

The Returns Obtained From International Mobility By Doctorate Holders. Some Evidence from Spain.

Diego Dueñas-Fernández

Department of Foundations of Economics. University of Alcalá (Spain).

Carlos Iglesias-Fernández

Department of Applied Economics. University of Alcalá (Spain).

Raquel Llorente-Heras

Department of Economic Analysis: Economic Theory and Economic History.
Autónoma University of Madrid (Spain).

Abstract

Given the important role played by science and knowledge in current patterns of economic growth, the economic and labour behaviour of doctorate holders merits attention, since they are at the centre of the most fundamental strategic processes on which human capital, productivity, innovation and economic well-being are founded. Consequently, the aim of this paper is to analyse the benefits derived from the international mobility of Spanish doctorate holders from several different perspectives, including academic, labour and economic effects. To this end, a set of probabilistic models were estimated, using information from the 2009 edition of the Spanish Survey on Human Resources in Science and Technology. Our results indicate that international mobility is associated with significant and positive academic and labour effects, whereas returns in terms of income are much less marked. We also found that most of the positive effects were limited to the higher education sector and did not filter through to the private sector. The large number of Spanish doctorate holders working within higher education could be the key factor which explains these results.

Key words: Spanish doctorate holders, mobility, returns

1. Introduction.

Since publication of the seminal work by Solow (1957), there has been general agreement on the relevance and importance of science in sustaining economic outcomes. The level of economic welfare presently enjoyed by our affluent societies depends strategically on our capacity for economic growth, based on innovative processes in which science and knowledge play a central role.

Science and knowledge are, however, economic factors that are produced within an increasingly complex process. The traditional view of the National Science System as one that was closed and inward looking, with little exposure to foreign influences, has increasingly changed to embrace alternatives where international connections and mobility are at the centre of knowledge generation. Policies aimed at encouraging researcher mobility are becoming ever more important elements of science, technology and innovation policies.

In recent decades, the key productive resources at the core of economic growth have been subjected to an intense process of globalisation and internationalisation. In the context of human resources, and more specifically in the case of the most skilled workers, trends towards internationalisation appear especially clear, with the assimilation of international ideas and knowledge from overseas and an increase in international mobility related to study periods spent abroad. Nowadays, human capital, the most important element of human resources, is increasingly acquired abroad. Academic exchange programmes (for example, the Erasmus programme in Europe¹) facilitate the internationalisation of human capital overseas for each country. The business sector also benefits from the above-mentioned patterns, through expanding international networks, labour relations based on collaboration and mobility of human capital. In short, international mobility has witnessed a marked increase in recent years, to reach considerable levels (OECD, 2008), and this is also true in the case of Spain (see Aceituno, 2007 and Pérez-Sedeño, 2005, for instance).

¹ See, for example, Bracht *et al* (2006) or Maiworm and Teichler (1996).

In spite of being a recent phenomenon, economic analyses have already explored the international mobility of human resources. These analyses have paid particular attention to the study of the most qualified element of human resources, usually comprising researchers and doctorate holders. Taken from an individual perspective, economic analyses have approached this specific kind of international mobility by considering it a human capital investment (Becker, 1964). This point of view implies that the aim of those people undertaking these decisions is to obtain future economic or academic benefits by meeting present costs. Participation in international mobility may help to achieve higher wages in the future, obtain a better post, consolidate employment or improve academic proficiency. People make human capital investment decisions when the present value of expected earnings is greater than direct and indirect costs. However, if people were shown the different costs and benefits associated with human capital, they might make different investment decisions. This occurs because each person's profile differs according to their personal, family and professional perspectives. Generally speaking, international academic mobility should be considered an important decision made with future economic outcomes in mind; consequently, international mobility decisions made by doctorate holders are usually analysed within the context of a theoretical and empirical human capital framework.

A great deal of economic research has been conducted on this question. These studies have explored a wide range of topics aimed at identifying the main determinants of international mobility decisions, and have included measuring results stemming from international mobility, gaining a deeper understanding of knowledge generation processes or determining the relationship between the business and university sectors as regards this issue.

Given the above arguments, the aim of this paper is to analyse the benefits obtained by Spanish doctorate holders from international mobility. To this end, a multi-perspective approach will be taken. First, we will analyse academic returns, in terms, for example, of books or papers published. Next, the impact of the international mobility of Spanish doctorate holders on their labour situation will be addressed, considering the probability of finding employment and achieving a better post. Lastly, returns in terms of increased income will also be considered.

In our opinion, the above-mentioned questions should be addressed from several different perspectives. Firstly, an understanding of the returns derived from international mobility decisions will help us to improve the way in which economic and educational policies are designed and applied. Secondly, a study based on the possibilities offered by a new Spanish database will enable relevant and interesting analyses. Lastly, this study will allow the Spanish case to be included in the existing international comparisons of the topic.

This paper is organised as follows: in section 2, we survey the relevant literature on the international mobility processes of doctorate holders. In section 3, we describe the data used and give a descriptive analysis of the target population, whilst in section 4 we focus on methodological considerations. Our results are reported in section 5 and in section 6 we present our conclusions.

2. The Economic Analysis of International Mobility of Doctorate Holders.

Since the publication of the paper by Marshall (1964), a great deal of literature has been produced providing an economic analysis of academic mobility. Briefly, mainstream studies of human resource flows in science have focused on a narrow range of analytical questions.

Firstly, those studies which have analysed the determinants of international mobility decisions taken by doctorate holders should be mentioned (Hauknes, 1994; Ackers, 2005a, 2005b; Crespi *et al*, 2005 and 2007, for instance). The results reported in these studies have underlined the explicative power of individual traits and the context of personal mobility, such as the characteristics of the public R&D system, the financial support available or the existence of international networks (Breschi and Lissoni, 2001; Altbach and Knight, 2007 or Bozeman and Gaughan, 2007). Furthermore, the role played by a flexible migration policy has generally been mentioned, since it promotes the migration of highly skilled people and researchers (Morano-Foadi, 2005). It should be noted that some studies have included a gender perspective in their analyses, concluding that there are significant gender differences among those undertaking academic mobility (Ackers, 2003; De Grip *et al* (2008); Mogu rou, 2004; Faggian *et al*, 2007).

Secondly, some studies have analysed the employment paths followed by doctorate holders (OECD, 2001 and 2010, Acker, 2004, Morano-Foadi, 2005). The usual outcome of such studies is to provide guidance to good practise in implementing national projects to promote academic mobility: they generally conclude that participation in international mobility is beneficial not only for the doctorate holders themselves but also for society as a whole in terms of the process of knowledge transfer, and support economic policies promoting international mobility decisions due to the associated positive benefits. Auriol (2007) presented the main mobility patterns of doctorate holders in seven countries of the OECD. This research showed that the largest number of doctorate holders in the labour force was to be found in Germany and Switzerland. In agreement with another study (Acker, 2003 and 2008), Auriol also found important differences between male and female doctorate holders in terms of salaries and reported satisfaction with their situation.

Although the literature has often focused on the existence of a brain drain (Johnson and Regets, 1998), a third and recent area of research has highlighted the importance of the diffusion of knowledge and internationalisation of human resources (OECD, 2001; She, 2011). A knowledge-based economy requires particular attention to be paid in national migration policies to the mobility of highly skilled people. Naturalisation processes or access to resident status could be included in the immigrant recruitment strategies of countries with relaxed immigration policies (Tremblay, 2005). However, overseas recruitment policies have faced significant obstacles, even though the promotion of academic mobility by universities in order to obtain overseas experience leads to better recruitment in the home country (Musselin, 2004). Acker (2005a) has suggested that brain drains are unidirectional, homogeneous and permanent and may result in a process of circulation, with “winner” and “loser” regions in terms of scientific migration. Nevertheless, scientific migration is generally considered the transfer of knowledge between countries.

Lastly, a great deal of the literature concerns the study of the principal consequences and effects of academic mobility on the outcomes for researchers and doctorate holders who migrate for academic reasons. Within this context, studies that have focused on productivity – both from an academic and a labour point of view – have highlighted the improved employment status and careers or salaries of doctorate holders who have participated in academic mobility (Boschma and Fritsch, 2007). Although these studies have not provided any clear evidence of a significant link between academic mobility and salaries (Barbezat and Hughes, 2001), academic mobility has been shown to have a positive effect on productivity and academic performance (Trajtenberg, 2005; Hoisl, 2007). The effect of gender has also been analysed, in an attempt to identify determinants of sex differences in academic career promotion (Scott *et al.*, 1993). The organisation of academic careers has also been considered in the literature, particularly in relation to the effects of international mobility on economic and academic outcomes (Cameron and Blackburn, 1981; Ehrenberg, 1992, for instance). The research by Ackers (2003, 2004 and 2008) should also be considered, which has contributed the concept of “tied migration” or re-circulation of scientific migration.

Significantly, it has been suggested that the returns obtained from international mobility in terms of knowledge production are linked to certain qualitative dimensions of mobility (Cañibano, *et al.*, 2008). Access to better sources of funding or networks may promote the international mobility of doctorate holders. In their study of Nordic doctoral students, Kyviak, *et al.* (1999) concluded that the main disadvantages of international mobility were related to poor contact with foreign professors, short duration of the experience, lack of social and family contact and short-term funding, among others.

With regards to the Spanish case, little evidence exists to date. Cañibano, *et al.* (2011) analysed the mobility of doctorate holders working in Andalusia and established different patterns of international mobility, demonstrating significant differences in terms of frequency, duration and destination. Their results indicated that episodes of international mobility occurred at 4 year intervals, with an average duration of 1 to 3 weeks. They also found very significant gender differences. From a more general perspective, the studies by Aceituno (2007) and Pérez-Seldeo (2005) should also be mentioned. International mobility does not necessarily lead to better rewards, at least in the Spanish case, due to certain organisational and institutional characteristics of the academic system, strongly based on internal promotion (Cruz-Castro and Sanz-Menéndez, 2010). Lastly, Iglesias *et al.* (2011) identified the main determinants supporting international mobility for Spanish doctorate holders, concluding that a period of international mobility appears to be a requisite associated with the start of an academic career rather than a consequence of its development.

3. Data and Descriptive Analysis.

We used data from the Spanish Survey on Human Resources in Science and Technology (HRST), a new survey carried out by the Spanish Statistical Institute (INE). The analysis sample was taken from the second edition of this survey, specifically 2009. Spanish doctorate holders living in Spain in the previous year with a level 6 education according to the International Standard Classification of Education (ISCED 97) were surveyed. This population is defined as individuals taking tertiary education programmes leading to an advanced research qualification, and therefore, undertaking advanced studies and original research not solely based on coursework². Since information on Spanish doctorate holders living abroad is not available, some data selection bias was inevitable, and this fact explains our choice of the type of econometric model to be estimated. A final consideration was that the data included in the HRST-2009 refer only to people under 70 years old. However, this was not considered a significant limitation since the mobility of highly skilled people in Spain is a recent phenomenon (Aceituno, 2007; Cañibano, *et al*, 2008; OECD, 2008, and Pérez-Sedeño, 2005).

The HRST includes information on the social and employment situation of doctorate holders in Spain, together with data about their experience of international mobility. International mobility is measured on the basis of information about their previous overseas study visits reported by the individuals surveyed. The information is organised into seven items concerning the countries in which doctorate holders have lived during the past 10 years (1999-2009) for a minimum duration of one month. In contrast to the 2006 HRST edition, the 2009 version adds countries of residence by continent, classifying individuals who have not moved with the abbreviation “NMOV”. Thus, when using the HRST-2009 version it is not possible to analyse international mobility by country. In addition, the maximum number of study periods overseas included in the survey is limited to seven. However, this limitation does not appear to affect the information collected, since the frequency of answers drops dramatically from the fourth mobility period onwards. Previous studies conducted of the Spanish case (Cañibano *et al*, 2011) have indicated that episodes of international mobility usually occur at 4 year intervals. In our sample from the HRST-2009, the average for episodes of international mobility was approximately 2.63 study periods over ten years, with an average duration of 21 months³.

We created a dichotomous variable which took the value 1 if the doctorate holder had lived abroad in the past 10 years for at least one month (the period analysed in the survey) and the value 0 when the abbreviation “NMOV” appeared beside each of the seven possible items; in others words, when no international mobility episodes had been reported.

Table I shows the general situation of Spanish doctorate holders regarding international mobility. An incidence index has also been included, which highlights the most relevant features identified when comparing the international mobility experiences of different doctorate holder populations. For example, 22.1% of women have reported international mobility episodes, but the same figure for the total population (men and women) is 20.84%. Thus, by dividing both frequencies a value of 1.06 is obtained. This value indicates that women are more highly correlated with international mobility than men because the value is greater than one. According to Table I, Spanish doctorate holders who report episodes of international mobility are most likely to be:

- Women (slightly higher than for men, at 6% more).
- Young people under 34 years old.
- Undertaking a doctorate in the area of the Natural Sciences.
- Working in higher education.
- Earning a low to medium annual income (between 20,001 to 30,000 Euros).

The fact that the highest index value was obtained for younger people indicates that age is the most important feature defining international mobility in Spain. As can be seen from Figure A.I, which shows the distribution of doctorate holders in Spain by age, a generational difference exists, with higher or more intensity mobility being registered among younger people. The average age of doctorate holders reporting episodes of international mobility is 38 years old, compared to 44 among doctorate holders who did not report mobility. In conclusion, international mobility is a new pattern associated with the younger generation. From another perspective, previous studies have concluded that international mobility has been used as a kind of apprenticeship for a future academic career (Iglesias *et al*, 2011).

² For more details, please see the INE website. http://www.ine.es/metodologia/t14/t1430225_09.pdf

³ Bearing in mind that the HRST-2009 only analyses international mobility episodes of a minimum duration of one month.

Individuals who wish to work in higher education are required to have this type of experience. The HRST-2009 clearly indicates that the greater part of Spanish doctorate holders are working in the education sector, and more specifically, in teaching posts. The 45.3% are employed in specific tasks related to higher education (see Figure A.II in the Annex). Since this finding is clearly not in agreement with the existing literature, the surprising result obtained for women requires further analysis in order to identify whether this structural outcome is specific to the Spanish case.

Table II gives the academic and professional characteristics of Spanish doctorate holders according to their international mobility experience. The data shows that international mobility is associated with considerable academic and professional advancement. The incidence index value is above one in the case of publishing one or more books, having more than six academic papers published, holding one or more patents, supervising a Master's or doctoral thesis and collaborating with international research groups. Although the highest index value was obtained for the case of holding one patent, most of these returns are related to academic rather than professional careers. Once more, it would appear that the behaviour of Spanish doctorate holders is more related to employment in educational tasks within the university system because they obtain typically academic benefits.

4. Methodological Strategy

We expected that the consequences of international mobility would embrace a wide range of aspects. Therefore, we considered a number of approaches for analysing the returns derived from the international mobility of Spanish doctorate holders. Specifically, we focused our analyses on three basic aspects: academic returns, employment outcomes and effects on annual net income.

Academic returns

Analysis of the academic returns of international mobility was conducted considering the six different HRST-2009 variables included in Table II. In order to summarise the information and extract its main components, we first applied Pearson correlations, and the results are given in Table A.I (see Annex). As can be observed, the only variable which did not have a significant relationship with international mobility was publication of books. For the remaining variables, that is, publication of papers, holding patents, supervision of Master's or doctoral thesis and, above all, collaboration with international research groups, a significant and positive relationship was found. However, a negative relationship can be observed between international mobility and the variables annual net income and company start-up.

On the basis of these results, a factor analysis was conducted in order to identify and summarise different patterns of scientific production. The ultimate objective for applying this methodology was to identify typical patterns in terms of academic returns. The results of this strategy are shown in Table A.II of the Annex. On the basis of this Table, it could be stated that Spanish doctorate holders can basically be differentiated into two groups: a first group linked to the academic world, where returns mainly centred on the publication of books and papers, supervision of Master's and doctoral theses and collaboration with international research groups; and a second group associated with the business sector, where returns were mainly related to obtaining a higher income, developing patents and forming companies. According to the Pearson correlation, the first group would be more closely linked to international mobility (the correlation with international mobility was 0.151), whereas the second group would be linked negatively (with a correlation of -0.064). Thus, international mobility appears to be a phenomenon that occurs mainly in the academic field and, therefore, could be expected to be more closely related to academic returns.

To measure the intensity of the relationship between academic returns and international mobility, a *logit* model was developed to estimate the likelihood of having experienced international mobility according to all previous academic returns.

Explicative variables explain the probability of participating in international mobility according to different kinds of academic return (books, papers, patents, company start-up, supervision of a Master's or doctoral thesis and collaboration with a international research network), whilst controlling for several personal variables (sex, age, potential labour experience⁴, marital status, region of residence and area of doctorate). The objective was to determine the relationship between participation in overseas study and academic results by observing the coefficients of the first set of explicative variables.

⁴ Potential experience is defined as the difference between age of doctorate holder and year of obtaining the doctorate.

Labour outcomes

We based our analysis of the impact of international mobility on employment on two main issues: employability and the possibility of finding employment in a high-ranking occupation.

Our strategy was very similar to that applied for academic returns. Firstly, as regards the relationship between employability and international mobility of Spanish doctorate holders, we estimated another *logit* model, this time to determine the likelihood of being employed (value 1 for dependant variable) versus being unemployed or economically inactive (value 0 for dependant variable) according to participation in international mobility, controlling once again for the previously mentioned personal characteristics.

Secondly, from an occupational perspective, it should be borne in mind that occupational improvement depends indirectly on the number of categories considered in the variable and their order. The HRST-2009 classifies labour occupations using three ISCO-88 codes. However, Spanish doctorate holders are mainly classified within the code “231”, which is related to teaching in higher education. According to the data shown in Figure A.II, about 45.3% of our sample worked in this category. Therefore, to analyse how international mobility affects the occupational achievements of Spanish doctorate holders, different occupational classifications were considered. First, we applied the original ISCO-88 labour occupation classification without any modifications, and labelled this variable “original ISCO-88 occupations”. Second, we defined an alternative variable, recoding the original ISCO-88 information into 8 aggregated categories and further differentiated the “231” category by crossing it with the information on professional status reported in the HRST. This new variable was labelled “ISCO-88 and Professional Status” (Included in figure A.II). Lastly, a third variable was considered, using information reported only by doctorate holders teaching in higher education about their professional status. This last possibility was labelled “Professional Status” (Included in figure A.III). Based on these categories, several ordered logit (*ologit*) models were estimated, controlling for all the variables mentioned above.

Net income

Lastly, the returns of international mobility in terms of net income were estimated using a similar methodology to that which was applied in order to determine the effects on improved position in the occupational hierarchy. First, a new ordered logit model (*ologit*) was estimated. The model now examined how international mobility affects monetary returns through an analysis of annual net income. In the Spanish Survey of Human Resources in Science and Technology, annual net income variable differences are organised into the following categories: “Under 10,000 Euros”, “From 10,000 to 20,000 Euros”, “From 20,001 to 30,000 Euros”, “From 30,001 to 35,000 Euros”, “From 35,001 to 40,000 Euros”, “From 40,001 to 45,000 Euros”, “From 45,001 to 50,000 Euros” and “Over 50,000 Euros”. The HRST-2009 does not offer direct information about salary or labour returns but merely provides general annual net income. However, as the model developed only considered employees, this income could be a good proxy of salary. The controlling variables included in this last model were the same as those used previously, taking into account both personal and labour characteristics.

We ran the regression considering a number of different populations, the first of which was the total population included in the HRST. Next, we focused on Spanish doctorate holders working in the higher education sector. Third, since academic and net income effects can be related, we ran additional *ologit* models for Spanish doctorate holders working in the higher education sector but now including variables for academic returns in the set of explicative variables (we called this estimation “higher education with academic return variables”). In all cases, we conducted separate estimations for men, women and both genders together, to identify gender-based differences.

5. Results.

In this section, we report the results obtained from applying the previously explained methodologies and considering the following different aspects: academic returns; employability, labour occupation and professional status tenure, and net income improvements.

Academic returns: better scientific production.

Table III shows the results we obtained for the influence of participation in international mobility on academic returns. We ran an econometric model for men, women and the entire target population, to identify gender-based differences in specific patterns. Focusing on the variables concerning academic achievement (which are shadowed for easier interpretation), some results merit emphasis:

- Publication of books was linked to participation in international mobility. However, this pattern was less marked for men than for women.
- Company start-up was only linked to international mobility for women. For men, international mobility was counterproductive. This finding reflects and confirms previous results indicating that international mobility is more related to higher education than to the business sector.
- Developing a patent showed an uncertain connection with international mobility, but nevertheless presented a positive relationship. In the case of the total population, holding one or more patents presented a slight relationship with international mobility (7% for one patent and 5.4% for two or more patents). In the case of men, positive effects only emerged where more than two patents were held, whereas for women these effects appeared when one patent was held.
- In contrast, supervision of Master's or doctorate theses was intensely linked to international mobility, especially in the case of men.
- Lastly, collaboration with an international research network was the feature that showed the strongest link with international mobility. Consequently, as is logical, it is essential to promote international research network mobility.

To sum up, international mobility strongly determines academic returns. This finding is supported by the fact that most Spanish doctorate holders work in higher education, and more particularly, that those who participate in international mobility are precisely those engaged in an academic career. However, international mobility should also be promoted within the business world, since it favours the development of patents. Lastly, with regard to gender, the international mobility of women was more strongly associated with academic returns in general terms.

Labour returns: improving employment, labour occupation and professional status.

Firstly, Table IV (again the key variables are shadowed) depicts the results concerning employability. All coefficients, both for men and for women, showed that international mobility improved employability, after controlling for the relevant personal and professional variables. Specifically, Spanish doctorate holders who have participated in international mobility showed a 54% increase on average in probability of being employed. In the case of men the probability is increasing by 33% and in the case of women is double (114%).

Secondly, Table V summarises the results obtained for the relationship between occupational hierarchy and international mobility, showing only the coefficients obtained for the international mobility variable in relation to different classifications for occupational categories. The remainder of the controlling variables are not shown.

Overall, our results indicate that international mobility only leads to occupational improvement among those who perform tasks related to higher education. In this sector, participation in international mobility presents a 22.9% probability of improving professional status (achieving a higher occupational category), and this probability is even higher for women, standing at 32.7 %, which establishes international mobility as an important tool for advancement among women, at least within the academic world. Appropriate labour matching only occurs within higher education, where people who have participated in international mobility obtain employment at higher professional levels. In contrast, it seems that the human capital represented by Spanish doctorate holders is not fully appreciated outside the university context.

Economic returns: increasing income.

Lastly, we examined the monetary returns of international mobility by estimating several ordered logit (*ologit*) models using level of annual net income as the dependent variable for wage earners. The variables considered were the same as those used previously, taking into account both personal and labour characteristics. When running the model, we considered different populations; thus, for the sake of simplicity, Table VI only shows the coefficient obtained for the international mobility variable for each population.

International mobility only led to a higher income among those people performing tasks related to higher education (with a probability of 4.2%). Furthermore, differentiating by gender showed that it was only in the case of women that international mobility increased the possibility of obtaining a higher income, with a probability of 8.7 per cent. Thus, the monetary returns of international mobility were partial, corresponding exclusively to the higher education sector, and probably poor. Furthermore, when considering estimations of another type of academic return (according to the last coefficients in Table VI), it can be observed that international mobility had no effect on monetary returns, at least in terms of annual net income, for either men or women.

In conclusion, the evidence is quite weak, and it is not possible to affirm the existence of monetary compensation related to international mobility and the generation of human capital overseas.

To summarise, we found that international mobility was associated with academic achievement but not with economic returns. This conclusion is supported by the fact that the majority of Spanish doctorate holders work in higher education, in jobs that are usually linked to the public sector where wages and other profits are generally fixed and may be low. The returns in this context were not closely linked to labour productivity, at least not in the same way that we usually observe in private sector.

6. Conclusions.

There is no doubt that human resources play a central role in current patterns of economic growth, which are increasingly based on knowledge, innovation and technology. Nowadays, these processes often occur in contexts where internationalisation and globalisation are fundamental conditions for the success of human capital investment and productivity. Bearing these arguments in mind, the aim of this research was to study the international mobility processes undertaken by the most qualified element of Spanish human resources: doctorate holders.

Using data from the new edition (2009) of the Spanish Survey of Human Resources in Science and Technology, several analyses were conducted. On the basis of a Human Capital Theory framework, the objective was to identify the returns derived from this kind of decision. Since we are aware of the complexity of this subject, several perspectives were considered in order to cover all relevant aspects of the consequences of international mobility for doctorate holders. Therefore, our analyses addressed the academic, labour and income effects. It is our view that several key outcomes should be emphasised in the main conclusions:

Firstly, our descriptive analysis suggests that Spanish doctorate holders are engaged predominantly in tasks linked to teaching and research, particularly within the higher education sector. A lower number of doctorate holders were observed working in private and non-university sectors, so it can be concluded that this group of skilled workers encounter few employment opportunities outside the university context.

Secondly, from an overall point of view, our estimations indicated that participation in international mobility clearly implied positive returns for Spanish doctorate holders, through improving outcomes in several areas.

Thirdly, returns from participation in international mobility by our target group arose mainly in achievement related to academic aspects, such as better academic results, internal promotion or higher professional status. International mobility strongly determined the academic returns obtained by Spanish doctorate holders in relation to all the dimensions we considered.

Fourthly, with regard to labour returns, outcomes were two-fold. On the one hand, international mobility clearly improved employability. On the other, our results indicate that participation in international mobility implies occupational improvement to some extent.

Fifth, monetary returns, in terms of the net income earned by Spanish doctorate holders, were scant and highly correlated with academic returns; thus, they disappeared after controlling for this latter type of effect in our econometric models.

Lastly, there are two central conclusions, derived from the previous set of outcomes:

- First, international mobility only produces relevant returns in the case of Spanish doctorate holders who work in the higher education sector performing tasks related to teaching and research. These returns drop dramatically or even disappear for doctorate holders working in other sectors.
- Second, international mobility does not appear to be linked to obtaining a higher income. Thus, academic rather than monetary returns are the most significant consequence of international mobility for Spanish doctorate holders. This is explained by the specific labour characteristics of this sector: jobs are usually linked to the public sector, where wages and other profits are generally fixed and administrative rules determine the main aspects of labour relations.

The implications of our results for economic policies are clear, and indicate the need to design and implement actions aimed at improving the use and situation of our most highly skilled workers, doctorate holders, in the Spanish private sector.

Furthermore, initiatives aimed at encouraging relationships between the university system and business in terms of doctorate mobility and job opportunities should also be welcomed, since they would stimulate the possibility of gaining economic and labour returns from international mobility in the business sector. Finally, a more flexible approach to the organisation of work within the Spanish public higher education sector, such as introducing flexible wages linked to productivity, would help to provide positive incentives for international mobility decisions.

Acknowledgements

This paper is based on the research project “Flows of Human Resources in Science and Technology. Searching for excellence through talent”, funded through the Spanish National Plan for Research, Development and Innovation. Reference CSO 2009–09003.

References

- Altbach, P.G. & Knight, J. (2007) “The internationalization of higher education: Motivations and realities”. *Journal of Studies in International Education*, 11(3-4), 290-305.
- Aceituno, P. (2007) “Informe Innovacef: Aportaciones para el regreso de los investigadores españoles en el extranjero”. *Revista de Trabajo y Seguridad Social CEF*, 296.
- Ackers, L. (2003) “Managing Work and Family Life in Peripatetic Careers: The Experiences of Mobile Women Scientists in the EU” *Symposium on Science Policy. Mobility and Brain Drain in the EU and Candidate Countries*
- Ackers, L. (2004) “Managing relationships in peripatetic careers: Scientific mobility in the European Union”. *Women’s Studies International Forum*. Elsevier. 27. 189-201.
- Ackers, L. (2005a). “Moving people and knowledge: scientific mobility in the European Union”. *International Migration* vol. 43 (5): 99-131.
- Ackers, L. (2005b) “Promoting scientific mobility and balanced growth in the European Research Area”. *Innovation* vol. 18 (3): 301-317
- Ackers, L. (2008) “International mobility and metrics: a new form of indirect discrimination?” *Minerva*. Vol. 46. 411-435.
- Auriol, L. (2007) “Labour Market Characteristics and International Mobility of Doctorate Holders: Result for Seven Countries”. *OECD Science, Technology and Industry Working Papers*. 2007/02. OECD Publishing. <http://dx.doi.org/10.1787/310254328811>
- Barbezat. A. & Hughes. J. (2001). “The effect of job mobility on academic salaries”. *Contemporary Economic Policy*; Oct 2001; 19. 4; 409-422.
- Becker, G., 1964. *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. New York. Columbia University Press.
- Boschma. R. A. & Fritsch. M. (2007) “Creative Class and Regional Growth – Empirical Evidence from Eight European Countries”. *JENA Economic Research Papers*. 2007-66
- Bozeman. B. & Gaughan. M. (2007). “Impacts of grants and contracts on academic researchers’ interactions with industry” *Research Policy*. 36. 5. 694-707.
- Bracht, O., Engel, C. Janson, K. Over, A. Schomberg, H. & Teicheles, U. (2006) “*The professional Value of Erasmus Mobility: Final Report*”. Kessel: International Centre for Higher Education Research
- Breschi. S. & Lissoni. F. (2001). “Knowledge spillover and local innovation systems: A critical review”. *Industrial and Corporate Change*. 10. 4. 975-1005.
- Cameron, SW. & Blackburn, RT., 1981. “Sponsorship and Academic Career Success”. *The Journal of Higher Education*, 52, 4, 369-377.
- Cañibaro, C.; Otamendi, J. & Andujar, I. (2008) “Measuring and assessing researcher mobility from CV analysis: the case of the Ramón y Cajal programme in Spain”. *Research Evaluation*. Vol. 17, Nº 1. March 2008. 17-35 (15).
- Cañibaro, C.; Otamendi, J. & Solis, F. (2011) “International temporary mobility of researchers: a cross-discipline study” *Scientometrics*. 10 1007/s11192-011-0462-2. Springer
- Crespi. G., Geuna. A. & Nesta L. (2005). “Labour Mobility of Academic Inventors. Career Decision and Knowledge Transfer. Working Paper 139. *Science and Technology Policy Research (SPRU)*. University of Sussex.

- Crespi, G., Geuna, A. & Nesta L. (2007). "The mobility of university inventors in Europe". *Journal of Technology Transfer*. 32. 3. 195-215.
- Cruz-Castro, L. & Sanz-Menéndez, L., (2010) "Mobility versus job stability: assessing tenure and productivity outcomes". *Research policy*, 39, 1. February. 27-38.
- De Grip, A.; Fouarge, D & Sauermann, J. (2008): "What affects international migration of European science and engineering graduates?" *REFLEX WP-6*.
http://www.fdeuw.unimaas.nl/roa/reflex/documents%20public/publications/REFLEX_workingpaper06_gr_admigration_totaal.pdf
- Ehrenberg, R.G., 1992. "The Flow of New Doctorate" *Journal of Economic Literature*, 30, 830-875.
- Faggian, A., P. McCann & S. Sheppard (2007): "Some Evidence That Women Are More Mobile Than Men: Gender Differences In U.K. Graduate Migration Behaviour," *Journal of Regional Science*, 47(3), 517-539.
- Hauknes, J. (1994). "Modelling Mobility of Researchers". *STEP Report*. Oslo.
- Hoisl, K., 2007. "Does mobility increase the productivity of inventors?" *Discussion Paper Munich School of Management*. 2006-13.
- Iglesias, C., Llorente, R. & Dueñas, D. (2011). "International Mobility of Spanish Doctorate-Holders. What determinants matter?" *X Spanish Economic Policy Congress*. University of Málaga.
- Johnson, M. & Regets, M. (1998) *International Mobility of Scientists and Engineers to the United States: Brain drain or brain Circulation?* National Science Foundation, Arlington, VA. Div. of Sciences resources Studies.
- Kyviäk, S., Karseth, B., Are Remme, J. & Blume, S. (1999) "International mobility among Nordic doctoral students". *Higher Education*. Vol. 38. 379-400.
- Maiworm, F. & Teichler, U. (1996) *Study Abroad and Early Careers: Experiences of Former Erasmus Graduates*. London. Jessica Kingsley.
- Marshall, H.D., 1964. *The Mobility of College Faculties*. PAGEANT Press. New York.
- Moguérou, Ph. (2004). "A double gender-family inequality phenomenon in the international mobility of young researchers". *Research Institute on Education (IREDU)*. University of Bourgogne.
- Morano-Foadi, S. (2005) "Scientific Mobility, Career Progression and Excellence in the European Research Area". *International Migration*. Vol. 43. Issue 5. 133-162. December.
- Musselin, C. (2004) "Towards a European academic labour market? Some lessons drawn from empirical studies on academic mobility". *Higher Education*. Vol. 48. 55-78
- OECD (2008) *The Global Competition for Talent. Mobility of the Highly Skilled*. OECD.
- OECD (2001) *International Mobility of the highly Skilled* OECD Proceedings. Paris.
- OECD (2010) *Draft Guidelines, Model Questionnaire and Indicator*. OECD.
- Pérez-Sedeño, E. (2005) Los Programas de Formación y Movilidad del Personal. Investigador de Flujo Directo e Inverso: Problemas, retos y soluciones. *Informe del Proyecto EA 2005-0004*.
- She, Q (2011) "International student mobility and highly skilled migration: A comparative study of Canada, the United States and the United Kingdom". University of Saskatchewan Library Electronic Theses & Dissertations.
- Solow, R. (1957) "Technical Change and the Aggregate Production Function". *Review of Economic and Statistics*, August, 312-320.
- Scott, J., Allison, PD. & McGinnis, R., 1993 "Rank Advancement in Academic Careers: Sex Differences and the Effects of Productivity" *American Sociological Review*, 58, 703-722.
- Tremblay, K. (2005) "Academic Mobility and Immigration". *Journal of Studies International Education*. Fall 2005, Vol 9. Nº 3. 196-228.
- Trajtenberg, M. (2005). "Recombinant Ideas: The Mobility of Inventors and the Productivity of Research". *CEPR Conference*. Munich.

Table I. Spanish doctorate holders: Descriptive analysis. (Source: HRST. 2009)

		% No Mobility	% Mobility	Incidence index (Regarding Mobility)
Total doctorate holders		79.16	20.84	-
Sex	Men	80.1	19.9	0.95
	Women	77.9	22.1	1.06
Age	16-34 years	44.7	55.3	2.66
	35-39 years	65.4	34.6	1.66
	40-44 years	83.5	16.5	0.79
	45-49 years	91.2	8.8	0.42
	50-54 years	93.8	6.2	0.30
	More than 55 years	95.9	4.1	0.20
Marital Status	Married or cohabiting	83.2	16.8	0.80
	Single	64.9	35.1	1.68
	Separated, divorced or widowed	83.7	16.3	0.78
Area of doctorate	Natural Sciences	68.5	31.5	1.51
	Engineering and Technology	78.9	21.1	1.01
	Medical Sciences	90.3	9.7	0.47
	Agricultural Science	78.7	21.3	1.02
	Social Sciences	82.9	17.1	0.82
	Humanities	82.8	17.2	0.83
Labour status and sector	Working–Business	84.9	15.1	0.72
	Working–Public Administration	82.1	17.9	0.86
	Working–Higher Education	74.6	25.4	1.22
	Working–Private non profit institution	76.5	23.5	1.13
	Unemployment	74.8	25.2	1.21
	Economically inactive/others	95.8	4.2	0.20
Annual Net Income	Under 10,000 Euros	76.1	23.9	1.15
	10,000 - 20,000 Euros	71.6	28.4	1.36
	20,001 - 30,000 Euros	69.2	30.8	1.48
	30,001 - 35,000 Euros	73.3	26.7	1.28
	35,001 - 40,000 Euros	75.5	24.5	1.18
	40,001 - 45,000 Euros	80.6	19.4	0.93
	45,001 - 50,000 Euros	86.4	13.6	0.65
	Over 50,000 Euros	88.8	11.2	0.54

Table II. Spanish doctorate holders: academic returns. (Source: HRST. 2009).

		% No Mobility	% Mobility	Incidence index (Regarding Mobility)
Total doctorate holders		74.79	25.21	-
Books	None	74.87	25.13	1.00
	1 or 2	74.55	25.45	1.01
	3 or more	74.94	25.06	0.99
Papers	None	86.20	13.80	0.55
	1 or 2	76.50	23.50	0.93
	3 to 5	78.34	21.66	0.86
	6 to 10	69.67	30.33	1.20
	11 or more	67.84	32.16	1.28
Patents	None	75.38	24.62	0.98
	One	67.28	32.72	1.30
	2 or more	70.34	29.66	1.18
Company start-up	No	79.07	20.93	0.83
	Yes	82.31	17.69	0.70
Supervision of Master 's or doctoral thesis	No	82.23	17.77	0.70
	Yes	73.31	26.69	1.06
Collaboration in international research groups	No	89.76	10.24	0.41
	Yes	63.58	36.42	1.44

Table III. Logit models for the probability of having participated in international mobility. Academic returns of Spanish doctorate holders. (Source: HRST. 2009)

		Total			Men			Women		
		B	Exp(B)	P>z	B	Exp(B)	P>z	B	Exp(B)	P>z
Sex	Men	r.p.								
	Women	0.023	1.023	0.106	-			-		
Age	16-34 years	r.p.								
	35-39 years	-0.829	0.437	0.000**	-0.862	0.422	0.000**	-0.894	0.409	0.000**
	40-44 years	-1.758	0.172	0.000**	-1.881	0.152	0.000**	-1.735	0.176	0.000**
	45-49 years	-2.174	0.114	0.000**	-2.515	0.081	0.000**	-1.841	0.159	0.000**
	50-54 years	-2.618	0.073	0.000**	-2.752	0.064	0.000**	-2.608	0.074	0.000**
	More than 55 years	-2.928	0.053	0.000**	-3.148	0.043	0.000**	-2.745	0.064	0.000**
Potential labour experience	PLE	0.069	1.071	0.000**	0.012	1.012	0.191	0.172	1.188	0.000**
	PLE ²	-0.007	0.993	0.000**	-0.001	0.999	0.277	-0.018	0.982	0.000**
Marital Status	Married or cohabiting	r.p.								
	Single	0.557	1.745	0.000**	0.719	2.052	0.000**	0.351	1.420	0.000**
	Others (Separated, divorced or widowed)	0.573	1.774	0.000**	0.880	2.411	0.000**	0.184	1.202	0.000**
Autonomous Community of residence	Andalusia	r.p.								
	Catalonia	-0.174	0.840	0.000**	-0.040	0.961	0.274	-0.362	0.696	0.000**
	Madrid	-0.010	0.990	0.686	0.311	1.364	0.000**	-0.387	0.679	0.000**
	Valencia	-0.381	0.683	0.000**	-0.173	0.841	0.000**	-0.604	0.547	0.000**
	Galicia	-0.170	0.843	0.000**	0.225	1.252	0.000**	-0.700	0.496	0.000**
	Rest of regions	-0.167	0.846	0.000**	-0.053	0.948	0.075	-0.359	0.698	0.000**
Area pf doctorate	Natural Sciences	r.p.								
	Engineering and Technology	-0.544	0.581	0.000**	-0.872	0.418	0.000**	0.105	1.111	0.011**
	Medical Sciences	-0.561	0.571	0.000**	-0.786	0.456	0.000**	-0.358	0.699	0.000**
	Agricultural Sciences	-0.455	0.634	0.000**	-0.633	0.531	0.000**	-0.181	0.835	0.001**
	Social Sciences	-0.361	0.697	0.000**	-0.162	0.851	0.000**	-0.605	0.546	0.000**
	Humanities	-0.023	0.977	0.310	-0.236	0.790	0.000**	0.169	1.184	0.000**
Books	None	0.000	0.000	0.000**	0.000	0.000	0.000**	0.000	0.000	0.000**
	1 or 2	0.118	1.126	0.000**	-0.029	0.971	0.207	0.376	1.457	0.000**
	3 or more	0.103	1.109	0.000**	0.089	1.093	0.001**	0.198	1.220	0.000**
Papers	None	r.p.								
	1 or 2	0.176	1.192	0.000**	-0.321	0.726	0.000**	0.630	1.878	0.000**
	3 to 5	-0.108	0.898	0.000**	-0.624	0.536	0.000**	0.291	1.338	0.000**
	6 to 10	0.128	1.136	0.000**	-0.305	0.737	0.000**	0.426	1.531	0.000**
	11 or more	0.213	1.238	0.000**	-0.108	0.898	0.007**	0.319	1.376	0.000**
Patents	None	r.p.								
	One	0.068	1.070	0.021**	-0.435	0.647	0.000**	0.844	2.325	0.000**
	2 or more	0.052	1.054	0.128	0.169	1.184	0.000**	-0.133	0.876	0.027**

r.p. reference person. ** Level of significance > 95 %.

Table IV. Logit models for employability and international mobility of Spanish doctorate holders. (Source: HRST. 2009)

		Total			Men			Women		
		B	Exp(B)	P>z	B	Exp(B)	P>z	B	Exp(B)	P>z
Sex	Men	r.p.								
	Women	-0.411	0.663	0.000**	-			-		
Age	16-34 years	r.p.								
	35-39 years	0.259	1.296	0.000**	0.981	2.667	0.000**	-0.093	0.912	0.136
	40-44 years	0.389	1.475	0.000**	0.929	2.533	0.000**	0.046	1.047	0.513
	45-49 years	0.782	2.187	0.000**	0.656	1.928	0.000**	0.929	2.531	0.000**
	50-54 years	0.307	1.359	0.000**	0.829	2.292	0.000**	-0.232	0.793	0.008**
	More than 55 years	-1.574	0.207	0.000**	-1.714	0.180	0.000**	-1.242	0.289	0.000**
Potential labour experience	PLE	0.098	1.103	0.000**	0.097	1.102	0.000**	0.089	1.093	0.000**
	PLE ²	-0.003	0.997	0.000**	-0.004	0.996	0.000**	-0.002	0.998	0.039**
Marital Status	Married or cohabiting	r.p.								
	Single	-0.188	0.828	0.000**	-1.010	0.364	0.000**	0.438	1.550	0.000**
	Others (Separated, divorced or widowed)	0.053	1.054	0.282	0.229	1.257	0.003**	-0.071	0.931	0.270
Autonomous Community of residence	Andalusia	r.p.								
	Catalonia	0.068	1.070	0.196	-0.106	0.900	0.121	0.084	1.088	0.319
	Madrid	-0.347	0.707	0.000**	-0.173	0.841	0.007**	-0.594	0.552	0.000**
	Valencia	-0.234	0.792	0.000**	0.002	1.002	0.980	-0.559	0.572	0.000**
	Galicia	0.310	1.363	0.000**	0.482	1.619	0.000**	0.055	1.056	0.538
	Rest of regions	-0.190	0.827	0.000**	0.171	1.186	0.003**	-0.569	0.566	0.000**
Area of doctorate	Natural Sciences	r.p.								
	Engineering and Technology	0.490	1.633	0.000**	0.747	2.112	0.000**	0.322	1.380	0.000**
	Medical Sciences	0.526	1.692	0.000**	0.614	1.847	0.000**	0.505	1.657	0.000**
	Agricultural Sciences	-0.401	0.670	0.000**	-0.087	0.916	0.396	-0.547	0.578	0.000**
	Social Sciences	0.376	1.457	0.000**	0.021	1.021	0.690	0.895	2.446	0.000**
	Humanities	-0.307	0.736	0.000**	-0.284	0.753	0.000**	-0.162	0.850	0.001**
International Mobility	No	r.p.								
	Yes	0.435	1.545	0.000**	0.765	2.148	0.000**	0.285	1.330	0.000**
Constant		3.034	20.781	0.000**	2.931	18.751	0.000**	2.811	16.625	0.000**
-2 log probability		56.797			26.750			28.408		
Cox and Snell R-square		0.030			0.051			0.020		
Nagelkerke R-square		0.112			0.203			0.071		

r.p. reference person. ** Level of significance > 95 %.

Table V. Ordered logit models (*ologits*) for labour occupation hierarchy and international mobility of Spanish doctorate holders. (Source: HRST. 2009)

	B ¹	Exp(B) (No Mobility)	1-Exp(B) (Mobility)	R ² Cox and Snell
ISCO-88 and Professional Status	0.292**	1.339	0.661	0.190
Original ISCO-88 occupations	0.399**	1.490	0.510	0.223
Professional status	-0.260**	0.771	1.229	0.218
Original ISCO-88 occupations				
Men	0.382**	1.465	0.535	0.226
Women	0.443**	1.557	0.443	0.230
Professional status				
Men	-0.178**	0.837	1.163	0.192
Women	-0.396**	0.673	1.327	0.250

No international mobility is the reference category. **Level of significance > 95%.

Table VI. Ordered logit models (*ologits*) for net annual income and international mobility of Spanish doctorate holders.

	B	Exp(B) (No Mobility)	1-Exp(B) (Mobility)	R ² Cox y Snell
Total	0.082**	1.085	0.915	0.241
Men	0.117**	1.124	0.876	0.242
Women	0.049**	1.050	0.950	0.189
Higher Education	-0.043**	0.958	1.042	0.236
Men	0.061**	1.063	0.937	0.221
Women	-0.091**	0.913	1.087	0.254
Higher Education with academic return variables	0.099**	1.104	0.896	0.250
Men	0.159**	1.172	0.828	0.249
Women	0.053**	1.054	0.946	0.281

**Level of significance > 95%. (Source: HRST. 2009)

Annex.

Figure A.I. Perceptual distribution of Spanish doctorate holders by age and international mobility (Yes or no). (Source: HRST. 2009)

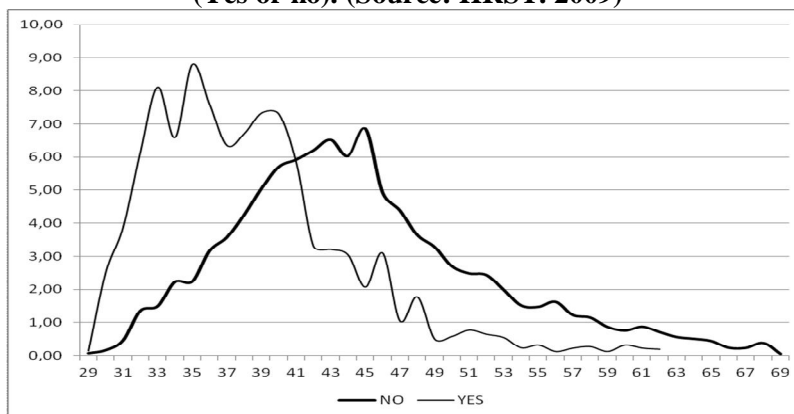


Figure A.II. Perceptual distribution of Spanish doctorate holders by labour occupations (ISCO-88 and Professional Status). (Source: HRST. 2009)

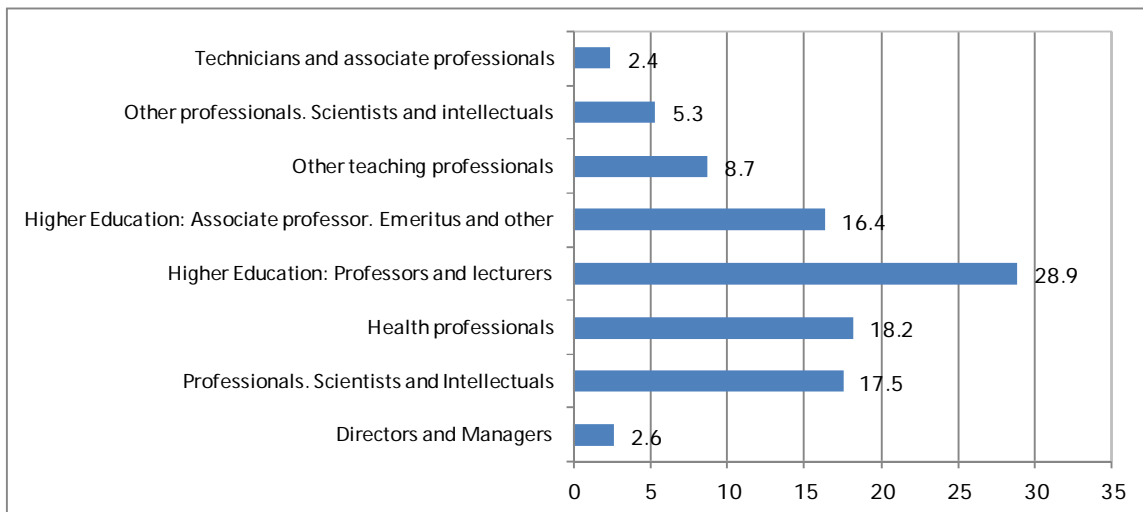


Figure A.III. Perceptual distribution of Spanish doctorate holders by professional status in higher education. (Source: HRST. 2009)

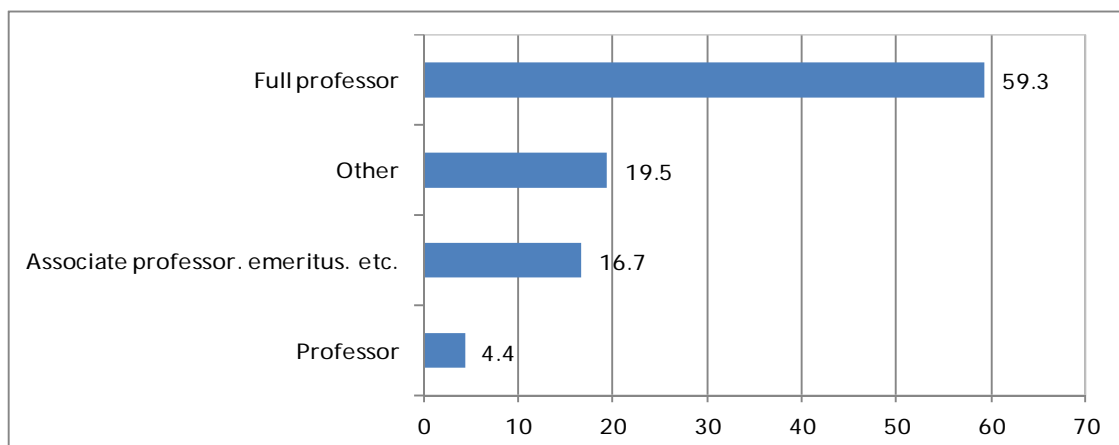


Table A.I. Pearson correlations between academic and professional returns and international mobility. (Source: HRST. 2009)

Variables	Correlations	International Mobility
Annual net income	Correlation of Pearson	-0.173
	Sig. (bilateral)	0.000**
Books (2007-2009)	Correlation of Pearson	0.000
	Sig. (bilateral)	0.926
Papers (2007-2009)	Correlation of Pearson	0.132
	Sig. (bilateral)	0.000**
Patents (2007-2009)	Correlation of Pearson	0.038
	Sig. (bilateral)	0.000**
Forming a company (2007-2009)	Correlation of Pearson	-0.013
	Sig. (bilateral)	0.000**
Supervision of Master’s or doctoral thesis (2007-2009)	Correlation of Pearson	0.104
	Sig. (bilateral)	0.000**
Collaboration with international research groups (2007-2009)	Correlation of Pearson	0.316
	Sig. (bilateral)	0.000**

** Level of significance > 95%.

Table A.II. Factorial analysis of academic and professional returns and Pearson correlation between obtained factors and international mobility. (Source: HRST, 2009)

Variables	Component scores	
	Group 1 (factor 1)	Group 2 (factor 2)
Annual net income	0.131	0.259
Books (2007-2009)	0.267	-0.243
Papers (2007-2009)	0.392	-0.189
Patents (2007-2009)	0.160	0.556
Forming a company (2007-2009)	0.052	0.665
Supervision of Master's or doctoral thesis (2007-2009)	0.365	-0.015
Collaboration with international research groups (2007-2009)	0.341	-0.039

Factors	Correlations	International mobility
Factor 1	Correlation of Pearson	0.151(**)
	Sig. (bilateral)	0.000
Factor 2	Correlation of Pearson	-0.064(**)
	Sig. (bilateral)	0.000

** Level of significance > 99%.