

**"BLUE SKY II 2006": WHAT INDICATORS FOR SCIENCE, TECHNOLOGY AND  
INNOVATION POLICIES IN THE 21<sup>ST</sup> CENTURY?**

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**INTERNATIONAL MOBILITY OF DOCTORATE HOLDERS: FIRST RESULTS AND  
METHODOLOGY ADVANCES**

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**ABSTRACT**

This paper discusses difficulties encountered in the measurement of international mobility of the highly skilled that are linked to differences in national migration systems. These differences influence the content of data sources for migration statistics as well as the definition of immigrant populations. Having looked at the potential of existing OECD data sources and using the first results of a new joint OECD/Eurostat/UNESCO project on the professional careers and mobility of doctorate holders, the paper proposes the establishment of new indicators of international mobility by crossing variables on the origin (citizenship, country of birth) and characteristics (age, residential status, country of education, reasons for moving) of migrants. These indicators will in any case have to be built and interpreted in the light of national or regional migration policies.

## 1. Introduction

1. Measuring the international mobility of the highly skilled is a real challenge for statisticians. The inherent weakness of international migration statistics is compounded by the problem of taking into account the level of qualifications of people covered by these statistics. The OECD has been working for several years on issues relating to the international mobility of students, researchers, scientists and other highly skilled groups, while attempting at the same time to improve the available statistical tools (OECD 2001a). Of the various initiatives reviewed below, this article will look in greater detail at the one designed to follow doctorate holders' career path, the program first results from which seem quite promising in terms of improving our understanding of the cross-border movements of doctorate holders

2. The first part of this article offers some basic considerations for understanding the current international statistical landscape. While migrations are by their nature international, the fact remains that their measurement strongly relies on national concepts linked to countries' migration policies and policies for the acquisition of citizenship, which produces the following paradox: there is very little in the way of internationally comparable statistics on international migrations. Moreover, apart from the fact that qualifications are rarely taken into account in the statistics, education systems and qualifications differ greatly from one country to the next, and this influences the nature of the statistics describing them. We shall then go on to consider which databases recently introduced or enhanced within the OECD can be used to obtain data on international mobility of the highly skilled.

3. The third part of the article presents and discusses the initial results from a project launched less than two years ago by the OECD in cooperation with UNESCO and Eurostat, to measure careers and international mobility of doctorate holders. These initial results shed some interesting light on the characteristics of the populations concerned in six countries (Germany, Australia, Canada, the United States, Portugal, and Switzerland), and on possible new approaches that might improve the measurement of international mobility and migrations.

## 2. A paradox: statistics on international migrations are not comparable

4. OECD countries have many different kinds of migration policies and systems. In schematic terms, we can distinguish on one hand the "countries of immigration" or settlement that have been populated through successive waves of immigration (Australia, Canada, United States and New Zealand) and that use a system based on the granting of permanent residence permits. The other countries, for the most part in Europe, tend to use a system of delivering temporary residence permits. This influences the sources of data used for measuring migrations at the national level, and also affects the definition of the immigrant population and the way it is counted.

### 2.1. Data sources on international migrations

5. Four kinds of data sources on international migrations can be identified:<sup>1</sup>

- a) Population or foreigner registers are used in many countries of Northern Europe (Germany, Belgium, Netherlands, the Nordic countries). Nationals and/or foreigners are supposed to register with the authorities, and this makes it possible to estimate the numbers of residents and immigrants. However, rules governing registration, and in particular length of stay, vary among countries, and this affects the international comparability of the data from these registers. Moreover, departures are not recorded as systematically as arrivals.

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1. See OECD (2001b) pp. 269-275 and Lemaitre G. (2005) for further details.

- b) Residence and work permits are widely used in several OECD countries, including those that have population registers. The main difficulty in using them as a source of internationally comparable statistics is that the length-of-stay rule varies. “Settlement” countries (Australia, Canada, United States and New Zealand) tend to grant permanent residence permits (of unlimited duration), while the other countries deliver primarily temporary visit or work permits, the length of which varies depending on the country. Thus, the statistical coverage of certain migrant groups, such as students, will vary from one country to another. Furthermore, the population groups targeted by such permits depend as well on the free circulation agreements in effect (the Schengen Agreement, for example). Nevertheless, efforts are underway at the OECD to establish harmonised flow statistics on arrivals, using visitor permits (OECD, 2006).
- c) Population censuses and labour force surveys provide data not only on the foreign population, but also on level of education and occupation, which is generally not the case with the other data sources. Moreover, these sources are harmonised internationally. Their limitations have to do with their infrequency, in the case of censuses, and with the sample size for certain categories, in the case of labour force surveys. We shall return to these data sources in greater detail later in this article.
- d) There are specific surveys conducted in some countries, such as for passengers entering or leaving the territory. The best known is the United Kingdom's International Passenger Survey, but Australia and New Zealand also use similar ones.

## 2.2. *Definitions and measurements of the immigrant population*

6. The preceding discussion points to several conclusions. First, data on arrivals or immigrants are more systematic than those on departures or emigrants (as we shall see below, emigrant numbers are often estimated using “mirror” data for immigrants in the host country). Second, population censuses and labour force surveys, which are the most reliable sources for international comparisons, provide data essentially in the form of stocks and not flows (which are more usefully derived from permits or passenger surveys). Third, although there is an accepted international definition of “migrant”<sup>2</sup>, this is not really taken into account in national statistics, for obvious reasons of compatibility with countries' migration systems. This, together with the difficulty of tracking changes in individuals' successive situations, makes it particularly difficult to draw distinctions between short-term or temporary migrations and long-term or permanent migrations, and to identify successive or back-and-forth movements across borders.

7. At this point, we may offer some further considerations on the definition of the immigrant population. This also depends on countries' migration systems. The most widely used rule in the so-called immigration countries (Australia, Canada, the United States and New Zealand) for defining an immigrant is by place of birth (a person born abroad), while it is citizenship that counts in most other countries, especially in Europe. This reflects the fact that the process of acquiring citizenship has historically been more systematic and swifter in immigration countries, as a means of encouraging settlement. This has an impact on the statistics resulting from these two measurements, as can be seen in Table 1.

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2. “A long-term migrant is a person who moves to a country other than that of his or her usual residence for a period of at least a year (12 months), so that the country of destination effectively becomes his or her new country of usual residence. A short-term migrant is a person who moves to a country other than that of his or her usual residence for a period of at least three months but less than a year (12 months), except in cases where the movement to that country is for purposes of recreation, holiday, visits to friends or relatives, business, medical treatment, or religious pilgrimage.” (United Nations 1998)

**Table 1. Doctorate holders by origin in six OECD countries (percentages)**

	Australia (2001)	Canada (2001)	Germany (2004)	Switzerland (2004)	United States (2003)	Portugal <sup>1</sup>
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Citizens of the country</b>	86.0	82.0	92.6	69.9	88.3	92.1
<b>Foreign citizens</b>	14.0	18.0	7.4	30.1	11.7	7.9
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Born in the country</b>	53.6	45.9	82.5	58.9	74.3	82.5
<b>Foreign born</b>	46.4	54.1	12.0	41.1	25.7	17.5
<b>Birthplace unknown</b>			5.5			

1. Data for Portugal are provisional and refer to doctorate holders who received their doctorate between 2000 and 2004.

Source: First OECD/Eurostat/UIS data collection on careers of doctorate holders.

8. For all countries together (other data show that this is true beyond the six countries presented here), the foreign population is larger when measured by country of birth than when measured by citizenship. This is because a portion of the foreign-born population will have acquired the citizenship of the country of residence. Another, albeit much smaller, portion of that population, however, will have always had the citizenship of the host country despite being born abroad. This is the case, for example, with communities of repatriates from Portugal's former colonies. On the other hand, persons born of foreign parents in a given country may, depending on legislation, not be able to acquire the citizenship of that country. This question of definition of the immigrant population is thoroughly discussed by Dumont and Lemaitre (2005) in their recent analysis of census data, to which we shall return later.

9. The shortcomings of these measurements suggest the crossing of data on several criteria (place of birth, of residence, citizenship, citizenship at birth, length of stay etc.) so as to refine the interpretation and thus record more accurately the immigrant, foreign or mobile population. We shall attempt to demonstrate that in the remainder of this article.

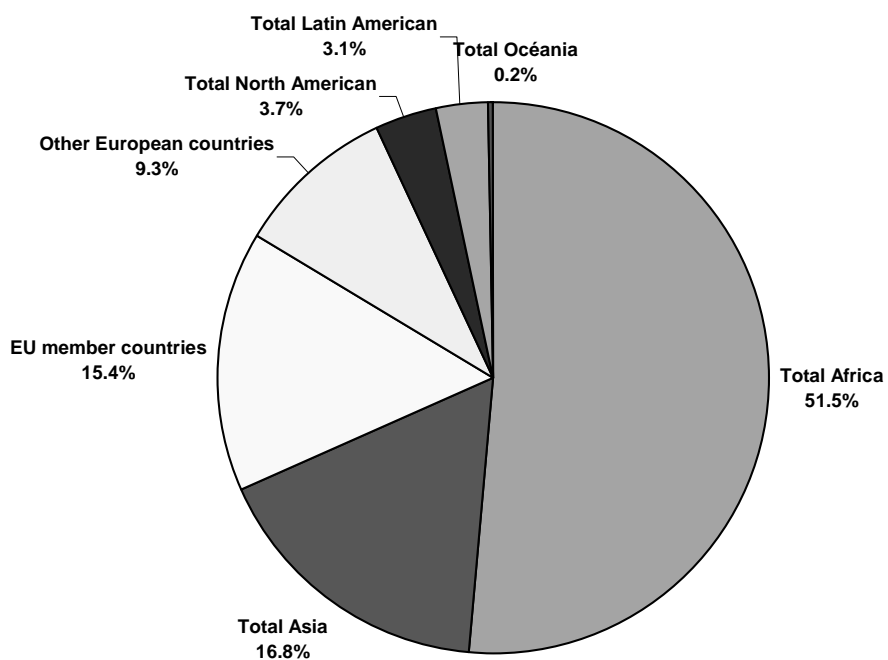
### **3. Two databases for measuring international mobility of the highly skilled**

#### **3.1. The OECD education database**

10. The OECD has for many years been collecting statistics in cooperation with the European Commission (Eurostat) and UNESCO (UNESCO Institute for Statistics) on member countries' education systems. The collection of data covers education spending, personnel and students at all levels of the education system, using a joint questionnaire issued by the three international organisations addressed to the authorities (ministries or statistics bureaus) responsible in each country for compiling the statistics.

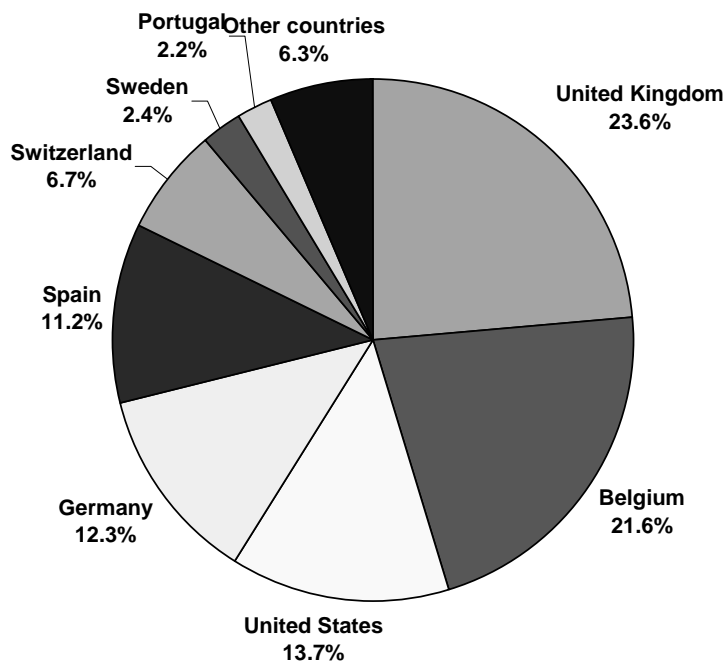
11. One of the matrices produced by the OECD database is that for foreign students by citizenship, sex, level of diploma, and field of study, enrolled in higher education in each OECD country. The data are therefore collected in the host country, but the combined host country-student citizenship table also reveals students' choices of foreign destination, through observation of the "mirror" data.

Figure 1a. Distribution of foreign students in France by region of origin, 2003



Source: OECD Education Database.

Figure 1b. Distribution of French students in other OECD countries, 2003



Source: OECD Education Database.

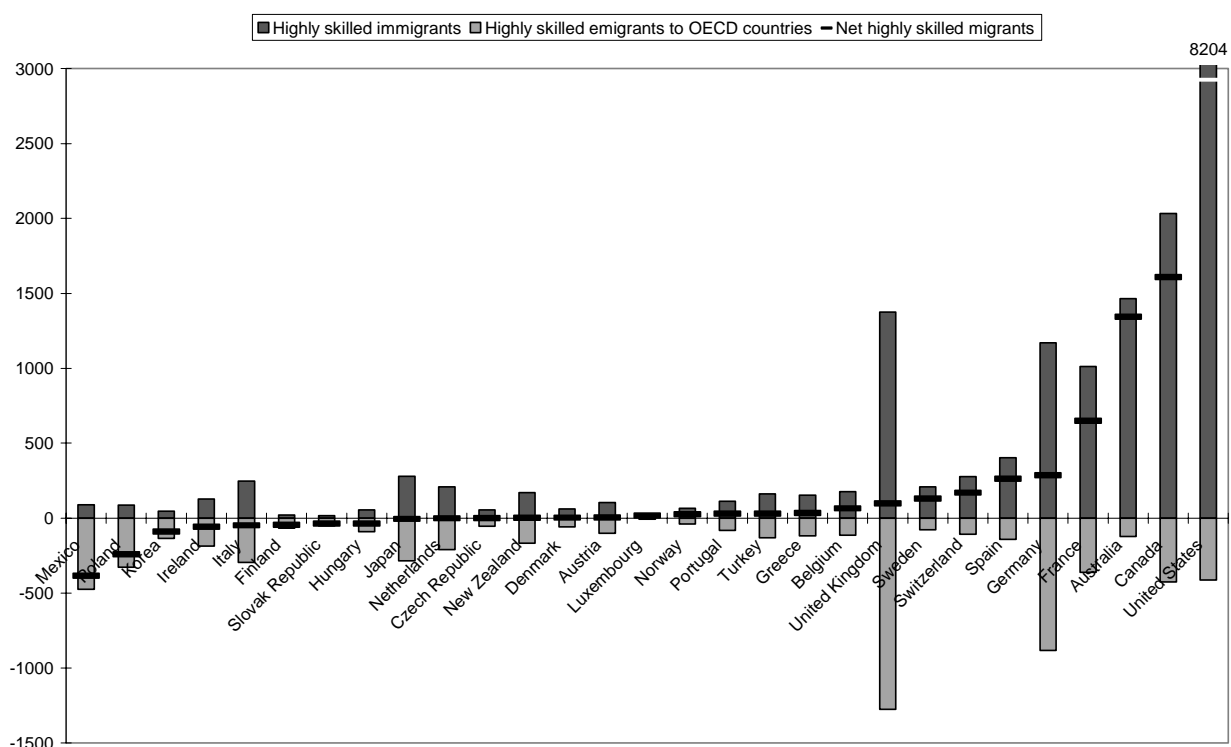
12. One of the problems in interpreting these data has to do with a point already mentioned, namely the fact that they are gathered according to the citizenship criterion. Thus, the OECD publication "Education at a Glance" (OECD, 2005, page 263) gives the reader the following warning: "*Students are classified as foreign students if they are not citizens of the country in which the data are collected. While pragmatic and operational, this classification yields some inconsistencies as a result of differing national policies regarding the naturalisation of immigrants and the inability of several countries to report foreign students net of foreigners who are permanent residents in their country of study. Indeed, countries that naturalise immigrants stringently overestimate the size of their foreign student body, compared to more lenient countries. Bilateral comparisons of the data on foreign students should therefore be made with caution, since countries differ in the definition and coverage of their foreign students. In particular, some countries only report foreigners who have come to their country expressly for the purpose of pursuing their education, while other countries report both resident and nonresident foreign students.*"

13. The group of national experts in charge of education indicators (INES) has examined this question and proposed ways of improving the 2005 joint questionnaire. The approach selected is to gather data according to three variables in order to refine the information: citizenship, residential status in the country (temporary or permanent) and country of prior education. Results have been obtained for half of the countries, and they make it possible to determine whether there is student mobility as a function of residential status or country of last diploma. In countries of the European Union, it is this last criterion that is determinant, because the notion of temporary or permanent residence loses its meaning with application of the Schengen Agreement.

### **3.2. *The OECD database on immigrants and expatriates***

14. Most OECD countries, and many other countries, held their last population census in or around the year 2000. The OECD took the occasion to gather the data from those censuses from national statistics bureaus and to establish a database on the number of residents in OECD countries, by place of birth, citizenship, and level of education. The information contained in this database therefore reflects the cumulative effect over past decades of population movements within and toward the OECD zone. Moreover, it is also possible, again using "mirror" data, to estimate the expatriate population from the number of residents in one OECD country born in another OECD country or nonmember country, whether naturalised or not. Emigration rates have thus been calculated for about a hundred countries, and they include data on the highly skilled. These data show that most OECD countries are net beneficiaries of highly skilled migration (Figure 2).

**Figure 2. Immigrant and emigrant population 15 years and over with a higher education degree in OECD countries (in thousands)**



Source: OECD Database on Immigrants and Expatriates.

15. This database is expected to be supplemented, in a second phase, with more detailed statistics by field of study, occupation, length of stay in the country, and some other variables. The limitation on this exercise, however, lies in the fact that population censuses are infrequent and the data quickly become obsolete. The exercise could nevertheless be repeated with the next census cycles.

#### 4. Measuring the international mobility of doctorate holders: a new methodological approach

16. The OECD Directorate for Science and Technology follows researchers closely in their careers and in their international mobility. For this reason, it decided in 2004 to launch a project to follow the career paths of young doctorate holders, who constitute the next generation of researchers, and to look closely at their international mobility. The effort to appreciate international movements requires cooperation from the major immigration and emigration countries, and partnership among various international organisations for coordinating the projects. A group of experts has been established, currently consisting of 30 countries, including France, Germany, the United States, Canada, Australia, China, Russia and India, as well as some smaller countries such as Uganda that may experience a "brain drain". The project is being coordinated jointly by the OECD, the European Commission through its statistics office Eurostat, and the UNESCO Institute for Statistics.

##### 4.1. Interpretation of data on the origin and residential status of migrants

17. The methodology developed by the expert group consists of gathering data on immigrant populations through the host countries, recognising the difficulty in obtaining departures data and the need to avoid double counting. As well, it was decided to collect data using several criteria relating to the origin of migrants, in order to interpret the migration data more accurately. Data were therefore collected on

doctorate holders by country of birth and citizenship (whether by birth or by acquisition), crossed with residential status (permanent or temporary), length of stay in the country, previous country of residence, and other demographic or education variables (in particular, country of previous degree). The sources used may be population censuses, labour force surveys, targeted surveys (a methodology and a questionnaire for such surveys have been developed as part of the project), or a combination of these sources.

18. An initial data collection was conducted in September 2005, and the results are presented below. Six countries (Germany, Australia, Canada, United States, Portugal and Switzerland) were able to provide these data.

19. We showed above (Table 1) that these data confirm differences in measurement of the immigrant population when interpreted using place of birth or citizenship. The data on Australia and Canada show, in fact, that a great portion of their population acquired the citizenship of the country through naturalisation (Table 2).

**Table 2. Doctorate holders who are citizens of the country, by type of citizenship**

	Australia (2001)			Canada (2001)			United States (2003)			Portugal <sup>1</sup>		
	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total
Citizens of the country	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
By birth	61.0	63.5	61.7	53.5	64.7	56.6	82.7	87.0	84.2	87.0	86.9	87.0
By naturalisation	38.1	35.4	37.3	46.5	35.3	43.4	17.3	13.0	15.8	13.0	13.1	13.0

1. Data for Portugal are provisional and refer to doctorate holders who received their doctorate between 2000 and 2004.

Source: First OECD/Eurostat/UIS data collection on careers of doctorate holders.

20. The data for Canada and the United States also show that the population born in the country is roughly equal to that holding citizenship of the country by birth, and that the foreign population is roughly equal to that born abroad, minus the people who have acquired the citizenship of the country (the difference being accounted for by nationals born abroad, box 3 of Schedule 1). This is because birth within the territory automatically conveys the citizenship of the country, i.e. *jus soli* applies in their case: boxes 2 and 5 of schedule 1 are equal to zero. This is not however the case in most other countries. In Germany and in Switzerland, for example, legislation governing the granting of citizenship is much stricter, and children and grandchildren born in the country of immigrant parents may not have acquired the citizenship of their place of birth. The data supplied by Germany and Switzerland in the course of this exercise are unfortunately incomplete, and we were not able to include them.

### Criteria for granting nationality/citizenship in OECD countries

There are two rules that determine an individual's nationality/citizenship of origin: *jus soli* or "law of the soil" and *jus sanguinis* or "law of the blood", relating respectively to place of birth and to parents' nationality. While one will take precedence over the other depending on the country, it is common to find a combination of both. We must distinguish schematically, then, among three categories of countries: those where *jus soli* predominates and there is little recognition of *jus sanguinis*; those that apply both *jus soli* and *jus sanguinis*; and those where the main rule is *jus sanguinis*. The classification of any country in one or another of these categories may however change over time as legislation evolves.

1. Countries where the place-of-birth rule or *jus soli* prevails: this is the case for the United States, Canada and Ireland.
2. Countries where place of birth (*jus soli*) and parents' nationality (*jus sanguinis*) are both considered in granting citizenship: a child born in Australia, in Belgium, in New Zealand, in Portugal or in the United Kingdom will have the citizenship of that country if, at the time of its birth, one of its parents also held that citizenship, or was permanently settled in the territory.
3. Countries where the parents' nationality or *jus sanguinis* prevails. The following countries grant citizenship to a child if one of its parents has that citizenship: Germany, Austria, Denmark, Spain, Finland, France, Greece, Italy, Japan, Luxembourg, Norway, Netherlands, Switzerland, Sweden and Turkey.

The acquisition of citizenship by naturalisation is based on other criteria: age, residence, lack of criminal record, means of support, etc. (updated and adapted from OECD 1995, pages 165 to 189).

21. The fact remains, however, that for "immigration countries", such as Canada and the United States, the number of doctorate holders born abroad who have acquired citizenship (box 4 of Schedule 1) will provide an indicator of definitive or long-term immigration, while those who were born abroad and have foreign citizenship (boxes 6 and 7 of Schedule 1), with the exception of those who chose to retain their original citizenship even though they settled definitively in the country, will give an indication of more recent immigration or of temporary mobility toward the country. Information on residential status (permanent or temporary) can refine the data on the timing (recent or earlier) of arrivals in the country. These data show, for example, that the foreign-born population is much more integrated in Canada, either through naturalisation or the granting of permanent residence, while the temporary resident population is more significant in the United States (Table 3).

**Schedule 1. Population makeup of a country by origin of its inhabitants**

	Citizens	Non citizens
<b>Natives</b>	1. Native and citizen by birth	5. Native and non citizen
	2. Native and citizen by naturalisation	
<b>Foreign born</b>	3. Foreign born and citizen by birth	6. Foreign born, non citizen and permanent resident
	4. Foreign born abroad and citizen by naturalisation	7. Foreign born, non citizen and non permanent resident

**Table 3. Distribution of foreign-born doctorate holders in Canada, the United States, and Portugal**

	<b>Canada (2001)</b>	<b>United States (2003)</b>	<b>Portugal<sup>1</sup></b>
<b>Citizens</b>	<b>67.8</b>	<b>55.9</b>	<b>90.4</b>
By Birth	0.9	3.6	78.6
By naturalisation	66.9	52.4	11.7
<b>Foreign citizens</b>	<b>32.2</b>	<b>44.1</b>	<b>9.6</b>
Permanent residents	26.1	30.0	6.6
Nonpermanent residents	6.1	14.1	1.7
Unknown			1.3
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

1. Data for Portugal are provisional and refer to doctorate holders who received their doctorate between 2000 and 2004.

Source: First OECD/Eurostat/UIS data collection on careers of doctorate holders.

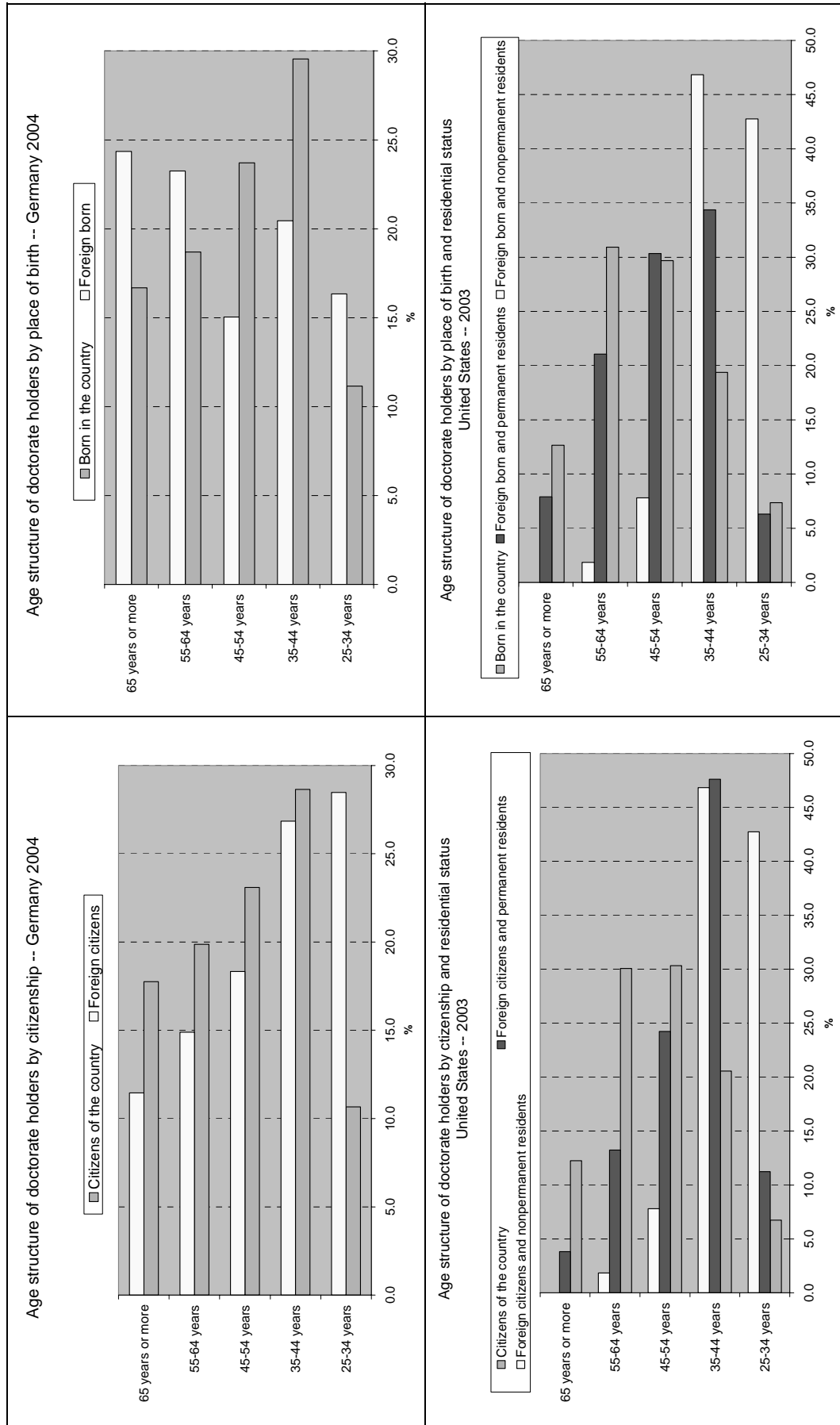
22. Table 3 also reveals very clearly a feature peculiar to Portugal: the importance of the foreign-born population holding Portuguese citizenship by birth, which accounts for 78.6% of the entire population born outside the territory. These are persons who were repatriated at the end of the colonial wars, and following the de-colonisation process pursued by Portugal.

23. Finally, supplementary data on date and place of doctorate award and previous degree, as well as on length of stay in the country, can be used in the case of long-term immigration to determine whether there has been a “brain drain”. Similarly, this information, supplemented by still other data on the intention or not to remain in the country, can be used, in the case of more recent immigration or of countries where naturalisation rates are low, to explicate the figures on doctorate holders of foreign citizenship.

#### **4.2. Long-term migration or temporary mobility?**

24. This information is for the time being only partially available for Canada and the United States, as we shall see in the following section, but the observation of comparative data by country of birth and by citizenship nonetheless validates the interpretation as to how long ago the migration occurred. It would seem, for example, that in the United States, 85% of doctorate holders born abroad are permanent residents, compared to only 68% among those of foreign citizenship. Moreover, if we assume that recent migration or temporary mobility applies essentially to young graduates, we see that the approach of comparing data by country of birth and by citizenship confirms this assumption, in that foreign doctorate holders measured by citizenship are younger than those measured by place of birth (Figures 3 to 6).

**Figures 3 to 6. Age structure of doctorate holders by place of origin**



Source: First OECD/Eurostat/UIS data collection on careers of doctorate holders.

25. The above data for the United States show, moreover, that the age structure of foreigners with permanent resident status tends to resemble that of the native-born population, especially when measured by place of birth. People who choose permanent residency tend to assimilate willingly into the local population.

26. The picture becomes clearer if we look at the countries or regions of origin of doctorate holders in Canada and United States, the two most important regions of origin are Asia and Europe. If we compare percentages in terms of birth place and citizenship, we find that doctorate holders born in Asia represent 55% of foreign-born doctorate holders, while those who hold an Asian country's citizenship represent only 44% of all foreign-born doctorate holders, which shows that a good portion of those who were born in Asia have acquired US citizenship.<sup>3</sup> A similar phenomenon can be observed in Canada: 38% of doctorate holders were born in Europe (13% of them in the United Kingdom), while 27% have a European citizenship (6% of them British). On the other hand, 14% were born in the United States, while 21% have US citizenship, which means that 7% of US doctorate holders in Canada were born outside the United States. These may be US citizens who were born in Canada, or may be doctorate holders born, for example, in Asia who have acquired US citizenship but are working in Canada. This highlights the complexity of the cross-border patterns of doctorate holders' movements.

#### 4.3. *Using supplementary data on the reasons for mobility: the United States*

27. Beyond keeping count of cross-border movements, policymakers are interested in the reasons or motives for these movements. The project on doctorate holders' careers is thus trying to collect information of a qualitative kind on mobility intentions and reasons. These data are for the moment available only for the United States, but they offer some evidence on how mobility motivation has evolved over time, and how this relates to the residential status of migrants in the country.

**Table 1. Table 4. Reasons given by doctorate holders for coming to the United States over the last 10 years (2003 data)**

<i>Entered the country over the last five years</i>	Citizens of the country (by naturalisation)	Foreign citizens		Total
		Permanent residents	Non-permanent residents	
Educational opportunities in the United States	28.1	14.4	26.0	23.1
Family-related reasons	20.3		6.0	8.9
Job or economic opportunities	25.0	45.6	28.5	31.7
Scientific or professional infrastructure in my field	26.6	40.0	39.5	36.4
<b>All reasons</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<i>Entered the country five to ten years ago</i>	Citizens of the country (by naturalisation)	Foreign citizens		Total
		Permanent residents	Non-permanent residents	
Educational opportunities in the United States	19.9	27.4	38.1	31.0
Family-related reasons	32.5	10.7	4.2	10.7
Job or economic opportunities	21.7	29.2	21.3	25.0
Scientific or professional infrastructure in my field	21.1	30.1	35.6	31.3
Other reasons	4.8	2.6	0.7	2.1
<b>All reasons</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

Source: First OECD/Eurostat/UIS data collection on careers of doctorate holders.

28. The data from Table 4 show that over the last 5 years, educational opportunities in the United States became less prominent as a motivation than job or economic opportunities, compared to the preceding five years. Reasons relating to scientific or professional infrastructures also became more important. These trends are particularly marked among doctorate holders with permanent resident status. For those who have acquired US citizenship, family-related reasons also play an important role, although less so in the last five years compared to the preceding five years.

3. US citizens born in an Asian country nevertheless account for a small portion.

## 5. Conclusions

29. This article has highlighted the difficulties inherent in the availability and the interpretation of data on international migrations. These problems have to do for the most part with differences among countries' migration systems, legislation and policies.

30. The joint OECD/Eurostat/UNESCO project on the professional careers and international mobility of doctorate holders offers some promising initial results, thanks to a new methodological approach that crosses a number of criteria relating to the origin of migrants. Thus, in "immigration countries" such as Canada and the United States, the foreign-born and naturalised population will give an indicator of long-term immigration; the foreign-born population of foreign citizenship that does not have permanent resident status will give an indication of more recent or temporary immigration; while the number of foreigners born abroad and holding permanent residency could be interpreted as representing an intermediate situation.

31. Supplementary data on the time and place of degree award, length of stay in the country, migration reasons and intentions can show whether a "brain drain" or temporary mobility is involved. Such data are also necessary for interpreting information on countries where citizenship is harder to acquire and where the notion of permanent or nonpermanent residency does not apply. The project on careers of doctorate holders is trying to gather such data and to construct indicators of international mobility. In interpreting them, however, due consideration will have to be given to countries' migration policies and systems, which evolve over time (waves of naturalisation or changes in legislation, for example). If sufficiently robust indicators are to be built, then, they will probably have to be customised according to groups of countries with similar migration systems.

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