

# Statistics in focus

## SCIENCE AND TECHNOLOGY

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Author

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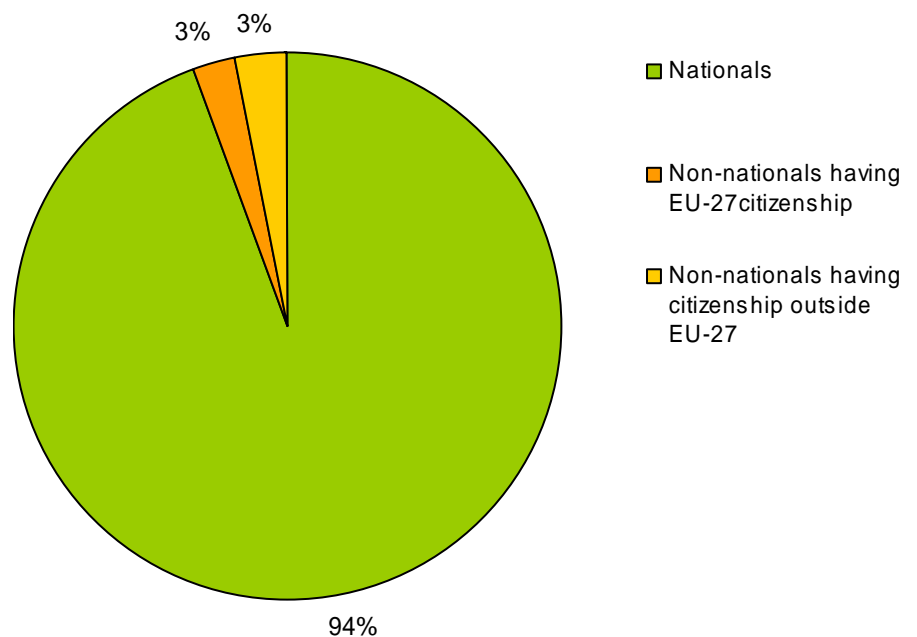
# How mobile are highly qualified human resources in science and technology?

*In Luxembourg 46% of the human resources in science and technology (HRST) are of foreign nationality. At EU level the figure is 6%, half of whom are from other EU countries. Most EU citizens moving to Denmark to work are HRST and Denmark also has the highest job-to-job mobility rate amongst employed HRST. Nearly every third foreign student in higher education in the EU is studying in the UK and over 30% of the tertiary students in Cyprus are foreign.*

Cross-border mobility provides great opportunities for businesses to harness the pool of highly skilled and specialised workers. Increasing international movements due to market globalisation, enlargement of the European Union combined with the opening of borders and free movement of workers are some of the factors that influence the mobility of human resources in science and technology in the EU.

## In the EU 6% of the human resources in science and technology are non-nationals

**Figure 1: Share of human resources in science and technology (HRST) aged 25-64 years in the EU by nationality, 2006**



The EU aggregate does not include BG, IT, LV, LT, MT, RO, SI and SK

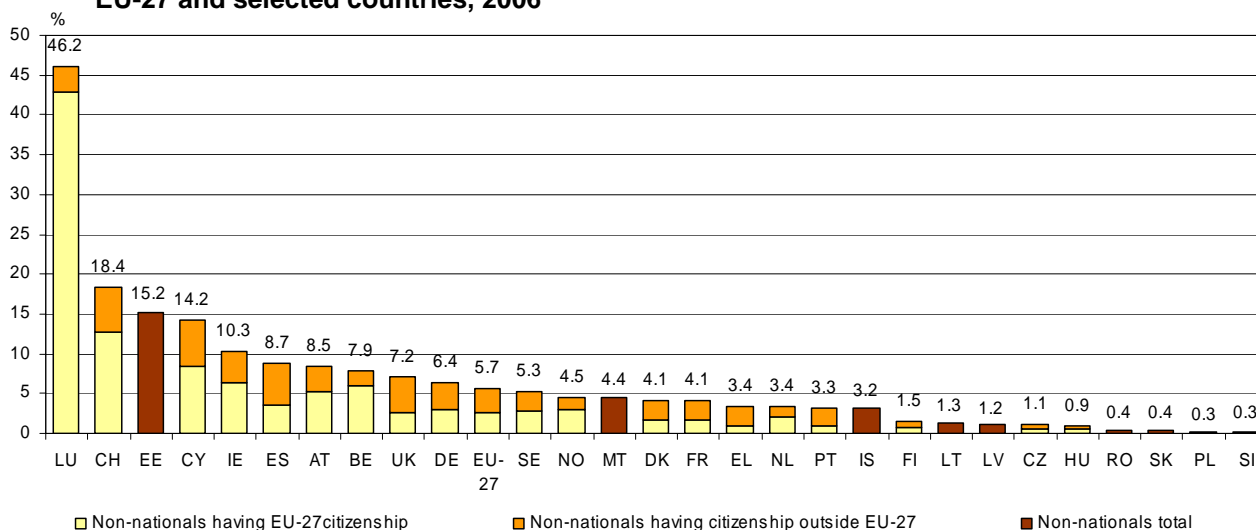
Source: Eurostat HRST data base

Figure 1 shows the international mobility of human resources in science and technology (HRST) in the EU.

In 2006 some 6% of the EU's HRST were non-nationals (i.e. citizens of a country other than their country of residence). These non-national HRST were equally divided between citizens of other EU countries and citizens of countries outside the EU. Nevertheless, national disparities exist, as can be seen from the figures and tables below.

## In Luxembourg nearly half of the human resources in science and technology are non-nationals

**Figure 2: Share of non-national human resources in science and technology (HRST), aged 25-64 years, in EU-27 and selected countries, 2006**



Exceptions to the reference year: IE, LU, IS and CH 2005 data.

Only the total of all non-nationals is available for EE, MT, RO, SI, SK in 2006; for LV in 2004; for LT in 2003.

The EU aggregate does not include BG, IT, LV, LT, MT, RO, SI and SK

Source: Eurostat HRST data base

**Nationality:** Nationality is decided by citizenship. It is defined as the particular legal bond between an individual and his state acquired by birth or naturalisation whether by declaration, option, marriage or other means in accordance with national legislation. The following aggregates can be distinguished:

- *Nationals:* Persons having citizenship of the country of residence.
- *Non-nationals:* Persons having a citizenship different to the country of residence.
  - *Non-nationals having EU-27 citizenship:* Citizens of an EU-27 country different to country of residence.
  - *Non-nationals having citizenship outside EU-27:* Citizens of a country outside the EU-27.

Figure 2 shows big disparities in the share of non-nationals among Human Resources in Science and Technology (HRST) aged 25 to 64 in Europe. All countries apart from five have a share below 10%. Of these five, Luxembourg stands out with 46.2% of HRST being non-nationals. This is partly explained by its favourable climate for foreign investment and the size of the country.

Switzerland, with the second largest proportion of non-national HRST, has a share that is not even half that in Luxembourg.

National disparities also appear in the two categories of non-national HRST. Of the non-national HRST in Luxembourg, nine out of ten are citizens of another EU Member State. In contrast, in Greece and Portugal seven out of ten non-national HRST are citizens of countries outside the EU instead.

Turning to the share of active HRST in countries' active populations (see Table 1), in Luxembourg there is almost no difference between the national and non-national EU populations. In contrast, the share of HRST is much higher among the non-national EU citizens living in Denmark than among the national population. Of the EU citizens that have moved to Denmark to work, 78.8% are highly qualified.

In Greece only 20.8% of the active EU citizens are HRST and for citizens from other parts of the world the share is even lower (13.3%).

**Table 1: Active HRST as a percentage of the total active population, 25-64 years old, by nationality, in EU-27 and selected countries, 2006**

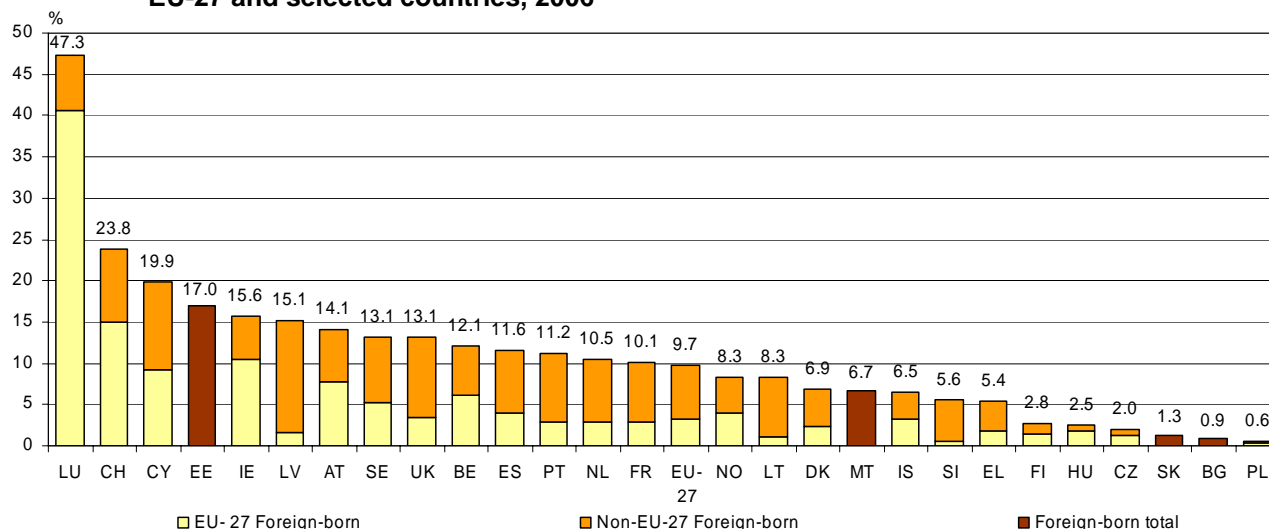
		BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE	UK	IS	NO	CH
Active HRST aged 25-64 as % of total active population by nationality	Nationals	46.8	29.9	34.9	49.8	44.7	46.2	38.5	31.7	40.1	40.4	:	41.0	34.8	38.0	43.9	32.1	31.1	49.3	39.2	31.2	22.0	22.9	39.5	31.3	48.9	47.9	42.2	45.4	47.9	52.3
	Non-nationals having EU-27 citizenship	41.4	:	40.9	78.8	33.5	:	42.1	20.8	37.9	27.1	:	37.1	:	:	43.4	35.0	:	52.4	46.4	44.4	29.6	:	:	:	48.4	51.1	42.8	:	59.5	44.2
	Non-nationals having citizenship outside EU-27	33.8	:	38.3	52.8	23.1	31.8	56.4	13.3	20.9	24.4	:	28.3	:	:	33.4	38.7	:	29.4	16.3	33.3	16.8	40.5	18.4	:	34.9	39.7	46.9	:	32.6	31.0

Exceptions to the reference year: IE, LU, IS and CH: 2005.

Source: Eurostat HRST data base

## Nine out of ten foreign-born HRST in Latvia were born in a country outside the EU

**Figure 3: Share of foreign-born human resources in science and technology (HRST), aged 25-64 years, in EU-27 and selected countries, 2006**



Exceptions to the reference year: IE, LU, CH, LV and IS 2005; LT 2003.  
Only the total of all foreign-born is available for EE, BG, MT and SK in 2006.  
EU aggregate does not include: BG, DE, EE, IT, MT, RO and SK.

Source: Eurostat HRST data base

**Country of birth:** Country of birth is defined as the country of residence of the mother at the time of birth. The following aggregates can be distinguished:

- *Natives:* Persons born in their country of residence.
- *Foreign-born:* Persons born in a country other than their country of residence.
  - *EU-27 Foreign-born:* Persons born in an EU-27 country other than their country of residence.
  - *Non-EU-27 Foreign-born:* Persons born in a country outside EU-27 other than their country of residence.

The second approach to observing foreign Human Resources in Science and Technology (HRST) in EU countries is by *country of birth*, which shows big similarities with the nationality criterion. The shares of foreign-born HRST are somewhat higher, as foreign-born immigrants may obtain the citizenship of their country of residence as part of the integration process, but their country of birth will never change.

In Figure 3, Luxembourg again stands out with nearly half of its HRST population born in another country (47.3%). By comparison, Poland and Bulgaria are at the other end of the scale with shares of foreign-born

HRST of only 0.6% and 0.9% respectively. In the new EU Member States (with the exception of Cyprus, Estonia and Latvia) the shares of foreign-born HRST are comparably low (below 9%).

As seen in the results by *nationality*, the same type of disparities exists within the detailed categories of foreign-born population. In Luxembourg, a large majority (around 80%) of the foreign-born HRST were born in another EU Member State. By comparison, in Latvia nine out of ten foreign-born HRST were declared as born in a country outside the EU. However, the majority of the foreign-born in Latvia, and also in Estonia and Lithuania, are of Russian origin.

With HRST accounting for over 70% of its active residents who were born in another EU country, Denmark once again stands out. Norway and Poland follow with 62.4% and 58.7% respectively. In contrast, in Greece and the Czech Republic only 29.0% and 30.4% respectively of the active persons born in other EU countries were HRST.

**Table 2: Active HRST as a percentage of the total active population, 25-64 years old, by country of birth in EU-27 and selected countries, 2006**

	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE	UK	IS	NO	CH		
Active HRST aged 25-64 as % of total active population by country of birth																																
Natives	46.9	29.8	35.0	49.8		43.5	38.0	31.6	40.0	40.3		40.2	34.1	32.5	43.3	31.9	31.0	50.4	39.8	31.2	21.2	22.9	40.7	31.2	48.9	48.8	41.8	45.2	47.8	51.9		
EU27- Foreign-born	46.2		30.4	73.1			43.3	29.0	36.4	32.7		46.2	30.6	40.1	43.9	38.3		51.8	45.7	58.7	34.3		32.4	44.5	48.0	46.9	43.6	46.6	62.4	46.7		
Non-EU27- Foreign-born	37.0	69.6	38.2	50.7		42.1	58.8	16.5	26.1	34.7		32.9	34.7	38.6	40.6	51.1	40.6	35.8	20.3	41.0	29.2		24.3		39.6	38.6	48.0	48.7	40.0	36.2		

Exceptions to the reference year: IE, LU, CH, LV and IS 2005; LT 2003.

Source: Eurostat HRST data base

## 7% of the EU-27's students participating in tertiary education were foreign

Table 3: Number and share of foreign students participating in tertiary education in all fields and in Science and in Engineering, in EU-27 and selected countries, 2004

Country	In all fields		In Science		In Engineering	
	Number of foreign students	% foreign students of total student participation	Number of foreign students	% foreign student of student participation in Science	Number of foreign students	% foreign student of student participation in Engineering
EU-27	1 206 913	6.6 s	122 674 s	7.8 s	135 882 s	6.1 s
BE	37 091	9.6	3 482	9.7	3 407	7.7
BG	8 286	3.6	239	2.1	1 363	2.7
CZ	14 923	4.7	1 676	5.6	2 132	3.2
DK	17 162	7.9	2 230	11.3	2 893	12.9
DE	260 314	11.2	41 948	12.1	46 593	12.9
EE	1 090	1.7	:	:	:	:
IE	10 201	5.6	:	:	:	:
EL	14 361	2.4	:	:	:	:
ES	41 734	2.3	2 348	1.0	3 355	1.0
FR	237 587	11.0	:	:	:	:
IT	40 641	2.0	2 542	1.7	5 846	1.8
CY	6 679	32.0	563	21.5	75	8.9
LV	2 390	2.0	80	1.0	51	0.4
LT	738	0.4	13	0.1	150	0.4
LU	:	:	:	:	:	:
HU	12 913	3.1	893	3.7	1 689	3.1
MT	442	5.6	11	2.4	18	2.6
NL	21 259	3.9	2 042	5.0	2 133	4.8
AT	33 707	14.1	4 010	14.1	4 069	13.6
PL	8 118	0.4	170	0.1	560	0.2
PT	16 155	4.1	1 603	5.2	3 132	3.7
RO	9 730	1.5	154	0.5	769	0.6
SI	1 108	1.1	104	1.9	167	1.0
SK	1 640	1.0	110	0.7	218	0.8
FI	7 915	2.6	884	2.5	2 343	2.9
SE	36 458	8.5	4 693	11.3	7 186	10.0
UK	364 271	16.2	52 879	16.3	47 733	26.4
IS	489	3.3	56	4.1	24	2.4
NO	12 392	5.8	2 056	9.3	854	6.2
CH	35 705	18.2	5 208	23.0	5 436	20.4
TR	15 298	0.8	1 318	0.9	2 301	0.8

s: In all fields: estimated EU aggregate of percentages without LU. In Science and Engineering: estimated EU aggregate without EE, IE, EL, FR and LU.  
 Exceptions to the reference year: EE, IE, LV and RO 2003. Source: Eurostat HRST data base

One major objective is for European universities to attract highly qualified staff and students and maintain their research reputations, for example by developing international exchanges of knowledge and expertise. More than 1.2 million students who followed a third level of education were foreigners in Europe in 2004. That is equivalent to 6.6% foreigners among the total number of students in tertiary education.

The United Kingdom is one of the most popular destinations, with nearly a third of EU-27's foreign student population. British universities have spent heavily on facilities to attract foreign students and offer a wide choice of higher education courses. Germany, despite having the second largest foreign student population, has almost 30% fewer foreign students than the UK.

Looking at the share of foreign students among the total student population at tertiary level, Cyprus stands out with 32.0%. This country has taken a series of measures to promote participation in higher

education and to extend the international dimension of education.

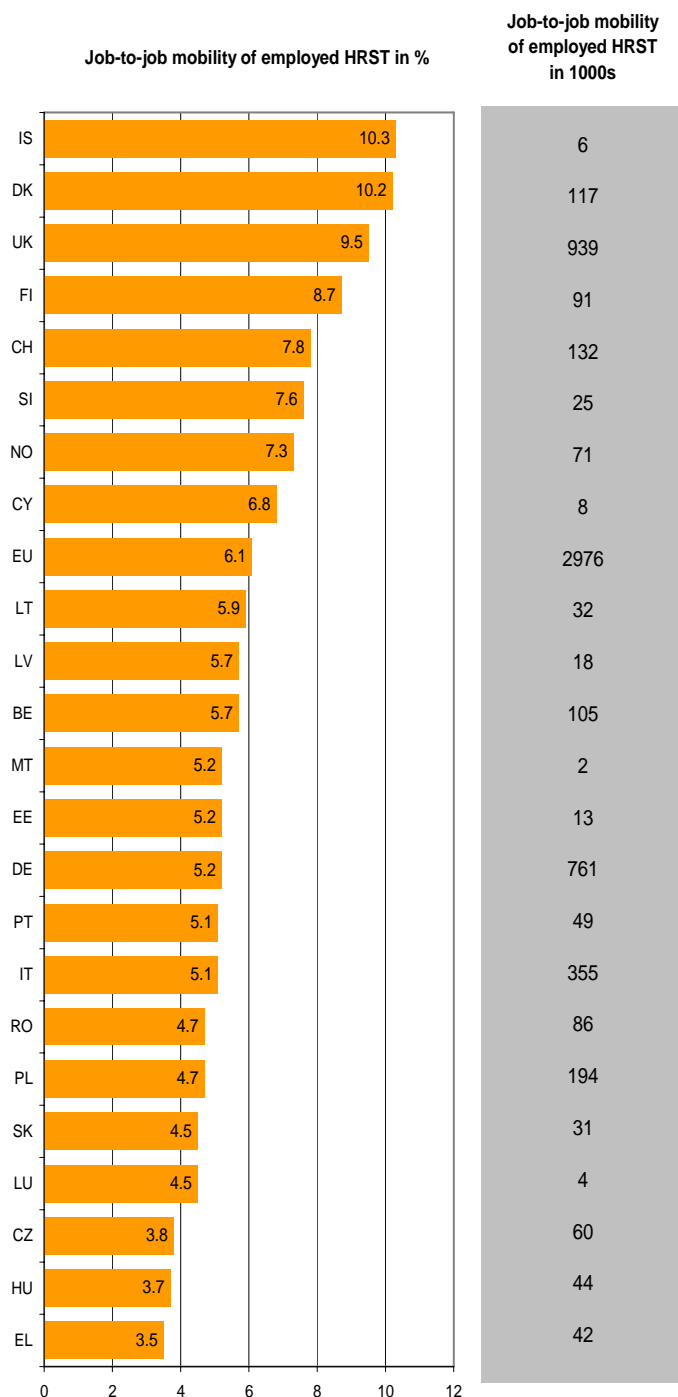
More than a quarter of a million foreign students in tertiary education were studying Science or Engineering (S&E) in the EU. A high share of foreign students in these fields of education is a key factor for technological innovation and economic competitiveness.

Large disparities exist, however, in S&E at national level. In most countries the number of foreign students tends to be higher in engineering than in science, while the share of foreign students among the total student participation in science and in engineering varies largely from one country to another.

Of the EU member states the UK has the highest share of foreign students among students in engineering (26.4%) and the second largest share of foreign students among students studying science (16.3%). Conversely Cyprus showed a much higher share of foreign students among students studying science than engineering, with 21.5% compared to 8.9%.

## HRST change job most often in Denmark

**Figure 4: Job-to-job mobility for employed HRST aged 25-64 years, in thousands and as a percentage, in EU-27 and selected countries, 2005**



The EU aggregate was calculated by adding together the figures for 20 of the 27 countries (without BG, IE, ES, FR, NL, AT and SE).

Source: Eurostat HRST data base

Job-to-job mobility shows people's ability to move between different jobs in the same country. Mobile Human Resources in Science and Technology (HRST) in a country can nourish and stimulate a country's economy by circulating hard-earned knowledge between companies and institutions.

Figure 4 illustrates this job-to-job mobility for employed HRST. It shows, at national level, the highly qualified personnel aged 25-64 years who changed job between 2004 and 2005, both in numbers and also as a proportion of the total number of HRST employed.

In 20 of the 27 European countries, close to 3 million HRST changed job between 2004 and 2005. This gives a European share of job-to-job mobility of employed HRST of 6.1%.

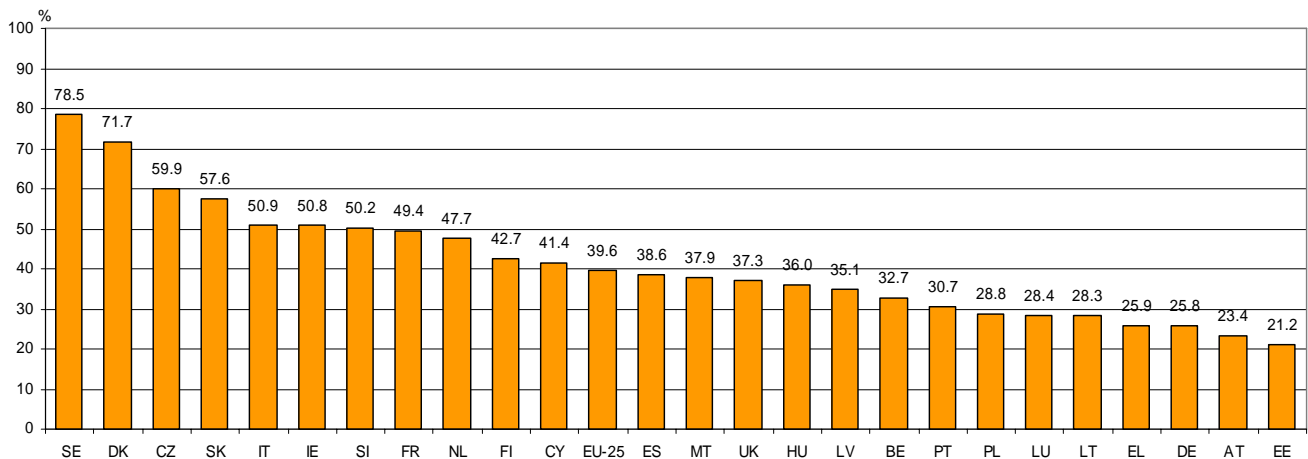
In absolute terms, the United Kingdom had the highest number of employed HRST who had been mobile in 2005 (around 939 000 persons). Germany and, at a lower extend, Italy followed with around 761 000 and 355 000 mobile HRST respectively.

Proportionately, Denmark is the EU country showing the highest percentage of job-to-job mobility with 10.2%. The United Kingdom also scored a high percentage of job-to-job mobility with 9.5%. Of the countries outside the EU, Iceland has the highest proportion of job-to-job mobility for employed HRST (10.3%).

These results tend to illustrate the impact of more flexible labour markets existing in these top-ranking countries. In the United Kingdom, for example, it can be assumed that, even if hotly debated from a different perspective, the major reforms of the labour market over the last 20 years (deregulation, trade union reforms and, more recently, the New Deal policies) has had a considerable impact on job-to-job mobility.

Of the new EU Member States, only Slovenia and Cyprus have job-to-job mobility rates higher than the EU aggregate for employed HRST (7.6% and 6.8% respectively). Among the other new Member States the lowest mobility rates are found in Hungary and the Czech Republic. Together with Greece, they all have rates below 4%.

**Figure 5: Percentage of total population who think that changing jobs every few years is good for people, by country, 2005**



This figure refers to the total population.

Source: Eurobarometer 64.1, European Commission, 2006

Overall, throughout Europe the mobility of HRST is still limited, as only 3% of these highly skilled employees in the EU countries are citizens of another EU country.

In this context, it is interesting to compare these figures with the results from the 2006 European Commission publication "Europeans and mobility: first results of an EU-wide survey". This publication, based on the Eurobarometer survey on geographic and labour market mobility, shows that the benefits of job mobility are perceived differently from one Member State to another (Figure 5).

The results for the total population (not only HRST aged 25-64 years) shows that in Europe, close to 40% believe that changing job every few years has a positive impact on people.

Unsurprisingly, it was found that in Denmark, where the level of mobility is high, respondents firmly believe in the benefits of job mobility (72%), whereas Greeks are much more sceptical (26%).

By contrast, it is surprising that, after Sweden and Denmark, the Czechs were the most positive about whether changing jobs every few years is good. Surprising, because only 3.8% of the HRST actually did so in 2005 (see Figure 4).

## Job Mobility Policies – Flexisecurity concept

### The Danish flexisecurity model

"The concept of *flexisecurity* is primarily based on the idea that the two dimensions of flexibility and security are not contradictory, but mutually supportive. Flexibility is not the monopoly of the employers, just as security is not the monopoly of the employees. In modern labour markets, many employers are beginning to realise that they might have an interest in stable employment relations and in retaining well qualified. On their part, many employees have realised that to be able to adjust their work life to more individual preferences, they too have an interest in more flexible ways of organising work.

Flexisecurity is a new term, which was first coined in the Netherlands in the aftermath of the labour law reform of 1999, the "Flexibility and Security Act" (Wilthagen and Troos, 2004). The Danish employment system is often referred to as a prime example of a labour market with a well functioning flexicurity arrangement.

The model combines high mobility between jobs with a comprehensive social safety net for the unemployed and an active labour market policy. The high degree of mobility from employer to employer is linked to the relatively modest level of employment protection in the Danish labour market.

Finally, it is important to note that the Danish "model of flexicurity" is not the result of a well-defined grand scheme, but the outcome of a long historical development with strong elements of path-dependency. Thus, the high level of worker mobility supported by a low level of employment protection is a long-standing feature of the Danish labour market dating back to the General Agreement between the social partners that was the outcome of a general strike in 1899. Similarly, when it comes to income security, the present version of the system for economic support for the unemployed dates back to the last large reform of the unemployment benefit system in 1969."

Sources: *Flexisecurity – Policies addressing job mobility* by Per Kongshøj Madsen, Centre for Labour Market Research, Aalborg University, November 2006 and *Employment in Europe 2006*, European Commission, DG for Employment, Social Affairs and Equal Opportunities, Unit D1, October 2006.

## ➤ ESSENTIAL INFORMATION – METHODOLOGICAL NOTES

### 1. Human Resources in Science and Technology—HRST—concepts

HRST and their sub-groups are measured in terms of educational achievement and occupation, following the guidelines in the *Canberra Manual, OECD, Paris, 1994*.

#### • HRST — Human Resources in Science and Technology

Individuals who fulfil at least one of the following conditions:

- have successfully completed tertiary-level education in an S&T field of study (ISCED '97 version, levels 5a, 5b or 6)

and/or

- work in an S&T occupation as professionals or technicians (ISCO '88 COM, codes 2 or 3).

### 2. Data sources

The indicators presented are derived from **Eurostat's education database** or from the **European Union Labour Force Survey (EU LFS)**. The most recent data were compiled in April 2007 and refer to the second quarter 2006.

### 3. Nationality and Country of Birth

This issue of Statistics in Focus presents results based on a set of new indicators on human resources in science and technology (HRST) domain that has been developed following recommendations in two working papers presented by Eurostat in 2005 and 2007.

These indicators give a picture of the HRST populations and sub-populations by nationality and/or country of birth. There are two ways of defining an immigrant. The first is to consider the immigrant as a person with a foreign nationality, the other is to consider the immigrant as a person who is foreign-born and, at some stage, immigrated to his or her country of residence. Based on these two concepts, the breakdowns by nationality/country of birth are based on the following criteria:

#### By Nationality:

Nationality is decided by citizenship. It is defined as the particular legal bond between an individual and his state acquired by birth or naturalisation, whether by declaration, option, marriage or other means in accordance with national legislation. The following aggregates can be distinguished:

- *Nationals*: Persons having citizenship of the country of residence.
- *Non-nationals having EU-27 citizenship*: Citizens of an EU-27 country different to the country of residence.
- *Non-nationals having citizenship outside EU-27*: Citizens of a country outside the EU-27.

#### By Country of birth:

Country of birth is defined as the country of residence of the mother at the time of birth. The following aggregates can be distinguished:

- *Natives*: Persons born in their country of residence.

- *EU-27 Foreign-born*: Persons born in an EU-27 country other than their country of residence.

- *Non-EU-27 Foreign-born*: Persons born in a country outside EU-27 other than their country of residence.

### 4. Foreign students

Data on foreign students in tertiary education show the potential (participation) inflow of foreign students from the education system into the stock of Human Resources in Science and Technology (HRST) at national level.

Foreign students means the number of foreigners enrolled during the reference period and participating in a third level education (ISCED levels 5 and 6). To minimise national differences between education systems and to increase cross-country comparability, HRST data use the International Standard Classification of Education (ISCED'97) developed by UNESCO to define higher education.

*ISCED level 5*: programmes that are theory-based and are intended to provide sufficient qualifications for gaining entry into advanced research programmes and professions with high skill requirements and programmes that are generally more practical/technical/occupationally specific than the above-mentioned programmes.

*ISCED level 6*: reserved for tertiary programmes that lead to the award of an advanced research qualification. The programmes are devoted to advanced study and original research.

### 5. Fields of education

The variable "field of highest level of education or training successfully completed", which has been part of the regular EU LFS collection since 2003, is completed in accordance with the Manual on Fields of Education and Training (Eurostat, 1999), in line with the International Standard Classification of Education (ISCED, 1997).

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

- **Science, mathematics and computing (EF4),**
- **Engineering, manufacturing and construction (EF5),**
- **All fields of education (EF0-EF9).**

### 6. Statistical abbreviations and symbols

: Not available

s Eurostat estimate

u Unreliable value

### 7. References

The European Commission publication "Europeans and mobility: first results of an EU-wide survey" can be found on the following website:

[http://ec.europa.eu/employment\\_social/emplweb/publications/index\\_en.cfm](http://ec.europa.eu/employment_social/emplweb/publications/index_en.cfm)

## ***Further information:***

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