A double gender-family inequality phenomenon in the international mobility of young researchers

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Abstract

In this paper, we raise the question of gender differences in the geographic mobility of young researchers. We try to answer to three main questions regarding the international mobility of young researchers during the post-doc period: Are there differences among genders? Does "family" have an impact? Is the effect of family related variables similar among genders? With a French survey, we find that if postdoc is as common for women as for men, females are less mobile internationally, especially in direction of the United States. The impact of the "family" on the probability of taking a postdoc position and on the location of postdoc is different among genders. Married women take less frequently such appointments and, when they do so, they are less mobile internationally. There are no similar effects for males.

JEL classification: F22, J16, J61
Keywords: migration; geographical mobility; brain drain; immigrants; family; skilled labor; doctorate; gender gap

Introduction

European countries, as many other OECD countries, seem to have a problem in attracting and retaining students in science, especially at advanced levels, and research tracks. This is particularly the case at post-doctoral level.[1] The European Commission has been interested in this subject for many years now. In January 2000, the EC adopted a communication which proposed the creation of the ERA. This communication also promotes the mobility of researchers. In the chapter 5, "More abundant and more mobile human resources", one can read: "More use should be made of future, at national and European level, of the possibility of using mobility as an instrument of information and technology transfer" (European Commission, 2000, p. 16). In 2001, a specific communication, "A Mobility Strategy for the ERA" followed. Its main goal was to create a favourable environment for the mobility (European Commission, 2001).[2] Recently, the Commission focused on the careers of European scientists. Indeed, themes related to the mobility of researchers can not be decently analysed without dealing with the specific questions related to the profession researchers and their careers.[3] One of the objectives is to attract and retain women and minorities who are still under-represented in many fields, into S&T education and occupations (OECD 2003, Moguérou 2004).

Many studies showed that, in the academic sector, gender differences in career development and scientific productivity are explained by marriage and motherhood. Many women experience conflict regarding their abilities to play simultaneously the role of wife, mother and academics, as family roles remain quite unchanged. Studies reveal that having children affect the scientific productivity of women and/or their career advancement (Cole 1987, Long 1990, Finkel *et al.* 1994, Finkel and Olswang, 1996, Perna 2001, Gaio and Cabral-Cardoso 2002, Mason and Goulden 2002, Varner 2003, Wilson 2003). Women also report specific difficulties with job mobility (Forster 2001) or geographic mobility (Shauman and Xie 1996). On this last aspect, researchers long ago suggested that married women's inability to initiate a family move refrain them in having some career opportunities (Mincer 1978, Marwell *et al.* 1979, Ruane Morrison and Lichter 1988). These questions had often been tested for dual career couples (Boyle *et al.* 1992, Bielby and Bielby 1992). It is based on the hypothesis that geographic mobility has a positive effect on career advancement. The conclusion of these studies is in general that the career interruption caused by the move is a serious setback in women's scientific careers (Campbell 1988, McElrath 1992, Kulis and Sicotte 2002).

In this short contribution, we raise the question of gender differences in the geographic mobility of young researchers. More precisely, we try to answer to three main questions regarding the international mobility of young researchers during the post-doc period:

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[1] In a comparison between France and the United States, we showed that the specificities of the French scientific environment (institutional rigidities, uncompetitive salaries…) led to a brain drain at the post-doctoral level. And worse than that, the post-doctorate period abroad is not always valuated in the French academic labour market. Cf. Moguérou (2002).

[2] Many concrete actions were undertaken, in the context of the 3% objective, such as the creation of a web-portal for the mobility of researchers and the European networks of the mobility centres (European Commission 2002, 2003a, b).

[3] particularly those related to " 'Addressing change and promoting adaptability and mobility in the labour market', and 'Promoting development of human capital and lifelong learning' with its focus on increasing investment in human resources" (European Commission, 2003c, p. 3).

- Are there differences among genders?
- Does "family" have an impact?
- Is the effect of family related variables similar among genders?

We use a survey carried out at IREDU in 2001 on 500 recent French Ph.D. graduates in science and engineering. We study the geographic mobility of these young doctorates up to 5 years after the completion of their thesis.

In the first section, we present the survey used in this paper. In the second section, we wonder if there are gender differences in the international migration of postdocs. The third section studies the impact of the family context on the international mobility.

I. The survey

The goal of the 2001 Iredu survey was to understand the careers and the R&D activities of recent French Ph.D. graduates in S&T (physics, chemistry, biology and mathematics), 5 years after the completion of the thesis. The survey was carried out by telephone and by e-mail. There were three stages in the questionnaire. The first type of questions was related to the description of the thesis with a complete set of questions (funding, duration, publications and conferences, nature of research, career perspectives…). The second part of the questionnaire described the post-doc positions (duration, nature of R&D activities, localisation, earnings…). The third part was devoted to the "post-postdoc jobs" (work structure, nature of R&D activities, publications, research networks, job satisfaction…). The final sample is 504 Ph.D. graduates of many French universities (Table 1).[4]

Table 1. Location of university awarding Ph.D. in our sample, by field (%).

	Physics	Chemistry	Biology	Maths	Total
Île-de-France (Paris region)	25	33	37	55	35
Grenoble	24	20	8	2	14
Toulouse	14	10	5	11	9
Lyon	6	5	10	2	7
Strasbourg	3	3	7	0	4
Bordeaux	2	7	3	2	4
Montpellier	1	4	5	0	3
Nancy	3	2	3	9	3
Other	21	17	23	19	21

Source: Irédu 2001 survey.

[4] The survey, without being fully representative of the French situation, is quite representative in terms of disciplines and locations of university awarding Ph.D.

II. Are there differences in the international mobility among genders?

In France, the post-doctorate was not a common experience until the late 1970s. However, the increase in the number of Ph.D. graduates, the lack of funding available for post-doc in France and the internationalisation of science have increased the number of French Ph.D.s seeking post-doc positions abroad. North America and especially the USA is the preferred destination of French Ph.D.s. In some disciplines, more than 50% of Ph.D. graduates do a post-doc. This is particularly the case in life sciences. In our sample, 59% of individuals held a post-doc position, and 21% two post-docs or more (Table 2).

Table 2. Proportion of post-doc and location of post-doc, by discipline (%).

	Physics	Chemistry	Biology	Maths	Total
% of post-doc	46	51	79	28	59
% 2 post-docs or more	13	15	31	4	21
		First post-doc			
Post-doc in France	41	31	36	8	38
Post-doc in the USA	26	23	34	54	30
Other countries	33	46	29	38	32
		Second post-doc			
In France	56	53	55	50	58
In the USA	11	20	27	50	21
Other countries	33	27	18	0	22

Source: Irédu 2001 survey.

The incidence of postdoc is different among genders. 69% of females ever held a postdoc. This is only the case of 53% of males. But these figures convey the over-representation of women in biological sciences, disciplines where the proportion of postdoc appointments is the highest. So, we have to control for the effects of the field of doctorate and for other factors that are likely to affect the post-doc experience (nature of research activity during thesis, type of thesis funding, duration of thesis, career perspectives, family status…).

Table 3. Proportion and location of post-doc, by gender (%).

	Males	Females	Total
One post-doc	53	69	59
Two, or more, post-docs	17	28	21
% of post-doc 1 abroad	71	51	62
% of post-doc 2 abroad	47	36	42

Source: Irédu 2001 survey.

We model the probability of doing a postdoc with the following model:

$$y_i^* = \boldsymbol{\beta}'\mathbf{x}_i + \varepsilon_i, \quad \varepsilon_i \sim N(0,1)$$

where y_i* is a latent unobservable variable. The dependent variable y_i, which describes the postdoc experience, is linked to the latent variable as follows:

$$y_i = \begin{cases} 1 \text{ si } y_i^* > 0 \\ 0 \text{ si } y_i^* \leq 0 \end{cases}$$

$y_i = 1$ if the individual has done a postdoc $y_i = 0$ otherwise. $\mathbf{x_i}$ is the vector of explanatory variables and $\boldsymbol{\beta}$ the vector of parameters to estimate.

The log of the likelihood function to maximise is:

$$\ln L(\boldsymbol{\beta}) = \sum_i \left[y_i \ln \Phi(\boldsymbol{\beta}'\mathbf{x_i}) + (1 - y_i) \ln(1 - \Phi(\boldsymbol{\beta}'\mathbf{x_i})) \right]$$

where Φ(.) is the normal cdf function.

The results of the estimation of 4 models are presented in the Table 4.[5] We find that the probability of doing a postdoc is similar among genders as the coefficient related to this variable is not significantly different from zero (models 1 to 3)[6], other things equal.

[5] Not all the variables are presented here by lack of space. Full details can be provided by the author.

[6] The probability of undertaking a postdoc is mainly affected by the discipline, the nature of thesis research, the number of publications during thesis and the career perspectives at the beginning of thesis. There are also other effects not presented such as the thesis funding and the thesis laboratory.

Table 4. Probability of doing a postdoc (marginal effects).

	Model 1	Model 2	Model 3	Model 4	
				Males	Females
Constant	-0,025	0,066	-0,144	-0,078	-0,079
	(0,087)	(0,166)	(0,174)	(0,230)	(0,276)
Gender: female	0,051	0,068	0,072		
	(0,055)	(0,056)	(0,057)		
Married, or equivalent	-0,104**	-0,085*	-0,085*	0,009	-0,200**
status, at the end of thesis	(0,051)	(0,052)	(0,052)	(0,072)	(0,086)
Thesis: mainly basic	0,127**	0,118**	0,105*	0,157**	0,062
research	(0,053)	(0,054)	(0,055)	(0,074)	(0,088)
Ph.D. discipline: physics	0,123	0,111	0,134	0,070	0,152
	(0,083)	(0,083)	(0,084)	(0,113)	(0,141)
Chemistry	0,114	0,058	0,087	0,021	0,084
	(0,085)	(0,087)	(0,089)	(0,121)	(0,141)
Biology	0,346***	0,328***	0,352***	0,327**	0,306**
	(0,087)	(0,089)	(0,091)	(0,130)	(0,134)
Highest grade to Ph.D.	0,183***	0,162***	0,165***	0,255***	0,108
(“felicitations du jury”)	(0,051)	(0,052)	(0,053)	(0,075)	(0,083)
Thesis duration		-0,005	-0,004	-0,008*	-0,001
		(0,003)	(0,003)	(0,004)	(0,005)
Number of publications		0,031***	0,026**	0,036**	0,010
during thesis		(0,011)	(0,011)	(0,015)	(0,017)
Career perspectives:			0,205***	0,212***	0,224***
academic			(0,057)	(0,079)	(0,083)
Controlling for thesis laboratory			Yes		
Controlling for thesis funding			Yes		
ln L	-252.2	-245.3	-236.4	-145.0	-76.6
ln L0	-331.6	-330.6	-330.6	-206.6	-117.3
Chi2	158.8***	170.6***	188.3***	123.3***	81.5***
Number of observations	482	482	482	292	190

Source: Irédu 2001 survey. ML estimation of probit models. Dependent variable: probability of ever having a postdoc appointment. Significance levels of coefficients: * significant at 10%, ** significant at 5%, *** significant at 1%.

However, the location of postdoc is different among genders (Table 5). In this table we model the probability of doing a postdoc in France, in the USA, or abroad in another country, relative to the probability of not doing a postdoc. We note:

- $y_i = 1$, if the postdoc was done in France.
- $y_i = 2$, in the USA.
- $y_i = 3$, abroad in another country.
- $y_i = 0$, if the individual has never done a postdoc (the reference).

We estimate the following model:

$$\begin{cases} \Pr\left[y_i = 0 \middle| \mathbf{x_i}\right] = \dfrac{1}{1+\sum_{j=1}^{q}\exp\left(\mathbf{x_i'\beta_j}\right)} \\ \Pr\left[y_i = m \middle| \mathbf{x_i}\right] = \dfrac{\exp\left(\mathbf{x_i'\beta_m}\right)}{1+\sum_{j=1}^{q}\exp\left(\mathbf{x_i'\beta_j}\right)} \quad \text{pour } m = 1...q \end{cases}$$

where $\boldsymbol{\beta}_m = \left(\beta_{0m}...\beta_{Km}\right)'$ is the vector of parameters to estimate which includes K coefficients (and the constant). β_{km} is the effect of the explanatory variable x_k on the outcome m. The vector $\boldsymbol{\beta}_m$ is different for each outcome of the dependent variable. Thus, we have to estimate $q(K+1)$ parameters, where q is the number of outcomes (here $q = 3$).

The log of the likelihood function is:

$$\ln L\left(\boldsymbol{\beta_1} \ldots \boldsymbol{\beta_q}\right) = \sum_{i=1}^{n}\sum_{m=0}^{q} d_{im} \ln \Pr\left[y_i = m\right]$$

where $d_{im} = 1$ if the outcome m is chosen by the individual i, and $d_{im} = 0$ otherwise.

The results show that females have a higher probability – around 0.17-0.20 – of staying in France for their postdoc compared to males, when controlling for all the other effects. Similarly, women have clearly a lower probability (of about -10%) of doing a postdoc in the USA. The probability of going in a country other than France and the USA for a postdoc appointment is not affected by gender.[7]

[7] The coefficient of this variable is not significant even if its sign is negative as expected.

Table 5. Location of postdoc (marginal effects).

	Model 1			Model 2			Model 3		
	France	USA	Other	France	USA	Other	France	USA	Other
Constant	-0,10***	-0,06***	-0,09	-0,09***	-0,13***	-0,08	-0,23***	-0,14***	-0,06
	(0,024)	(0,017)	(0,084)	(0,026)	(0,020)	(0,092)	(0,037)	(0,029)	(0,117)
Gender: female	0,17***	-0,10***	-0,02	0,17***	-0,10***	-0,02	0,20***	-0,11***	-0,06
	(0,015)	(0,010)	(0,044)	(0,015)	(0,011)	(0,047)	(0,020)	(0,014)	(0,059)
Married at the end of thesis							0,05***	-0,10***	-0,05
							(0,017)	(0,013)	(0,054)
Thesis: mainly	0,04***	0,04***	0,13***	0,02*	0,04***	0,14**	-0,03	0,03**	0,16**
basic research	(0,014)	(0,009)	(0,051)	(0,014)	(0,010)	(0,055)	(0,019)	(0,014)	(0,069)
Ph.D. discipline:	-0,03	-0,01	0,09	-0,03	-0,01	0,10	-0,04	0,02	0,11
physics	(0,024)	(0,016)	(0,078)	(0,024)	(0,018)	(0,083)	(0,029)	(0,023)	(0,098)
Chemistry	-0,09***	-0,02	0,17*	-0,09***	-0,06***	0,17*	-0,07**	-0,05*	0,20*
	(0,025)	(0,017)	(0,085)	(0,025)	(0,019)	(0,091)	(0,032)	(0,025)	(0,110)
Biology	0,03	0,18***	0,12	0,01	0,18***	0,12	-0,03	0,18***	0,14
	(0,024)	(0,017)	(0,079)	(0,025)	(0,018)	(0,086)	(0,031)	(0,024)	(0,102)
Highest grade				0,11***	0,08***	0,00	0,10***	0,09***	0,00
				(0,013)	(0,010)	(0,045)	(0,017)	(0,013)	(0,053)
Career perspective:							0,18***	0,07***	0,00
academic							(0,019)	(0,014)	(0,058)
Controlling for thesis funding					yes				
Controlling for thesis lab.					yes				
ln L		-566.8			-538.0			-452.17	
ln L0		-647.7			-645.3			-581.8	
Chi2		161.8***			214.5***			259.3***	
Number of obs.		482			482			482	

Source: Irédu 2001 survey. ML estimation of multinomial logit. Marginal effects for the three alternatives: doing a postdoc in France, in the USA or in another country (reference: no postdoc). * significant at 10%, ** significant at 5%, *** significant at 1%.

III. Does family have an impact? Is the effect of family related variables similar among genders?

The effect of "family" on the probability of taking a postdoc appointment is different among genders (Table 4). Indeed, if the coefficient related to this variable for the whole sample is not highly significant, when we estimate separated models for men and for women (same table, model 4), we find that married women, or in an equivalent status at the end of their thesis, have a lower probability of doing a postdoc (-20%). There is not a similar effect for men.

The effect of the family context on the international mobility is also different among genders. The variable "married at the end of thesis" decreases the probability of doing a postdoc in the USA by 10% and increases the probability of doing a postdoc in France by 5% when men and women are considered altogether (Table 5). However, the models estimated in the Table 6 show that these effects are far stronger for women than for men. Females who are married have a decreased probability by 16% of doing a post-doctorate in the USA compared to women who are not married. There is no similar significant effect for males.[8]

Table 6. Location of postdoc, by gender (marginal effects).

	Males			Females		
	France	USA	Other	France	USA	Other
Constant	-0,37***	-0,18***	-0,12	0,21***	-0,41***	-0,10
	(0,026)	(0,030)	(0,125)	(0,066)	(0,030)	(0,146)
Married, or	0,04***	0,02	0,00	0,09***	-0,16***	-0,06
equivalent status	(0,011)	(0,015)	(0,059)	(0,035)	(0,012)	(0,070)
Graduate from a	0,08***	-0,07***	-0,04	0,22***	0,05**	-0,49
engineering school	(0,013)	(0,017)	(0,070)	(0,072)	(0,024)	(0,338)
Thesis: mainly	-0,01	0,09***	0,13*	0,00	0,02	0,09
basic research	(0,012)	(0,016)	(0,073)	(0,037)	(0,012)	(0,082)
Discipline: physics	0,20***	-0,10***	-0,02	-0,40***	0,24***	0,11
	(0,020)	(0,026)	(0,105)	(0,072)	(0,023)	(0,139)
Chemistry	0,11***	-0,14***	0,11	-0,18***	0,12***	0,03
	(0,019)	(0,027)	(0,109)	(0,070)	(0,024)	(0,141)
Biology	0,19***	0,11***	0,01	-0,20***	0,26***	0,13
	(0,021)	(0,029)	(0,118)	(0,063)	(0,021)	(0,133)
Highest grade	0,09***	0,10***	0,02	0,08**	0,08***	-0,02
	(0,011)	(0,016)	(0,062)	(0,031)	(0,011)	(0,066)
Career perspective:	0,14***	0,05***	0,09	0,11***	0,10***	0,04
academic	(0,013)	(0,017)	(0,071)	(0,032)	(0,012)	(0,068)
Controlling for thesis funding			Yes			
Controlling for thesis lab			Yes			
ln L		-312.3			-200.2	
ln L0		-371.2			-255.3	
Chi2		117.9***			110.2***	
Number of obs.		292			190	

Source: Irédu 2001 survey. ML estimation of multinomial logit. Marginal effects for the three alternatives: doing a postdoc in France, in the USA or in another country (reference: no postdoc). * significant at 10%, ** significant at 5%, *** significant at 1%.

Conclusion

In this paper, we showed, with a survey of young French Ph.D. graduates, that if postdoc is as common for women as for men, females are less mobile internationally, especially in direction of the United States. The impact of the "family" on the probability of taking a postdoc position and on the location of postdoc is different among genders. Married women take less frequently such appointments and, when they do so, they are less mobile

[8] The probability of doing a postdoc in France is increased by 4% for men who are married compared to men who are not married. For women, the effect is 9%. Even if the marginal effect of the family status on the probability of doing a postdoc abroad in a country other than the USA is negative (-6%), it is not significant..

internationally. There are no similar effects for males. These gender differences may be explained by the family roles that remain quite unchanged, with women assuming the primary responsibility for domestic roles. To solve the difficulties experienced by young females Ph.D. in combining career and family roles, specific programs have to be developed to facilitate the international mobility of young researchers – to take into account the specificities of research careers – and to promote gender equality on these aspects. However, a more general cultural change in the scientific community seems to be needed to facilitate progress towards gender equality.

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