

## INTERNATIONAL MOBILITY OF SPANISH MEN AND WOMEN DOCTORATE HOLDERS

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**Abstract:** Scientists are faced with many challenges along their international trajectory as they balance professional and family goals. Certain theoretical frameworks support the concept that career paths are shaped by social and institutional forces in science, whereas other theories point to family constraint factors as the reasoning behind scientists' decisions to either go abroad or return home. Commonly, women scientists report many challenges when deciding to move internationally.

In this paper we aim to exploit data from the Survey on Human Resources in Science and Technology, carried out by the Spanish Statistical Office in 2010, by analysing the life course of 4,123 Spanish doctorate holders. The results indicate there is a strong influence of institutional forces constituting a scientific culture which promotes rules and certain habits about how scientists should progress in their careers. Such forces lead to increasing rates of international mobility. At the same time, the data reveal that decisions about leaving and returning depend on the life course of the doctorate holder, and usually involve some family and personal considerations. Women have adopted a similar career track to men regarding international mobility, although women with children present low rates of high mobility and, by contrast, childless women present higher rates of high mobility than childless men.

**Key Words:** international mobility, women scientists, children, scientific culture, career track.

## **Introduction**

It is broadly known that scientists are recently more mobile than ever before. This phenomenon can be explained by the internationalisation of higher education and the globalisation of the scientific labour market (Connell and Wood, 2002; Recchi and Favell, 2009). Nowadays, international mobility is critical for professional development (Mahroum, 2000; Iredale, 2001) and, according to Ackers (2008), it often serves as a transitional stage for scientists to gain access to steadier and higher positions in academia.

Not surprisingly, personal and professional goals are intertwined throughout scientists' lives. Frequently, scientists make mobility decisions simultaneously with significant decisions about personal life (e.g. marriage, parenthood, place of residence, professional goals, etc.). In this paper we assume that personal and professional spheres are mutually affected and, correspondingly, mobility shapes and is shaped by the life course of the doctorate holders.

Thus far literature tends to emphasise the impact that family has on doctorate holders' decisions regarding mobility and professional development (Cooper and Makin, 1985; Bielby and Bielby, 1992; Kley, 2011; Ackers, 2004; Tharenou, 2008; Shauman, 2010). In the same vein, a common understanding establishes that women cope with family obstacles to a greater extent than men when pursuing international mobility and professional development in scientific careers (Xie and Shauman, 2003; Ackers, 2004; Shauman, 2010; Kley, 2011).

This paper aims to identify the influences that drive international mobility decisions of men and women doctorate holders in science careers by analysing the mobility strategies of Spanish scientists from the Survey on Human Resources in Science and Technology, led by the Spanish Statistical Office. The survey highlights significant differences between men and women's mobility patterns. As a result, this paper contributes to broadening the spectrum of literature on mobility by adopting a gender perspective and exposing the findings from the survey. Using the Spanish Survey on Human Resources in Science and Technology allowed an in-depth international comparison, since the survey was led across European countries by the OCDE in collaboration with UNESCO, and conducted by the European Statistical Offices.

In the first section we explore the main debates in literature on mobility and gender and the effect of mobility strategies on the family. We finalise this section with two questions which guide our research. Second, the methodology section addresses the Survey on Human Resources in Science and Technology and the corresponding analysis we carried out for the purpose of this study. This section also exposes the limitations of the data in its portrayal of the mobility experience of Spanish

doctorate holders. The third and fourth sections illustrate a description of the data and the results of the statistical analysis. Finally, section five summarises the main conclusions and proposes initiatives to stimulate fair play for movers and, particularly, for women involved in scientific careers.

### **International Mobility Determinants and Patterns of Spanish Researchers**

The importance of international mobility for professional development in individual careers is highlighted in a considerable number of scientific works (Mahroum, 2000; Suutari, 2003; Ackers, 2008; Solimano, 2008). Most of these works emphasise the positive effects of international mobility over its negative effects, or the absence of any effects; for example, mobility fosters the acquisition of new skills and competences, provides socialisation for new members within the scientific area (Gläser and Laudel, 2001) and allows scientists to gain prestige derived from influential networks (Laudel, 2001).

The growing importance of mobility in scientific careers has inspired recent works about the agency of highly skilled professionals managing their own careers through international mobility, and progressing within their careers throughout different organisations and contexts (Arthur and Rousseau, 1996; De Fillipi and Arthur, 1996; Bimber et al., 2005; Sullivan and Arthur, 2006; William, 2006; Jokinen et al., 2008). Despite its growing importance, Inkson et al. (2012) point out that that agency of highly skilled people is strongly restricted by established institutional forces, therefore, the advancement of their careers depends on social and economic forces. According to Castells (1996) and Held et al. (1999), there are certain limitations regarding migration policies and work permits, depending on the nationality of the highly skilled professional and the country of destination. Further to the aforementioned literature, González Ramos (2011) states that Spanish scientists are likely to move internationally in response to the lack of desirable professional opportunities in the domestic labour market, even if it means overcoming important personal challenges.

The forces which drive mobility are diverse and interrelated, both on an institutional and individual level. From an institutional perspective, the knowledge area plays a primary role in mobility decisions. For example, some scientific cultures are more likely than others to promote international careers because of international collaborations (Gläser, 2001; Connell and Wood, 2002). Mobility may be inevitable because certain disciplines require special equipment such as astrophysical

observatories, big laboratories or supercomputer centres located outside the home country.

From an individual perspective, there are important issues involved in the life course of highly skilled people. Literature on this topic links mobility decisions with biological and personal dimensions, and empirical evidence shows that mobility depends on the age of the scientist. Young scientists are more likely than their older counterparts to move internationally for learning purposes or even to satisfy an adventurous spirit. On the contrary, older professionals place more value on other commitments related to family and the workplace and may choose to remain in the home country (Blossefeld et al., 2005; Buchholz et al., 2009). Cooper and Makin (1985) show that people under 35 years old with no children are more mobile than those with children because accommodation is marginally less important to them. These studies highlight age and life course as important dimensions in the decision-making process regarding mobility.

Gender, and its affect on mobility, is an important dimension that contextualises the theoretical approach of this paper. When analysing mobility patterns of highly skilled women, family and partnership are often cited as the main challenges which consign women to slow professional progression and drop-outs in their careers (Bagilhole and Goode, 2001; Hardill, 2004; Ackers 2004, 2008). González and Vergés (2012) point out that woman hold a more vulnerable position than their male counterparts due to traditional roles within society which may affect their decisions about balancing family and careers throughout their entire life course. Their research sustains that non-linear careers and slow progression of women might be explained by institutional constraints in a male-dominated model, along with personal decisions about balancing family and professional aspirations.

Despite facing institutional constraints, women raise stimulating debates concerning mobility rates. In the past, literature portrayed women with little interest in international careers (Mincer, 1978) but this idea was refuted as women began taking on new professional roles in subsequent decades (Adler, 1984; Bielby and Bielby, 1992; Selmer and Leung, 2003). More recently, empirical data about migration trends in the world show that skilled women migrate even more than skilled men (Docquier et al., 2007 and 2009; Dumont et al., 2007). According to Kofman (2000 and 2012), the invisibility of the female workforce is due to gender segregation in the labour market which undervalues the presence of professional women across the world.

Contemporary literature offers a new interpretation of women's mobility. For example, Faggian et al. (2007) suggest that mobility of women might partially be the result of a gender bias in the domestic labour market. The researchers state that women may use migration as a counterweight to

balance employment difficulties in hostile labour environments. Instead of remaining unemployed or underemployed, women might decide to move in search of more female labour-friendly environments. Similar to men, women adopt the decision to move to other countries due to their strong desire to advance professionally. In couples, recent studies suggest that the partner with the highest opportunity in the labour market (regardless of their sex) might take the initiative to move abroad even if it affects the whole family (Green, 1997; Hardill, 2004; Ho, 2009; Leemann, 2010). Dual-career scientist partners tend to engage in more negotiated decisions about mobility, since both partners are mutually interested in developing a professional career and having a family. According to the social exchange theory (Hood, 1983; Bielby and Bielby, 1992; Abraham et al., 2010), decisions about mobility are negotiated by the couple. Both partners express their reasons and make commitments in line with the family interest, although men and women express different reasons from the gender-role ideology.

Thus, according to previous literature we propose the following two research questions:

1. To what extent is agency important to men and women separately for designing their own careers along their life course? Or, conversely, to what extent are their decisions about mobility affected by institutional constraints enforced by scientific cultures?
2. To what extent are personal and family circumstances decisive in explaining men and women's mobility patterns? This question aims to expose the mutual influence of professional and personal decisions during the doctorate holder's life course.

### **Description of Data and Analysis Design**

The objective of the Survey on Human Resources in Science and Technology from the Spanish Statistical Institute was to analyse labour conditions, employment and mobility patterns of Spanish doctorate holders (ISCED 6 and PhD) younger than 70 years old. The survey was based on a sample of 4,123 doctorate holders, who were selected from the directory of doctorate holders of the University Council, and complemented with data from the Census of Inhabitants. The study used a systematic equal probability sampling method with a random starting point. Doctorate holders were classified by the year that they received their doctoral degree, their age, the university where they studied and their current place of residence.

The information from this survey was obtained by using a mixed method of administration. A first round of questionnaires was distributed by post, fax, telephone or internet. In order to complete the

second round of questioning, researchers carried out personal interviews with participants. Eventually the response rate reached 68.7%.

The survey was administered in 2009, although mobility questions covered the period from 2000 to 2009. The questions referred to the mobility strategies of doctorate holders, taking into account the following aspects: stays for a minimum period of three months, destination countries, and how long doctorate holders lived in each country from 2000 to 2009. The long time period for the study allowed researchers to thoroughly examine the mobility experience of the doctorate holders. We used the information to classify doctorate holders according to frequency of mobility along their life course. As a result of this analysis, the data produced three groups of movers based on a low, medium, or high pattern of mobility.

The analysis plan consisted of exploring the movers' characteristics in terms of professional features (career phase, knowledge field, and sector of occupation) and personal information (sex, age, marital status, and parenthood). In order to address the first research question, we examined the probability of moving internationally for men and women doctorate holders separately, assuming that the two groups may show different patterns of mobility. A segmentation analysis was carried out in order to confirm this hypothesis and reveal the importance of personal and professional characteristics in predicting mobility. For the second research question, we examined the influence of personal and professional motivations on the decision to move, taking into account different mobility patterns and parenthood status of the doctorate holders.

Our analysis covers doctorate holders with medium and long-term experiences (at least 3 months) since the survey provides valuable information about the mobility of doctorate holders who stay at least three months, but lacks information on shorter periods of mobility. The survey does not include information about short stays (less than three months) which is quite common among academics. This lack of information produces a limitation in the data.

### **Who are the Movers in the Spanish Innovation System? Description of Personal and Professional Features of Male and Female Movers**

According to the Survey on Human Resources in Science and Technology, only 20.71% of the global population have moved internationally during their professional careers. A first glance at the data reveals that women are more likely than men to move, although there is no statistical confidence; mobile women represent 21.78% of movers, whereas men represent 18.87%. Despite the slight difference between the number of men and women movers, the mobility patterns of both

groups vary greatly, as we can observe upon further analysis.

The results also highlight personal and professional determinants in the profile of doctorate holders who move internationally. As literature illustrates (Cooper and Makin, 1985; Blossfeld et al., 2005; Buchholz et al., 2009) doctorate holders under 35 years old show the highest percentage of international mobility. As previously suggested, Table 1 states that rates of mobility decrease when the population is older. The same trend can be observed across gender lines. Additionally, mobility is more frequent among single doctorate holders (around a third of the total population for both men and women) than among married, divorced, or widowed doctorate holders. Certainly, parenthood is a determinant in mobility decisions, as doctorate holders without children show the highest percentage of international mobility. Conversely, doctorate holders with children show the lowest rates of mobility. The number of children in the family is also a determining factor when moving; when doctorate holders have one child under the age of 18, the mobility ratio reaches 13.89 (13.10% men; 14.96% women); however, with two or more children, the ratio decreases to 8.46 (8.47% men; 8.43% women).

**Table 1. Percentages of International Mobility and Characteristics of Doctorate Holders**

		<b>Total</b>	<b>Men</b>	<b>Women</b>
		20.71	19.87	21.78
<b>Personal Dimensions</b>				
<b>Age</b>	29 – 34	53.35	57.00	50.00
	35 – 40	32.44	34.39	30.57
	41 – 48	12.43	12.93	11.76
	49 – 69	4.87	4.00	6.60
<b>Marital Status</b>	Married	17.14	15.60	19.33
	Single	33.51	36.89	30.30
	Divorced or similar and widowed	15.66	17.74	13.60
<b>Children under 18</b>	No minor	26.87	26.04	27.89

	One minor	13.89	13.10	14.96
	Two or more minors	8.46	8.47	8.43
<b><i>Professional Dimensions</i></b>				
<b>Areas of Doctorate Degree</b>	Natural Science	31.38	32.65	29.67
	Engineering	20.23	15.6	32.29
	Health Science	10.05	7.16	12.93
	Agriculture Science	22.39	18.06	27.42
	Social Science	17.01	18.00	15.89
	Humanities	17.16	12.80	22.59
<b>Doctorate Grant</b>	No	12.68	11.72	14.13
	Yes	32.79	34.63	30.96
<b>Income</b>	< 20,000	25.19	25.74	24.84
	20,001 – 35,000	28.36	31.74	25.16
	35,001 – 45,000	21.52	18.38	25.41
	> 45,000	12.71	12.98	12.17
<b>Sector</b>	Higher Education	25.52	25.93	24.96
	Government	17.54	15.90	19.49
	Private	14.81	12.15	18.18
	IPSFL	25.97	26.44	25.37
	Unemployment	26.97	23.08	30.00

Professional determinants also play a role in mobility decisions, as mobility seems to vary depending on the knowledge area of the doctorate holder. First, the natural sciences field has a high rate of mobility (31.38%). Second, women in engineering show rates of international mobility twice

as high as their male counterparts, which can be explained by the hypothesis of Faggian et al. (2007) regarding the counterbalance of gender bias in the labour market. According to these authors, women engineers who face great employment obstacles in a male-dominated environment (Cockburn, 1999; Faulkner, 2000) would be driven to migrate more frequently than their male counterparts. Third, these data confirm the results of Cañibano et al. (2011) that scientific cultures seem to differ in their mobility patterns and even in their motivation for moving in the first place.

International mobility increased significantly if doctorate holders had obtained a research grant (32.79%). This relationship underlines the importance of institutional cultures driving the doctorate holders' careers and, as Gläser and Laudel (2008) propose, such processes contribute to the socialisation of new members along their career paths. In such a way, scientists who were selected as doctoral students received additional support for developing their careers, which very likely encouraged them to move internationally, becoming catalysts for excellence (Elder et al., 2011).

Unemployed doctorate holders present the highest percentage of mobility (26.97%). This fact bolsters the theory of Faggian et al. (2007) which explains the great tendency of mobility for marginalized players in the scientific labour market. It seems that the unemployed population leaves the home country in response to the lack of opportunities in the labour market. Once again, unemployed women show a greater percentage of mobility than unemployed men (women reach 30%; men, 23.8%) indicating that women face more obstacles in gaining access to the labour market. These findings present an interesting line of research for further studies.

To find out what determinants are the best predictors of international mobility, we carried out a segmentation analysis based on the CHAID (Chi-Squared Automatic Interaction Detection) algorithm (Kass, 1980). This analysis uses non-binary decision trees for large datasets in a recursive partitioning method. The first step is to create a categorical predictor out of any continuous predictors by dividing the respective continuous distributions into a number of categories with an approximately equal number of observations. The next step is to cycle through the predictors to determine the pair of categories for each predictor that is least significantly different to the dependent variable computing Person Chi-square tests. If the respective test for a pair of predictor categories is not statistically significant as defined by the alpha-value, then it will merge the respective predictor categories and repeat this step (i.e., find the next pair of categories which now may include previously merged categories). The next step is to choose the split predictor variable with the smallest adjusted p-value. This process continues until no further splits can be performed, given the alpha-values and p-values.

In order to predict international mobility for men and women separately, it was necessary to build two different decision trees for men and women. As predictor or explanatory variables, we used the large dataset with all the previous dimensions of the dataset: age of doctorate-holder, marital status, parenthood, areas of doctorate degree, grant, sector of performance and salary. The CHAID procedure uses three criteria for eligibility: firstly, the size of the nodes where the parent node was >100 and the child node was >30; secondly, the level of significance ( $=0.01$ ); and thirdly, the maximum level of segmentation (3 levels maximum). We decided to split two decision trees because previous analysis showed that the general model was unspecific about gender. In terms of quality criteria, both models show high overall percentages of classification: 79.2% for the women’s decision tree and 83.2% for the men’s decision tree. The figure in Annex 1 shows both decision trees.

The decision trees for men and women’s samples show that age is the best predictor for explaining international mobility. The age groups are similar in both sexes. The women’s sample is split into three groups: Under 35, 35-40 and over 40, whereas men are split into four groups: Under 35, 35-39, 40-48 and over 48. This last group in the male sample includes 600 doctorate holders without international experience. As a result, we conclude that successive cohorts show different and incremental patterns of mobility.

In the second level of prediction, the data show more diversity between men and women’s patterns of mobility. International mobility of women is depicted by grants received, knowledge area and income. It is not until the third level of prediction that marital status appears as a determinant. Conversely, the second level of prediction in the men’s sample introduces three variables: 1) Sector of performance; 2) Area of knowledge; and 3) Marital status. In the male model doctoral grants do not appear as a determinant that drives international mobility until the third level of prediction.

Table 2 shows the final groups displayed by the CHAID algorithm, indicating the main dimensions that predict mobility for male and female doctorate holders.

**Table 2. Main Predictors of International Mobility for Male and Female Doctorate Holders**

<b>Node</b>	<b>Dimensions</b>	<b>Probability</b>	<b>N</b>	<b>p-value</b>
<b>Women</b>				
<35	Doctorate grant	0.55	92	.007

	Without grant	0.35	21	
35-40	Natural Sc., Eng. & Humanities	0.40	128	.000
	Health, Social Sc. & Agriculture	0.20	53	
>40	≤ 35,000	0.8	25	.010
	>45,000	0.8	26	
	35,001-45,000 & single	0.30	51	.000
	35,001-45,000 & other marital status	0.11	30	
<b>Men</b>				
< 35	Gov., Higher Ed., IPSFL & grant	0.71	82	.002
	Gov., Higher Ed., IPSFL & no grant	0.46	26	
	Unemployed & private sector	0.28	10	.006
35-40	Natural Sciences & single	0.65	51	.005
	Natural Sc. & other marital status	0.43	77	
	Other areas, unemployed, High. Edu.	0.32	50	.001
	Other knowledge areas & sectors	0.12	19	
41-48	Single, divorced & widowed	0.24	46	.000
	Married & doctoral grant	0.17	41	.000

	Married & no doctoral grant	0.7	33	
>48		0.4	24	.000

According to the results, men under 35 who work in the government sector, higher education or non-profit institutions, and with some type of doctoral grant, show the highest probability of international mobility (.71). In second place, the best predictors of mobility for men aged 35-40 are knowledge area and marital status (.65). Finally, in third place, age and doctoral grants explain the highest probability of women’s mobility (.55). In other words, being a woman under 35 years old with a doctoral grant is the best predictor of mobility. Single male movers among the 35-40 age group are most commonly from the natural science field, whereas female movers from the same age group are involved in natural science, engineering or humanities (.40).

Generally, single men and women present the highest probability of international mobility, for example, women over 40 years old with a salary of €35,001-45,000 (.30), and men aged 35-40 involved in natural science (.65). Married men present a low probability of moving internationally, even if they have received some type of doctoral grant (.24). This effect is relevant in our discussion regarding family interference and personal issues for men and women movers. Correspondingly, it confirms that life course and, particularly, partnership and family are relevant to predict mobility rates for doctorate holders.

Two questions in the survey (see Table 3) address the influence of professional and personal issues on the decision of leaving and returning. Percentages indicate that doctorate holders left Spain for different reasons: academic purposes (60% men; 55.6% women); postdoctoral positions (34.1% men; 33.3% women); and the pursuit of new jobs (22.7% men; 24% women). Conversely, personal and family issues make up a low rate of mobility, although women present a higher percentage of responses (10.4%), than men (8.1%). In summary, women’s responses show that their career tracks drive their individual decisions about planning and executing international mobility experiences.

**Table 3. Motivations for Leaving and Returning by Sex**

	Leaving		Returning	
	Men	Women	Men	Women

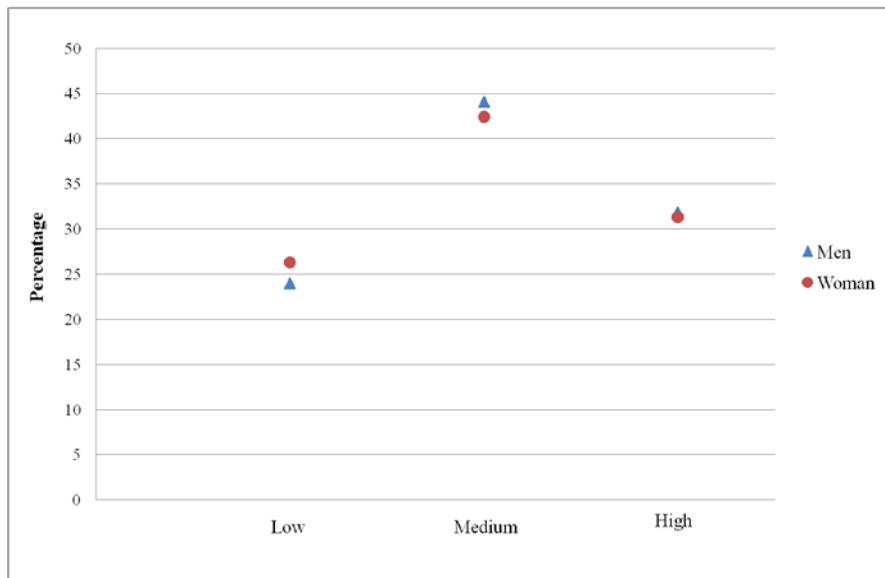
Doctorate	13.1%	14.9%	14.5%	15.4%
Postdoctoral	34.1%	33.3%	17.7%	22.6%
Job offer	22.7%	24.0%	30.4%	27.9%
Academic	60.0%	55.6%	20.3%	15.2%
Family	8.1%	10.4%	35.7%	38.6%
Politics	0.2%	0.3%	2.5%	2.7%
Other	8.7%	5.3%	12.4%	12.2%

When asked about their decisions to return, both women and men reported family reasons as a main motivation, but women slightly exceeded men (35.7% men; 38.6% women). According to their responses, the next best predictors for returning are job offers (30.4% men; 27.9% women) and academic projects (20.3% men; 15.2% women). From these results we conclude that the motivation for returning does not vary as much as we expected between men and women doctorate holders. In order to clarify if male and female careers differ regarding family-issue related mobility, we need to collect more details from the data set, as we will do upon further analysis.

### **Mobility Patterns of Frequent Movers**

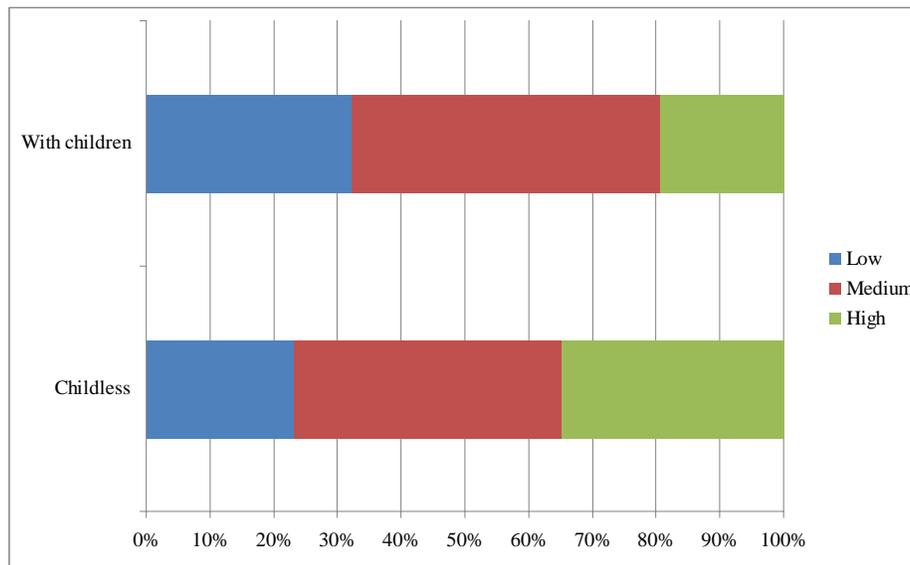
In this section we address mobility patterns in terms of frequency of stays over the last ten years, which allows us to determine the factors that shape international mobility decisions of doctorate holders. The Spanish survey of Human Resources in Science and Technology provides information about the number of stays carried out from 2000 to 2009, which split the sample of movers into three different groups: 23.1% of movers completed one or two stays, 43.3% completed three stays, and 31.6% completed four or more stays. In summary, the number of doctorate holders who completed three or more stays in the last ten years surpasses those who only completed one or two stays. Based on this portrayal of the sample, we classified movers into three profiles: Low, medium, and high level of mobility. Figure 1 shows patterns of mobility according to these profiles of the doctorate holders. Both men and women set similar trends, although women exceed men only in the low level category of mobility.

**Figure 1. Patterns of Mobility for Male and Female Movers**



Thus, further analysis is necessary to determine how family issues are affecting men and women’s patterns of mobility. Figure 2 shows a significant association (p-value .000) between parenthood and the mobility pattern of doctorate holders. This association indicates that movers with children typically show a low pattern of mobility as opposed to their childless counterparts who are more likely to move internationally. On the one hand, doctorate holders without children make up a large percentage of movers with a high level of mobility; 34.9% of this group completed four or more stays in the last ten years. On the other hand, doctorate holders with children comprise the lowest percentage of movers with a high level of mobility (19.4% completed three or more stays). In other words, movers with children usually completed one or two stays in the last ten years, whereas movers without children presented higher percentages of high mobility patterns with four or more stays during the last ten years.

**Figure 2. Mobility Patterns for Parent Movers**



By contrast, Table 4 does not show significant differences for explaining mobility patterns according to frequency of mobility and sex of the doctorate holders, and the Chi-Square confirms that no association exists between sex, parenthood, and frequency of mobility. Nevertheless, the data set in Table 4 shows that women with children report the lowest rates of high mobility (12.5%), and childless women report the highest rates of high mobility (36.1%), even more than childless men (33.8%). These figures suggest that women are more conditioned by children than men, as they represent the two extremes of mobility frequency. This result suggests that women’s decisions vary greatly depending on their personal and professional goals. When compared to male mobility patterns, childless women are even more strongly oriented to professional careers and pursuing internationalisation.

**Table 4. Mobility Patterns Based on Parenthood and Sex of Movers**

		<b>Low</b>	<b>Medium</b>	<b>High</b>
<b>With children</b>	Men	28.0%	47.0%	25.0%
	Women	37.5%	50.0%	12.5%
<b>Childless</b>	Men	22.9%	43.3%	33.8%

	Women	23.4%	40.5%	36.1%
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### **Institutional Forces and Personal Decisions in the Life Course of Movers**

The results of the Spanish Survey on Human Resources in Science and Technology suggest that international mobility is still concentrated in a small sector of doctorate holders (20%), although patterns have been increasing in recent times as younger generations are more mobile than their older predecessors. Mobility rates decrease throughout different cohorts, showing high percentages of mobility among young cohorts. The survey results reflect the recent adoption of the internationalisation of scientific careers in Spain and, more importantly, they demonstrate the life course effect, where the younger the doctorate holder is, the higher the probability is of pursuing international mobility.

The primary motivations that movers give to explain mobility are academic reasons or employment in postdoctoral phases. In other words, mobility fosters career development. Correspondingly, the probability of being internationally mobile in scientific careers increases, as there is a high percentage of movers who have received doctoral grants within this group. In that sense, an unfair distribution of grants may disfavour the competitiveness of candidates in scientific careers, endangering the model of excellence in science. Moreover, scientific cultures tend to push scientists into international careers, wherein some areas entail different patterns of mobility. For instance, the percentage of mobility in natural science is higher than mobility in other knowledge areas. Therefore, mobility is shaped by institutional determinants such as grant schemes and scientific cultures.

Hostile working environments suggest that institutional forces drive the mobility of doctorate holders. The results point to the possibility that scientists are pushed abroad if they are unemployed or if they perceive a hostile environment to access the labour market, such as the case of women in engineering. Since engineering areas are male-dominated workplaces, women may be urged to be mobile. The facts support this theory, although further research is necessary.

Based on these results, we derive that the agency of men and women movers seems limited by institutional forces, although high percentages of frequent mobility also suggest a certain autonomy and decisiveness about doctorate holders' career paths. The results expose doctorate holders with medium (three stays) and high levels of mobility (more than four stays) in the last ten years, suggesting some autonomous decision-making in their careers. This tendency is adopted similarly

by men and women doctorate holders, but women present higher percentages of low level of mobility than men.

The research also highlights that personal and professional purposes are intertwined throughout the life course of doctorate holders, shaping their mobility patterns and life styles. Our analysis confirms that both personal and professional aspirations mould the decisions of men and women in terms of their international mobility patterns. Mobility is more common in single doctorate holders than in married, divorced or widowed people, and their decisions are stimulated by opportunities in the scientific labour market. Men and women expose family and personal reasons for explaining their return to Spain while professional aspirations also play a role.

Data also show a strong link between mobility patterns and parenthood, whereby children seem to influence the mobility patterns of both men and women. Doctorate holders with children show low rates of mobility at every level (low, medium, and high) but these figures increase in the women's sample. By contrast, childless movers report a high percentage of a high level of mobility, which suggests high internationalisation of their careers.

Women show more dependence on family issues than men. According to the survey, family is the most common motivation for return. It seems that children are an influential factor more for women than for men, since women present the lowest and the highest percentages of mobility patterns. Women with children appear more oriented to their families, just as women without children are more oriented to their careers. Indeed, the mobility patterns of childless women raise new insights in feminist research about the agency of women in scientific careers and the importance of decisions about family and work. These women show the highest percentage of mobility which is most likely related to the adoption of a strong professional orientation and even more competitiveness than their male counterparts.

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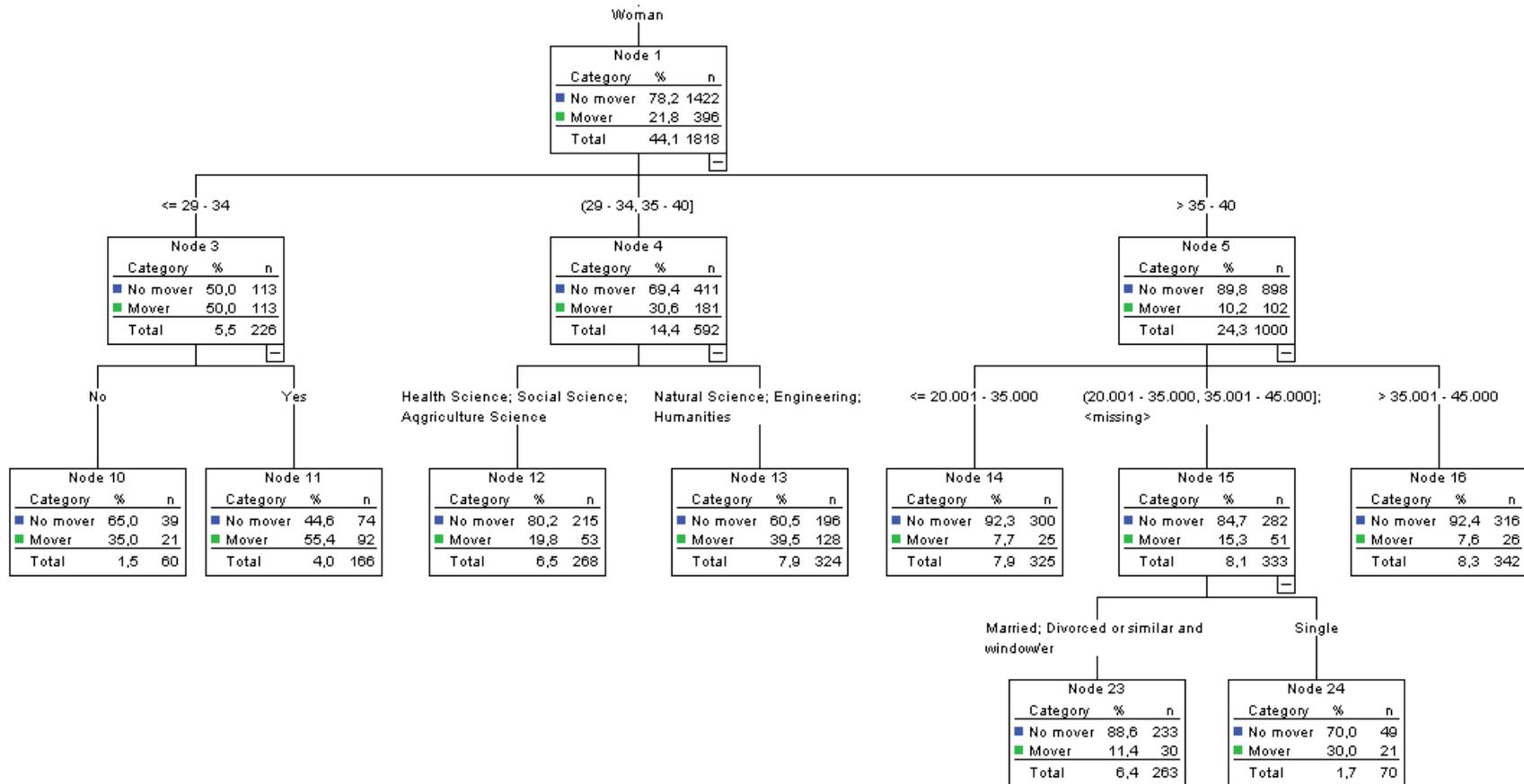
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**Annex 1**

**Female decision tree**



Male Decision Tree

