case

of doctors of science while that one of the worked hours could even be negative in the case of the doctors in humanities. Maybe, in this case, the different working methods identifying labour activity are gathered depending on whether the worker is a doctor of science or humanities.

The suitability between the training received and the job influences the professional activity as well. So, to state a clear relation strengthens the likelihood of choosing becoming a university teacher, which is more noticeable among doctors in science. Similarly, the higher the minimum level of required studies to carry out the job is, the higher the chances of becoming a university teacher and the lesser that of developing another professional activity. Such effect is also greater among doctors of science. To sum up, both effects prove a greater suitability of doctoral education to the development of a university professional career especially in the case of doctors of science.

Finally, the effect of the expected wages penalizes the selection of any professional career in the humanities case especially among university teachers. That is, the low wages expected in the humanities area causes it to be less likely to be chosen vs. the science option. Besides, this effect is also negative when selecting a university career instead of any other professional activity, due to the lower wages for university teachers stated in the descriptive statistics. A positive effect of the likelihood of developing a professional career outside the university can only be estimated for the case of doctors of science.

(TABLES A3 AND A4)

5. Conclusions

This paper has analyzed the determining factors for doctors when choosing a professional career. In order to deal with this matter, the doctor sample information provided by the 2006 Survey on Human Resources in Science and Technology has been used

To choose a professional career is mainly influenced by doctors' area of knowledge. For such reason, in this paper the survey has differentiated between science and humanities teachers in order to prove exactly whether the professional projection differs when it is a technical training or it is a social sciences-oriented. In relation to the professional alternatives, given that most of the interviewees work as university teachers, it has been decided to gather professional selections into two groups: university teachers and other professional activity.

For the estimation of results it has been applied a multinomial logit model where wages endogeneity is controlled by means of the estimation of a *Mincerian* equation. Out from the analysis of the descriptive data and the results of the estimations, several interesting conclusions are stated, which might be useful when designing forthcoming doctoral education courses guidelines.

As in the case of the rest of the nearby countries, it is observed a constant increase in the graduation of new doctors caused by the Spanish public university's need to expand continuously and by a firm sector (public and private) encouraged by the economic growth of our country during the last two decades which demanded highly-qualified

labour work. The area of knowledge with a lesser contribution of doctors is humanities with hardly 30%. Besides, it is revealed it's decreasing relative weight throughout the analyzed period.

The survey data present that doctors' professional choice has undergone a remarkable change. Currently, less than half of the working interviewees work for higher education institutions, this means that public and private firms begin to absorb its growing number. However, behaviour is different according to the area of knowledge, as even if the university keeps on being the commonest choice for doctors of humanities, a job outside the university is now becoming the main option for doctors of sciences.

Besides the results of the estimations indicate that when choosing a professional career, an individual's research skills as well as his research training period are taken into account. As for the Spanish case, it is observed that the labour market does not value neither post-doc education nor the international mobility yet.

For every knowledge area, the professional career at a public firm is linked mainly to the university environment where it seems easier to make it compatible both teaching and research activities according to the type of contract and the time devoted to the main labour activity. It is this group that it is noticed a better suitability between the training received and the professional activity developed which may determine greatly the selection of a professional future. Finally, the expected wages' effect penalizes the choice of a professional career at the university vs. any other professional option, as well as the selection of a humanities training vs. a science's one.

To conclude, the analysis of the determining factors when selecting a professional career highlights that the area of knowledge of humanities has been penalized through the last decade with a less relevance in the total number of PhD graduates. Besides, even if there are several factors determining the inclination for one training option or the other, it is the labour market expected wages that tend to move people away from humanities training and from a professional future option at the university. This is a very important fact if there is a wish to change doctoral education to be more firm-oriented because if people notice that in certain areas of knowledge the wages are penalized when being moved from the university environment to the firm's (particularly humanities) then the number of doctors of this area will be dramatically reduced. Moreover, the greatest demand for doctors of science and the monetary incentive that the professional career outside the university represents, might cause an ageing problem and loss of quality among university teachers in the long term

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APPENDIX A

Table AI. Earnings according to the area of knowledge (percentage of workers for each interval)

Interval	Natural Sciences	Engineering and technology	Health	Agricultural Sciences	Social Sciences	Humanities
Less than 10000	2.78	1.69	1.18	1.86	2.73	6.11
From 10001 to 20000	13.96	9.81	7.68	14.23	11.79	16.53
From 20001 to 30000	30.90	23.43	13.34	29.90	24.28	30.21
From 30001 to 35000	18.13	17.51	11.26	22.47	16.63	16.65
From 35001 to 40000	13.62	17.01	12.91	12.99	16.28	11.20
From 40001 to 45000	9.90	10.91	11.51	9.48	11.79	9.62
From 45001 to 50000	5.31	7.53	13.31	4.74	6.83	5.87
More than 50000	5.39	12.10	28.80	4.33	9.68	3.81

Table AII. Descriptive statistics of variables included in the estimation

		Science		Humanities		Science				Humanities			
						University teacher		Other professional activity		University teacher		Other professional activity	
		Mean	St dev.	Mean	St dev.	Mean	St dev.	Mean	St dev.	Mean	St dev.	Mean	St dev.
Personal characteristics													
Male		0.56	0.50	0.52	0.50	0.62	0.49	0.53	0,50	0.49	0.50	0.59	0.49
Age		39.75	7.38	42.77	8.57	39.69	6.76	39.89	7,57	41.80	7.81	43.80	8.69
Marital Status													
	Married	0.70	0.46	0.66	0.47	0.72	0.45	0.69	0,46	0.66	0.47	0.66	0.47
	Other	0.04	0.20	0.07	0.26	0.05	0.21	0.04	0,20	0.08	0.26	0.07	0.25
	Single	0.26	0.44	0.27	0.44	0.24	0.43	0.27	0,44	0.26	0.44	0.27	0.44
People under his responsibility		1.29	1.31	1.14	1.24	1.28	1.22	1.30	1,36	1.13	1.20	1.16	1.30
***Training and research*:**													
PhD length		5.47	2.94	6.48	337	5.38	2.59	5.54	3.13	6.23	3.15	6.81	3.46
Post-doc studies		0.17	0.37	0.17	0.37	0.18	0.38	0.16	0.37	0.24	0.42	0.06	0.24
International mobility		0.30	0.46	0.26	0.44	0.36	0.48	0.26	044	0.32	0.47	0.15	0.36
Published books		1.33	2.78	2.80	3.95	1.79	2.99	1.08	2.65	3.50	4.24	1.78	3.29
Published papers		5.72	7.34	5.65	9.21	7.65	8.12	4.60	6.65	6.57	6.27	4.01	7.43
Job characteristics													
Public sector		0.78	0.41	0.87	0.33	0.99	0.09	0.66	0.47	0.98	0.13	0.70	0.46
Worked hours		41.10	8.77	37.17	10.20	40.72	8.33	41.32	9.02	37.74	10.75	36.29	9.23
Full time		0.95	0.21	0.91	0.29	0.96	0.20	0.95	0.22	0.91	0.28	0.89	0.31
Permanent contract		0.71	0.45	0.75	0.43	0.75	0.43	0.69	0.46	0.71	0.45	0.81	0.39

Table AII (Con't)

		Science		Humanities		Sciences				Humanities			
						University teacher		Other professional activity		University teacher		Other professional activity	
		Mean	St dev.	Mean	St dev.	Mean	St dev.	Mean	St dev.	Mean	St dev.	Mean	St dev.
Relation between job and doctoral studies													
	High	0.59	0.49	0.64	0.48	0.81	0.39	0.45	0.50	0.84	0.37	0.34	0.47
	Normal	0.22	0.42	0.21	0.41	0.15	0.36	0.27	0.44	0.13	0.34	0.33	0.47
	Low	0.19	0.39	0.15	0.36	0.04	0.20	0.28	0.45	0.03	0.17	0.33	0.47
Minimum training level													
	Post-doc	0.09	0.29	0.05	0.21	0.11	0.31	0.08	0.28	0.06	0.24	0.02	0.14
	Doctor	0.33	0.47	0.41	0.49	0.60	0.49	0.18	0.38	0.63	0.48	0.07	0.25
	Graduate	0.52	0.50	0.47	0.50	0.25	0.44	0.67	0.47	0.29	0.45	0.75	0.43
	Undergraduate	0.03	0.18	0.04	0.21	0.03	0.18	0.03	0.17	0.02	0.12	0.09	0.29
	Professional training	0.02	0.15	0.03	0.17	0.00	0.02	0.04	0.18	0.00	0.04	0.07	0.26
Earnings													
	Less than 10000	0.02	0.14	0.05	0.21	0.01	0.11	0.02	0.15	0.04	0.19	0.06	0.24
	From 10001 to 20000	0.11	0.31	0.15	0.36	0.09	0.28	0.12	0.33	0.14	0.35	0.16	0.36
	From 20001 to 30000	0.23	0.42	0.28	0.45	0.24	0.43	0.23	0.42	0.26	0.44	0.30	0.46
	From 30001 to 35000	0.16	0.37	0.16	0.37	0.20	0.40	0.14	0.34	0.16	0.37	0.16	0.37
	From 35001 to 40000	0.14	0.35	0.13	0.34	0.18	0.38	0.12	0.33	0.14	0.35	0.12	0.32
	From 40001 to 45000	0.11	0.31	0.10	0.30	0.14	0.34	0.09	0.29	0.12	0.32	0.08	0.28
	From 45001 to 50000	0.08	0.28	0.06	0.24	0.08	0.27	0.09	0.28	0.07	0.25	0.05	0.22
	More than 50000	0.14	0.35	0.06	0.25	0.06	0.24	0.19	0.39	0.06	0.24	0.07	0.26
No. of observations		8,693		3,493		3,243		5,450		2,117		1,376	

Table AIII. Multinomial Logit

	University teacher. Sciences area (Choice=1)		**University teacher. Humanities area (Choice=3)**		**Other professional activity. Humanities area (Choice=4)**	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Constant	-4.811	-6.02	-2.973	-4.23	2.389	7.36
Personal Characteristics						
Age	-0.026	-5.36	0.026	5.12	0.060	12.56
Male	0.330	5.68	-0.136	-2.07	0.417	5.97
Married	0.256	3.38	0.164	1.91	-0.002	-0.03
Other marital status	0.500	3.40	0.614	3.94	0.396	2.53
Dependent people	-0.072	-2.69	-0.178	-5.64	-0.166	-5.33
Training and research						
PhD length	0.035	3.34	0.098	9.04	0.077	7.82
Taking a post doctoral	-0.921	-11.72	-0.569	-6.61	-0.511	-3.80
Published books	0.042	3.57	0.205	18.37	0.144	11.30
Published papers	0.013	3.15	-0.018	-3.55	-0.013	-2.13
International mobility	0.017	0.24	0.100	1.28	-0.079	-0.84
Job characteristics						
Public sector	1.012	13.30	0.823	9.50	0.750	8.03
Permanent contract	-0.702	-5.06	-0.823	-5.81	-0.035	-0.26
Full time	-0.037	-9.95	-0.086	-19.53	-0.084	-18.92
Worked hours	4.281	21.85	3.629	19.21	0.291	3.69
Relation job-PhD high	1.101	9.57	1.356	8.51	0.227	2.65
Relation job-PhD normal	1.737	16.04	2.309	15.35	0.084	0.94
Minimum training level: post-doc	3.866	5.33	2.491	4.08	-1.076	-4.15
Minimum training level: doctor	4.715	6.54	3.918	6.52	-1.107	-5.90
Minimum training level: graduate	2.689	3.73	1.929	3.22	-0.350	-2.38
Minimum training level: undergraduate	3.851	5.26	2.169	3.42	0.429	2.28
Earnings						
Estimated wages	-0.906	-10.96	-1.431	-15.54	-1.460	-16.64
No. of remarks: 12,186 χ^2= 8,689.42 Prob>χ^2= 0.00 Pseudo R^2= 0,28						

Dependent variable basic option is: Other professional activity. Sciences area (Choice=2).
The reference variables are: *Single, Relation job/PhD low* and *Minimum training level: professional training*.

Table AIV. Marginal effects

	University teacher. Sciences area (Choice=1)		Other professional activity. Sciences area (Choice=4)		University teacher. Humanities area (Choice=3)		Other professional activity. Humanities area (Choice=4)	
	dy/dx	Statistic z	dy/dx	Statistic z	dy/dx	Statistic z	dy/dx	Statistic z
Personal Characteristics								
Age	-0.006	-8.32	-0.002	-2.15	0.003	5.57	0.005	12.97
Male	0.048	5.73	-0.052	-4.45	-0.027	-4.26	0.031	5.36
Married	0.037	3.43	-0.041	-2.76	0.011	1.40	-0.007	-0.91
Other marital status	0.059	2.42	-0.127	-4.24	0.053	2.85	0.016	1.07
Dependent people	-0.004	-1.03	0.030	5.63	-0.015	-4.97	-0.011	-4.14
Training and research								
PhD length	0.002	1.16	-0.015	-7.56	0.009	8.26	0.005	6.00
Taking a post doctoral	-0.109	-12.25	0.164	10.99	-0.033	-4.70	-0.022	-2.24
Published books	-0.001	-0.64	-0.027	-11.20	0.019	16.65	0.009	9.05
Published papers	0.003	4.69	0.0001	0.55	-0.002	-4.22	-0.001	-2.29
International mobility	0.002	0.17	-0.005	-0.34	0.011	1.48	-0.008	-1.08
Job characteristics								
Public sector	0.324	42.73	-0.448	-43.97	0.164	27.70	-0.040	-5.46
Permanent contract	0.119	12.38	-0.206	-15.53	0.052	7.24	0.036	5.32
Full time	-0.098	-3.91	0.154	5.56	-0.079	-4.25	0.023	2.55
Worked hours	-0.002	-4.02	0.015	19.94	-0.007	-15.52	-0.006	-14.10
Relation job-PhD high	0.201	14.19	-0.333	-20.85	0.178	14.14	-0.046	-6.01
Relation job-PhD normal	0.143	6.29	-0.249	-11.80	0.130	5.53	-0.024	-3.58
Minimum training level: post-doc	0.638	5.05	-0.557	-13.01	0.027	0.28	-0.107	-17.21
Minimum training level: doctor	0.619	4.96	-0.644	-15.40	0.197	1.94	-0.172	-15.34
Minimum training level: graduate	0.377	3.44	-0.400	-5.16	0.121	1.89	-0.098	-5.87
Minimum training level: undergraduate	0.647	5.81	-0.545	-13.98	-0.019	-0.25	-0.083	-8.30
Earnings								
Estimated wages	-0.084	-6.72	0.288	17.70	-0.112	-12.15	-0.092	-12.01

The marginal effects have been calculated as an average over every covariate average.
The reference variables are: *Single, Relation job/PhD low* and *Minimum training level: professional training.*

APPENDIX B. Definition of variables and Wages estimation

Table BI. Definition of variables found in the different estimations

Multinomial logit depending variable	
Professional career	Variable taking value 1 if the person is a doctor of science and a university teacher, 2 if he is a doctor of science and has other professional activity, 3 if he is a doctor of humanities and a university teacher and 4 if he is a doctor of humanities and has other professional activity
Wages equation dependent variable	
Current wages logarithm	Wages are specified in eight annual earning intervals
Independent variables	
Worker characteristics:	
Age	Age of worker
Age^2	Squared age of worker
Male	Dummy variable that takes value 1 if the worker is a man and 0 if the workers is a woman
Married	Dummy variable that takes value 1 if the worker is married and 0 otherwise
Single	Dummy variable that takes value 1 if the worker is single and 0 otherwise
Other marital status	Dummy variable that takes value 1 if the worker has a marital status which is not either married or single and 0 otherwise
People under his responsibility	Number of people who financially depend on the worker
Training and research:	
PhD length	Time passed from the beginning of the doctoral studies until title is obtained
Taking post-doc studies	Dummy variable that takes value 1 if the worker is taking post-doc studies and 0 otherwise
Published books	Number of published books between 2003 and 2006
Published papers	Number of published papers between 2003 and 2006
International mobility	Dummy variable that takes value 1 if the worker has international mobility and 0 otherwise
University	Dummy variable that takes value 1 if the worker has become a doctor at this university in particular and 0 otherwise
Doctor of sciences	Dummy variable that takes value 1 if the worker is a doctor of science and 0 if he is a doctor of humanities
Job characteristics:	
Public sector	Dummy variable that takes value 1 if firm's activity belongs to the public sector and 0 if it belongs to the private sector
Permanent contract	Dummy variable that takes value 1 if the worker has a permanent contract and 0 if it is a temporal one
Full time contract	Dummy variable that takes value 1 if the worker has a full-time contract and 0 if it is part-time one
Worked hours	Number of hours worked during the week of reference
PhD /job relation: high	Dummy variable that takes value 1 if PhD /job relation is high and 0 otherwise
PhD / job relation: normal	Dummy variable that takes value 1 if PhD / job relation is normal, and 0 otherwise
PhD / job relation: low	Dummy variable that takes value 1 if PhD / job relation is low and 0 otherwise
Minimum training level: post doctoral	Dummy variable that takes value 1 if minimum training level for a job is post doctoral and 0 otherwise
Minimum training level: doctor	Dummy variable that takes value 1 if minimum training level for a job is to be a doctor and 0 otherwise
Minimum training level: graduate	Dummy variable that takes value 1 if minimum training level for a job is to be a graduate and 0 otherwise
Minimum training level: undergraduate	Dummy variable that takes value 1 if minimum training level for a job

	is to be a undergraduate and 0 otherwise
Minimum training level: professional training	Dummy variable that takes value 1 if minimum training level for a job is to have taken a professional training and 0 otherwise
University teacher	Dummy variable that takes value 1 if the worker is a university teacher and 0 if he has other professional activity
Expected wages	Expected annual wages logarithm

Table BII. Wages estimation

	Coefficient	Standard Error
Constant	1.484	14.97
Personal characteristics		
Age	0.056	12.22
Age^2	-0.0001	-9.61
Male	0.107	14.43
Married	0.072	7.08
Single	0.089	4.83
Other marital status	0.024	6.45
Training and research		
Doctor of science	0.137	15.56
Taking post-doc education	-0.043	-4.07
Published books	0.004	3.20
Published papers	0.001	1.41
Job characteristics		
Public sector	0.076	6.30
University teacher	-0.042	-5.30
Permanent contract	0.245	24.03
Full-time contract	0.231	10.66
Worked hours	-0.021	-37.09
No of remarks: 12,193 χ^2= 5,516.20 Prob>χ^2= 0.00		

The reference variable is *Single.*