Trajectories from public sector of research to private sector :
an analysis using French data on young PhD graduates
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Abstract :
The organisation of research is a powerful factor structuring the labour market for recent doctorate recipients. The queue for permanent research positions in the academic sector has created a specific labour market for young doctorates, characterised by a proliferation of post-doctoral programmes and fixed-term contracts. In that specific context, our paper deals with the way the young PhD graduates enter the labour market, the way they get a job as researcher in the private or public sector and how much the return of the job mobility from the public academic sector to the private sector is. Using a longitudinal survey provided by the Cereq, our results suggest that even if nearly the half of the cohort has a direct access to jobs in the research sector (private or public), 20% remain in trajectories dominated by under-qualified jobs or recurrent unemployment. Our empirical investigation show a negative or non significant returns of the job mobility from the public academic sector to the private sector.

1. Introduction

The French academic system yields around 10 000 PhD per year, so that France is among countries which have a huge number of young PhD. Comparatively, Europe has 68 000 new PhD each year and USA more than 40 000 (Nsf, 2002). Young PhD, being the main producers of knowledge, are mainly employed in the public sector for research (Béret, Giret and Recotillet, 2002), however, for a while, they are attracted to the private sector.

One of the major transformations of doctoral training occurring during the last decade is the multiplication of the links between the academic sector and the R&D sector (Beltramo, Paul and Perret, 2001), encouraged by the new orientations of the public policy of the public sector for research. Since the mid-nineties, the papers dealing with the analysis of job opportunities for young doctorates show an increasing proportion of them employed in the private sector (Béret, Giret and Recotillet, 2003 ; Martinelli and Molinari, 2000). Young scientists, especially those with degrees in mechanics, engineering sciences or computer science, are more and more attracted to the private sector and less and less to academic careers.

The organisation of research is a powerful factor structuring the labour market for recent doctorate recipients. One particular point relates to research jobs in academic systems. The

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queue for permanent research positions has created a specific labour market for young doctorates, characterised by a proliferation of post-doctoral programmes and fixed-term contracts financed by research contracts immediately after obtaining the doctorate. In that specific context, our paper deals with the way the young PhD graduates enter the labour market, the way they get a job as researcher in the private or public sector and how much the return of the job mobility from the public academic sector (PAS) to the private sector is. It is useful in that context to remember that the governmental policies tend to improve transfers between academia and industrial R&D for young PhD. In our sample, young PhD students have graduated in exact sciences and human and social sciences in 1998 and are surveyed in 2001. The survey has been carried out by the Cereq. The longitudinal information allows us to study the job mobility between the public academic sector and the private sector.

The paper is organized as follows. The next section reviews some analytical issues and theoretical considerations on the regulation of labor market for young scientists. The data we use in this analysis is described in section 3. Section 4 presents an empirical analysis of the data which addresses a first overview of the main trajectories of PhD graduates on the labor market. Section 5 focuses on the trajectories characterised by a job mobility from the public to the private sector. In this section, we develop a non parametric matching estimator to compare the wages obtained in the private sector, depending on a prior experience or not in the public and/or academic sector. Finally, section 6 discusses some implications of our results.

2. The labor market for doctorates: some theoretical aspects

Recent improvements in the data available about the doctorates labor market have given rise to a growing body of literature. Most studies argued the wage competition model of the standard neoclassic theory fails to explain the allocation of manpower on this market. If most of them agreed on the existence on different segments (Ehrenberg, 1992), few are focused on barriers between them.

Generally, the offer-side theories, notably the job search theory, are under developed to explain this mobility of PhD doctorates. One notable exception is the study by Zucker and alii (1999) who model labor mobility as a function of scientist's quality (as measured by scientific citations) and his or her reservation wage. As shown by Freeman (1980), and more recently by Stern (1999), the wage incitation is rather low for young PhD doctorates and some other

determinants should be used to enlighten strategies of job mobility. The paper published by Stern in 1999 explicitly illustrates how the researchers pay to be scientists on the American labour market, based on the observation that research activities are less attractive in terms of wages. In a slightly different perspective, using French data on young PhD graduates, Giret, Perret and Recotillet (2003) analyse the return of years of doctoral training regarding the choice of finding a job in the private sector, and especially in the R&D sector. They show that even if doctoral training has a positive effect on recruitment in the PSR, they do not gain greater wages than engineers.

From the demand-side in the private sector, if a considerable amount of papers has been written concerning the cooperation between university research and scientific activity in industry, little has been written considering the impact technology transfer has in doctorates careers and mobility between the two sectors. As Stephan (2001) points out, technology transfer may have direct and indirect education implications for PhD students. Indirectly, faculty may affect the curriculum by initiating new program or updating training. Directly, technology transfers offer the possibility of linking students to industry more efficiently, by providing opportunities for industries and students to meet (Stephan, 2001, p.201). However, she noted that technology transfers have the potential to have negative impacts on students by changing the nature of the relationship between faculty and student or postdocs. This seems to be the case for the US biomedical research where private funding may divert them from their academic research without completion of their degree.

However, our main question is to know if technology transfer may affect the recruitment and the mobility of new doctorates between the two sectors. In France, the organization of research and development within companies seems to generate a particular situation for the recruitment with competition between the elite engineering schools graduates and the PhD graduates. As noted in Beltramo, Paul and Perret (2001), several factors may explain the large percentage of industrial researchers recruited from shorter degrees than a PhD, whereas the latter is the minimum level required for academic research. Firstly, the internal cooperation inside the firm between R&D and the other functions explains that engineering graduates are more efficient in maintaining links with production due to the tacit knowledge exchanged during the process and the advantages gained by a "common culture". Secondly, the reduction of R&D costs of producing in line with an externalisation of R&D, may lead to a decrease in the demand of PhD graduates without reducing the possibility of being able to assimilate

outside information and scientific knowledge (Beltramo, Paul and Perret ; 2001, p.822). Furthermore, their cases studies show that if the company adopt a career path where researcher may access high positions outside the R&D activity, it gives preference to the recruitment of engineering graduates, who are more adaptable and mobile than PhD graduates. So, as Béret (2002) noted it, the proportion of PhD among industrial researchers is not increasing in France.

The queue for permanent research positions in the French labor market (Martinelli and Molinari, 2000, Mangematin, 2001, Béret and alii, 2002) has created a specific labor market for young doctorates, characterised by a proliferation of post-doctoral programmes and fixed-term contracts financed by research contracts immediately after award of the doctorate. In the public academic sector, recruitment for a for permanent job depend to the opportunities to placement which are less frequent than the job offers. In the job competition model, Thurow posits that potential employees are ranked in a labor queue by employers based on their personal characteristics. When job openings arise, employers select those individuals at the top of the respective labor queue. Consequently, workers will occupy different position in the public and in private labor queue. PhD graduates possessing a particular set of characteristics will be considered desirable for some jobs and the same time, undesirable for the others. As Romer (2000, p.33) noted it to explain the difficulties of PhD graduates in the US labor market, the key point is to distinguish between people who are trained exclusively for employment in research universities and people who can work in research and development in the private sector.

Offering a fixed term contract in public academic research is a mean to observe research productivity, specially for university or public research center which does not recruit their PhD student. Moreover, postdoctorates and other fixed-term contracts with their short tenure provide considerable flexibility to the recruitment and reduce the asymmetric information on the ability. If, generally, those who demonstrate exceptional potential are immediately recruited in securing positions, the competition between the others has been getting more intense. The point is to know whether the potential productivity of PhD graduates employed in public fixed-term contracts gives an advantage or a better position in the labor queue for a private R&D job. It will depend on employer preference. However, if the end of the fixed-term contract in the academic sector is considered as a failure, it seems to be doubtful that R&D companies recruit these graduates. If the recruitment of scientist from the public

academic sector is a mean to introduce their researcher into scientific networks (Arora and Gambardella, 1997), reputation and membership within the same scientific community, the drop-out in the access to the public sector can be viewed as the signal of a lower potential and associated with a reputation of lower quality research. The quality of the scientist level has also a strong impact on the technology transfer. As Zucker and alii (1997) showed for the biotechnology industries in the US labor market, only the very valuable intellectual human capital, "the star scientist", with high quality publications, would serve as a basis for mobility from university to firm. On the other hand, a first job in the public research sector may be considered as a more valuable experience and thus, a more profitable recruitment than a graduate without experience on the labor market. As Robin showed it (2002), a moderate teaching activity during the PhD increases one's chance to get a private research contract : teaching skills may act as a signal of one's communicative skills, a type of skills highly valued by firms.

3. The Data

The study uses data from the "Generation 98" survey, a sample of 55 000 individuals leaving the French educational system in 1998 and interviewed in 2001, carried out for the Cereq. The "Génération 98" includes useful information on young people characteristics (family 's socioeconomic status, age, highest grade completed, highest grade attended, university area, job…) and work history since 1998 until 2001. Of the 55 000 school leavers, we reduce the sample to 1265 respondents leaving higher education with a PhD. Data are also available for two other cohorts, those graduated in 94 and 96. However, for the first cohort, the sample size did not allow a detailed analysis by field level. Moreover, only the database for those graduated in 1998, contains an exhaustive longitudinal information on the first three years of active life of the cohort.

Table 1 shows the occupational allocation of doctorates for the three cohorts, three years following graduation, in the public sector, in the academic public sector and in the R&D sector. We can observe that the part of graduates employed in the public sector fall dramatically since 1997: for the last cohort, less than one graduate on two is recruited in the public sector. The decrease of the part of employment in the public academic sector mainly explains the general fall of the employment in the public sector. This pattern is likely to

reflect more restricted access to job recruitment in the public research sector, in Cnrs[1] or higher education than in the middle of the nineties (for example,see Bideault and Rossi, 2003). However, contrary to what may be expected, the proportion of PhD in the R&D private sector did not increase in the same proportion, except for those who completed an engineering schools before their PhD or who were graduated in mechanics, engineering sciences or computer science. As highlighted in table 1, differences exists by discipline levels. Generally, the recruitment in public sector, notably in the academic sector is still important for PhD graduates in social and human science: in 2001, the majority is employed in the public academic sector whereas only one third of graduates in exact science is in this sector. However, in economics, law and management sciences and in chemistry, the number of graduates in the public academic sector increases.

In table 2, we present the motilities between the two sectors. During the three year following the PhD graduation, 20% of doctorates obtain successive jobs in the private and in the public sectors, the majority moves from the pubic to the private sector.

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[1] National scientific center

Table 1 – Occupation position 3 years after graduation

	Part of graduates employed in the public sector			Part of graduates employed in the public academic sector			Part of graduates employed in the private R&D sector		
Cohorts	1997	1999	2001	1997	1999	2001	1997	1999	2001
PhD graduates	66	61	53	51	50	40	15	16	18
PhD graduates in exact sciences	61	54	47	48	47	35	18	22	24
PhD graduates in human and social sciences	85	76	70	64	57	53	1	2	1
PhD graduates who completed an engineering schools	66	51	35	56	46	33	19	36	40
By discipline									
Mathematics and physical sciences	-	58	43	-	51	30	-	21	26
Mechanics, engineering sciences or computer science	-	50	36	-	42	27	-	25	31
Chemistry	-	40	51	-	34	39	-	31	25
Life sciences, geology	-	62	60	-	53	44	-	16	14
Economics, law and management sciences	-	63	73	-	50	60	-	4	1
Humanities	-	84	68	-	61	43	-	1	1

Céreq

Table 2 – Mobility between the public and the private sector

	PhD graduates in exact sciences	PhD graduates in human and social sciences	Alll
All the jobs in the private sector	40,5	29,2	37,4
All the jobs in the public sector	39,2	58,4	44,4
Mobility from the private to the public sector	5,5		5,7
Mobility from the public to the private sector	9,4	12,3	8,0
More than one mobility between the two sectors	5,4		4,5
Total	100,0	100,0	100,0

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4. A first statistical overview of the trajectories of PhD graduates

The transition to the labor market for PhD graduates consists of a number of successive stages: unemployment, employment in public academic sector, in the private R&D sector, in others jobs in the private or public sectors. As Stephan and Levin (2001) pointed out, the first three or so years, following the end of the PhD are critical to the scientist level and the career in the academic sector. For the French PhD graduated in 1998, our data allows us to identify precisely the early career stages. The surveys shows this phase in the form of a "calendar" for a period of three year after graduation. This calendar includes a monthly information on the various stages occupied on the labor market, the duration of the stage, the transition from one stage to another.

For example, for three individuals, the calendar is :

1	PhD	U	U	U	P	P	P	P	P	P	---	---	P
2	PhD	PhD	U	U	U	U	P	R	R	R	---	---	R
3	PhD	R	R	R	R	R	R	R	R	R	---	---	U
	t1	*t2*	*t3*	*t4*	*t5*	*t6*	*T7*	*t8*	*t9*	*t10*			*t40*

where PhD= at PhD
        U= unemployment
        P= employment in the public academic sector
        R= employment in the private R&D sector

Understanding transition from school to work needs to make a full use of these calendars. Our strategy aims at taking account of all the information provided by the calendar. In so doing, we define a concept of "typical paths" in order to obtain several representative and homogeneous paths from the 1265 calendars in our database. Typical paths can be calculated by several methods (for example see Abbott and Hrycak, 1990). From a general point of view, the problem is to define the distance between trajectories and to parse data automatically in such a way that the paths that lay close be grouped together. It is thus possible to define path classes and to obtain a polychotomous variable that indicates to which class a person belongs. We used here the variant developed at LIHRE (Espinasse, 1992). The distance is written as:

$$D_{i,j} = \Sigma_t X_t \quad \text{with} \qquad X_t = 1 \text{ if } S_{i,t} \# S_{j,t}$$
$$X_t = 0 \text{ if } S_{i,t} = S_{j,t}$$

where $S_{i,t}$ is the position of the person i at the instant t. Clusters are then made up through an ascending hierarchical classification.

The graphs (see Appendix 1) give an overview of the main trajectories of PhD graduates in the labor market. 9 trajectories may be distinguished:

- 1: a delayed access to the public academic sector (employment in public research or in higher education): *8% of* PhD graduates,
- 2: a stabilization in under-qualified jobs: *6% of* PhD graduates,
- 3: a delayed access to a qualified job (professional, manager, outside the public or private research sector) following an unemployment spell: *5% of* PhD graduates,
- 4: a direct stabilization in the private R&D sector: *17% of* PhD graduates,
- 5: a delayed access in under-qualified jobs after an unemployment spell: *2% of* PhD graduates,
- 6: a progressive exit from the public academic sector: *4% of* PhD graduates,
- 7: a direct stabilization in the public academic sector: *32% of* PhD graduates,
- 8: a direct stabilization in a qualified job (professional, manager): *18% of* PhD graduates,
- 9: recurrent unemployment: *8% of* PhD graduates.

Two trajectories seem to be problematic: the trajectory of recurrent unemployment and the trajectory of progressive exit from the public academic sector. 75% of graduates in the first trajectory spent at least twenty months of unemployed and about 66% were unemployed in March 2001. For the second trajectory, the exit from the public was followed by an unemployment spell with different consequences for the graduated: if more than 40% accessed a qualified job (outside the research sector), 33% were still unemployed. However, it is important to note that two other trajectories with less unemployment are also problematic: 10% of PhD graduates could only access under-qualified jobs, directly (8%) or indirectly (2%). For the majority, professional downgrading is a recurrent situation in the labor market.

Finally, the five other trajectories, which gather 80% of PhD graduates, represents a more favourable transition : in 2001, three years after graduation, doctorates had worked in a qualified job since at least one year. However two trajectories didn't lead to the private or public research sector, respectively 5% and 18% of graduates find more or less easily qualified jobs outside the research sector. Three trajectories lead to private or public research sectors. It is important to note that we found only one trajectory for the access to the private sector but two trajectories for the public sector. In the private sector, the recruitment follows the graduation immediately and the risk to exit this sector is very low. In the public academic sector, we observe two kinds of transition : a direct access for 32% of graduates and a delayed access for 8% of graduates, the half of them were unemployed for at least 6 months following their Ph.D.

Table 3 shows the distribution of graduates by discipline group. The most notable difference is probably the relative high percentage of PhD graduates in exact sciences in the trajectory of access to the private research sector. Conversely, graduates in human and social sciences are more numerous in the trajectory of direct stabilization in the public academic sector and in the trajectory of recurrent unemployment.

Table 3. A typology of trajectories of PhD students in the labor market.

	Exact sciences	Human and social sciences	All
a delayed access to the public academic sector.	9%	8%	8%
a stabilization in under-qualified jobs	5%	6%	6%
a delayed access to a qualified job	6%	5%	5%
direct stabilization in the private R&D sector	23%	17%	17%
a delayed access in under-qualified jobs after an unemployment spell	2%	2%	2%
a progressive exit from the public academic sector	4%	4%	4%
a direct stabilization in the public academic sector	29%	32%	32%
a direct stabilization in a qualified job	17%	18%	18%
recurrent unemployment	5%	8%	8%

5. A non parametric matching estimator to assess the return for a job experience in the PSR

In this section, we try to assess the impact of a job in the public or academic sector on the subsequent wage earned in the private sector or in the R&D private sector. In that sense, we need to turn to the econometric evaluation literature, widely developed on that topic for twenty or so years (see for example the huge number of papers published by Heckman on that topic) and to refer to studies on treatment effects (Heckman, Ichimura and Todd, 1997, 1998). We are interested here in the impact of a treatment T_1 (being employed in the public and/or academic sector after graduation) in comparison to the non-treatment situation T_0 on a targeted outcome, the wage earned for those employed in the private sector 3 years after graduation. The well known problem that arises in that typical evaluation exercise is the bias due to the use of a non randomised sample. To overcome to this problem, a vast literature on statistical non parametric matching estimator has been developed in the last ten years

(Heckman, Ichimura and Todd, 1997, 1998; Becker and Ichino, 2002 ; Dehejia and Wahba, 1999, 2002…) following the publication of Rosenbaum and Robin in 1983.

The aim of these methods is to obtain an average treatment effect as if experimental data were used for computation and is given by the following difference:

$$E\left(W_1 \middle| T = 1\right) - E\left(W_0 \middle| T = 0\right) \qquad [1]$$

That means one need to construct from the population of interest a control group and a treated group. However we do not observe W_0, the outcome of interest the participants would have had they not participated. This not observed outcome is the so-called counterfactual expectation, $E\left(W_0 \middle| T = 1\right)$. Because the counterfactual is by construction unobservable, we need to estimate it on the basis of the observable expectations, $E\left(W_1 \middle| T = 1\right)$ and $E\left(W_0 \middle| T = 0\right)$. In other words, we prone to use a non parametric matching estimator which consist of establish a control group for the non treated such that the control is very closed to the treated group according to the vector X of observables. From a statistical point of view, it implies that: $W_0 \perp T \middle| X$, so that the treatment effect of the treated is the difference between the wage expectation in the control and treated groups.

Since the matching procedure requires that the two groups are elaborated conditionally on the X's, one should find two distinctive groups for which the X's are the same. In so doing, the method is inappropriate and the use of a propensity score obtained from a Logit or Probit estimation overcome the problem. This way of doing allows us to get a unique number for each set of similar X's. And, as Rosenbaum and Robin pointed out, for the same propensity score in the two groups, one get the same distribution of the entire vector X independently of the treatment. This is the so-called balancing property of the propensity score and its guarantees that the construction of the two groups is random. Furthermore, the computation of the propensity score might be restricted to the common support of the X's, so that the computation is restricted to units for which the value of the X overlaps for the treated and control groups. At this stage, it is still not possible to implement the non parametric matching estimator. Actually, as the probability to observe two individuals with the same propensity score is closed to zero, we need to make use of complementary methods (for details, see Becker and Ichino (2002) or Dehejia and Wehba (1999)). Four methods are in use in this paper, the nearest neighbour method, the stratification method, the radius method and the kernel method, which seems to have the best properties (Heckman, Ichimura and Tood, 1998;

Hirano, Imbens and Ridder, 2000). Briefly, the stratification method consists of splitting the propensity score distribution into intervals on which treated and control units have the same average of the propensity score. The nearest neighbour is based on finding the units for which the propensity score is the closest. The radius method restrict the definition of the nearest neighbour to an predefined interval, so that it is usually better to use the radius method. The Kernel method allows us to smooth the split into several intervals in taking weighted average conversely proportional to the distance between the propensity score of the two groups.

Applied to our sample, the results are given in the following tables[2] (tables 1 to 3). Three empirical tests have been carried out : the first one try to assess the return for a job mobility from public to private sector without any condition on activity research. Depending on the chosen method, the confidence value varies, implying a different interpretation of the test. Three methods on four give us a significant average treatment effect for the treated. More precisely, the assessment show a wage loss when coming from the public sector, such that there is apparently no paid knowledge transfer for this kind of job mobility. It is more likely because the treated have not found a tenure job in the public that they turned to the private sector. In that case, the employers on the private sector sanction the graduates by offering wages lower than those offered to those who have not been in the public sector before.

Table 1 – Job mobility from public to private sector

Job mobility from public to private sector Number of treated: 150	Average treatment effect	Bootstrapped standard error	Confidence value
Nearest Neighbour method	-192.787	103.003	-1.872*
Radius method	-127.140	59.369	-2.142**
Stratification method	-180.965	62.622	-2.890***
Kernel method	-110.863	69.799	-1.588

Our second investigation consists of assessing the job mobility from the public sector of research (so-called PSR) to the private sector, including R&D activities. The computations rather show convergent evidence, although two average treatment effects are not significantly different from zero. However, it seems that the average treatment effect is greater in a negative way on the wage earned in the private sector. One might assume that specific competencies, particular science knowledge-based have no wage counterparts in the private

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[2] The computation have been done with Stata 7.0 software using the Stata programs written by Becker and Ichino (2002).

sector. As in the precedent case, PhD beginning their career by job in the PSR are sanctioned in the private sector, more had they came from the overall public sector.

Table 2 –Job mobility from public sector of research to private sector

Job mobility from PSR to private sector Number of treated: 116 Number of control units:	Average treatment effect	Bootstrapped standard error	Confidence value
Nearest Neighbour method	-221.110	116.465	-1.899*
Radius method	-118.233	79.068	-1.495
Stratification method	-157.725	64.978	-2.427**
Kernel method	-113.483	71.935	-1.578

Finally, our third empirical test try to estimate the difference in wage expectation for PhD graduates employed in the R&D private sector between those having been treated (that is a job experience in the PSR after graduation) and those who had not. None of our estimations confirm that there is a wage premium for this kind of trajectory. Nevertheless, the value of the average treatment effect decreases significantly, so that the sanction operated by private employers in the R&D sector is not so valuable. If a knowledge transfer exists, it could be not solely materialized by a significant improvement of the wage earned. So that we are rather in favour of the assumption that a job mobility from the PSR to the private R&D has a slightly different meaning than the one given in the theoretical background we developed in the second section.

Table 3 – Job mobility from public sector of research to private industrial research

Job mobility from PSR to R&D private sector Number of treated units: 35 Number of control units: 139 (except for the NN method, 31)	Average treatment effect	Bootstrapped standard error	Confidence value
Nearest Neighbour method	26.114	143.082	0.183
Radius method	-21.162	104.212	-0.203
Stratification method	-30.880	93.837	-0.329
Kernel method	-19.564	108.416	-0.180

6. Concluding remarks

As we pointed out in the introduction of the paper, few papers have been devoted to labour market for young scientists in France and especially on the particular topic of the evaluation of doctoral training in the mobility's from public sector for research to private sector. The specific patterns of transition from school to work for young PhD associated to a very singular organization of public research in France had created a narrow labour market for research. However, for a while, the public sector for research is no more the principal employer of young doctorates in exact sciences, whereas in human and social sciences, the recruitments in the public sector are still the most job opportunities (Béret, Giret and Recotillet, 2002). The transformation of job opportunities for young scientists is accompanied by the public policy for research which encourages the development of links between universities and firms.

Our knowledge of career paths for young doctorates is rather limited, at least in France and this paper attempts to improve the empirical knowledge on that topic. The first empirical part of the paper precisely described the trajectories for these young doctorates, showing that even if nearly the half of the cohort has a direct access to jobs in the research sector (private or public), some remain in trajectories dominated by under-qualified jobs or in recurrent unemployment. Another problematic trajectory consists of a progressive exit from public sector. To go further in that direction, the last section investigates the differences between the doctorates who had jobs in the public and then in the private sector and the doctorates who directly entered the private sector. Using a non parametric matching estimator to controlled for the selection bias due to the choice of one or the other sector, we show that there is no positive wage gain when quitting the PSR. Whereas the theoretical backgrounds show evidence of a positive effect on career paths for researchers moving from PSR to R&D sector, our results are more in favour of no effect, at least, on the wage earned in the private sector. At the beginning of the career a such mobility does not overlap the global framework considered in theoretical developments. That means that this is likely more the PhD graduates who are not recruited on tenure positions that move in the first years. Consequently, there is more certainly a negative signal effect behind this result, which counterbalances the knowledge transfer effect.

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Appendix 1

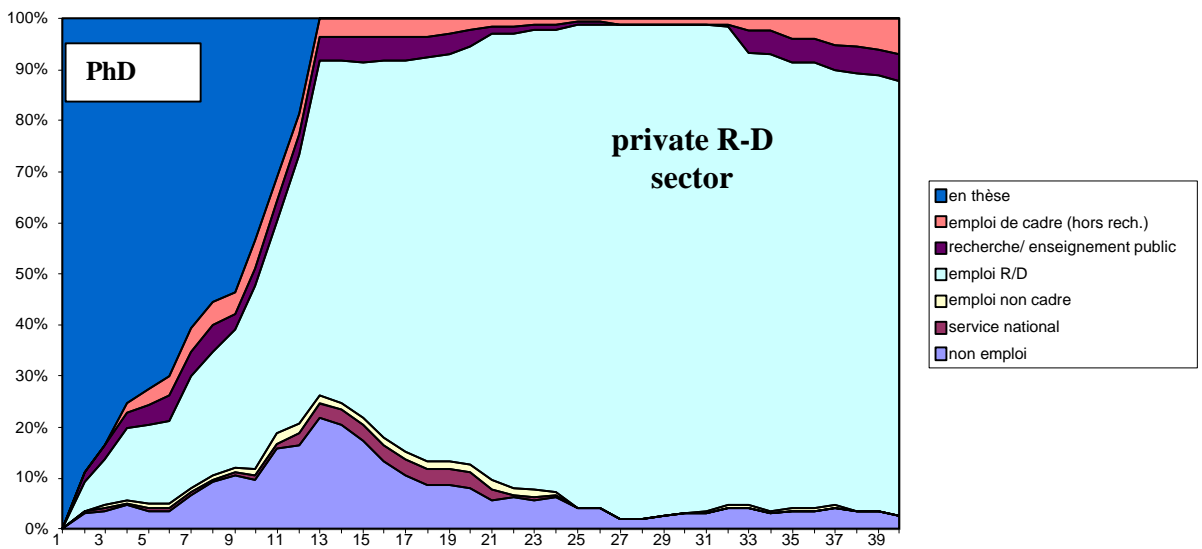### A delayed access to the public academic sector
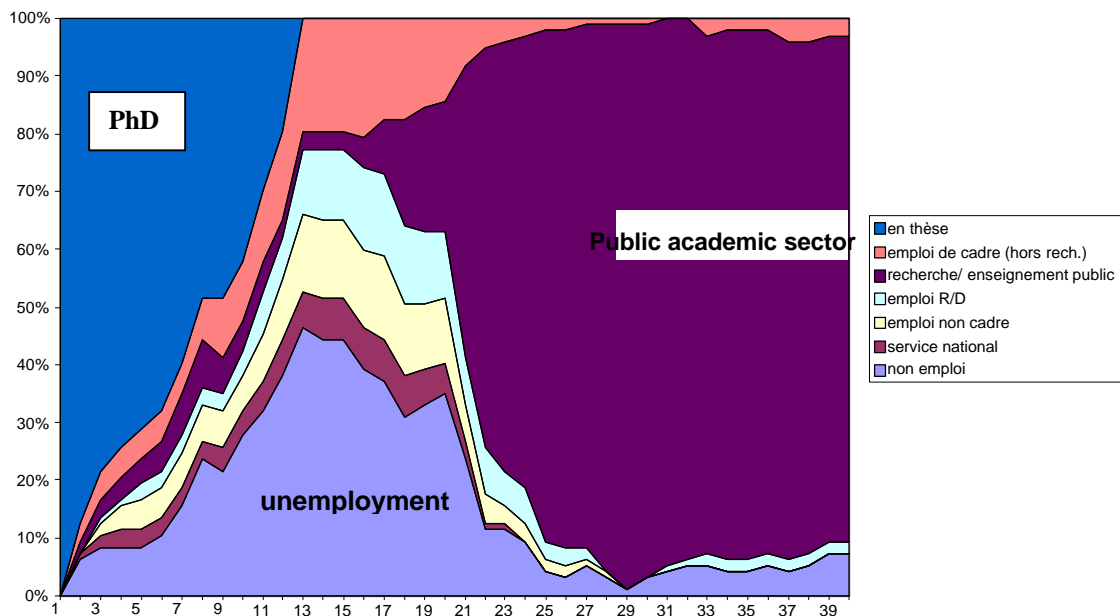
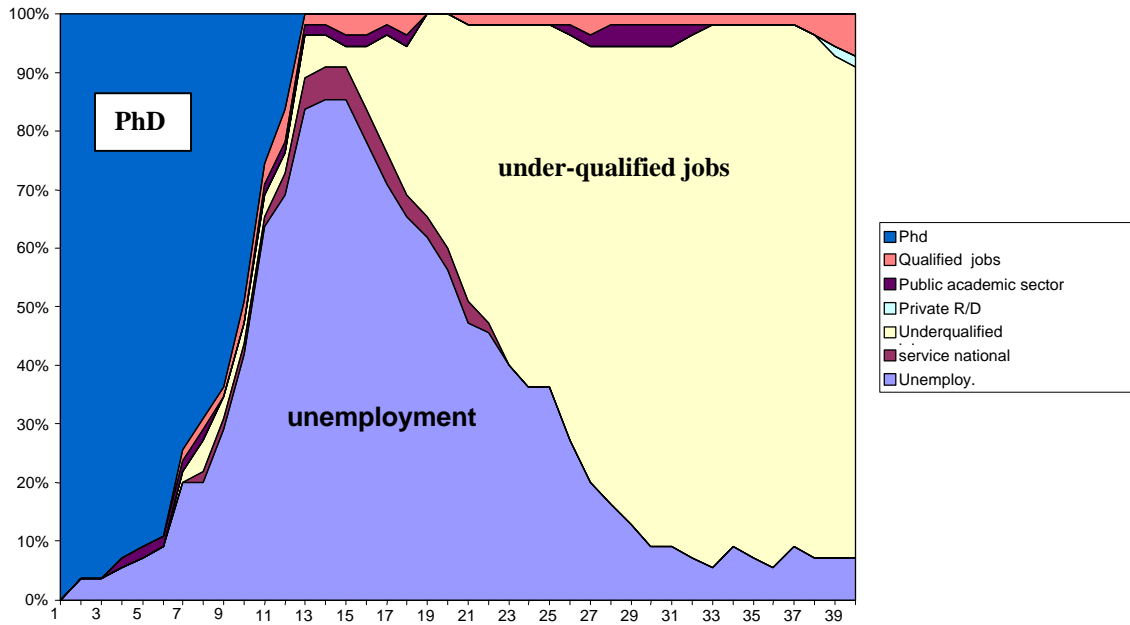### A stabilization in under-qualified jobs
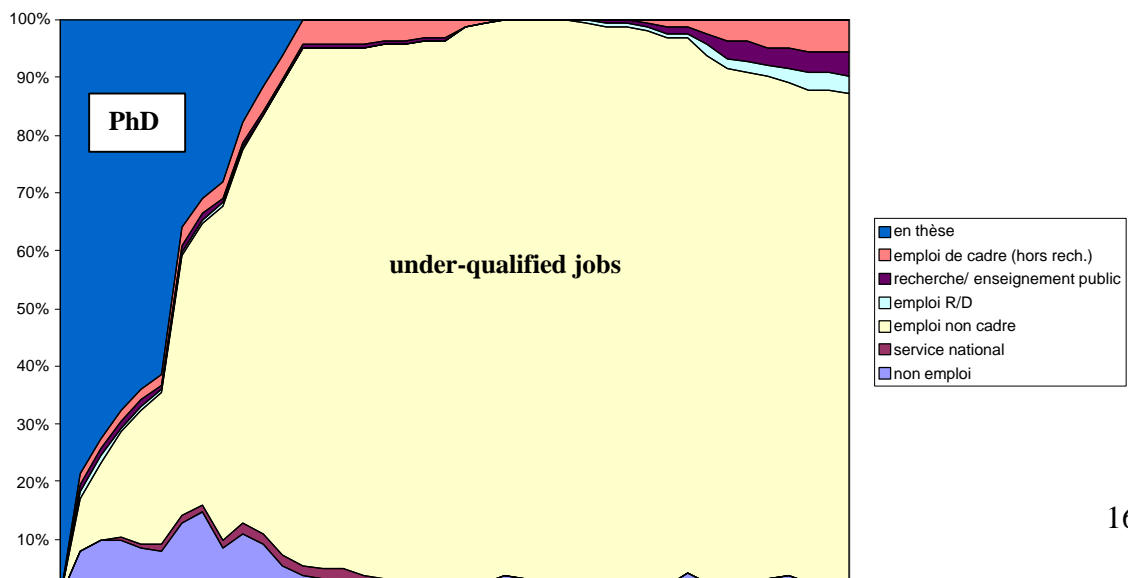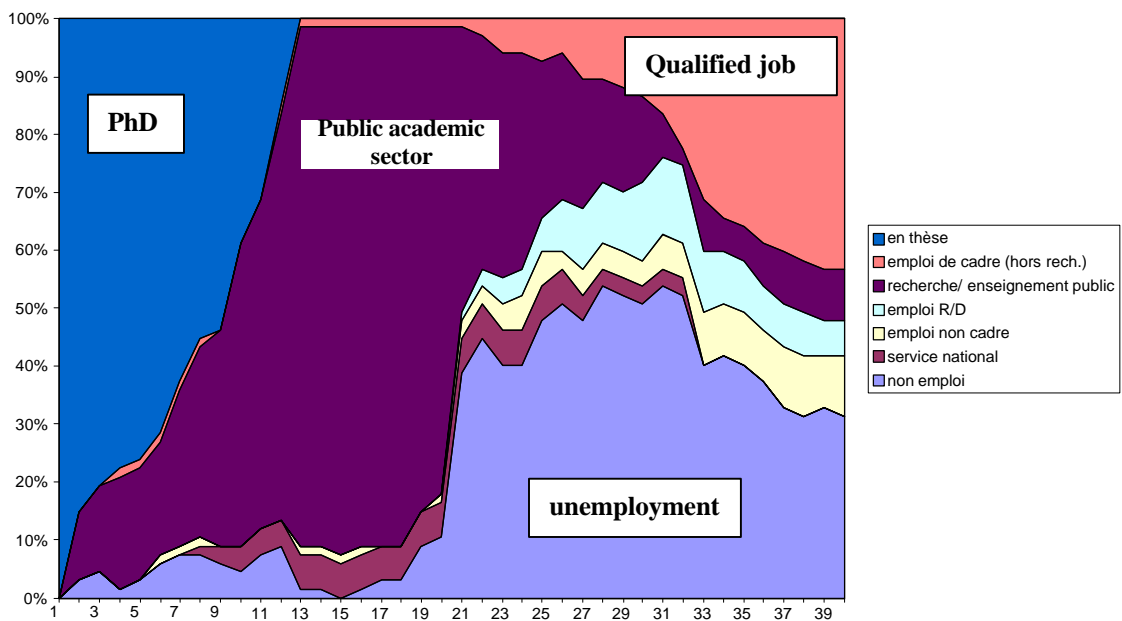
A delayed access to a qualified job
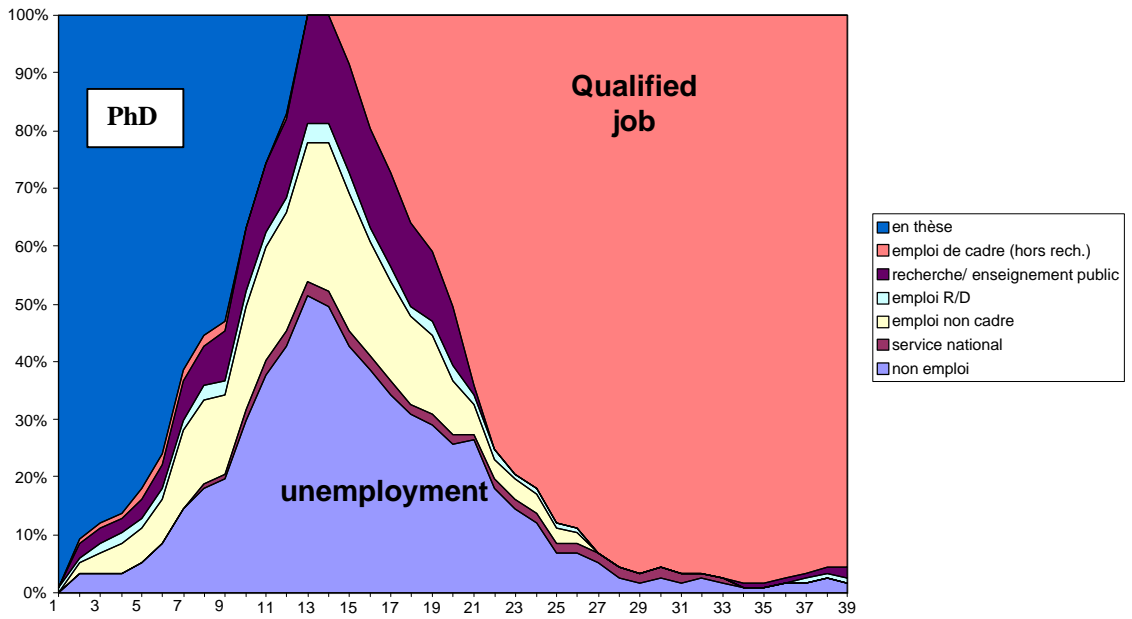
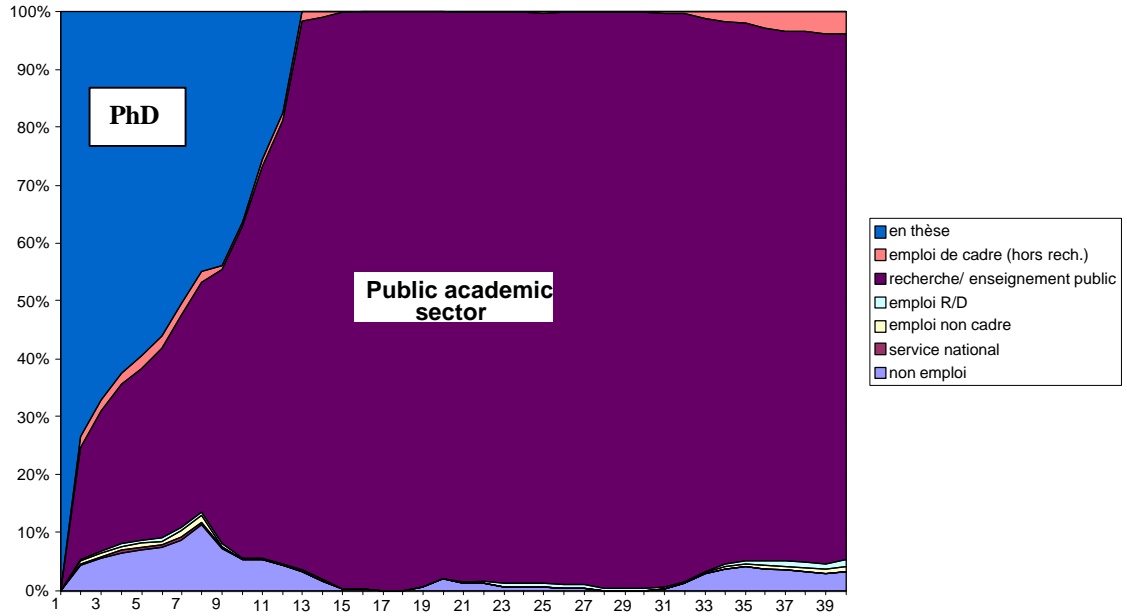## A direct stabilization in the private R-D sector

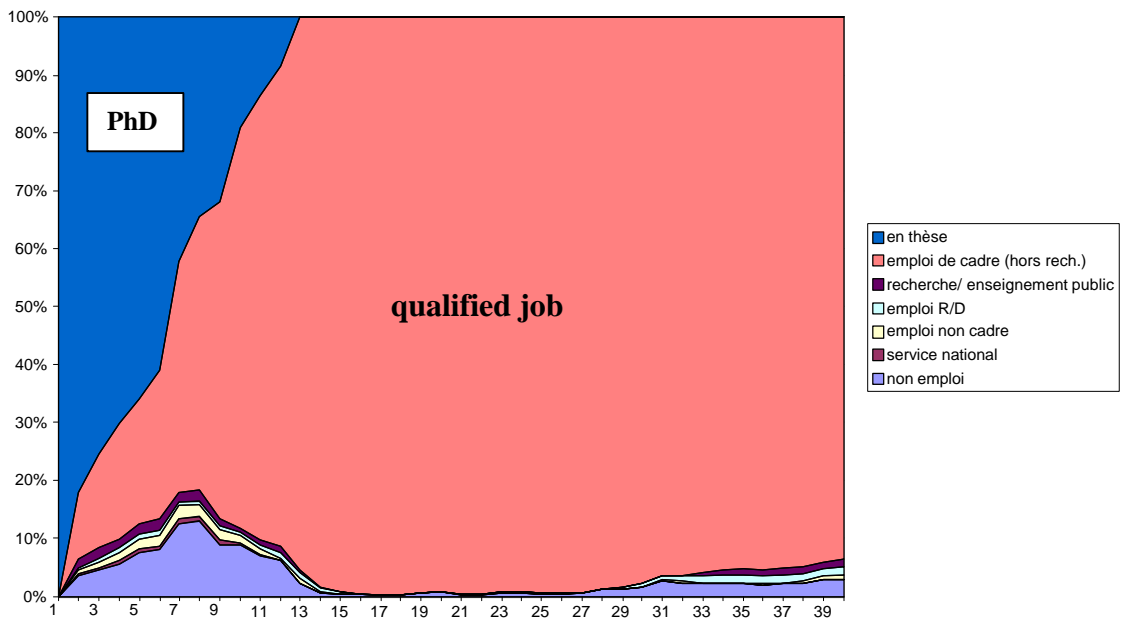**A delayed access in under-qualified jobs after an unemployment spell**

A progressive exit from the public academic sector

A direct stabilization in the public academic sector

A direct stabilization in a qualified job

Recurrent unemployment

PhD

unemployment

Legend:
- en thèse
- emploi de cadre (hors rech.)
- recherche/ enseignement public
- emploi R/D
- emploi non cadre
- service national
- non emploi