Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

No. 94
November 2011

TRÉSOR-ECONOMICS

Do PhDs have difficulty finding work in corporate R&D?

This study was prepared under the authority of the Directorate General of the Treasury (DG Trésor) and does not necessarily reflect the position of the Ministry for the Economy, Finance and Industry.

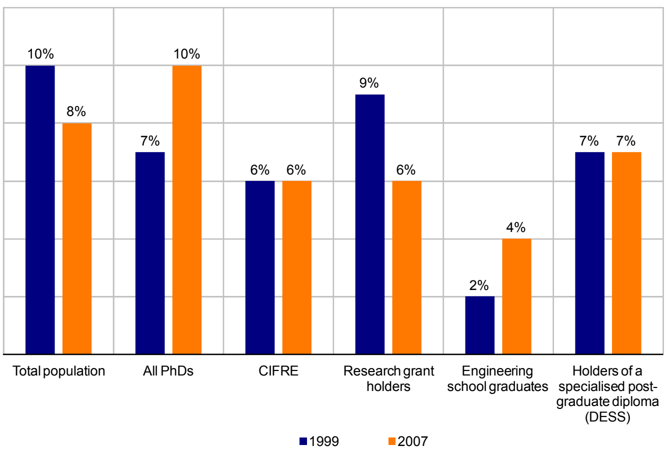
- Unemployment is high among people with doctorates in France, both in relation to other graduate categories and by comparison with PhDs in other countries. The rate varies widely from one subject area to another, however. The unemployment rate for people with university doctorates in mechanical, electronic, computer engineering and engineering sciences is low, being close to that for engineering school graduates (around 4%). The rate for young PhDs in chemistry, literature and the human sciences, on the other hand, is three times higher.

- By comparison with holders of a "Bac+5" level of education (high school graduation plus five years of higher education, generally leading to a master's or equivalent degree), there are relatively few PhDs in private R&D, most being employed in the public sector. While this is not a French specificity and the same observation can be made in all developed countries, there are grounds for wondering whether companies may have a selection bias against PhDs in favour of engineering school graduates.

- To test this hypothesis, we use an econometric model to compare the productivity of PhDs with that of other graduates in a private sector R&D unit. From this it emerges that the productivity of PhDs is comparable to that of engineering school graduates, and that, for a given level of seniority, they are not paid less. Consequently, there is no selection bias against PhDs. Given the competences available and the specific features of companies, no fewer PhDs are hired in private-sector R&D teams than would be economically optimal. However, the mismatch in the supply of doctoral training programmes could lead to under-utilization of human capital.

- The econometric analysis clearly shows the importance of the role played by researchers holding a degree other than the Bac+5 or a PhD in the production of innovations. Young people's disaffection from scientific subjects and the French economy's growing need for researchers[1] is all the more cause for concern. All science training courses, including even the shortest ones, need to be supported, and not just doctoral courses.

Unemployment rate, three years after obtaining degree, for Bac+5 and above, in 1999 and 2007



Source: Centre d'étude et de recherche sur les qualifications (Céreq), Enquêtes "génération" 1996 and 2004.

(1) Paul Cahu, Lilas Demmou (2009) and Emmanuel Massé, "The economic impact of the 2008 research tax credit reform" Trésor-Economics no. 50, January 2009.

MINISTÈRE DE L'ÉCONOMIE
DES FINANCES ET DE L'INDUSTRIE

1. France has a relatively high unemployment rate for PhDs:

1.1 Earning a doctorate offers less and less insurance against unemployment

Since the beginning of the 1990s, unemployment among PhDs is the highest in the "holders of a Bac+5 degree or above" category. The gap widened especially in 2007, when the unemployment rate of PhDs 3 years after obtaining their degree rose to 10%, versus 4% for engineering school graduates and 7% for holders of a DESS specialised post-graduate diploma, which has been replaced by the "*master professionnel*" (vocational master's) degree since the "LMD" reform[1].

Table 1: Rate of unemployment for higher education graduates 3 years after earning their degree (in %)

	1997	1999	2001	2004	2007
Total population	11	10	8	9	8
All PhDs	8	7	7	11	10
Of which PhDs having benefited from:					
- CIFRE contract	3	6		6	6
- Research grant		9		9	6
Engineering school graduates	5	2	2	6	4
Holders of a DESS specialised post-graduate diploma	10	7	5	11	7

Sources: Céreq, situation 3 years after earning doctorate in 1994, 1996, 1998, 2001 and 2004.

This high unemployment among young PhDs appears to be specific to France, among OECD countries. In 2006, the unemployment rate for young PhDs having earned their degree three years earlier was 4% in Germany, and less than 2% in the United States.

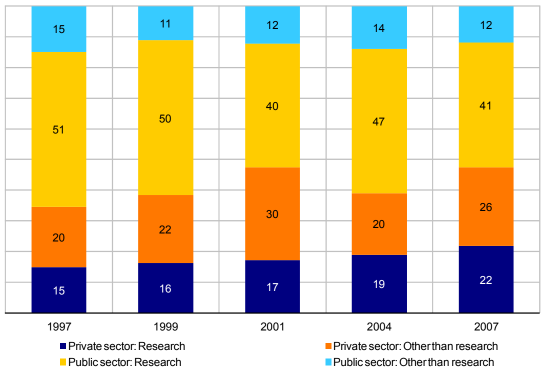
It should be noted, however, that the unemployment rate for young PhDs in France conceals wide disparities, in particular by type of funding for the thesis and by subject area. For PhDs who have received a research grant or who have benefited from a "CIFRE" contract, the unemployment rate has remained stable or fallen since 1999, and below the rates for holders of a vocational master's degree or for PhDs in general.

The unemployment rate for PhDs also varies greatly from one subject area to another. While unemployment among young PhDs in mechanical, electronic and IT engineering and in engineering sciences has risen since the early-2000s, it remains close to the figure for engineering school graduates (4% on average over the period 1999-2007 for both categories), even though they are probably in competition with each other. Conversely, people with PhDs in chemistry, literature and the human sciences experienced a rate of unemployment on the order of 15% over the period 1999-2007.

1.2 The majority of holders of doctorates work in the public sector, but private-sector employment is on the rise

In 2007, 52% of PhDs who had received their degree in 2004 and were in work were working in the public sector, according to the *Observatoire de l'emploi scientifique* 2009. This share fell sharply in the second half of the 1990s but appears to have stabilised since then (see Chart 1). Among these young PhDs employed in the public sector, three out of four are researchers. The share of young PhDs engaged in research in companies has been rising continuously since the mid-1990s, reaching 20% in 2007, but this is less than the figure for young PhDs engaged in other functions in the private sector.

Chart 1: Where holders of PhDs in France are employed, by sector and type of activity engaged in (in %), 3 years after earning their degree



Source: Céreq, Enquêtes "génération" 1994-1996-1999-2001-2004.

The interest being shown in PhDs' entry into working life, into research especially, is motivated by the need to boost the French economy's growth potential. Now growth theory treats an economy's human capital as a major growth driver (see Box 1), but only if it can be put to use in the production process. The hypothesis of a mismatch between private-sector research laboratories and PhDs is cause for concern, in this regard, since it amounts to saying that France uses its human capital less than optimally.

(1) "Within the framework of the harmonisation of European higher education systems, the French university cursus now comprises three degrees: Bachelor (*Licence* in French) - Master - Doctorate. This new organisation (L.M.D. in French) will increase the mobility of European students, mobility between subjects and between vocational and general streams." Translated from the French Ministry of Higher Education and Research website.

Box 1: **The importance of human capital in economic growth**

Early work on the economics of growth highlighted the role of technological progress in economic growth. Economists modelled economic activity with the aid of production functions comprising labour, capital (physical and/or human) and technology as inputs. At the very beginning, capital accumulation was modelled, but not the accumulation of technology[a]. At the end of the 1980s, Paul Romer proposed a model in which technological change is made endogenous: a research sector generates technical progress, which is then used by the other sectors. Its model underscores the importance of human capital in growth, and in particular that of human capital devoted to research.

Romer's model comprises four inputs, two of which model a society's level of knowledge, i.e.:

- K : physical capital;
- L : quantity of labour;
- H : human capital, measuring the cumulative effect of educational and training activities;
- A : level of technological progress.

Knowledge consists of human capital and technological progress. The level of technological progress is seen as the non-rival component of knowledge, i.e. several agents can use it at once, while human capital is the rival share, which companies cannot appropriate simultaneously.

The economy is split into three sectors:

- **The R&D sector**: which uses a portion of human capital (H_A) and the stock of knowledge (A) to produce new knowledge in the form of new designs, with a production rate $\dot{A} = \delta H_A A$ where δ is a parameter of researchers' productivity;
- **The intermediate goods sector**: which uses the designs from the research sector and capital to produce intermediate goods x ;
- **The final output sector**: which uses labour, the remainder of human capital (H_y) and intermediate goods (x) , pourto produce the final good $Y(H_Y, L, x) = H_y^{\alpha} L^{\beta} \sum_{i=1}^{\infty} x_i^{1-\alpha-\beta}$

Knowledge contributes to production in two ways: by increasing the number of designs and hence of intermediate goods contributing to production of the final good and by expanding the stock of knowledge, which raises the productivity of the research sector.

After solving the equation, Romer finds that the rate of growth of the economy g is equal to the rate of growth of physical capital and to the rate of growth of the stock of knowledge:

$$g = \frac{\dot{Y}}{Y} = \frac{\dot{K}}{K} = \frac{\dot{A}}{A} = \delta H_A$$

Therefore growth is a function of the human capital devoted to research and of the productivity of researchers. The larger this capital, the stronger the growth.

Romer's work gave rise to the theory of endogenous growth and has inspired many economists subsequently[b].

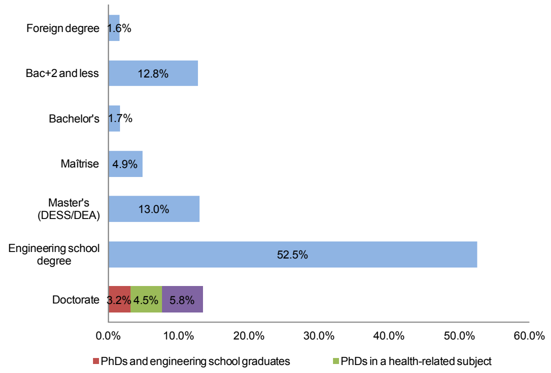
a. Solow R. M. (1957), "Technical Change and the Aggregate Production Function", *The Review of Economics and Statistics*, Vol. 39, No. 3, pp. 312-320, August, treats the stock of knowledge as an exogenous public good. Lucas R. E. (1988), "On the Mechanics of Economic Development.", *Journal of Monetary Economics*, 22(1), pp. 3-42, treats the production of knowledge as a side effect of production of the final good.

b. In the 1990s, Aghion and Howitt developed a theory in which growth is endogenous: Aghion P. and Howitt P. (1998), "Endogenous Growth Theory", *MIT Press*.

1.3 Although it is low, the share of PhDs in private-sector R&D is in line with the international average

Engineering school graduates predominate in the distribution of research personnel in private-sector companies by degree held. They represent more than 50% of company researchers, versus only 13.5% for PhDs (see Chart 2). Among PhDs, 23% are also engineering school graduates and one in three earned his or her doctorate in a health-related subject (medicine, pharmacology or odontology) (Observatory of employment in science 2009).

Chart 2: Distribution of company researchers by highest level of degree obtained, in 2007



Source: Ministry of Higher Education/Directorate General for Research and Innovation-Directorate General for Higher Education and Employability-Information System and Statistics-C1.

This low representation of PhDs in private-sector laboratories is not specific to France, as it occurs in many countries, including those considered to be in the forefront of innovation.

- In Japan, PhDs accounted for only 5% of company researchers in 2005[2], versus 13.5% in France in 2007.
- In Germany, PhDs accounted for 5.7% of R&D personnel (including researchers, laboratory technicians, blue-collar and administrative staff) in industrial companies in 2005[3]. In France, this proportion was 7.7%[4] in 2007.
- In the United States, 12.1%[5] of private-sector employees working in R&D and holding a higher education science degree were PhDs in 2006. Compare this figure with the proportion of PhDs among researchers and technicians in private-sector R&D laboratories (all degrees and all subjects combined) in France, i.e. 8.7%[6] in 2007.

Consequently, international comparisons appear to show that French PhDs are no worse off than their foreign counterparts as to their position in private-sector research. In addition, this small presence of PhDs in company research teams does not appear to explain the French economy's innovation deficit relative to other countries. This observation raises questions about the added value of a doctorate relative to other degrees, when one looks at companies' innovative capacities.

2. Econometric analysis suggests that the high rate of unemployment among PhDs (especially in relation to engineering school graduates) cannot by explained by insufficient productivity

A question underlying this debate is that of the returns on a doctorate, particularly relative to engineering school degrees, in private-sector R&D laboratories. Do companies treat PhDs working in private-sector research according to their worth?

2.1 A comparative analysis of the productivity of PhDs and engineering school graduates is a good way of detecting possible selection bias.

This study yields pointers to an answer within the theoretical framework (introduced by Griliches on 1979[7]) of a "knowledge production function", to which are added the shares of this or that category of degree-holder among researchers, as explanatory factors of the R&D unit's productivity. Companies' R&D output is thus explained by a set of factors influencing this output (the econometric model's explanatory variables), one of these factors being the research teams' composition by type of degree-holder.

R&D output is commonly measured by the number of patent applications[8]. Nevertheless, this indicator comprises a number of well-known limitations. In the first place, patents are not necessarily the best way to protect innovations, and some innovative companies prefer to keep their innovation secret. Only 27% of companies engaged in R&D applied for patents in 2007[9]. What is more, the value of patents can vary greatly, whereas the "number of patents" variable assigns the same weighting to all patents, regardless of their value. Finally, a single invention can give rise to patent applications in several countries, in which case it is counted several times over in R&D output. The variable used here, namely the sum of patents filed with the INPI in France, the European Patent Office, the United States Patent Office, and those in other countries (including via the PCT[10], internationally), therefore exceeds the number of inventions patented by the company. Nevertheless, and given the costs of patent filings, we may consider that the quality of a patent rises with the number of filings, in which it may not necessarily be preferable to confine ourselves to the number of patented inventions.

R&D output is explained essentially by the size and composition of research teams, and by the financial resources committed. Because this output is measured here by the number of patents applied for, other factors are included in the model in order to account for the propensity to file patent applications, e.g. the type of research the company engages in (basic, applied, experimental), company size and sector, defence research contract, etc. (see Box 2). By including these adequate control variables we can largely attenuate the imperfections associated with the choice of the "number of patents" variable as a measure of R&D output.

(2) OECD, R&D database, 2009.

(3) Source: Calculated by the Ifo Institute based on the 2005 Ifo Investitionstest concerning 1,093 companies in the industrial sector.

(4) This proportion refers to all sectors combined. However, it would not be all that different if we confine ourselves to industry alone, which accounts for 84% of private-sector R&D spending.

(5) National Science Board. 2010. Science and Engineering Indicators 2010. Arlington, VA: National Science Foundation (NSB 10-01).

(6) This figure is based on the findings of the "Enquête R&D" (R&D survey).

(7) Griliches Z. (1979), "Issues in Assessing the Contribution of Research and Development to Productivity Growth", *The Bell Journal of Economics*, Vol. 10, No. 1, pp. 92-116, Spring.

(8) Other, less widely-used measures include the share of recent products in revenue or the product renewal rate (Crépon B., Duguet E., Mairesse J. (2000), "Mesurer le rendement de l'innovation" (Measuring the return on innovation, *Économie et Statistique* no. 334). We performed a regression using the revenue generated on products less than three years old as a dependent variable, the variable being available in the Insee "Innovation" survey (CIS 2008). The small size of the sample obtained after matching up the "researchers" part of the R&D survey with the "Innovation" survey (around 500 observations) yields a very imprecise estimate and consequently results that are difficult to utilise, without invalidating those presented here.

(9) 2007 R&D survey figures.

(10) Patent Cooperation Treaty.

Box 2: **Modelling the output of private-sector R&D**

The estimate is based on a negative binomial model adapted to the counting variables, such as the number of patents. This model has been preferred to the Poisson model, which is more constrained: because Poisson's law depends on only a single parameter, it has the characteristic of an equal variance and expectation. Here, however, it appears that the observations are "over-dispersed" relative to the Poisson model[a]. The negative binomial law, having a variance greater than expectation, provides a solution to the problem.

By writting γ_i the number of pattents filed by company i, X_i the vector of the explanatory variables of the output of patents by company i and β the vector of coefficients associated with vector X_i (this being the vector we are trying to estimate), the hypothesis of a negative binomial model leads us to write the conditional expectation and variance of γ_i as follows:

$$E\langle \gamma_i | X_i \rangle = e^{x'_i\beta}$$

$$V\langle \gamma_i | X_i \rangle = e^{x'_i\beta}(1 + \alpha e^{x'_i\beta})$$

α is the parameter of over-dispersion. The larger it is, the greater the over-dispersion; when $\alpha = 0$, we find the Poisson model. In our model, as pointed out above, the observations are "over-dispersed", α is significantly greater than zero.

The vector X_i combines the following variables:

- the logarithm of the total number of researchers;
- the logarithm of the R&D workforce excluding researchers (technicians, blue-collar and administrative personnel);
- the logarithm of internal R&D spending (DIRD) other than the payroll;
- the share of researchers in each degree category;
- the share of researchers in each age group (as a proxy for experience);
- the logarithm of the total company workforce;
- the shares of internal R&D spending (DIRD) devoted respectively to basic, applied and experimental research (inpercentages).
- an indicator that is worth 1 if the company carries out research under contract with the Ministry of Defence, and 0 otherwise;
- sector indicators.

Sector and size are strongly liable to influence the propensity to file patents. In addition to these traditional factors, the existence of a contract with the Ministry of Defence, which in most cases requires secrecy, may negatively affect the propensity to file patents. The degree to which R&D is situated upstream or downstream (i.e. the respective shares of basic, applied and experimental research) is taken into account also, with basic research affording fewer patenting opportunities than the others.

have the drawback of reducing the precision of the estimates, on the other hand they generally do not skew them, unlike measurement errors regarding explanatory variables[b].

a. The hypothesis of over-dispersion of data was validated thanks to a likelihood-ratio test that compares the negative binomial model and the Poisson model.

b. These generally skew the parameters towards zero (see for example Griliches Z. and Mairesse J. (1995), "Production Functions: the Search for Identification", *NBER Working Paper* No. 5067, March).

The data are provided by the "Annual survey of resources devoted to research and development in companies" conducted by the Ministry of Higher Education and Research for 2007. In addition to the regular annual section, the 2007 survey contains a section on the characteristics of researchers, which covers a sub-sample of 3,143 companies. This section notably informs us about the distribution of researchers by degree and age (but not about the cross-distribution of these two variables). The other variables introduced into the econometric analysis, along with the number of patents, stem from the regular section of the survey (characteristics of the company, its spending and its R&D resources)[11].

2.2 Econometric analysis provides information about both the determinants of R&D output and the comparative productivity of researchers

2.2.1 Fairly predictably, it appears that what influences the production of innovations is the aggregate scale of resources devoted to R&D

Variables relating to the number of researchers and R&D spending other than personnel costs very significantly influence the number of patent filings (see Table 2). A 1% rise in R&D spending-not including personnel-(respectively in the number of researchers) would lead to a 0.46% (respectively 0.33%) increase in the number of patents.

(11) The number of patents has been corrected for the 175 companies that sell at least part of their R&D outside their group. The following proportionality rule has been applied:

1. resources from non-group companies are subtracted from internal R&D spending;
2. the ratio of the resulting amount to internal R&D spending is calculated;
3. the number of patents is divided by this ratio, yielding the corrected number of patents.

The scale elasticity of the R&D function, which is the sum of the two previous elasticities, plus that of the size of the research workforce (which does not emerge significantly), would come to 0.83, which means that a 1% increase in all resources devoted to R&D would lead to a 0.83% increase in the number of patents filed. We would thus see slightly diminishing returns on R&D, which is a classic result in the literature, but which needs to be interpreted with caution since it might simply result from a measurement error bias (Griliches, 1990[12]).

Researchers' age appears to make little difference. The positive effect of experience and the negative effect of the obsolescence of knowledge acquired during one's studies appear to offset each other more or less, except at the end of studies. Indeed, taking the 40-44 age group as our reference, only the 25-29 age group emerges significantly. A 1% increase in this population relative to 40-44 year-olds would raise the number of patents filed by 1.2%.

Table 2: Impact of different factors on the logarithm (ln) of the number of patents

ln(researchers workforce)	0.328***
ln(R&D, workforce, excl. researchers)	0.044
ln(R&D spending, excl. personnel costs)	0.460**

Share of «engineers»[a] with PhDs, excl. health sector	0.00
Share of PhDs who are not «engineers» (excl. health sector)	REF
Share of health sector PhDs	0.012
Share of *«engineers»*	0.003
Share of master's and *agrégations*[b]	−0.018***
Share of *maîtrise* dabd below	0.003
Share of foreign graduates	0.006

Share of under 25s	0.01
Share of 25-29s	0.012**
Share of 30-34s	0
Share of 35-39s	0.004
Share of 40-44s	REF
Share of 45-49s	−0.008
Share of 50-55s	0.001
Share of over 55s	0.003

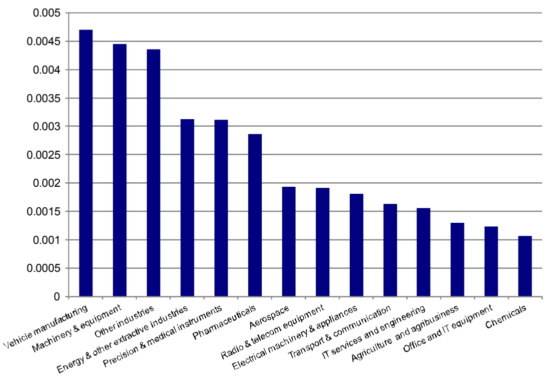
Share of applied research	−0.002
Share of expirmental development	REF
Share of basic research	−0.009*
ln(company workforce)	0.068
Defense research (0 is the REF)	−0.729**

Agriculture and agribusiness	REF
Véhicle manufacturing	1.809**
Other industires	1.560***
Aerospace	−0.107
Chemicals	−0.327
Energy and other extractive industries	0.246
Radio and telecom equipment	0.654
Precision and medical instruments	0.704
Electrical machinery and appliances	0.927*
Office and IT equipment	0.253
Machinery and aquipment	1.625***
Pharmaceuticals	0.53
IT services and engineering	0.025
Transport and communications	0.364

a. Translator's note: "Engineers" here refers to graduates of specialised engineering schools.
b. Translator's note: The highest French civil service competitive examination for certain positions in the public education system.
Key: * significant to a threshold of 10%, ** significant to a threshold of 5%, *** significant to a threshold of 1%.
Interpretation: REF refers to the reference modality: the coefficients associated with the other modalities should be seen as the difference between the impact of these modalities and that of the reference modality.

Moreover, the sector appears to be an important determinant of the number of patents, and this can be observed directly also by examining the ratio of the number of patents to R&D spending by sector (see Chart 3). Among the 5 sectors where research spending is highest, we find 3 whose coefficients emerge significantly and positively in the regression (vehicle manufacturing, machinery and equipment, other industries). Finally, carrying out R&D under contract with the Ministry of Defence reduces the percentage of patents filed by 72%, which reflects a strong impact, though one consistent with intuitive expectation (see Box 2).

Chart 3: Average number of patents by sector, by research spending (in thousands)



Source: R&D survey and its section on "researchers" (2007).

(12) Griliches Z. (1990), "Patent Statistics and Economic Indicators: A survey", Journal of Economic Literature, *American Economic Association*, vol. 28(4), pp. 1661-1707, December.

2.2.2 Econometric analysis yields no evidence of a productivity deficit on the part of PhDs vis-à-vis engineering school graduates capable of accounting for the lower employment rate of the former

With regard to the impact of initial training, there appears to be no significant difference in the productivity of PhDs (excluding the health sector), engineering school graduates and holders of a *maîtrise* or below, in research functions. Nor does a combination of a PhD and an engineering school training appear to yield any significant gain in terms of production of patentable inventions relative to each of these forms of training taken separately. Holders of a master's or the French *agrégation*, on the other hand, appear to be significantly less productive than these categories, with a 1% rise in the share of PhDs to the detriment of holders of the master's and *agrégation* leading to a 1.8% rise in the number of patents filed. The fact that holders of a *maîtrise* or below outperform those with a master's and *agrégation*, which looks surprising at first sight, may be explained by a selection effect, as the first of these tend to be internally-promoted former technicians, probably. This should be seen in the context of the strong representation of these categories of graduates among researchers (especially "Bac+2" and below, see Chart 2). Finally, PhDs in the health sector do not appear to be significantly more productive than the other graduate categories.

Productivity comparisons need to be completed by wage comparisons in order to assess whether PhDs suffer from selection bias, as some studies suggest[13]. Yet, according to Céreq's most recent "Génération" survey[14], science PhDs (excluding the health sector) holding a position of engineer or technical executive in companies are better-paid than engineering school graduates in the same positions, for a given level of seniority. The net median monthly pay for a PhD having graduated in 2004, in these positions, was €2,380 in 2007, compared with €2,200 for an engineering school graduate who graduated in the same year.

Consequently, companies' demand for PhDs, in R&D functions, does not appear to be sub-optimal compared with that for engineering school graduates.

3. Which leaves the weak representation of PhDs in private-sector R&D unexplained. Some avenues are worth examining, however

This study shows, first, that the weak representation of PhDs in private-sector R&D teams is not specific to France and, secondly, that young PhDs are not discriminated against compared with engineering school graduates in terms of pay, relative to their productivity.

3.1 Improving work opportunities for PhDs entails better communication by post-graduate faculties vis-à-vis students and potential employers

Wide gaps in unemployment rates by subject area suggest a need for improved student counselling. It is crucial that students contemplating embarking on a doctorate be provided with the fullest possible comparative information on job opportunities for holders of the different doctorates, by subject area and by faculty.

As well as informing students, post-graduate faculties also need to communicate better with companies, particularly regarding doctoral selection and validation criteria, since employers have difficulty identifying the competences gained in the course of preparing a thesis. It is also up to the PhD to make clear what, in his training, while not specifically connected with his research work, could prove useful for a career in the private sector, in research or elsewhere (e.g. working methods, capacity to think conceptually, knowledge of English, etc.).

Table 3: Unemployment rate for young PhDs in France, by subject area

	1999	2001	2004	2007	Moyenne sur la période
Mathematics, Physics	5%	5%	7%	9%	7%
Mechanical, Electronic, Computer engineering, Engineering sciences	2%	2%	6%	6%	4%
Chemistry	14%	10%	14%	16%	14%
Life and Earth sciences	8%	7%	11%	10%	9%
Law, Economics, Management	7%	5%	11%	8%	8%
Literature, Human Sciences	6%	20%	17%	11%	14%
All PhDs	7%	5%	11%	10%	8%
Engineering school graduates	2%	2%	6%	4%	4%

Source: Céreq, situation of PhDs 3 years after earning doctorate in 1996, 1998, 2001 and 2004.

(13) Harfi M., Auriol L. (2010), "Les difficultés d'insertion professionnelle des docteurs: les raisons d'une exception française" (The difficulties experienced by PhDs in finding work: reasons for a French exception), Centre d'analyse stratégique, *Note de veille* no. 189, Juillet.

(14) Calmand J., Epiphane D. and Hallier P. (2009), "De l'enseignement supérieur à l'emploi: voies rapides et chemins de traverse" (From higher education to work: fast tracks and scenic routes) *Notes Emploi Formation*, no. 43, Octobre.

3.2 3.2 Remedying the disaffection for science degrees

With respect to the training of research personnel, the issue is more about steering young people towards science degrees in general rather than towards doctorates in particular.

According to projections by the French Directorate of Evaluation, Forecasting and Performance[15], enrolments in science courses in higher education (universities and non-university engineering schools) is expected to decline by 6.7% between 2009 and 2019, falling from 490,282 to 457,460, representing 32,822 fewer students. University science courses are forecast to be especially hard-hit, falling 16.7%, whereas enrolments in non-university engineering courses are forecast to rise by nearly 8,570 between now and 2019 (+9.4%). This overall decline is all the more disquieting, as demand for researchers in scientific specialities is expected to grow significantly in the coming years, following a series of government measures in support of R&D, such as the research tax credit, the young innovative companies programme, the Investments for the Future Programme, etc.

Even so, the findings of the econometric analysis in no way justify putting greater emphasis on the number of PhDs than on the number of engineering school graduates. Nor do they suggest the latter should be encouraged to complete their studies with a doctorate. Moreover, short study courses should not be overlooked, because research needs not only researchers, but also technicians, and also because some of these may turn out to be very good researchers themselves, as the econometric analysis shows. What is needed, therefore, is to promote a whole range of advanced scientific training opportunities for young people. This no doubt entails starting very early in children's schooling to awaken their interest in the sciences.

Nicolas RIEDINGER

Meryam ZAIEM

(15) (2010) "Projection des effectifs de l'enseignement supérieur pour les rentrées 2010-2019" (Projecting enrolments in higher education for the 2010-2019 academic years), *Note d'information*, no. 10.07, Octobre.

Publisher:

Ministère de l'Économie, des Finances et de l'Industrie

Direction Générale du Trésor
139, rue de Bercy
75575 Paris CEDEX 12

Publication manager:

Benoit COEURÉ

Editor in chief:

Jean-Philippe VINCENT
+33 (0)1 44 87 18 51
tresor-eco@dgtresor.gouv.fr

English translation:

Centre de traduction des ministères économique et financier

Layout:

Maryse DOS SANTOS

ISSN 1777-8050

Recent Issues in English