

Doctorate holders

The beginning of their career

Demand for reliable information on highly skilled people, and more specifically doctorate holders, has risen as the role played by knowledge and research in innovation and economic performance is increasingly recognised.

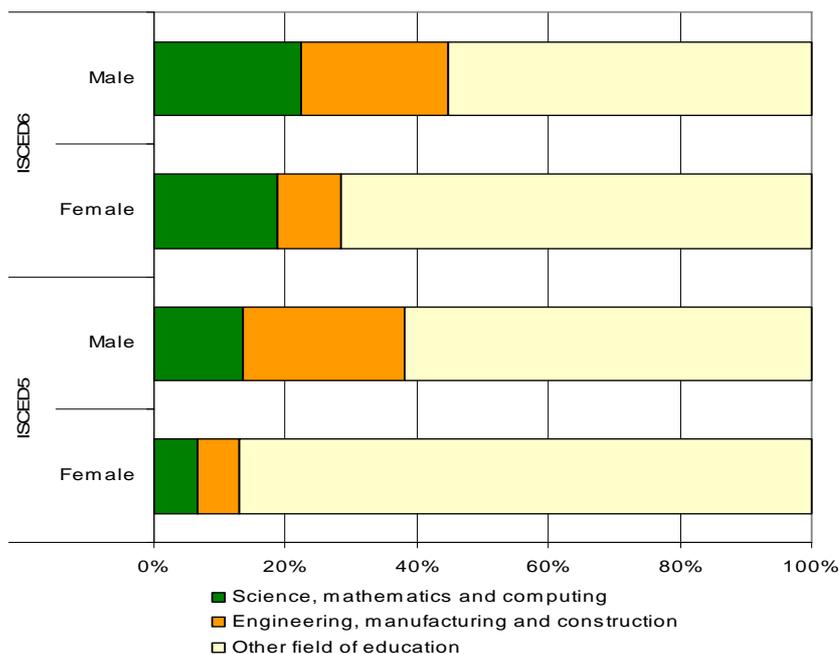
The main focus in this paper is on doctorate holders and will review the supply of and demand for doctorate holders starting from the education inflows up to the detail of their employment.



Doctorate holders form the most educated group of the population and those most likely to contribute to the development and expansion of knowledge, science and technology. Despite this, only 3% of tertiary students were studying for a doctoral degree in 2004. The highest graduation rate for doctorates was found in Sweden. In Estonia and Cyprus more than 60% of the new doctorate graduates were women.

Of the tertiary student population in EU in 2004, 3% were following a doctoral programme

Figure 1: Tertiary education participation by level of education, gender and field of education, in proportions, in the EU, 2004



EU-27 excluding DE, FR, LU and SI.

Source: Eurostat HRST database

For ISCED definitions see methodological notes on page 2 and 7.

In 2004 in the EU, 18.2 million students were in tertiary education, 3% of them in a doctorate programme (ISCED level 6). As shown in Figure 1, the distribution in terms of level and field of education and gender varies widely in the EU. 25% of tertiary students at ISCED level 5 were following a science or engineering (SE) course. This proportion rises to over 37% for doctoral students (ISCED level 6).

When one looks at the specific fields of education chosen, marked preferences appear. Female students were underrepresented in science and engineering (SE), at both ISCED levels 5 and 6.

Statistics in focus

SCIENCE AND TECHNOLOGY

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Of the tertiary students at ISCED level 5 following an SE course, only 30% were female. In fact, the choice of discipline is highly gender-dependant and fields such as engineering are generally largely male-dominated. For example, 63% of male students at

ISCED level 5 in science and engineering chose to study engineering, compared to 48% of female students. At ISCED level 6, the share of females choosing engineering fell to 34%.

More than 40% of doctoral students in Greece and Cyprus were in science

ISCED level 5 – First stage of tertiary education (not leading directly to an advanced research qualification)

This level consists of tertiary programmes that have an educational content more advanced than those offered at levels 3 (upper-secondary education) and 4 (post-secondary non-tertiary education). Level 5 programmes do not, however, lead directly to the award of an advanced research qualification (level 6). Such programmes must have a cumulative theoretical duration of at least 2 years from the beginning of level 5. Bachelor's degrees in many English-speaking countries, the *Diplom* in many German-speaking countries or the *Licence* in many French-speaking countries meet these criteria.

ISCED LEVEL 6 – Second stage of tertiary education (leading to an advanced research qualification)

This level is reserved for tertiary programmes which lead to the award of an advanced research qualification. The programmes are therefore devoted to advanced study and original research and are not based on course-work only. This level of education requires the submission of a thesis or dissertation of publishable quality which is the product of original research and represents a significant contribution to knowledge. In addition, it prepares graduates for faculty posts in institutions offering ISCED 5A programmes, as well as research posts in government and industry, etc.

In Europe the important role played by doctoral study in achieving a competitive and knowledge-based economy is well established. Doctorate holders are expected to contribute significantly to the improvement of science and are expected to pass on their hard-earned knowledge to other parts of society.

Table 2 shows that in absolute numbers, in 2004, even without counting Germany, doctorate students in the EU were 1.4 times more numerous than in the United States and 7.4 times than in Japan. But European universities are facing more and more challenges and substantial international competition.

More than 50% of the EU doctorate students (Germany excluded) were found in three Member States: France (101 309), the United Kingdom (89 378) and Spain (76 895). But in terms of share of doctorate students in total tertiary education, the Czech Republic, Finland and Austria had the highest proportions in the EU with around 7%.

In the EU Member States where data was available for field of education, at least one doctorate student in four followed a science or an engineering course in 2004. In the Czech Republic, Ireland and Greece more than every second doctorate student was in science or engineering.

Looking at the split between these two specific fields of education, more than 40% of doctorate students chose science in Greece and Cyprus. Conversely, in the Czech Republic and Finland, the preference was for engineering studies, as more than a quarter of doctorate students chose this field of education.

Table 2: Participation of doctorate students (ISCED level 6), in total and in selected field of education and as percentage of total tertiary education, in the EU and selected countries, 2004

	Total doctorate student (ISCED6) participation	As % of all participation in tertiary education	Doctorate participation by field of education	
			In Science	In Engineering
EU-27	525 601	3.3	:	:
BE	7 014	1.8	2 143	946
BG	4 834	2.1	766	1 107
CZ	23 282	7.3	5 005	6 856
DK	5 093	2.3	926	1 018
DE	:	:	:	:
EE	1 653	2.5	469	219
IE	4 339	2.3	1 613	705
EL	18 907	3.2	8 346	2 277
ES	76 895	4.2	11 486	7 782
FR	101 309	4.7	:	:
IT	37 608	1.9	9 486	7 305
CY	202	1.0	85	5
LV	1 425	1.1	225	209
LT	2 623	1.4	488	577
LU	27	0.1	:	:
HU	7 835	1.9	1 813	840
MT	17	0.2	:	:
NL	7 054	1.3	:	:
AT	15 524	6.5	2 558	2 037
PL	32 054	1.6	4 892	6 544
PT	17 445	4.4	3 080	2 813
RO	18 045	2.6	1 799	2 916
SI	:	:	:	:
SK	9 371	5.7	1 402	2 255
FI	21 207	7.1	3 060	5 481
SE	22 460	5.2	4 492	4 994
UK	89 378	4.0	23 978	12 874
IS	51	0.3	7	5
NO	4 356	2.0	1 207	645
CH	15 850	8.1	4 525	1 686
HR	541	0.4	63	84
TR	24 891	1.3	3 608	4 682
JP	71 389	1.8	10 368	13 170
US	375 642	2.2	:	:

Source: Eurostat HRST database

EU-27 excluding DE and SI.

Exceptions to the reference year: FR and LU 2003.

New doctorate holders twice as numerous in Europe than in the United States in 2004

Table 3 gives a breakdown of awarded doctorates in 2004. In absolute numbers, there were twice as many in Europe as in the United States and six times more than in Japan. At national level, Germany recorded the highest number of doctorates awarded in 2004, with more than 23 thousand in all fields of education. After Austria, Germany had also the second highest share of doctorates among all tertiary degrees awarded (8.0% and 7.2% respectively).

The share of doctorates awarded to females is below parity in most of the Member States. On average, 43.4% of new doctorate holders in the EU in 2004 were females. The United States registered a higher proportion with 47.7%. Estonia and Cyprus are the two EU Member States with the highest proportion of female doctorate graduates, with more than 60%.

Traditionally popular courses for doctorate students are science and engineering. In Table 3, 28% of all EU new doctorates graduated in science and 14% in engineering. In addition, the share of doctorate graduates among total tertiary graduates in science

was 7.4% in the EU. Germany and Sweden were the two EU Member States with the highest proportions, with over 18% each. By comparison, in engineering, the number of doctorate graduates as a percentage of all tertiary graduates in the EU was only 2.8%. Sweden, with 9.2%, scored the highest in this field of education.

Female doctorate graduates in the 2004 cohort were more under-represented in engineering (23.6%) compared with science (39.1%). The share of female graduates is generally higher in such fields as 'Health' or 'Education'.

Nevertheless, national disparities are noteworthy. Bulgaria, Latvia and Estonia had relatively high proportions of females awarded a doctoral degree in engineering (39.2%, 38.5% and 37.5% respectively). In science, parity and above was reached in 7 Member States, of which Cyprus, with 83.3%, and Lithuania, with 61.4%, had highest shares. But with Cyprus, care has to be taken with regards to the small amount of doctorates awarded.

Table 3: New doctorate graduates (ISCED level 6), in all and selected fields of education, by gender and as proportion of the total tertiary graduated population, in the EU and selected countries, 2004

	In all fields			In science, mathematics and computing			In engineering, manufacturing and construction		
	Total	% female	as % of all tertiary graduation	Total	% female	as % of tertiary education in science	Total	% female	as % of tertiary education in engineering
EU-27	93 235	43.4	2.6	26 117	39.1	7.4	13 000	23.6	2.8
BE	1 479	33.9	1.9	658	28.9	9.5	89	20.2	1.2
BG	392	50.8	0.9	77	55.8	3.4	74	39.2	1.0
CZ	1 732	35.6	3.2	410	34.9	10.0	468	21.2	5.8
DK	788	35.9	1.7	100	26.0	2.3	376	27.9	8.0
DE	23 138	39.0	7.2	6 025	29.5	18.7	2 107	11.8	3.9
EE	209	62.2	2.0	50	44.0	5.7	16	37.5	1.9
IE	683	45.7	1.2	265	45.3	3.2	108	28.7	1.5
EL	1 295	38.1	2.7	711	32.3	8.6	119	21.0	2.4
ES	8 168	47.5	2.7	2 249	48.9	6.9	603	27.9	1.2
FR	8 420	41.7	1.4	4 042	38.4	5.3	779	25.9	0.8
IT	6 351	50.9	2.0	1 931	54.0	8.1	1 177	31.2	2.4
CY	13	61.5	0.4	6	83.3	1.7	:	:	:
LV	84	58.3	0.4	15	53.3	1.2	13	38.5	0.7
LT	301	57.5	0.8	70	61.4	3.8	62	33.9	1.0
LU	:	:	:	:	:	:	:	:	:
HU	893	42.9	1.3	171	32.7	6.4	36	33.3	0.7
MT	5	20.0	0.2	:	:	:	:	:	:
NL	2 679	39.4	2.8	499	37.7	7.2	483	23.4	5.6
AT	2 443	40.5	8.0	444	35.1	17.2	397	18.6	6.3
PL	5 460	46.9	1.1	867	52.9	3.5	908	24.1	2.7
PT	3 963	54.7	5.8	1 013	51.5	13.8	579	35.6	5.8
RO	2 680	49.3	1.8	151	45.7	1.9	690	28.7	2.7
SI	355	40.6	2.4	93	40.9	16.7	86	25.6	3.9
SK	854	45.0	2.4	177	46.3	5.3	155	29.7	3.0
FI	1 759	48.7	4.6	306	43.1	9.9	361	25.5	4.4
SE	3 834	42.6	7.1	944	39.1	18.3	1 096	25.9	9.2
UK	15 257	43.1	2.6	4 843	37.9	5.6	2 218	21.2	4.6
IS	10	50.0	0.4	4	50.0	1.3	:	:	:
NO	756	39.8	2.4	:	:	:	6	50.0	0.2
CH	2 952	36.9	4.9	791	32.7	13.3	319	20.4	4.4
TR	2 680	38.0	1.0	368	37.8	1.5	418	34.9	0.8
JP	15 160	24.9	1.4	2 482	19.7	7.9	3 355	10.1	1.7
US	48 378	47.7	2.0	7 211	40.7	3.3	6 154	18.5	3.2

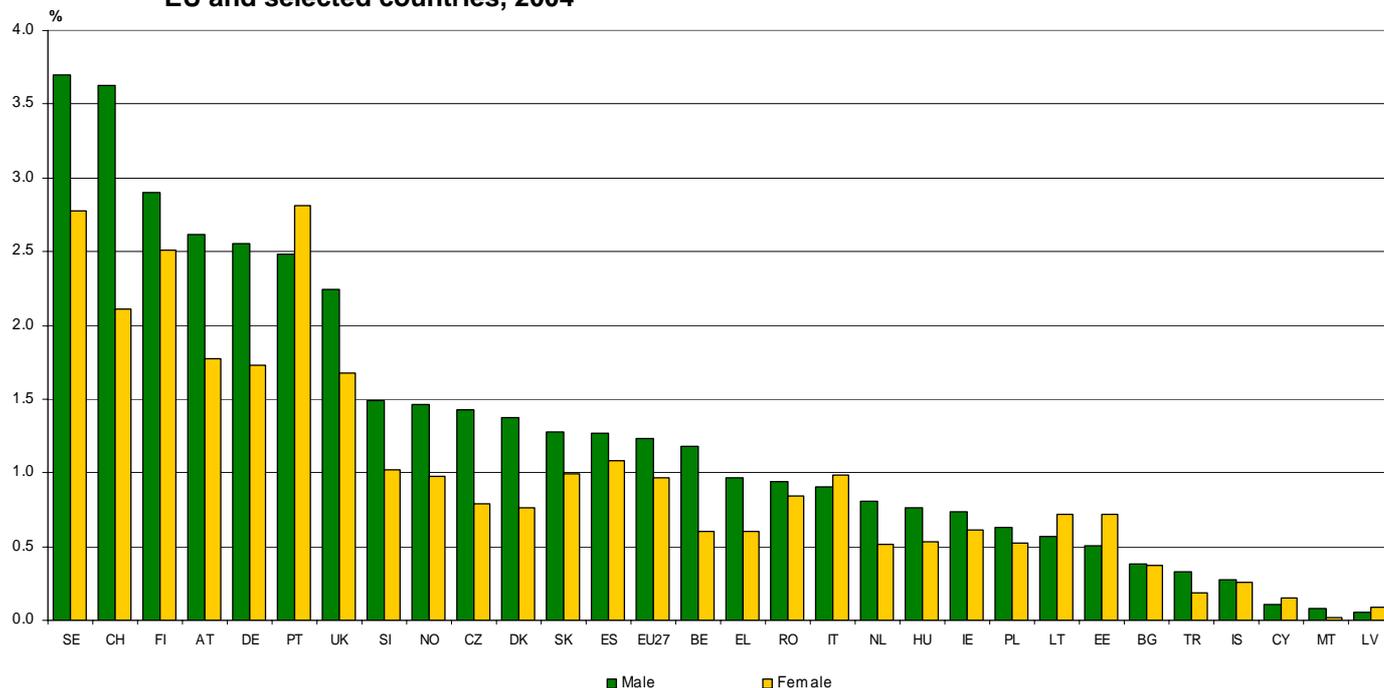
EU-27 excluding LU. Exceptions to the reference year: FR, MT and FI 2003.

Source: Eurostat HRST database

How to read the table: In Belgium, 1.9% of all tertiary graduates achieved a doctorate. Of these 1 479 new Belgian doctorate holders 33.9% were female. In details, 658 new doctorates graduated in "Science, mathematics and computing", of which 28.9% were female. These 658 corresponded to 9.5% of the total tertiary graduates in this specific field of education.

Sweden had the highest graduation rate of new doctorate holders

Figure 4: Graduation rate of new doctorate holders (ISCED level 6) as % of population, by gender, in the EU and selected countries, 2004



Source: Eurostat HRST database and demography statistics

EU-27 excluding FR and LU.

Exceptions to the reference year: MT and FI 2003.

Graduation rate is calculated as the sum of the proportion of new doctorate graduates for one age group in 2004 divided by the population of the same age.

A synthetic graduation rate can be used to simulate the ratio of new doctorate graduates among the total population (Figure 4). It gives a detailed picture of the situation by gender on a national level and explains why doctorate holders are a minority in society.

In Europe in 2004, Sweden scored the highest graduation rate of new doctorates. For every 100 Swedish females in 2004, close to three achieved a doctoral degree that year. Only Portugal had a higher share for females. The share for males in Sweden was nearly 4%. These scores may be due in part to the set of national measures taken in Sweden to encourage and support future doctorates during their study.

Austria and Germany have similar measures to guarantee some of the working conditions of doctorate students based on the standard set by the ILO. That may be one reason why these two countries lie in fourth and fifth positions respectively in Figure 4, having large shares of male and female graduation rates for new doctorates in 2004. However, as was the case for Sweden, in these two Member States also the graduation rate is much higher for males than for females (around 2.5% compared to around 1.7%).

The lowest graduation rates both for males and females are found in Cyprus, Malta and Latvia with a graduation rate of not more than 0.2% regardless of gender.

At the EU level, the graduation rates for males and females are relatively similar (1.2% and 1.0% respectively). But on a national level gender differences clearly appear both in and between the EU Member States.

In most of EU Member States, the graduation rate for males is higher than for females. As seen in Figure 4, only six EU Member States had the graduation rate for female doctorates higher than for males. These Member States were Portugal, Italy, the three Baltic countries (Estonia, Latvia and Lithuania) and Cyprus.

The predominance of new female doctorate holders is most notable in Portugal and Estonia. As mentioned earlier, Portugal also shows the highest female graduation rate of the EU Member States at 2.8%. After Portugal, Sweden and Finland are following with female graduation rates of 2.8% and 2.5% respectively.

The unemployment rate of doctorate holders in Germany was of only 3.2%

Careers of Doctorate Holders (CDH) project

'The importance of research and innovation in a competitive and globalised economy implies the availability of a highly skilled workforce. Doctoral graduates are at the same time the most qualified people in terms of educational attainment and those who are trained and most predisposed for research careers. They are expected to contribute to the advancement and diffusion of knowledge and technologies. In order to have a clear picture of the situation and to better understand the situation of doctorate holders on the labour market, the OECD initiated in 2004 a collaborative project with the UNESCO's Institute for Statistics (UIS) and Eurostat on *Careers of Doctorate Holders (CDH)*. The first results of this project were presented in a working paper in February 2007. This project aims at developing a regular and internationally comparable production system of indicators on the careers and mobility of doctorate holders building on surveys currently existing in some countries (in particular those of the United States and Canada) and on other data sources. The CDH project will help to determine the stock of persons having obtained a highly advanced degree across participating countries, as well as their demographic and educational characteristics, their labour market situation and international mobility.

A first metadata and data collection was launched in Autumn 2005, which provided a first set of results for seven countries: Argentina, Australia, Canada, Germany, Portugal, Switzerland and the United States. These first results shed light on the main demographic, educational, labour market and mobility patterns of doctoral graduates. They also mark some progress in the understanding of both the measurement issues and patterns of international mobility, notably by the use of qualitative indicators such as the intentions or reasons for mobility.'

Source: Auriol (2007) based on the first OECD/Eurostat/UIS data collection on CDH

Warning to readers: Results shown in this paper regarding the CDH project have to be treated with caution as data are from a first collection and currently under revision. Data cannot be considered as fully comparable, nevertheless, this new survey and data collection is considered as a potential source of new interesting information.

Table 5: Unemployment rates for doctorate holders and total population, by country and gender, in percentages

			Doctorate holders	Total population*
Australia	2001	Male	2.2	8.1
		Female	2.7	5.9
		Total	2.3	7.1
Canada	2001	Male	4.0	7.6
		Female	3.0	7.2
		Total	3.7	7.4
Germany	2004	Male	2.5	7.7
		Female	4.7	9.7
		Total	3.2	8.6
United States	2003	Male	2.5	5
		Female	3.7	4.6
		Total	2.9	4.8

* Data from the Australian Bureau of Statistics, the 2001 Census of Canada and the EU LFS database.

Source: Auriol (2007) based on the first OECD/Eurostat/UIS data collection on CDH

It is generally stated that highly educated people, such as doctorate holders, have higher employment rates than those who did not pursue higher education. Table 5 illustrates this, where the unemployment rate for doctorate holders remains lower than for the total population. The results of the four countries studied are between 2% and 4% for the doctoral population, while the range is between 5% and 9% for the total population. For example, in Germany, 8.6% of the total population was unemployed, while the rate for doctorate holders was only 3.2%.

A look at unemployment rates by gender also brings interesting information. In three countries, the unemployment rate for female doctorate holders was higher than for male. Particularly in Germany, the unemployment rate for female doctorate holders was almost twice as high as that for male doctorate holders (4.7% compared to 2.5%). On the other hand, Canada showed a higher unemployment rate for male doctorate holders.

Disparities are also found when looking at the difference between full- and part-time employment (Table 6). In all three countries, the share of part-time employment among doctorate holders is smaller than for the total employed population. Part-time employment of doctorate holders is over 18% in Australia.

Table 6: Full-time and part-time employment for doctorate holders and total employment, by country and gender, in percentages

		Doctorate holders		Total employment	
		Full-time employment	Part-time employment	Full-time employment	Part-time employment
Australia 2001	Male	85.7	14.3	84.2	15.8
	Female	71.7	28.3	58.3	41.7
	Total	81.8	18.2	72.8	27.2
Germany 2004	Male	94.0	6.0	93.7	6.3
	Female	71.7	28.3	63.0	37.0
	Total	87.1	12.9	79.9	20.1
United States 2003	Male	94.8	5.2	92.0	8.0
	Female	86.5	13.5	81.2	18.8
	Total	92.0	8.0	86.8	13.2

Source: Auriol (2007) based on the first OECD/Eurostat/UIS data collection on CDH

Unsurprisingly, part-time employment is more common for females, generally because of family obligations. For example in Australia, more than 40% of the total employed female population were working part-time in 2001. Table 6 shows that, to a lesser

extend, this tendency is the same for doctorate holders. Indeed, close to one third of employed doctorate holders in Australia and in Germany were working on a part-time basis.

88% of employed doctorate holders in Portugal work as professionals

Table 7: Distribution of employed doctorate holders by occupation and country, in percentages

ISCO-88 code	ISCO-88 title	Argentina 2005	Canada 2001	Germany 2004	Portugal 2000-2004	USA 2003
1	LEGISLATORS, SENIOR OFFICIALS AND MANAGERS	1.0	11.5	4.3	2.8	10.5
2	PROFESSIONALS	84.0	73.8	80.9	88.2	81.2
21	<i>Physical, mathematical and engineering science professionals</i>	20.5	15.9	18.0	6.6	16.2
211	Physicists, chemists and related professionals	}	6.5	5.0	3.7	5.2
212	Mathematicians, statisticians and related professionals		0.4	:	0.1	0.9
213	Computing professionals		0.4	3.9	2.1	0.3
214	Architects, engineers and related professionals	2.5	5.1	10.8	2.4	6.3
22	<i>Life science and health professionals</i>	21.5	9.4	34.3	2.3	14.2
221	Life science professionals	15.7	3.3	1.9	0.4	6.0
222	Health professionals (except nursing)	5.5	5.9	32.4	1.9	7.2
223	Nursing and midwifery professionals	0.3	0.2	:	0.0	1.0
23	<i>Teaching professionals</i>	36.4	37.1	13.3	78.3	33.1
231	College, university and higher education teaching professionals	35.4	37.1	6.6	76.4	29.7
232	Secondary education teaching professionals	0.3	:	5.3	1.5	1.9
233 to 235	Other teaching professionals	0.8	:	1.4	0.4	1.6
24	<i>Other professionals</i>	5.6	11.4	15.3	1.1	17.6
241	Business professionals	1.2	1.8	3.1	0.1	4.6
242	Legal professionals	1.4	0.8	3.9	0.1	0.4
243	Archivists, librarians and related information professionals	0.0	0.2	:	0.1	0.5
244	Social science and related professionals	2.8	8.5	3.1	0.9	7.6
245	Writers and creative or performing artists	0.0	:	2.3	0.0	1.8
	Other professionals	:	:	1.9	:	2.5
Other	Other ISCO-88 groups	10.3	14.7	14.8	8.6	8.4
Unknown		4.7	:	:	0.3	:
TOTAL	Total	100.0	100.0	100.0	100.0	100.0

Source: Auriol (2007) based on the first OECD/Eurostat/UIS data collection on CDH

Other features of doctorate holders' employment are found in the type of occupation (Table 7). In Argentina, Germany, Portugal and the United States, more than 80% of employed doctorate holders worked as expected, in a professional occupation. In Canada, this proportion was slightly lower, at around 74%, coinciding with a share of 11.5% of doctorate holders in management occupations. The United States also had a relatively high proportion of highly educated people in management, with 10.5%.

Looking closer at the breakdown between professional occupations some extreme differences appear. As these are the first results of a first data collection, differences can not be totally explained yet.

Knowing this, one can proceed with caution and see that, in four of the five countries analysed, the largest group of doctorate holders (at least one third) were working as teaching professionals. In Portugal nearly 80% of the doctorate holders held *teaching* professions.

Germany is an exception, as it is in *life, science and health* occupations that most doctorate holders were employed in 2004. In addition, almost one fifth of German doctorate holders worked in a *physical, mathematical and engineering science* profession.

Finally, Table 7 shows that a non negligible share of doctorate holders were employed in an occupation that does not match their high level of qualification. Indeed, in Germany and Canada, 15% of doctorate holders were found in an occupation that was not management or professional. One reason for this result could be possible underutilisation of recent doctorate graduates.

To summarise, doctorate holders are the most educated group in society and it is of high importance to analyse their career paths. Therefore the first results from the pilot survey of the CDH project are presented here. Some results (as in Table 7) vary widely, but it always takes time for new statistics to stabilise and until all differences can be explained.

➤ ESSENTIAL INFORMATION – METHODOLOGICAL NOTES

1. Data sources

The education indicators are derived from **Eurostat's education database** in April 2007. A warning needs to be raised as the European education systems differ between countries and for some countries duplications of degrees might exist. For more information about this and other education methodology, please refer to the internet site: <http://ec.europa.eu/eurostat>.

Data for doctorate holders are taken from a working paper based on the first results from the **data collection of the Career of Doctorate Holders (CDH) project** launched in 2004 jointly by the OECD/Eurostat/UNESCO Institute for Statistics (UIS) (Auriol, 2007). The working paper presents results from the first pilot data collection of seven countries carried out in September 2005. The CDH project was initiated in 2004 by the OECD in collaboration with Eurostat and the UIS. It aimed at developing a regular and internationally comparable production system of indicators on the careers and mobility of doctorate holders.

Implementation and development of the CDH project is still in progress. After deep revision and validation, the CDH 2006 statistics questionnaire was sent to the expert group and other countries and is due to be returned during spring 2008. Following the survey, national assessment reports would be prepared in 2008 on tables, indicators and the methodology used. Further information can be found on Circa under 'S&T and Innovation/Careers of doctorate holders (CDH)':

<http://circa.europa.eu/Public/irc/dsis/Home/main>

2. Level of Education

Tertiary education programmes are classified under the International Standard Classification of Education (ISCED'97) according to the following levels:

• ISCED level 5

This level combines two sub-levels:

- **ISCED level 5A:** Programmes that are largely theoretically based and are intended to provide sufficient qualification for gaining entry into advanced research programmes and professions with high skill levels,
- **ISCED level 5B:** Programmes that are generally more practical/technical/occupationally specific than ISCED level 5a programmes.

• ISCED level 6

Second stage of tertiary education, leading to an advanced research qualification.

3. Doctorate students

In general, the term doctorate defines tertiary education programmes which lead to the award of an advanced research degree (ISCED level 6), e.g. a doctorate in economics.

For the definition of this level, the following criteria are relevant:

- **Main criterion:** the doctorate typically requires the submission of a thesis or dissertation of publishable quality which is the product of original research and represents a significant contribution to knowledge.
- **Subsidiary criterion:** it prepares graduates for faculty posts in institutions offering ISCED 5A programmes, as well as research posts in government, industry, etc.

The programmes are therefore devoted to advanced study and original research and are not based on course-work only. They usually require 3-5 years of research and course work, generally after a Master's degree.

4. Fields of Education

In this publication, the fields of education are combined into the following categories:

- **Science, mathematics and computing (EF4)**
- **Engineering, manufacturing and construction (EF5)**
- **Other fields of education (EF0-EF3, EF6-EF9)**

For further information, please refer to the education methodology on the internet site:

<http://ec.europa.eu/eurostat>

5. Statistical abbreviations and symbols

: Not available

s Eurostat estimate

Further information:

Data: [EUROSTAT Website/Home page/Science and technology/Data](#)

Science and technology

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