School-to-Work Transition of Engineering graduates and PhDs in France: which consequences from a new tax credit for employers who hire young PhD graduates?

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Abstract: French governments have taken many initiatives towards strengthening the employability of PhD graduates in the private sector. The "Young Doctors Program" (DJD) was introduced in 1999 in order to encourage R&D employers to hire recent PhD graduates by a targeted measure of the Research Tax Credit. Since 2008, it has provided a substantial cost reduction if firms recruit recent PhD graduates. Our research seeks to address the positive impact of this program by examining the consequences such cost reduction have on the beginning of the careers of PhDs and graduates in engineering. Data from two national follow-up surveys conducted in 2007 and 2013 are analyzed to determine the potential positive impact of this DJD reform, using survival analysis models. Our results show that the speed for reaching stable employment for PhD graduates increased compared to engineers, especially in small firms.

Keywords: PhD graduates, R&D employment, university-to-work transition, tax credit, France.

Introduction

International comparisons on the scientific labour market show that the unemployment rate of PhD Graduates in France, three years after graduation, is much higher than in the other OECD countries (Harfi and Auriol, 2010). More particularly, PhD graduates in the private labour market suffer from competition with engineers who have graduated from elite school in the private labour market (Beltramo et al., 2001). They face strong difficulties finding a job in the R&D sector (Calmand 2011) whereas PhD are generally considered as positive factors in the innovation process (Romer, 2000). However, the likelihood of being recruited in the public academic sector is low (Bonnal and Giret, 2010) and decreasing these last years (Calmand et al., 2017)

Since 1999, French governments have tried to promote the recruitment of PhD graduates in the R&D sector. In 1999 was introduced a "Young Doctors Program" (DJD) of the Research Tax Credit (CIR) in order to reduce the cost of hiring PhDs for R&D sector firms. This program was substantively modified in 2008. Since 2008, it has provided a substantial cost reduction if firms recruit recent PhD graduates[1].

Our research seeks to address the positive impact of this program by examining the consequences such cost reduction has on the careers of PhDs and engineers for a nationally representative sample of graduates in exact sciences and human and social sciences in France.

[1] Expenses related to PhD recruitment are accounted for twice their cost during the first twenty four months following their first permanent contract. In addition, 200% of compensation cost can be included as operating costs.

More precisely, we attempt to assess the effect of the program over the course of time until first employment in R&D sector. In order to assess this effect, we use two national representative survey carried out by Cereq in 2007 and 2013. These follow-up surveys happen three years after graduation to gather longitudinal details about the early labour market history of graduates. Our econometric approach employs the survival regression framework.

The structure of the paper is as follows. Section 1 reviews the literature. Section 2 describes the database and the methodology. Section 3 presents descriptive statistics of the data. Section 4 synthetizes the main econometric results. Finally, section 5 draw some concluding remarks.

1. Literature review

From a theoretical point of view, several factors drive companies to recruit PhD graduates or engineers.

1.1 Factors explaining the demand for PhD

The recruitment of young PhDs can increase the innovation capacity of firms. They can boost the creative process within the company and facilitate patent filing. They also provide specific scientific skills as well as more transferable skills such as problem-solving skills, written and oral communication skills. Indeed, many studies show that these skills are crucial in the creation of innovation.

Another important function is to develop the absorption of knowledge and facilitate its transfer into the firm, which is especially important for tacit knowledge. This also increases the scientific watch capacity of the firm**.** In addition, the recruitment of PhDs may also have the advantage of creating or developing partnerships with universities and research centers (Lam, 2005; Garcia-Quevedo et al., 2012). They would play a role of "gatekeeper". It will be the case with the research centers from which the PhDs come, but more widely with the entire scientific community. Recruited doctors own a social and scientific capital that can be more easily recognized by many academic researchers.

They can also be an "entry ticket" for firms, allowing them to gain some scientific legitimacy. They thus constitute a showcase. This is particularly the case for small firms. The employment of PhD graduates may counterbalance the absence in the firm of a R&D centre (Thune, 2009)

1.2. Factors explaining the demand for engineering graduates

However, several explanatory factors may limit the access of PhDs to private R&D activities.

A first argument concerns the labour cost. PhDs are generally better paid in France than engineers in R&D jobs. Miotti and Margolis (2017) attribute this higher remuneration to a higher level wage reservation for PhDs compared to engineers. This higher labour cost would be a deterrent for some firms.

A second argument concerns the insufficient productivity of doctors for certain jobs in R&D. Indeed, they have very little professional experience in firms, unlike engineers who have accumulated several internships in companies during their training. They lack information on the operation of an enterprise, with regard both to the research and development department and more generally to all the other departments of the enterprise. It may be thought that this lack of industry-specific human capital decreases their relative productivity, except for those who have had firm experience. This may be even more important in development functions that require work in cooperation with other departments. Secondly, career management in R&D leads firms to offer employees jobs in R&D at the beginning of their career then to propose mobility to different functions, which is much easier for engineers than for doctors (Beltramo et al., 2001).

A third argument is related to the mode of recruitment in R&D activities. First, hiring engineers rely on their social capital which is highly developed within engineering schools in France (Duhautois and Maublanc, 2005 ; Grivilliers and Cassette, 2014). Firms, whose managers and recruiters come from engineering schools, tend to favor the recruitment of engineers, often from the school they come from. The transmission of information by alumni networks is also privileged. Second, the preference for engineers can also come from a signal effect: productivity, specific and general skills of engineering graduates are much better identified than those of PhD graduates. The selection at the entrance of the Grandes Ecoles on demanding academic criteria and the knowledge by companies of their curriculum give information on future productivity contrary to the PhD thesis and its scientific contributions that employers find difficult to assess.

A fourth argument is paradoxically linked to the development of research partnerships between the academic sector and the private sector. Companies may be led to outsource part of the research activities to public laboratories. University-industry relations can create temporary jobs, post-doc and thesis funding in the public academic sector, but may reduce jobs for researchers in the private sector (Beltramo et al., 2001)..

Finally, this literature review provides mixed evidence on the advantage of PhD graduate in the R&D labour market. Although several arguments may justify their recruitment to enhance the innovation process, they suffer from the disadvantages of higher labour costs and uncertainty about their productivity in the private sector. However, the reform of the tax credit can contribute to change the expected cost/benefits ratios of hiring a PhD graduate. Furthermore, the researches on incentives for R&D (Lokshin and Mohnen, 2007; Baghana and Mohnen, 2009) seems to show more beneficial effects for small firms than for large ones that rather benefit from a windfall effect. Because they face more difficulty in financing their R&D, Baghana and Mohnen (2009) argue that small firms will more reactive to changes in R&D tax incentives.

Based on these elements, three hypotheses can be suggested:

H1. The substantial amount of the tax credit should strengthen the relative position of doctors in the labour market. After controlling for the effect of last DJD reform, the speed of finding a stable jobs for PhD graduates will increase compared to engineers.

H2. PhD-engineers, PhD graduates who also obtained an engineer’s degree, combine the benefits of both degrees and the DJD program reduces their labour cost. We may expect that they benefit more from the program than other PhD graduates.

H3. This effect will depend on the characteristics of the firms. We expect that the DJD program will have stronger positive effect for small firms

2. An assessment of the effects of the Young Doctors Program on the duration of access to employment in R&D

The 2008 reform of the "Young Doctors Program" can be seen as a natural experiment. This public policy aims to modify the environment on the labour market in order to act on the hiring of doctors in R&D activity. To assess the effect of this measure, it is necessary to compare the situation of its beneficiaries before and after its implementation on the basis of a before-after estimator, the "treated group" being made of graduates who entered the labour market after the reform and the "control group" graduates who entered the labour market before the reform.

2.1. Database

Two Céreq surveys are used. The Generation 2004 survey focuses on school and university leavers in 2004. Respondents are followed over 3 years when questioned in 2007. This survey makes it possible to trace the professional trajectory of the "control group", that is to say the non-beneficiaries of the public measure. The Generation 2010 survey focuses on school leavers in 2010, interviewed in 2013. It traces the professional trajectory over the first three years of the "treated group", i.e. the beneficiaries of the measure.

The database contains 2200 PhD graduates surveyed in 2004 and 2007, three years after PhD graduation and 4500 engineering graduates also surveyed in 2004 and 2007. It includes general information on young graduates’ characteristics (Educational background and characteristics of the PhD, family’s socioeconomic status, job…) and work history. It also provides detailed information on conditions of doctoral studies for PhD students (financial support during the PhD, researcher institutions...).

2.2. Method

2.2.1. Econometric estimation

The estimated model is a standard duration model where censorship is measured by non-access to a first permanent job in R&D (in terms of PCS, functions or PCS and functions). The semi-parametric model of Cox and parametric models (accelerated life and proportional hazard) were tested[2]. The results obtained by the different models are comparable. We have chosen to present the results associated with the semi parametric model of Cox which has the advantage of not imposing a particular form on the hazard function.

Two different types of duration models are estimated.
The first model assumes that the duration of access to employment is completed when the graduate obtains a permanent job contract in R&D. The duration of access to employment is censored for all other situations observed in the labour market, in particular non-R&D jobs in the private sector and stable jobs in the academic sector (lecturer, research officer). This model may reveal a significant effect of the variable associated with the period (after the change in the DJD in 2008), but it is not necessarily a measure of the net effect. The before-after estimator is potentially biased if the economic environment changes as this estimator measures the sum of the policy effect and the changing economic environment. This limit can be lifted, at least partially, by comparing graduates from engineering schools to PhD graduates. The results of the econometric analysis will show a "reform effect" if we assume that the economic situation has had the same effect on the integration of PhD's and engineers.

The second model consider the analysis of multiple causes of failure by means of competing risk models. We take into account separately the other stable and qualified jobs obtained by doctors and engineers outside of private R&D. In this context, this event (a first permanent job

[2] For a detailed presentation of the models, we refer to Lancaster (1990) or Wooldrige (2010).

outside of private R&D) is separated from that of young people who are still potential beneficiaries of the Young Doctors program.

2.2.2. The definition of employment in R&D

The Céreq surveys only cover individual data reported by young people. The difficulty is we do not know whether firms that recruit young people are eligible to the DJD. Therefore, our aim is to identify for young people, in both generations, the first job in R&D and permanent contracts. In this case, it is assumed that firm are eligible to the tax credit[3].

We took over the two ways proposed by Margolis-Miotti (2017) to identify R&D and added a third method:
- the PCS method, the nomenclature of occupations and socio-professional categories corresponding to "research and development",
- the function declared at the time of hiring among a list of essential job functions. The job function declared is "Research and development, methods",
- an interactive variable combining PCS and function. An individual is classified in R&D if he meets both conditions. This third method is introduced to test the robustness of our estimates and consolidates the definition of employment in R&D.

2.2.3. Control variables

The different control variables introduced are:

- Gender
- Age of graduation
- At least one year late before middle school
- Did not attend middle school in France
- The baccalaureate track
- Baccalaureate with Honors (Good or Very Good)
- Fields of study[4]
- Educational level: Graduate of engineering schools (Master level), Only PhD, PhD + engineering degree
- Main sources of PhD funding (only for PhD).

3. Descriptive analysis

3.1. The rate of access to R&D in a first permanent job

Tables 1 and 2 compare the rate of access to a first permanent job in R&D, for engineers, PhDs-

[3] However, some firms engaged in R&D activities do not take advantage of the tax credit. Bozio et al. (2014) advance a number of potential explanations for this: insufficient information about program details, non-eligibility of some R&D activities to the tax credit, administrative complexity and bureaucratic costs, apprehension in dealing with the fiscal authorities…

[4] We use the same list as Margolis-Miotti (2017).

engineers and PhDs with different specialties, regardless of their date of entry into the labour market and according to generation. These tables stress the size of the advantage of engineers and PhD-engineers: their access rate is twice as high as that of doctors in engineering. However, the gap is narrowing for young people who left in 2010. If we refer to PCS, the rate of access in R&D of young engineers drops by 2.5 points while that of PhD-engineers increases by 5 points. The rate of doctors in engineering increases by 3 points. For the Generation 2010 survey, this access rate is 35% for engineers and PhD-engineers, but only 17.9% for doctors in engineering. PhDs in other fields are, on the other hand, unlikely to access to R&D jobs (less than 2%).

When the definition used to identify employment in R&D is declarative (function) or combines the two criteria (PCS and function), the results are fairly consistent with the previous ones, but slightly less marked for the function. It should be noted, however, that the third definition, which may be thought to allow better targeting of R&D jobs, is much more restrictive, even if it leads to the same observations on trends as the first two definitions.

Table 1. Rate of access to a first permanent job in R&D

		Generation					
		Number			%		
		2004 & 2010	2004	2010	2004 & 2010	2004	2010
Permanent job in R&D, PCS	Graduate of engineering schools	710	349	361	36,5	37,8	35,3
	PhD-engineer	201	74	127	33,4	30,3	35,2
	PhD in engineering	329	137	192	16,6	14,8	17,9
	PhD in other fields	18	8	10	1,8	1,9	1,8
	All PhD (without engineers)	347	145	202	11,7	10,7	12,4
Permanent job in R&D, Function	Graduate of engineering schools	740	357	383	38,0	38,6	37,4
	PhD-engineer	207	75	132	34,5	30,7	36,6
	PhD in engineering	353	152	201	17,8	16,4	18,8
	PhD in other fields	44	19	25	4,5	4,4	4,5
	All PhD (without engineers)	398	171	227	13,3	12,6	13,9
Permanent job in R&D, PCS and Function	Graduate of engineering schools	468	248	220	24,4	26,9	21,5
	PhD-engineer	173	65	108	28,7	26,6	29,9
	PhD in engineering	293	137	156	13,9	13,3	14,5
	PhD in other fields	13	5	8	1,3	1,2	1,4
	All PhDs (without engineers)	292	128	164	9,8	9,5	10,1

Source : Générations 2004 et 2010

3.2. Duration of access to first permanent job in R&D

The duration of access to the first job is determined by starting from the date of exit of the education system declared by the young graduate. The aim is to try to identify how long they have waited for a job that is eligible for the "Young Doctorate Program". As long as the young person is unemployed, inactive, in fixed-term contract or in a "non-managerial" job, the duration of access to employment is incremented. The duration of access to skilled jobs on non-R&D

permanent employment in the private sector was calculated ("other duration" in Table 2). These jobs are not eligible for DJD. Table 2 highlights important differences in these durations of access especially for engineers and PhDs. The duration of access to R&D for the former is significantly lower than for the latter, including PhD engineers. The comparison of durations between the two generations nonetheless indicates a rather significant decrease in duration of access to R&D for PhD graduates in 2010. There is a relative stability of this duration for graduates of engineering schools..

Table 2. Duration of access to the first permanent job upon leaving the education system

			PhD			
		Graduates of engineering schools	PhD-Engineers	Engineering fields	Other fields	Not Engineers
Gen2004 & 2010	Permanent job in R&D, PCS	5,7	7,3	11,8	9,6	10,6
		(6,9)	(9,1)	(10,3)	(10,0)	(10,9)
	Permanent job in R&D, Function	5,8	7,7	12,0	8,5	10,5
		(7,0)	(9,5)	(10,6)	(8,9)	(10,8)
	Permanent job in R&D, PCS & Function	5,6	7,5	11,9	9,7	10,6
		(6,8)	(9,3)	(10,5)	(10,2)	(10,8)
	Other permanent job	6,8	10,1	12,8	8,1	36,5
		(8,3)	(10,1)	(10,9)	(10,1)	(4,4)
	Censored duration	34,6	36,5	36,7	36,3	36,9
		(1,8)	(4,5)	(4,5)	(4,3)	(4,8)
Gen2004	Permanent job in R&D, PCS	6,8	10,8	14,2	14,1	14,2
		(7,4)	(10,1)	(11,1)	(11,2)	(11,0)
	Permanent job in R&D, Function	7,0	6,8	14,2	15,2	14,2
		(7,4)	(8,9)	(11,2)	(12,4)	(11,2)
	Permanent job in R&D, PCS & Function	6,9	6,8	14,1	10,5	10,5
		(7,3)	(9,1)	(11,4)	(9,8)	(9,8)
	Other permanent job	7,6	10,8	13,9	8,2	8,2
		(8,5)	(10,0)	(10,9)	(10,0)	(10,0)
	Censored duration	35	36,5	36,4	35,6	35,6
		(1,8)	(4,7)	(4,5)	(4,4)	(4,4)
Gen2010	Permanent job in R&D, PCS	4,5	7,7	10,1	8,2	10,0
		(6,3)	(9,4)	(9,4)	(9,2)	(9,3)
	Permanent job in R&D, Function	4,7	8,2	10,4	6,6	10,0
		(6,5)	(9,6)	(9,6)	(8,4)	(9,5)
	Permanent job in R&D, PCS & Function	4,2	7,9	10,1	7,8	10,0
		(5,9)	(9,5)	(9,6)	(8,9)	(9,6)
	Other permanent job	5,8	9,9	11,7	8,8	10,5
		(7,8)	(10,3)	(10,8)	(10,5)	(10,8)
	Censored duration	34,2	36,6	36,8	36,2	36,6
		(1,7)	(4,5)	(4,6)	(4,6)	(4,6)

Source : Générations 2004 et 2010. The numbers in parentheses are the standard deviations of the durations of access to a permanent job (CDI) at the exit of the education system.

4. Results

4.1. Results by degree

First we estimate a simple duration model (see Table A1), in which each degree was introduced separately. A dichotomous variable captures the Generation effect. It may correspond to the effect of the measure but also to the consequences of economic downturn of 2008.

The results indicate an overall faster access to R&D for PhD graduates in 2010, the effect being generally significant, all other things being equal, when taking into account the characteristics of PhDs and their disciplines. The effect is positive for the PhD in engineering fields and for the PhD-engineers. There is also a positive effect for PhDs graduates of the generation 2010, while no effect appears for PhD with other engineer fields.

The effects remain relatively robust if we replace the definition of employment according to PCS nomenclature equivalent to R&D by the other two definitions (function declared or combined PCS and function). Only the significance of the effect on the duration of PhD-engineer disappears when these two definitions are taken into account.

4.2. Results for PhD graduates and engineering graduates

A second set of estimates (see Table A.2) compares the speed of access of engineers in R&D sector relative to other degrees. Each estimate is for two subpopulations, with engineers still in reference. Two dichotomous variables are introduced, the generation variable as well as a diploma variable (the other being in reference), and finally an interaction variable (generation by diploma). This last interaction variable makes it possible to capture the effect of the diploma for the 2010 generation. Assuming that the effect of the economic conjuncture is the same for all graduates and is captured by the Generation 2010 dichotomous variable, the interaction variable measures the effect of the program.

Three results stand out:

-The Generation 2010 variable has rarely a significant effect, except when the R&D job is defined in terms of functions. In this case, it suggests there is a negative effect of the economic situation, which seems to be minor and fades when all individual characteristics are integrated into the estimates.

The coefficients by degree highlight the advantage of engineers in quick access to R&D jobs, regardless of the generation effect, compared to doctors of different fields (including engineering fields). On the other hand, no significant difference appears between engineers and PhD-engineers.

The main contribution of this estimate concerns the analysis of the interaction effect. The positive and significant coefficient associated with the cross effect of generation and diploma underlines an overall improvement in the relative position of doctors compared to engineers. Thus, for example, in the second column of Table A.2, for PhD-engineers, the effect of the measure compensates for the negative effect related to the advantage of engineers in R&D (the sum of the coefficients for the doctors in 2010, excluding the economic impact (- 0.05) which is insignificant, is -1.10 + 0.267 = -0.833).

In other words, all things being equal, the duration of access to employment is always higher for doctors, but access to employment is much faster for young PhDs in 2010. It looks as if the program had significantly accelerated the recruitment of PhDs in R&D compared to young engineers. The analysis by fields shows that the effect is significant only for PhDs in engineering fields, the probability of access to R&D is very low for the others and does not seem to change in 2010. In contrast, no significant effect appears for PhD-engineers. The program does not seem to have reduced their duration of access to employment.

Additional estimates were also made for all degrees (see table A.3). All graduates were introduced simultaneously, except engineers who are in reference. In this case too, only the cross effect for the PhDs in engineering fields is positive, while the effect of the diploma is negative. The measure has therefore benefited all PhDs, even if only PhD-engineers, have a relative advantage in 2010 compared to engineers. This is not the case for other doctors who remain at a disadvantage compared to engineers, especially when their specialty is far from engineering sciences. Finally, the results are relatively robust when replacing PCS by function to define R&D jobs.

In order to test the robustness of the results, competing risk models were estimated to take into account separately the other stable and qualified jobs obtained doctors and engineers outside of private R&D. In this context, employment in private R&D is separated from that of young people who are still potential beneficiaries of the Young Doctors program. The results of the competing risk model (Table A.4) confirm the previous results. The rate of access of PhD graduates to R&D remains lower than that of engineers. However, as before, the interaction effect is positive and significant, for PhDs with engineer fields and for all PhDs, indicating an increase in the speed of access of PhDs in R&D, relative to engineers. The interaction effect for R&D is, however, too weak to compensate for the initial disadvantage of doctors in access to R&D. On the other hand, the effects are not significant for doctors moving to other stable jobs, suggesting that there is a specific improvement in access to stable employment in R&D.

The results presented in Table A.5 (concurrent risk model with all degrees) are similar. The duration of access to R&D for PhDs specializing in engineering is improving in 2010. However, the effect is not applicable to PhD-engineers or doctors of other specialties.

4.3. The size of the firms

In order to determine whether the program has had a differentiated impact according to the size of the firm, we distinguish access to R&D by firm size. Table 3 shows the rates of access to R&D by firm size by type of degree.

Table 3. Rate of access to a first permanent job in R & D defined by the PCS according to the size of the firms

		Generation					
		Number			%		
		2004 & 2010	2004	2010	2004 & 2010	2004	2010
Firm with less than 200 employees	Engineers	291	157	134	15,8	17,9	13,7
	PhD-engineers	55	25	63	15,1	10,6	18,2
	PhD in engineering fields	179	64	115	9,2	7,7	10,9
	All PhDs	281	95	186	8	6,1	9,6
Firm with more than 200 employees	Engineers	317	142	175	17,2	16,2	18
	PhD-engineers	90	41	49	15,5	17,4	14,2
	PhD in engineering fields	103	51	52	5,3	5,6	4,9
	All PhDs	197	94	103	5,6	6	5,3

Source : Générations 2004 et 2010.

While the rate of access in R&D under permanent contract for doctors is relatively stable in large firms (with a slight decrease for PhDs-engineers), this rate has increased significantly in small and medium firms. The opposite trend is observed for graduates of engineering schools.

In order to test these results, we estimate competing risk duration models where two outcomes are possible in R&D depending on the size of the firm: firms with less than 200 employees and those with more than 200 employees. The results (Table A.5 and A.6) show that within small and medium-sized firms, the effect of the interaction variable is positive and very significant for all the doctors, PhDs-engineers as well as PhDs with engineers fields. On the other hand, the interaction variable is not significant for all the diplomas concerning access to R&D in large firms.

The Young Doctors program seems to have increased the speed of access to R&D of PhDs compared to graduates of engineering schools only in small and medium-sized firms. The effect appears insignificant for the recruitment of doctors in the large firms. We can suppose that this result can be explained in particular by the fact that small and medium-sized firms have tighter financial constraints (Dortet-Bernadet and Sicsic, 2017) and face greater uncertainty, especially when recruiting in R&D (Duhautois, Maublanc, 2005). They are therefore more likely to use this type of support. We can also assume that within these companies, networking with engineering schools is less developed.

5. Conclusion

These results argue for a rather positive effect of the Young Doctors program. PhD graduates in engineering specialties have improved their speed of access to R&D compared to engineers, when they graduated in 2010, that is after the reform of the program (H1). Competitive duration models indicate that this improvement is specific to R&D and does not concern all jobs. However, the speed of access to R&D of PhDs (excluding engineers who obtain a PhD), is always lower than that of engineers. In addition, some of the results indicate that PhD-engineers seem to have benefited more from the DJD program (H2). This program nevertheless seems to have accelerated the access of doctors to R&D only in small and medium-sized firms H3).

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Table A.1 Estimation of the duration of access to the first permanent job in R&D (separate estimates by diploma)

	Engineers		PhD-engineers		PhD in engineering fields		PhD in others fields		PhD not engineers		All PhD	
Gen2010 - PCS All control variables	0,123	0,107	0,243	0,159	***0,445***	***0,121***	0,409	0,434	***0,422***	***0,116***	***0,385***	***0,092***
+ funding during the thesis			**0,335**	**0,164**	***0,429***	***0,122***	0,392	0,451	***0,402***	***0,117***	***0,407***	***0,093***
Gen2010 - PCS et function All control variables	-0,099	0,133	0,129	0,168	***0,332***	***0,13***	0,373	0,558	**0,313**	**0,126**	***0,288***	***0,099***
+ funding during the thesis			0,192	0,173	**0,307**	**0,131**	0,566	0,631	**0,285**	**0,128**	***0,303***	***0,101***
Gen2010 - Function All control variables	0,095	0,102	0,176	0,154	***0,374***	***0,115***	0,181	0,297	**0,235**	**0,103**	***0,321***	***0,087***
+ funding during the thesis			0,201	0,158	***0,336***	***0,116***	0,035	0,307	***0,296***	***0,108***	***0,319***	***0,088***

Number	**Censored duration**		**Censored duration**		**Censored duration**		**Censored duration**		**Censored duration**		**Censored duration**	
	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
PCS	710	1238	201	404	329	1671	25	1422	354	3093	555	3497
Pcs-Function	468	1480	173	432	279	1721	15	1432	294	3153	467	3585
Function	740	1208	207	398	354	1646	53	1394	407	3040	614	3438

Note : The coefficients in bold and italic are significant at the 1% level. The coefficients in bold are significant at 5% and the coefficients in italic are significant at 10%.

Table A2: Estimation of the duration of access to first permanent employment in R&D (estimates separated by diploma/versus engineers)

		Engineers/ PhD-engineers		Engineers/PhD in engineering fields		Engineers/PhD in other fields		Engineers/ All PhDs	
Gen10-PCS	gen10	0,079	0,100	*0,162*	*0,097*	0,099	0,106	0,094	0,094
All control variables	docXXX	-0,236	0,187	***-0,802***	***0,159***	***-1,664***	***0,507***	***-0,681***	***0,135***
	gen10*docXXX	0,144	0,181	*0,247*	*0,150*	-0,053	0,492	**0,284**	**0,129**
Gen10-PCS+function	gen10	-0,150	0,122	-0,034	0,117	-0,146	0,132	-0,091	0,114
All control variables	docXXX	0,102	0,210	**-0,403**	**0,179**	**-1,366**	**0,611**	**-0,328**	**0,151**
	gen10*docXXX	0,288	0,203	*0,312*	*0,169*	0,396	0,593	**0,376**	**0,148**
Gen10-function	gen10	0,064	0,097	0,135	0,093	0,052	0,102	0,088	0,091
All control variables	docXXX	-0,124	0,184	***-0,693***	***0,153***	***-1,196***	***0,364***	***-0,574***	***0,129***
	gen10*docXXX	0,107	0,177	0,151	0,143	-0,061	0,325	0,195	0,123

Note: This table presents estimates by type of doctorate compared to engineers (engineers are systematically in reference for each estimate). The coefficients in bold and italic are significant at the 1% level. The coefficients in bold are significant at 5% and the coefficients in italics are significant at 10%. The results of the dichotomous variables generation 2010 and diploma (noted docXXX) as well as the interaction variable (gen10 * docXXX) are presented. The set of control variables has been introduced into the model.

Table A3. Estimation of the duration of access to first permanent employment in R&D (all diploma, engineers in reference)

		PCS		PCS-Function		Function	
		coefficient	SD	coefficient	SD	coefficient	SD
All control variables	Gen2010	0,119	0,094	-0,070	0,114	0,111	0,091
	Gen2010*PhD-engineers	0,113	0,174	0,249	0,194	0,133	0,171
	Gen2010*PhD in engineering fields	*0,279*	*0,147*	**0,335**	**0,166**	0,164	0,141
	Gen2010* PhD in other fields	0,172	0,429	0,186	0,542	0,007	0,297
	PhD-engineers	-0,163	0,164	0,164	0,181	-0,117	0,160
	PhD in engineering fields	***-0,876***	***0,144***	***-0,509***	***0,161***	***-0,728***	***0,139***
	PhD in other fields	***-2,267***	***0,413***	***-1,902***	***0,513***	***-1,523***	***0,297***

	Censored duration		Censored duration		Censored duration	
Number	yes	no	yes	no	yes	no
	1265	4735	935	5065	1354	4646

Note: The coefficients in bold and italic are significant at the 1% level. The coefficients in bold are significant at 5% and the coefficients in italics are significant at 10%. PhD in Health studies are included in the estimates.

Table A.4. Competitive risk models by diploma (exits to stable jobs in R & D or outside R & D)

		Engineers/ PhD engineers		Engineers/PhD with engineers fields		Engineers/PhD with other fields		Engineers/ All PhD	
Exit to first permanent job in R&D									
		Coef.	S.D.	Coef.	S.D.	Coef.	S.D.	Coef.	S.D.
All control	Gen10	0,090	0,100	0,150	0,097	0,090	0,106	0,096	0,094
Variables	docXXX	*-0,322*	*0,185*	***-0,965***	***0,158***	***-2,283***	***0,476***	***-0,801***	***0,134***
	Gen10*docXXX	0,149	0,181	**0,294**	**0,149**	0,161	0,434	***0,312***	***0,129***
Exit to first permanent job in other private job									
All control	gen10	-0,080	0,105	**-0,202**	**0,098**	*-0,189*	*0,109*	-0,191	0,095
Variables	docXXX	*0,322*	*0,177*	0,051	0,126	0,374	0,183	0,183	0,121
	Gen10*docXXX	-0,134	0,175	0,114	0,124	0,001	0,134	0,055	0,109

Note: The coefficients in bold and italic are significant at the 1% level. The coefficients in bold are significant at the 5% and the coefficients in italics are significant at the 10

Table A.5 Competitive risk models by diploma (exits to stable jobs in R & D or outside R&D)

		R&D - PCS		R&D – PCS+ function		R&D Function		Other stable jobs (no R&D)	
		Coef.	s.d.	Coef.	s.d.	Coef.	s.d.	Coef.	s.d.
All control variables	Gen2010	0,117	0,094	-0,029	0,114	0,146	0,091	*-0,168*	*0,095*
	Gen2010*PhD-engineers	0,134	0,174	0,235	0,194	0,125	0,172	-0,015	0,166
	Gen2010*PhD in engineering fields	**0,306**	**0,146**	**0,344**	**0,166**	0,169	0,141	0,061	0,121
	Gen2010* PhD in other fields	0,110	0,429	0,080	0,542	-0,091	0,297	-0,027	0,123
	PhD-engineers	-0,238	0,163	0,030	0,181	*-0,269*	*0,160*	***0,356***	***0,134***
	PhD in engineering fields	***-1,006***	***0,143***	***-0,727***	***0,161***	***-0,953***	***0,138***	***0,289***	***0,106***
	PhD in other fields	***-2,353***	***0,418***	***-2,079***	***0,523***	***-1,688***	***0,303***	0,116	0,133

	Censored duration		Censored duration		Censored duration		Censored duration	
Number	yes	no	yes	yes	no	yes	yes	no
	1265	4735	935	5065	1354	4646	2224	3776

Note: The coefficients in bold and italic are significant at the 1% level. The coefficients in bold are significant at the 5% and the coefficients in italics are significant at the 10%.

Table A.6 Competitive Risk Models by Diploma (Exit to stable jobs in R & D depending on the size of the firm)

Gen10 - PCS		Engineers/ PhD engineers		Engineers/PhD with engineers fields		Engineers/ All PhDs	
Firm with less than 200 employees							
All control Variables	Gen10	-0,161	0,157	-0,046	0,149	-0,07	0,145
	docXXX	-0,402	0,300	**-0,809**	**0,227**	**-0,702**	**0,196**
	Gen10*docXXX	***0,698***	***0,289***	**0,659**	**0,218**	**0,663**	**0,192**
Censored		2049		3328		4789	
Event		379		470		572	
Firm with more than 200 employees							
All control Variables	Gen10	0,269	0,147	***0,33***	***0,145***	*0,232*	*0,141*
	docXXX	0,025	0,274	**-0,692**	**0,265**	***-0,522***	***0,216***
	Gen10*docXXX	-0,348	0,265	-0,178	0,25	-0,128	0,203
Censored		2021		3378		4847	
Event		407		420		514	

Note: The coefficients in bold and italic are significant at the 1% level. The coefficients in bold are significant at the 5% and the coefficients in italics are significant at the 10%.

Table A.7 Competitive Risk Models by Diploma (Exit to stable jobs in R & D depending on the size of the firm)

		Firm with less than 200 employees		Firm with more than 200 employees	
		Coefficient	*S-D*	*coefficient*	*S-D*
All control variables	Gen2010	-0,067	0,145	*0,27*	*0,141*
	Gen2010*PhD-engineers	***0,639***	***0,278***	-0,358	0,257
	Gen2010*PhD in engineering fields	**0,660**	**0,214**	-0,141	0,244
	Gen2010* PhD in other fields	-0,025	0,564	-0,373	1,013
	PhD-engineers	*-0,435*	*0,261*	0,202	0,245
	PhD in engineering fields	**-0,851**	**0,209**	**-0,818**	**0,237**
	PhD in other fields	-0,302	0,575	**-2,919**	**0,873**
Event		572		514	
Censored		5361		5356	

Table A.8. Hazard Ratios (synthesis)

	PhD-engineers	PhD in engineering fields	All PhD graduates
R&D			
Before 2008	Ns.	2.6	2.2
After 2008	Ns.	1.9	1.6
Firms with less than 200 employees			
Before 2008	Ns.	2.2	2
After 2008	*1.3*	1.2	1
Firms with more than 200 employees			
Before 2008	Ns.	2	1.7
After 2008	Ns.	2°	1.7°

Reading : The rate of instant exit to a job in R & D for engineers is 2.6 times higher than that of doctors in engineering fields.

Note : ° Not significant difference before and after 2008