

PART 7. STRIKING A NEW PATH FOR MEASUREMENT FOR RECENT FLOWS

A Web-based E-survey on International Mobility of Scientists and Engineers



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E-Survey on Internationally Mobile Scientists and Engineers¹

1. Introduction to Using the WWW for an E-survey

The use of electronic transmission of survey questions and responses is not new. For years, statistical agencies have been collecting and remitting administrative and registry data electronically. As part of the activities carried out under the project under *new measurement development* and the need to collect as much timely information as possible in the process, an e-survey was designed and piloted.

What is new and interesting for the pilot survey needs is with the increase in computer usage and corresponding diffusion of computer related technologies one is able to reach people in their places of work and homes around the world and there exists the possibility to gather information from internationally mobile scientists and engineers on-line using the World Wide Web (Web). Yet, just as surveying via the Web has become more and more attractive for many researchers and data ‘hunters and gatherers’ like ourselves, dangers and pitfalls are numerous. In particular, as promising as an e-survey instrument is for our challenge on gathering information on international mobile scientists and engineers, one needs to be rigorous in guarding against the possibility of generating deceptive and misleading results and the inappropriate use of the results.

A Web-based e-survey presents an opportunity to reach individuals around the globe. It is a means to collect, organise and analyse vast volumes of data. It removes the burden of time and money for interviewers, stationery, postage and manual data entry. With the reduction in financial and human resource commitments required and the ability to ‘reach out and touch’ people around the world, this type of survey can complement national agencies’ statistics with timely information and expertise on experiences of internationally mobile scientists and engineers. The issues and concerns of international mobility of skilled workers are on many agendas in both the public and private sectors, and with the new technologies, we have an opportunity to work together for mutual benefit.

A Web-based e-survey presents another important opportunity for our research team — one can take advantage of existing technology to introduce personalisation to a questionnaire. For target populations with diverse characteristics (e.g. country of birth, country of work, multiple qualifications), personalisation can be an effective means of decreasing respondent burden and increasing information content from the respondent. Personalisation can guide and gently persuade and encourage the respondent through the survey with timely hints and reminders, providing cross-references for the respondent as he/she proceeds through the questionnaire. Personalisation is now a viable e-survey enhancement due to ‘back end’ technologies such as Common Gateway Interface (CGI) or Active Server Pages (ASP) which make it possible to analyse the answers ‘on the fly’ (between the pages of the survey) and send the respondent a set of customised and presumably more meaningful and easier to comprehend questions.

The use of the computer and access to the Internet (in the work place and/or in the home) suggest that if one can design a survey of sufficient utility and attraction to a target group, the potential number of people that can be reached and the quality and quantity of the responses

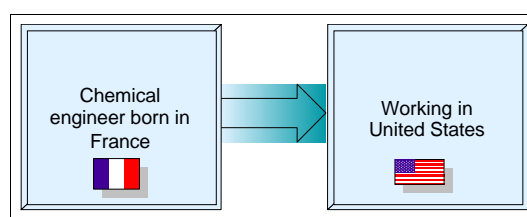
¹ This report was prepared by Wendy Hansen for *The Brain Drain — Emigration Flows for Qualified Scientists*.

can be enhanced with today's applications of on-line interaction. However, the adoption of technologies does not necessarily lead to increased productivity or increased quality. Our success depends on our ability to provide access and to attract and maintain the attention and co-operation of the respondent.

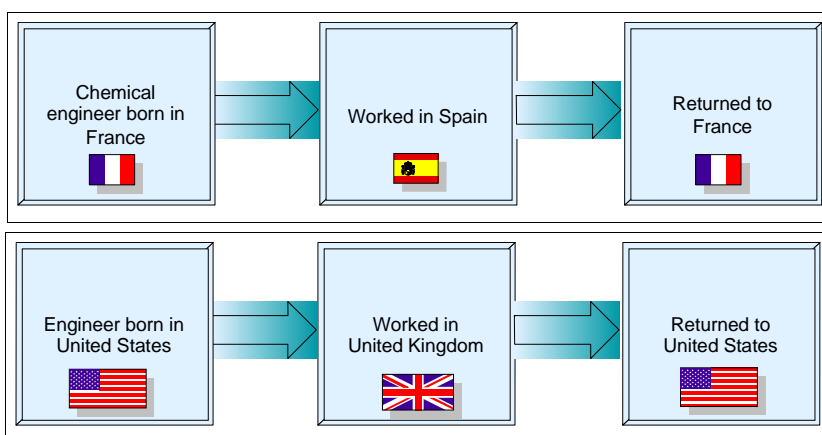
2. The E-survey — Conceptualisation and Design²

2.1. Defining the Target Group

The e-survey was designed with a specific target group in mind — internationally mobile European scientists and engineers. Initially, the plan was to limit the target group to persons born in *country x* (country x being a member state of the EU or candidate country) and working in *country y* (a country other than the country in which he/she was born). However, valuable information could also be uncovered by probing mobility of non-European scientists and engineers who had come to Europe to work (e.g. pull factors of Europe) or who had done so in the past (e.g. why didn't he/she stay?). It was decided to include individuals who were *currently working in a country other than the country in which he/she was born* **and** *those individuals who had, in the past, been internationally mobile*.



Just as information collected from a French-born chemical engineer working in the United States can provide intelligence on international mobility enhancements and barriers of today, so too can the experience of a French-born chemical engineer who worked in Spain and returned to France shed light on reasons for the mobility in the first place and the reasons for returning home. At the same time, information about American scientists and engineers could be collected to examine why they come to Europe and why they choose to stay (or not).



The target group includes:

Individuals who have at least one post secondary qualification (college or university) in one of the qualifying fields of study and are currently working in a country other than his/her country of birth

AND

² Research assistant O. Nomaler contributed to the e-survey design and development.

Individuals who have at least one post secondary qualification (college or university) in one of the qualifying fields of study who have been abroad (worked and/or studied) at one time or other and are back in his/her country of birth.

2.1. Sample and Coverage

The sample size and coverage for the pilot e-survey were assessed against the key objectives of the study:

Objective #1: Find facts and reasons about international mobility of European-born (EU and CEEC) qualified scientists and engineers.

Objective #2: Analyse facts and reasons about international mobility against characteristics such as country of birth, education level, field of specialisation, age, gender, occupation, destination country and earnings.

Objective #3: Test and verify the utility and appropriateness of the e-survey instrument and the Web medium for systematic data collection for DG Research in the future.

Sample selection and 'mail out' of the e-survey relied upon an intermediary organisation to reach internationally mobile scientists and engineers. The sample selection would be determined by discussions with and decisions of the intermediary organisation. (Details of the intermediary organisation follow in Section 3).

2.2. Motivation and Incentives

Motivating respondents and providing incentives is an important consideration to minimise the non-respondent error and maximise respondent input (answering of any and all questions in a complete manner). In practice, there are many ways of doing this. A popular and most direct approach is simply paying the respondent to fill out the survey. This was neither practical nor possible for the pilot survey. We set out to entice the respondent to complete the questionnaire by presenting a case of special interest of the subject matter.

First, a case of special interest and valued contribution was built. The invitation from the intermediary makes a brief introduction to the study, describes the importance and value of the e-survey (from the intermediary's, individual's, etc., point of view), suggests the utility of timely data and analysis and its potential to impact decision making and, finally, stresses the fact that this will only be possible with the participation of respondents like him/her. The e-mail sent out by the intermediary representative provides a hyper link to the survey. The first page of the e-survey again briefly describes the survey, its aims and the value of the respondent input.

The individual receives the invitation to complete the survey from the intermediary not from the research team (e.g. MERIT project team). Approaching the individuals through an employer or professional organisation/agency and mentioning the EC involvement and support of the work might presumably give the survey enhanced validity and thereby an enhanced response rate. People are more and more cautious of 'unknown' data collectors.

If the e-mail invitation succeeds in luring the respondent to the e-survey, he/she is greeted with a welcoming screen. The welcoming screen provides the respondent with links to the

project partners should he/she wish additional information on the research team. The first screen also recaps the survey goals, provides some information on the subject, gives directions on filling out the survey and provides guidelines on confidentiality and so on. The welcoming page also provides an estimate of the time the survey will take (9-11 minutes) so the respondent can go ahead and fill it in or alternatively make plans to revisit the site at a more convenient time.

2.3. Questionnaire Design

Objective #1: Find facts and reasons about international mobility of qualified scientists and engineers, vis à vis Europe (European born, Europe experience).

Objective #2: Have the capability to analyse the findings on international mobility against characteristics such as country of birth, education level, field of specialisation, age, gender, occupation, destination country and earnings.

Objective #3: Test and verify the utility and appropriateness of the e-survey instrument and the Web medium for systematic data collection in the future.

After reaching a workable definition of the target population, the next challenge was formulation and phrasing of the questions. This stage included major efforts to minimise response bias and non-response error. The objectives are clear — test a new survey instrument and gather socio-economic data to profile internationally mobile EU-born scientists and engineers and try to uncover some of the ‘push’ and ‘pull’ factors of their relocation. Once the questions were formulated, a web-based e-survey presented a number of challenges in the design stage. Although the e-survey format tempts one to try and gather every bit of information related to international mobility, the content and layout will of course impact on the degree of respondent co-operation. It was important for the respondent to be able to move through the entire survey even if he/she opted not to complete all the questions. Given the number of questions considered essential could only be brought down to twenty-three (23) questions in total, the minimisation of response time per question was an important consideration. The solution was to keep text entry fields to a minimum and use a combination of drop down menus for options (e.g. list of field of specialisation of degree) and multiple-choice format (e.g. Likert scale).

The respondent clicks a question button and a menu of responses pops up and he/she clicks on the answer that best describes his/her situation. Once an answer is chosen, the question reads as a complete sentence.

The personalisation of the menus assists the respondent as he/she makes her way through the questions and provides 'reminders' of the story line being developed. For instance, one question asks about how the individual heard of the position in the 'foreign' country and how he/she found the job. The menu shows the respondent his/her answer from an earlier question in the survey. This ‘personalisation’ of the questionnaire (and menus) allows one to avoid difficult to comprehend and time consuming question posing like "if you are 'x' then what/where/when/why is 'y'". The technology allows the respondent to read a seamless story while the changes go on behind the scenes.

The personalisation is based on three criteria:

(i) Geography

There are five categories of geographical 'givens'. In question 1 through 3, the respondent is asked to indicate the country of his/her birth, the country in which he/she lives and the country in which he/she works.

The answers lead to a number of profiles such as:

- i. He is born in *country a* and working and living in *country b*. (Example: a Danish-born engineer is working and living in Sweden).
- ii. She is born in *country a*, working in *country c* and living in *country b*. (Example: A Belgian-born chemist is living in the Netherlands and is working in Germany).
- iii. He is born and living in *country b* and working in *country c*. (Example: A Swedish-born economist is living in Sweden and working in Denmark).
- iv. She is born, living and working in *country a* and has worked abroad. (Example: An Italian-born physicist is back working in Italy after returning from working in the United States for two years).

The geographic categories and combinations described above are key elements of personalisation of the questionnaire. For instance, question 18 of the survey, "Are you planning to work back in the country of your birth" is directed only to people of category *i*, *ii* and *iii*. For people in category *iv*, the question is replaced with "Are you planning to work abroad again". Respondents who fall in the first three categories (*i* through *iii*) are asked about the reasons why they opted to work abroad whereas those in category *iv* are probed about reasons and factors of their return to their country of birth. Subsequent screens are personalised to the respondent such as the flag on the top left is the country of birth and the flag on the top right is the country in which he/she is located (working/living) at time of the survey.

(ii) Education Qualifications

The questions on the details of education qualifications are customised on the basis of earlier responses on degree(s). The e-survey and the personalisation present an opportunity to test information on multiple qualifications. Typically, if it can be found at all, education information on mobile scientists and engineers is limited to information on the highest qualification obtained. On this survey we ask the respondent to provide details on

more than one qualification (e.g. Bachelor degree and/or Master's degree and/or PhD). In all likelihood, the number of responses would prove to be too small to be reliable. That said, it is important to keep in mind the pilot e-survey was also being used to test the feasibility and practicality of this type of questionnaire and the content (e.g. are people willing to share the information and spend the time to provide details of multiple degrees/education history?).

(iii) Future plans and intentions

There are three (3) categories and they are related to the responses to the geographic questions. The intention questions are phrased based on past, current and future locations (planned) of the respondent. For example, an individual who indicates plans to return to his/her native country is asked to evaluate factors of his/her return. Individuals who respond that they have no intention of returning are queried as to what might make them change their mind. Those who reply that they do not know are asked of factors that might influence their decision.

Questions are included to gather data to develop a 'profile' of the internationally mobile scientists and engineers to address questions like:

- What, if any, are the differences between experiences and choices of men and women?
- What is the marital status of our respondent?
- How is age a factor to consider in international mobility?
- In what sectors do the scientists and engineers work — higher education or industry?
- What are the earnings of the internationally mobile scientists and engineers? Do they change jobs frequently?

2.4. Visual Design

"One of the challenges of web-based surveys is the variance of computer literacy among respondents, as is the processing power of their computers".³ Our target is internationally mobile scientists and engineers. We make the assumption that the scientist or engineer in all likelihood uses a computer or e-mail service or the Internet or the Web either on the job, at the office, in the home or combination thereof. It is highly unlikely the mobile scientist or engineer does not use either the Web or e-mail or have access to one or the other.

The first step in the visual design phase is the choice of the Web technology. The two applications for the pilot survey are the use of HTML pages and Java applets.

HTML pages are limited and offer less flexibility and control in terms of screen design and layout. Display can also vary greatly depending on browsers and browser settings. Research suggests that one cannot force (or indeed expect) the respondent to scroll down long pages of text. Thus, lengthy surveys need to be broken into many pages. This means that as a respondent completes a page, a page is submitted, it has to go back to the server to submit the information and retrieve the next (requested) page. This process can prolong response time, workload on the server and can suffer from a variety of problems (slow modems and telephone line glitches, system crashes and so on).

Java applets offer a toolbox of technologies for interactive displays. Many of today's browsers are capable of downloading this format; fewer browser setting problems can be expected. There are also downsides — incompatibility problems. Problems may arise with browsers of other platforms depending on the settings on respondents' systems and other tools such as security and fire walls.

There was quite an assignment of variables and subjects to pose to our respondents. Due to the broad range of characteristics, the multiple-choice questions would have rather long lists of alternative answers. For example, just consider the list of countries for geographic characteristics (e.g. country of birth). To overcome the time and tediousness of constantly scrolling down, the lists are organised on a series of pop-up menus with easy to use sub categorisations. For example on the countries' menu, countries are grouped (EU, North America and so on).

The colours and font and layout were chosen to enhance readability. In addition, given the range of questions and the story line the respondent is developing through the survey, navigation buttons were provided so the respondent could move forward and backward through the questionnaire. On the right side of each page is a panel listing the characteristics (variables) or themes of the questions. Once the respondent replies to a question, the colour changes and at a glance the respondent can see which questions he/she has responded to and which remain. This latter option could decrease the likelihood of 'accidental' incomplete questionnaires.

While research on Web-based surveys suggests that 'forced' answers not be used, this is a survey based on personalisation — the answer to one question helps phrase the next question. As such, there was a need to 'insist' on answers for some questions. On the first page, for example, there are necessarily four instances of 'have to answer' in order to proceed (country of birth, country of residence, country of citizenship and qualification). Without these questions being answered there was no point for the individual to continue. Through the rest

³ Dillman, D., Tortora R.D., and Bowker D., Principles for Constructing Web Surveys. dillman@wsu.edu.

of the survey, the use of 'must answer' questions are minimal.

2.5. Advantages and Disadvantages of a Web-based E-survey

Some of the advantages . . .

- ☞ The initial investment (time and financial resources) has been made. The survey can be updated (content and technology) with minimum resources.
- ☞ The Web-based e-survey will improve in response time and coverage as it 'rides along' with improvements to server service provision, software, application and technological developments (e.g. faster download time with improvements to the Internet speed and browser developments will enhance the operations of our survey software).
- ☞ The e-survey can serve as a powerful lure in approaching, negotiating and securing agreement and support from key intermediaries.

Some of the disadvantages . . .

- ☞ Without an active agent (e.g. telephone call interview) a great deal hinges on the ability of the survey to attract and keep the attention of the respondent.
- ☞ It is possible the survey arrives in the respondent's in-basket as just another of multitude requests and is ignored (although it is part of the intermediary's role to 'entice' the respondent to answer).
- ☞ Hardware and software incompatibility can lower response rate and deter respondent co-operation (e.g. frustration level with malfunctioning survey).

3. The Use of an Intermediary

One of the main challenges of surveying internationally mobile scientists and engineers is how to locate them. At the same time, the pilot survey was being used to study the utility and viability of a web-based e-survey. The solution was to work with an intermediary(s). An intermediary would have to have:

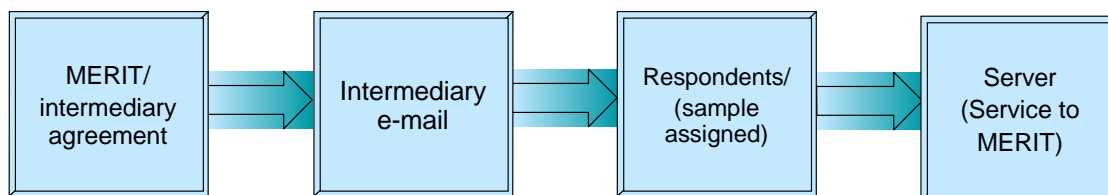
- i. access to mobile scientists and engineers
- ii. a clear understanding of the research and project goals
- iii. a vested interest in the successful carrying out of the e-survey and the findings of the survey.

Once a potential intermediary was identified, negotiations could begin and an agreement reached on a service-in-kind relationship:

Step 1. Negotiate an agreement to get the intermediary to buy into the idea and to commit support.

Step 2. The invitation is drafted and broadcast by the intermediary (e.g. e-mail invitation; announcement on intermediary web-site).

Step 3. The responses (via the service provider) go directly to the surveying body (MERIT) for database entry, analysis and report preparation(s).



3.1 Piloting the E-survey with an Intermediary —

The American Association for the Advancement of Science (AAAS)

www.AAAS.org

The American Association for the Advancement of Science (AAAS) is one of the most prestigious and respected associations of professionals in science and engineering in the world.

AAAS was founded in 1848, and serves some 265 affiliated societies and academies of science, serving 10 million individuals.

(www.aaas.org)

The AAAS has four primary programs, one of which is the Science and Policy Program. Support for the pilot e-survey was secured with Albert H. Teich, Director of Science and Policy Programs.

3.1.1 The Sample

The AAAS has some 135,000 members (2002) covering an extensive range of disciplines in which we are interested and have people located around the world, although most are in the United States. AAAS provided a random sample of 20,000 members (across the membership) — **there were no controls introduced for reaching known foreign-born**. Initially the plan was to target members identified as foreign-born. However, we also wished to learn of international mobility experiences of those other than EU-born. We could learn about the factors that brought US-born to Europe and factors of their return.

In total, there were 1,137 respondents that met the criteria for an eligible response rate of 5.7%. Given how many among the 20,000 actually met the survey criteria (were working abroad or had worked abroad) was unknown, there can be no true response rate calculated. Furthermore, there may be other response rate biases, for example, if the eligible respondents differed significantly from the eligible non-respondents. This could occur if the eligible respondents are more familiar with answering e-surveys than the eligible non-respondents.

In order to develop a crude idea of the extent of the possible biases, a comparison of the eligible respondents against the full population of AAAS members for four characteristics for which there was data for both groups was carried out: the percentage employed in education, age, gender and the percentage with a PhD. Of note, the very large size of the AAAS popula-

tion means that even minor differences between the eligible respondents and the AAAS population can be highly statistically significant.

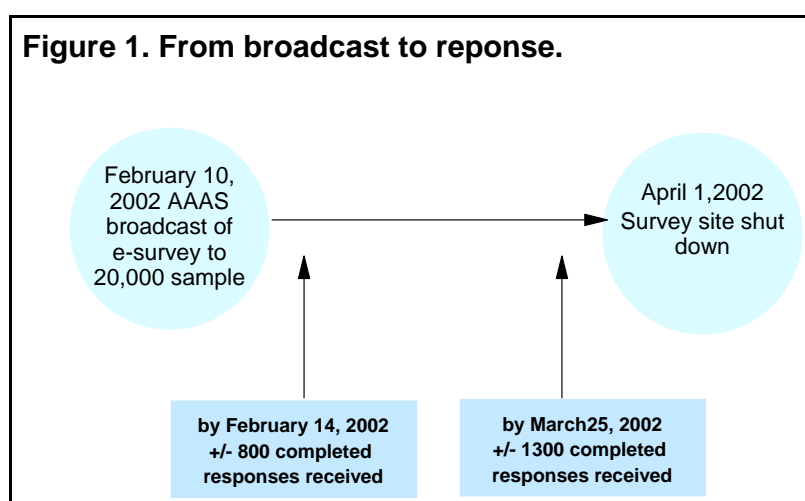
First, there was no statistically significant difference between the AAAS population and the eligible respondents for the percentage that work in education. The differences in the remaining three characteristics are statistically significant ($p < .01$). Compared to the AAAS population, the eligible respondents are slightly more likely to be women, substantially more likely to be under 44 years of age, and moderately more likely to have a PhD. These three differences could be due to greater mobility among better educated and among younger scientists, or they could reflect other factors, such as greater familiarity with using the Internet or more comfort with e-surveys. However, with the exception of the age difference, the eligible respondents are relatively similar to the AAAS population. This suggests that possible biases between the eligible respondents and the eligible non-respondents are unlikely to be large, thereby increasing confidence in the results.

4. E-Survey Activity Analysis — Technical Aspects

One goal of the pilot e-survey was to suggest directions for information gathering on internationally mobile scientists and engineers. This included providing documentation of the activity of the e-survey and an assessment of the activity of the survey instrument (relates to viability and resource implications). Is it practical for the Commission to consider using an e-survey of this type to ask questions of its scientific and engineering community? Can this type of e-survey be put in place to monitor international mobility of scientists and in engineers in Europe and between Europe and other regions?

4.1. Session Technical Information

AAAS broadcast the invitation to the survey on Monday, February 10, 2002 at 9:00 EST (Washington time). The survey was shut down April 1, 2002.



4.2. Time to Complete the Survey

The average time spent per session (the time the user took to complete and/or read the survey) was 523.97 seconds (or 8.7 minutes) and put the survey at the low end of the original estimate.

4.3. Respondent Reaction — Some Feedback

The survey was designed to receive comments. We provided the opportunity for respondents to give us additional information and insights about their international mobility experience. For example, text entry boxes were provided to query factors of moving. At the end of the survey, the respondents were asked to provide any additional information or insight they wish to add about their international experience.

We also provided the respondent with the opportunity to give feedback on the survey mechanism itself. It is important to allow the respondent to give feedback on his/her experience with the survey instrument. This promotes an exchange of ideas and willingness on our part to improve this 'pilot' survey. Moreover, considering the level of education and scientific and technical experience of our survey sample, we knew we could learn a great deal from their feedback to improve subsequent surveys.

The main complaint received was the difficulty the software presented for the respondent's browser. Although great efforts were made to accommodate various browser settings, the tools used to personalise the survey also resulted in unexpected technical difficulties. These technical challenges can be addressed on subsequent surveys with software updates and redesign of content.

The comments received ranged from rather sharp criticism of the limitations of the survey software to comments on the colour design of the layout to suggestions on the content. What was particularly interesting to us was, with rare exception, there were not the anticipated complaints on the length of the survey (e.g. too long and detailed). On the contrary, the comments tended to suggest additional detail was required for the fields of specialisation (discipline) and the list used (international classification) was too limiting for the highly specialised areas of science and engineering. This was encouraging. It also suggests we need to consider taking the opportunity to collect information on highly specialised fields and not rely solely upon the traditional classifications that inherently lag behind education and skill developments (e.g. ISCED).

A number of comments were received concerning the issue of mobility and the priority some of the respondents gave the issue; in turn, support for this type of survey was also expressed. The results tell of scientists and engineers are interested to provide details of their education, work history and international experience beyond our expectations and even asked for longer (more detailed lists) of disciplines and fields. The feedback identified areas that need additional attention (e.g. survey design adjustments) and other technical aspects for improvement (e.g. Applets cause incompatibility problems). The feedback signalled the willingness of the scientist and engineer community to provide information to support research for important policy issues such as international mobility.

5. Analysis of the Respondents⁴

5.1. Respondents

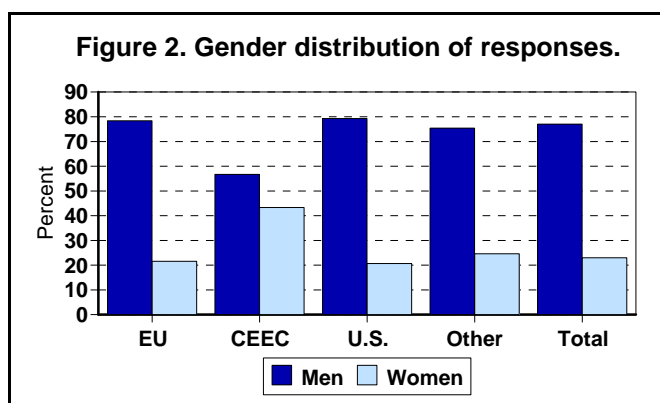
There was a total of 1,374 respondents. Of these, 1,137 were eligible (82.8%) and 237 ineligible respondents (17.2%) were not (these persons did not work or study outside of their country of birth).

One third of the eligible respondents was born in the EU so we have 386 EU persons who completed the survey. More than one quarter of the eligible respondents were born in the United States. Fewer than one in ten were born in the CEEC (Table 1).

Birth place	Percentage
Eligible responses	1,137
EU-born	33.9%
US-born	28.2%
CEEC-born	7.6%
All other countries	30.3%

5.2. Representation of Women

Overall, almost one quarter of the 1,131 persons who responded to the gender question are women. The representation of women varied by region. The EU and the United States showed about the same percentage of women - slightly more than one in five. The representation of women among the CEEC respondents was more than double that share at 43.3%. Across all the other countries, about one quarter of the responses came from women (Figure 2).



5.3. Age Profile

More than one in ten of the 1,110 respondents to the question on age were under the age of

	Total	EU born	CEEC born	US born	Other
Total respondents	1,110	378	29	310	393
Under 35 years of age	13.9%	15.9%	27.6%	7.1%	16.3%
35-44 years of age	28.6%	31.7%	34.5%	17.4%	34.1%
45-54 years of age	24.4%	23.0%	20.7%	27.1%	23.9%
55-64 years of age	20.7%	18.5%	3.4%	28.4%	18.1%
65 years of age and over	12.3%	10.8%	13.8%	20.0%	7.6%
	100.0%	100.0%	100.0%	100.0%	100.0%

⁴ This section was prepared with Anthony Arundel of MERIT.

35. Together with the share in the next age cohort of persons aged 35-44, 42.5% of the respondents were under the age of 45. Compared with the overall age profile, the EU-born respondents showed a younger profile as they did when compared with those born in the US. Almost half of the EU-born were under the age of 45 (47.6%) and another quarter or so were under the age of 55 (23.0%). Among the US-born contingent, only one quarter or so were under the age of 45 (24.5%) and almost half were 55 years of age and older (Table 2).

It was from the 29 CEEC-born respondents to the age question, the youngest age profile was produced: more than one quarter were under the age of 35 and more than one third under the age of 45.

5.4. Education Qualifications

Not surprisingly, given our survey was limited to AAAS members, almost all of the respondents reported at least one PhD. Interestingly, for both the persons born in the EU and those born in the US, the same share of about 92% reported a PhD as their highest qualification. For each region, about 5% reported a Master's degree and very few with a Bachelor degree as their highest degree. This profile showed marginally higher skill levels in terms of highest degree compared with the overall total where nine in ten reported a PhD. From the 30 CEEC-born persons, the largest share of Bachelor degrees (as highest) was reported — one in ten. With the 7% or so with a Master's degree, this left slightly more than four in five reporting a PhD (Table 3).

	Total	EU born	CEEC born	US born	Other
Total respondents	1,134	384	30	321	399
With a Bachelor degree	3.2%	2.8%	10.0%	3.4%	2.8%
With a Master's degree	6.2%	4.9%	6.7%	5.0%	8.3%
With a Doctorate	90.4%	91.7%	83.3%	91.6%	88.8%
	100.0%	100.0%	100.0%	100.0%	100.0%

Almost all of the 1,023 respondents' PhDs were in the 'hard' sciences and among those very few from engineering and applied sciences (Eng/App). Only 6.8% reported their degree in the humanities and only 4.2% in Eng/App. The specialisation profile of the PhD respondents varied by region (Table 4) (Refer to Annex for detailed list of disciplines).

	Total	EU born	CEEC born	US born	Other
Total respondents	1,023	352	25	291	355
Ag/Bio	39.7%	38.0%	24.0%	37.5%	44.2%
Eng/App	4.2%	2.2%	4.0%	4.7%	5.6%
Health/Med	24.7%	28.7%	44.0%	16.8%	27.0%
Math/Phys	24.5%	24.8%	28.0%	29.2%	19.4%
Other including humanities	6.8%	6.5%	0.0%	11.7%	3.7%
	100.0%	100.0%	100.0%	100.0%	100.0%

Among the 352 PhD EU-born respondents, most had their degree in agriculture and biologi-

cal sciences (Ag/Bio), close to two in five of them. The second most popular field was health and medicine (Health/Med) with 28.7% followed by mathematics and physical sciences (Math/Phys) with 24.8%. Almost no one had a degree in Eng/App (2.2%) and only 6.5% in the humanities. Among the 291 US-born respondents with a PhD, the share from Ag/Bio (37.8%) matched that of the EU-born. Among the US-born, there was slightly higher representation of people from Math/Phys and fewer from Health/Med compared with the EU-born persons. Of the 25 persons from the CEEC, most reported their PhD in Health/Med (44.0%) while the second most popular field was Math/Phys followed by Ag/Bio.

5.5. Sector of Employment

Among the 1,121 persons who responded to this question, most reported employment in the education sector. The second most popular sectors were the public sector and the business sector each with a 15% or so share. Fewer than one in ten were in the health sector and the non-profit sector and very few indeed reported self-employment (Table 5).

	Total	EU born	CEEC born	US born	Other
Total respondents	1,121	380	29	318	394
Business sector	14.7%	15.0%	3.4%	11.3%	18.0%
Education sector	48.8%	50.5%	51.7%	49.1%	48.8%
Health sector	8.7%	7.4%	6.9%	8.8%	10.2%
Non profit sector	7.6%	6.3%	13.8%	7.9%	8.1%
Public sector	14.9%	16.1%	17.2%	15.4%	13.2%
Self-employed	5.3%	4.7%	6.9%	7.5%	3.8%
	100.0%	100.0%	100.0%	100.0%	100.0%

When the EU-born respondents are considered, we see that an even larger share (50.5%) was in the education sector and a slightly larger share in the public sector than in the business sector (16.1% and 15.0%, respectively). Just under half of the US-born were working in the education sector. Compared with their EU-born colleagues, a larger share was in the business sector or self employed. Only 4.7% of the EU-born reported self employment compared with 7.5% of the US-born respondents. For the persons from the CEEC, it was the education sector again which drew the largest contingent (a share of 51.7%) with the second largest share in the public sector followed by the non profit sector.

6. International Mobility Analysis — The Movers⁵

In this section, the focus is on scientists and engineers who are (were) internationally mobile. A ‘mover’ is defined as a respondent that either is working, has worked, or has studied in a country different from their country of birth. The analyses is limited to EU-born. The US-born are presented for comparative purposes. Data sets for the eastern European countries were too small to consider in this section.

A note(s) on interpretation and application of the results of the pilot survey:

Point estimates for each variable, such as the percentage of EU-born or US-born respondents that moved to take advantage of higher salaries, will not reflect the motivations and characteristics of all EU-born and US-born scientists and engineers that have moved from one country to another. This survey was limited to AAAS members, who are unlikely to reflect the motivations, history, and characteristics of all EU-born and US-born scientists and engineers that have worked or studied abroad. In fact, EU-born members of the AAAS could differ in many ways from other EU scientists and engineers.

The main value of a study of this design is that it can be very useful for looking for *patterns* among different groups, such as the characteristics and motivations of EU-born respondents that have either returned to Europe from abroad, or left Europe to go abroad. The same applies to the US-born respondents.

Another method of interpreting the data is to compare the patterns between the EU-born and the US-born. Since both groups are drawn from the AAAS, these two populations should share some similarities that would increase the validity of comparisons. Many of the results of the comparisons between these two groups are consistent across many different questions, suggesting that there are marked differences in the mobility characteristics of the EU-born and the US-born.

6.1. Characteristics of the ‘Movers’

6.1.1. Country of birth of the movers

There is a total of 386 EU-born respondents and 321 US-born respondents that are movers. With the exception of the United Kingdom with 102 movers, there are fewer than 44 movers for each country within the EU in the sample. Table 6 shows the share of movers for the EU (and member countries) and the US.

There are no differences in the gender distribution between the EU-born and the US-born movers — one in five are women (21.6% of the EU-born and 21.2% of the US-born mover are women).

Total respondents	707
US	45.4%
Austria	2.3%
Belgium	2.0%
Denmark	0.6%
Finland	1.1%
France	3.7%
Germany	12.9%
Greece	1.4%
Ireland	1.3%
Italy	6.2%
Luxembourg	0.3%
Netherlands	2.7%
Portugal	0.8%
Spain	3.3%
Sweden	1.6%
United Kingdom	14.6%
Total	100.0%

⁵ This section was prepared with Anthony Arundel of MERIT.

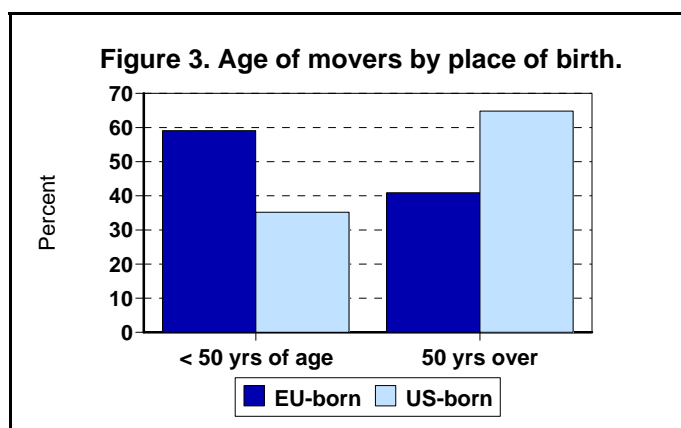
6.1.2. Age of the movers

The EU-born movers are younger than the US-born movers. The threshold occurs at age 50, with more Europeans under 50 and more Americans over 50 ($p = .000$) (Figure 3).

Differences in the number of countries lived in for work are 2.1 for US-born and 1.6 for EU-born, but this could be because the US-born are older. There is no statistically significant difference among those under the age of 50 (1.7 for EU-born and 1.9 for US-born), although older US-born have moved more than older EU-born (1.5 for EU-born and 2.2 for US-born).

There are statistically significant differences between men and women

movers when age is considered. More than two thirds (67.8%) of the women are under the age of 50, compared to only some two in five (43.1%) of the men ($p < .000$). This age difference holds for both the EU-born and the US-born, and by work location (abroad or at home).



6.1.3. Civil status of the movers

The respondents' civil status could influence whether or not they are currently working abroad. For example, respondents that met their spouse abroad might be more likely to stay abroad, or respondents with children might be less likely to return home if their children are integrated into their current country of residence.

More than half (55.4%) of the EU-born movers are married/cohabiting with children (very similar to the rate of 57.0% for the US-born movers), while 20.7% are single with no children. There is no statistically significant difference in civil status between EU-born and American-born movers ($p = .647$) (Table 7).

	EU-born	US-born
Total respondents	386	321
Single, no children	20.7%	16.5%
Single, with children	3.6%	4.0%
Married/cohabiting, no children	19.7%	22.1%
Married/cohabiting, with children	55.4%	57.0%
Other	0.5%	0.3%
	100.0%	100.0%

We do not have data on where the respondents met their spouse, but we do know if they have children. For EU-born and US-born movers combined, 67.4% of respondents that work in their country of birth have children compared to 51.6% of respondents that are currently working abroad ($p < .000$). For EU-born respondents only, 72.0% of those that currently work in the EU have children, versus 53.8% of those that are currently working abroad ($p < .000$). This suggests that children could increase the probability of returning home.

One possible explanation for the positive association between having children and living in the country of birth is that respondents with children are older and have therefore had more opportunities to return home. However, in all age groups, respondents with children are more likely to live in their country of birth. The difference is greatest among respondents in the

35-44 year age cohort — 62% that work in their ‘home’ country have children compared to 41% that work abroad ($p < .000$).

Respondents with children have changed jobs more frequently (a job change does not require a change of country), with an average of 1.90 job moves, compared to 1.67 for respondents with no children ($p = .006$). This difference remains after controlling for the effect of age (although the significance decreases to $p = .014$). The difference is not due to education, since there is no difference in the highest degree obtained by respondents with and without children.

There are significant differences in civil status by gender for both age groups. A higher percentage of women are single and fewer women than men have children. The results are similar for both the EU-born and their US-born colleagues and by place of current employment (at home or abroad).

Surprisingly, the results of our pilot survey tend to fit stereotypes: women have to choose between children and a career, while men don't. The results for those under the age of 50 could be explained if the women are younger than the men, but there is no possible age explanation for the group aged 50 and over (Table 8).

Table 8. Civil status, age and gender profile of movers.				
		Men	Women	Total
Under the age of 50 ($P=.002$)	Number of respondents	239	101	340
	Single, no children	25.1%	39.6%	29.4%
	Single, with children	2.1%	4.0%	2.6%
	Married/cohabiting, no children	20.5%	27.7%	22.6%
	Married/cohabiting, with children	51.9%	28.7%	45.0%
	Other	0.4%	0.0%	0.3%
	Total	100.0%	100.0%	100.0%
50 years of age and over ($P=.003$)	Number of respondents	315	48	363
	Single, no children	6.7%	20.8%	8.5%
	Single, with children	4.1%	10.4%	5.0%
	Married/cohabiting, no children	19.0%	18.8%	19.0%
	Married/cohabiting, with children	69.8%	50.0%	67.2%
	Other	0.3%	0.0%	0.3%
	Total	100.0%	100.0%	100.0%

6.2. Education of the 'Movers'

6.2.1. Degree level of the movers

There is no significant difference in the percentage of EU-born and US-born who have a PhD. Some 92% of the EU-born and the US-born report a PhD as their highest degree (Table 9).

	EU-born	US-born	Total
Total respondents	386	321	707
No university degree	0.5%	0.0%	0.3%
Bachelor/first professional	2.8%	3.4%	3.1%
Master's	4.9%	5.0%	5.0%
Doctorate	91.7%	91.6%	91.7%
Total	100.0%	100.0%	100.0%

There are no significant differences in the highest degree between men and women.

6.2.2. Specialisation of the movers

The strongest representation among the EU-born were people from the field of Ag/Bio as was the case with their US-born colleagues, each with more than one third from this field. Among the EU-born, the field of health ranked second followed by Math/Phys. For the US-born, the second largest group was in Math/Phys followed by health (Table 10).

	EU-born	US-born	Total
Total respondents	352	291	643
Agriculture/biological scs	38.1%	37.5%	37.8%
Engineering/applied scs	2.3%	4.8%	3.4%
Health/medicine	27.6%	16.8%	22.7%
Mathematics/Physical scs	25.6%	29.2%	27.2%
Humanities and other	6.5%	11.7%	8.9%
Total	100.0%	100.0%	100.0%

While there are no statistically significant differences in the PhD fields reported by women among the EU-born and the US-born, there are significant differences between men and women ($p < .000$). Table 11 shows the field of PhD for men and women. A lower percentage of women than men reported a PhD in Math/Phys (11.3% of the women compared with 31.4% of the men), while a higher percentage of women than men reported their PhD in Ag/Bio (52.8% of the women and 33.8% of the men).

	Men	Women	Total
Total respondents	497	152	649
Agriculture/biological scs	33.8%	52.8%	38.0%
Engineering/applied scs	4.0%	1.4%	3.4%
Health/medicine	22.5%	23.2%	22.7%
Mathematics/Physical scs	31.4%	11.3%	26.9%
Humanities and other	8.3%	11.3%	9.0%
Total	100.0%	100.0%	100.0%

6.2.3. Place of study

Table 12 shows the share of persons born in the EU and those born in the US that completed a degree outside of their country of birth, based on the level of degree. The results show that EU-born persons are much more likely than the US-born ($p < .000$) to have completed each type of degree abroad, or to have completed any degree abroad. In addition, PhDs are more likely to be taken abroad than degrees at the Bachelor or Master's level.

	EU-born	US-born
Total respondents	386	321
Bachelor earned abroad	20.2%	3.1%
Master's earned abroad	20.7%	4.0%
PhD earned abroad	35.5%	6.9%
Any degree earned abroad	41.2%	10.9%

A higher percentage of the EU-born PhD degree holders earned their PhD

outside of the EU compared with their US-born colleagues who took their PhD outside of the US. That is to say, one third (32.7%) of the EU-born took their degree outside of the EU while fewer than one in ten (7.5%) of the US-born earned their PhD outside of the US ($p < .000$). Among the 40 EU-born who earned their degree from the 'other' region/country, the main countries were Israel, Canada and Switzerland. It should be noted that even more

EU-born respondents moved outside of their country of birth to earn their PhD given the category of 'EU PhD degree) could have been a different country in the EU than their country of birth. Table 13 shows where the PhD was

	EU-born	US-born	Total
Total respondents	349	293	642
PhD earned in the EU	67.3%	4.4%	38.6%
PhD earned in the CEEC	0.3%	-	0.2%
PhD earned in the US	20.9%	92.5%	53.6%
PhD earned in other region	11.5%	3.1%	7.6%
Total	100.0%	100.0%	100.0%

earned for EU-born and US-born PhD qualified respondents.

6.3. Current Employment of the Movers

6.3.1. Occupation of the movers

The difference in occupation distribution of the EU-born movers and the US-born movers is not statistically significant ($p = .122$). The most frequent occupations reported for the EU-born are biology (20.2%), the social sciences (15.5%), education (13.7%), pure sciences (13.5%) and engineering (11.1%) (Table 14).

There are statistically significant differences between men and women in occupation distribution. As expected, based on the field of the PhD of women compared with men (shown earlier in Table 11), a higher percentage of women than men is working in biology/biochemistry and a smaller percentage of women than men is working in the pure sciences and engineering (Table 15) (Refer to Annex for detailed list of occupations).

	EU-born	US-born	Total
Total respondents	386	321	707
Managerial	10.4%	6.5%	8.6%
Humanities	1.0%	1.2%	1.1%
Social scs	15.5%	11.8%	13.9%
Biology/ biochemistry	20.2%	16.5%	18.5%
Engineer	11.1%	10.3%	10.7%
Health	6.5%	7.2%	6.8%
Pure sciences	13.5%	21.2%	17.0%
Education	13.7%	14.3%	14.0%
Clerical	0.0%	0.3%	0.1%
Finance	0.8%	0.6%	0.7%
Other	7.3%	10.0%	8.5%
Total	100.0%	100.0%	100.0%

	Men	Women	Total
Total respondents	554	149	703
Managerial	8.3%	10.1%	8.7%
Humanities	1.1%	0.7%	1.0%
Social scs	13.0%	17.4%	13.9%
Biology /biochemistry	16.8%	25.5%	18.6%
Engineer	11.9%	6.0%	10.7%
Health	6.3%	8.7%	6.8%
Pure sciences	19.9%	5.4%	16.8%
Education	15.0%	10.7%	14.1%
Clerical	0.0%	0.3%	0.1%
Finance	0.8%	0.6%	0.7%
Other	7.3%	10.0%	8.5%
Total	100.0%	100.0%	100.0%

6.3.2. Sector of employment of the movers

The sector of employment (type of industry or establishment) of the EU-born and the US-born are presented in Table 16. Again, the differences between the two groups are not statistically significant ($p = .394$). For both groups, half are working in the education sector. There were no significant differences between men and women for the sector of employment.

	EU-born	US-born	Total
Total respondents	380	318	698
Business enterprise	15.0%	11.3%	13.3%
Health	7.4%	8.8%	8.0%
Education	50.5%	49.1%	49.9%
Non-profit	6.3%	7.9%	7.0%
Public	16.1%	15.4%	15.8%
Self-employed	4.7%	7.5%	6.0%
Total	100.0%	100.0%	100.0%

6.3.3. Status of current place of work

Respondents that work for international firms or for international public organisations and agencies such as the United Nations or the Organisation for Economic Cooperation and Development (OECD) could move more frequently than those who work for national firms or organisations and agencies. The results show that in this case, although the differences while statistically significant, are minor.

In total, 620 of the EU-born and US-born respondents combined currently work for a national firm or organisation, while 78 work for an international firm or organisation (with no information available for 7 respondents). The ‘national’ employees have worked in an average of 2.20 countries compared to 2.47 countries for ‘international’ employees ($p=0.002$). In addition, the US-born worked in an average of 2.29 countries, slightly more than the EU-born who worked in 2.17 countries ($p=0.36$).

There are too few international employees to investigate the effects of the employer type on the motivations for moving or the factors influencing the decision to move again in the future, separately for the EU-born and the US-born. Furthermore, current status of the employee of an international or national employer may not reflect past employment history. A respondent that is currently working for a national employer could have worked previously for an international employer and vice versa. The survey does not provide data on the type of past employer(s), so it is not possible to trace the effect of the type of employer on the respondent’s history.

6.4. Current Employment and the History of the ‘Movers’

6.4.1. Current place of work

At the time of the survey, more than two thirds (69.5%) of all of the EU-born movers were working outside their home country. Of these, 80.6% were working in the US, 9.7% in other EU countries, 3.7% in Canada, and 4.9% in Switzerland. Only 1.1% were working in all other countries combined. None of the EU-born or US-born surveyed reported their current employment in the CEEC.

More than half of the EU-born persons were working in the US at the time of the survey

and slightly more than one third in the EU. The US-born are significantly ($p < .000$) more likely to be working in the US than the EU-born (Table 17).

All but 6 of the EU-born persons have not worked outside the country of their birth at some time (they had studied abroad). Since only 37.5% of the EU-born were currently working in the EU, compared to 83.2% of the US-born working in the US, we can observe Americans are more likely to return home after a period abroad.

	EU-born	US-born	Total
Total respondents	386	321	707
Working in the EU	37.3%	7.8%	23.9%
Working in the US	56.0%	83.2%	68.3%
Working in other region	6.7%	9.0%	7.8%
Any degree earned abroad	100.0%	100.0%	100.0%

6.4.3. Previous history

How the place of study (history of where people studied) relates to where people end up is of particular interest to our study. Is there a relationship between where people get their degrees and where they go (or stay) to work? Are EU-born who studied abroad less likely to return to the EU to work than those who worked abroad? Which is more likely to draw EU-born people away from the EU?

There are four types of work histories defined: (i) a respondent could have both studied and worked outside of the EU; (ii) worked outside of the EU only; (iii) studied outside of the EU only; and, (iv) neither studied or worked outside of the EU. This last case would be respondents who went directly to their employment abroad. The results are given separately for the two main age groups because of significant differences in the previous history by age. Results are grouped according to another potential factor of international mobility, age (Table 18).

	Under 50 years of age			50 years of age and over		
	No.	Working abroad	Working at home	No.	Working abroad	Working at home
Total respondents	228	70.6%	29.4%	158	67.7%	32.2%
Both studied and worked outside the EU	56	53.6%	46.4%	36	63.9%	36.1%
Only studied outside the EU	61	93.4%	6.6%	64	89.1%	10.9%
Only worked outside the EU	47	27.7%	72.3%	35	22.9%	77.1%
Neither studied or worked outside the EU	64	95.3%	4.7% ¹	23	67.7%	32.2% ¹
		100.0%	100.0%		100.0%	100.0%
P value	<.000			<.000		
¹ EU-born who only moved within the EU.						

The difference in the distributions is highly statistically significant ($p < .000$) for both age groups. The most significant results are the two in the middle — those who ‘only studied outside the EU’ and those who ‘only worked outside the EU’.

The EU-born persons who only worked outside of the EU are much more likely to be currently working in the EU compared with those who only studied outside of the EU. For example, 72.3% of respondents under the age of 50 who only worked outside the EU are currently working in the EU compared to 6.6% who only studied outside of the EU. The results for the respondents over the age of 50 show that this pattern is not due to an age effect, for example, when EU-born that complete a PhD abroad remain for a few years to work before returning to the EU. The pattern is similar for EU respondents over the age of 50, even though many years have probably passed since they completed their studies. These results suggest that *studying abroad* increases the ‘risk’ of remaining abroad much more than only working abroad.

One explanation of these results could be due to the young age of students when they study abroad — this could make them more amenable to adapting to a new country. Post doctorate positions are an important mechanism for attracting EU respondents to move abroad. Of note, 93.1% of EU-born respondents who received a post doctorate position currently have a job

abroad, compared to 64.0% of EU-born respondents who did not receive a post graduate position ($p < .000$)⁶.

Although our sample group is small, these results could have some policy implications. Perhaps more efforts should be made to encourage EU persons to study within the EU to lessen the likelihood of losing the best and brightest to the US. This could have impacts on the EU intra mobility programmes. At the same time, how can this be evaluated against the knowledge and experience to be gained by EU persons studying and networking abroad?

The results show the strong effect of studying abroad on the decision to work abroad has important policy implications. Although this is a 'pilot' study and our respondents are 'pre-selected' through the AAAS, the results suggest the value of carrying out a random survey of EU-born both within and outside the EU.

6.4.4. Previous history and the US-born

Only 54 of the 321 Americans with work or study experience abroad are currently working abroad. There is no difference for Americans by age in their previous history, so we only provide results in the following table for all ages combined. The majority of US-born within each relevant work history group have returned to the US. As with the EU-born, the US-born that have only studied abroad are less likely to have returned to the US than US-born who only worked outside the US, although the effect is not as great as it is for the EU-born (Table 14).

	No.	Working abroad	Working at home
Total respondents	321	16.8%	83.2%
Both studied and worked outside the EU	24	8.3%	91.7%
Only studied outside the EU	11	45.5%	54.5%
Only worked outside the EU	259	7.7%	92.3%
Neither studied or worked outside the EU	27	100.0%	0.0%
		100.0%	100.0%

Furthermore, very few US-born (3.4%) have only studied outside the US, which reduces the reliability of this result. The US-born who went abroad for a post graduate position were no more likely to currently work abroad than US-born who went abroad for another reason (21.4% versus 16.1%, $p = .256$).

6.5. Income of the 'Movers'

Respondents were asked to give their income in either US dollars (USD) or Euros, using 14 bands of 10,000 dollars or Euros. Results are available for 656 of the 707 movers (51 or 7.2% of the respondents did not reply to the income question). At the time of the survey, the two currencies were roughly at parity. The analyses are not adjusted for differences in purchasing power parities.

US-born movers earn more income than EU-born movers, with the shift occurring at the

⁶This difference is not due to respondents viewing a postgraduate position as a job. The percentages are almost identical for respondents below and above age 50. We can assume few in the latter group will still be post graduates.

60,000 USD per year — more EU-born earn less than 60,000 USD while more US-born earn over this amount. However, the difference is entirely due to the fact that the EU-born respondents are, on average, younger than their US-born colleagues. Once controlling for the effect of age, the difference in income between EU-born and US-born is no longer statistically significant.

Men under the age of 50 earn significantly more than women under the age of 50 ($p=.036$). Two thirds (66.9%) of women earn less than 70,000 USD compared with half (50.7%) of the men. There are no significant differences in the income of men and women over the age of 50.

There are no significant differences in the income of the EU-born and US-born that are working abroad. In contrast, there are large differences in income for those working at home, with US-born earning considerably more than EU-born. For respondents under 50 years of age, the division occurs at an income of 70,000 USD, with 84.1% of EU-born living in their home country earning less than this amount, compared to only 41.1% of US-born living in the US. For respondents over age 50, the division occurs at an income of 80,000 USD: 77% of the EU-born who are working in Europe earn less than this amount, compared to only 25% of the US-born working in the US.

Table 20 shows the comparison of the income distribution of the EU-born and US-born for those working at home and those working abroad. For simplicity, the 14 income categories have been reduced to quintiles with approximately the same number of respondents in each category⁷.

	EU-born				US-born			
	Under 50 years		50 and over		Under 50 years		50 and over	
	Abroad	Home	Abroad	Home	Abroad	Home	Abroad	Home
Total number	156	63	98	48	28	78	22	163
< 50,000 US\$	30.1%	52.4%	6.1%	22.9%	50.0%	24.4%	9.1%	4.3%
50,000-69,999	17.9%	31.7%	8.2%	29.2%	21.4%	16.7%	22.7%	11.0%
70,000-89,999	23.1%	6.3%	17.3%	16.7%	14.3%	21.8%	18.2%	20.2%
90,000-109,999	14.1%	6.3%	16.3%	12.5%	7.1%	16.7%	31.8%	23.3%
100,000	14.7%	3.2%	52.0%	18.8%	7.1%	20.5%	18.2%	41.1%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
P value χ^2	<.000		<.000		<.069		<.177	
P value for trend ¹	<.000		<.000		<.004		<.034	

1: liner by linear association.

There is a large difference in income by the location of work for the EU born, with Europeans working abroad earning significantly more than Europeans working at home. The trends are also significant, with the incomes of Europeans at home shifted towards the low end, while the incomes for those abroad are shifted towards the high end. In contrast, there is no difference in income for Americans by work location using the chi-square test, although an income shift occurs in both age groups. The income shift is weaker than the shift for Europe-

⁷ The results of statistical tests based on all 14 categories are similar to those based on five income categories.

ans, which suggests that Americans are able to demand higher salaries to work abroad than Europeans can command from working at home.

On the face of it, the results show that EU-born scientists have a strong income incentive to go abroad, while US-born face a disincentive to go abroad. However, there are alternative explanations. European scientists that go abroad could be more competent than those who remain at

home, thereby commanding higher incomes (this cannot be tested using the survey questions), or they could be active in disciplines with shortages of workers, such as IT or biotechnology. The latter possibility is likely to explain a small part of the higher incomes of the EU-born working abroad, but not all, because there are only minor differences in the distribution of job categories among the EU-born working abroad, and those working at home. Social scientists are more common at home, while biologists and educators are more prevalent abroad (Table 21). Social scientists working in Europe are paid slightly more than those working abroad, which would reduce income differences, but biologists working abroad are paid 50% more than those working at home, and educators abroad are paid 33% more⁸ which will increase income differences between respondents working at home and abroad.

	Working abroad	Working at home	Total
Managerial	9.3%	12.7%	10.4%
Humanities	0.4%	2.5%	1.0%
Social scs	13.8%	19.5%	15.5%
Biology/biochem	22.4%	15.3%	20.2%
Engineer	10.1%	13.6%	11.1%
Health	7.5%	4.2%	6.5%
Pure sciences	13.1%	14.4%	13.5%
Education	16.0%	8.5%	13.7%
Finance	0.4%	1.7%	0.8%
Education	100.0%	100.0%	100.0%

6.6. Mobility Plans of the 'Movers'

6.6.1. Plans and current place of work

The survey asked respondents about their intention to be 'mobile' in the future, plans to move to a different country. Respondents currently working abroad were asked about their intentions to return to their country of birth (home) within the next five years.

The differences among the EU-born and the US-born respondents are striking. Americans that are living abroad are far more likely than Europeans that live abroad to plan to return home: 51.9% of the US-born had plans to return home but only 13.4% of the EU-born, ($p < .000$). Moreover, US-born that are currently working at home are far less likely to plan to move abroad than EU-born working at home: 17.6% versus 33.1% ($p = .004$) of EU-born indicated plans to go abroad. Given that nine in ten of the EU-born working abroad are working in the US, these results suggest that the 'pull' of the US as a place to live and work is much greater than the 'pull' of the EU (Table 22).

The percentage of US-born abroad that plan to return to the US is almost identical between

⁸ The latter estimates are based on using the midpoint of each of the 14 income categories to create an interval value for income. Using this method, the EU born that work in the EU earn 54,025 USD, while those working abroad earn 16% more, or 62,127 USD.

those currently working in the EU (52.0%) and those working in all other countries combined (51.7%). Similarly, there is no significant difference in the future plans of the EU-born respondents that are currently working in the US versus other non-EU countries.

6.6.2. Plans and children

Having children does not increase the desire of the EU-born respondents to return to the EU, nor does it seem that children act as a deterrent to keep the EU-born persons at home. For example, 59.4% of the EU-born respondents with children who are working abroad do not plan to return to the EU compared to only 22.7% of the US-born with children who do not plan to return to the US. In fact, children appear to reduce the likelihood of the EU-born plans to return to the EU (Table 23).

The percentage of EU-born respondents that are working abroad and plan to return to the EU is 17.9% for those with no children compared with 9.8% for those with children. Furthermore, children are less likely to motivate the EU-born to remain in the EU than is the case for US-born. For those with children, 36.5% of the EU-born that are working in the EU intend to leave within the next five years compared to only 16.1% of the US-born that are working in the US.

	Currently working abroad		
Planning to return home?	EU-born	US-born	Total
Total respondents	268	54	322
Yes	13.4%	51.9%	19.9%
No	51.9%	20.4%	46.6%
Don't know	34.7%	27.8%	33.5%
	10.0%	100.0%	100.0%
	Currently working at home		
Planning to go abroad?	EU-born	US-born	Total
Total respondents	322	118	440
Yes	33.1%	17.6%	22.3%
No	29.7%	43.4%	39.2%
Don't know	37.3%	39.0%	38.4%
	100.0%	100.0%	100.0%

	Currently working abroad		
Planning to return home?	EU-born	US-born	Total
Total respondents	143	22	165
Yes	9.8%	54.5%	15.8%
No	59.4%	22.7%	54.5%
Don't know	30.8%	22.7%	29.7%
	100.0%	100.0%	100.0%
	Currently working at home		
Planning to go abroad?	EU-born	US-born	Total
Total respondents	85	174	259
Yes	36.5%	16.1%	22.8%
No	31.8%	51.1%	44.8%
Don't know	31.8%	32.8%	32.4%
	100.0%	100.0%	100.0%

6.6.3. Plans and differences among men and women

There are no significant differences between men and women in the future plans of the EU-born that are either currently living abroad or living at home. For the US-born, there is no difference by gender in the intentions of those living abroad, but among those living in the US, a higher percentage of women than men plan to move abroad (26.9% versus 15.5%) and fewer women have no plans to move abroad (25.0% versus 47.9%) ($p=.008$).

6.6.4. Plans and age

The respondents' intentions to move again decline with age (p for trend $< .000$), for both the US-born and the EU-born. The next table gives results by age for the EU-born only. For those working abroad and under 35, only 11.6% have no plans to return to the EU, compared to 75.0% of those between 55 and 64 years of age. Of interest, the effect of age on discouraging plans to leave the EU is not as strong, with only 38.5% of those between 55 and 64 having no plans to go abroad (Table 24).

Table 24. Intention to move by current location and age for the EU-born.					
Plans to return to the EU?					
Working abroad	No.	Don't know	No	Yes	
Total	262	34.7%	51.5%	13.7%	100.0%
<35 years of age	43	55.8%	11.6%	32.6%	100.0%
35-44 years	83	47.0%	39.8%	13.3%	100.0%
45-54 years	63	33.3%	58.7%	7.9%	100.0%
55-64 years	44	15.9%	75.0%	9.1%	100.0%
65 and over	29	0.0%	6.9%	6.9%	100.0%
Plans to go abroad?					
Working in the EU	No.	Don't know	No	Yes	
Total	116	37.9%	11.8%	32.8%	100.0%
<35 years of age	17	64.7%	16.2%	23.5%	100.0%
35-44 years	37	51.4%	25.0%	32.4%	100.0%
45-54 years	24	25.0%	38.5%	50.0%	100.0%
55-64 years	26	30.8%	83.3%	30.8%	100.0%
65 and over	12	0.0%	29.3%	16.7%	100.0%

6.7. Influences on Plans of 'Movers'

In order to inform on factors which influence HRST to move abroad to study or work, what brings them back home, respondents were asked about the importance of ten factors on their decision to move to a different country.

The results are broken down into the group of persons that have no plans to move and those that do have plans to move within the next five years. Results are not provided for persons who indicated no definite plans.

Although the tables only give the percentage who report that a factor is 'very important', the statistical significance of the difference between the EU-born and the US-born respondents is based on all three response options.

The interpretation of each factor depends on the current location of the respondent and whether or not they plan to move.

For respondents with no plans to move (Tables 25 and 26):

- i. For those back in their home country, the percentages give the proportion of respondents who found each factor *in their home country* to be a very important reason not to work outside of their home country.
- ii. For those working abroad, the percentages give the proportion of respondents who found each factor *in the country where they are currently working*

For respondents with plans to move (Tables 27 and 28):

- i. For those back in their home country, the percentages give the proportion of respondents who found each factor to be a very important reason to leave their home country.
- ii. For those working abroad, the percentages give the proportion of respondents who found each factor to be a very important reason to return to their home country.

6.7.1. No plans to leave the home country

The most important factors reported by EU-born respondents who do not plan to leave the EU are family responsibilities (cited as very important by 40.0%) and better living conditions in the EU (cited by 28.6%). Of interest, neither of these two factors concern the quality of work or access to R&D or leading edge technologies in the EU. The US-born also cite family responsibilities as the most important factor for staying in the US, but a significantly higher percentage of US-born compared with the EU-born cite quality of work factors such as better career advancement and business opportunities and better access to leading edge technology and to R&D. More US-born than EU-born cite the financial factors of better earning conditions and a more favourable taxation system. That said, a ‘more favourable tax system’ is the least important reason for US-born to remain in the US, with only 5.2% citing this as a ‘very important’ factor, although the higher score given to earning conditions could be due, in part, to low US taxes (Table 25).

Factor in <i>home country</i>	EU-born	US-born	P value¹
Number of respondents	35	116	
Contract/agreement is extended	17.1%	14.7%	0.796
Broader scope in position/activities	5.7%	19.0%	0.109
Better career advancement opportunities	11.4%	21.6%	0.005
Broader job/business opportunities	5.7%	17.2%	0.018
Better access to leading edge technologies	8.6%	16.4%	0.031
Better access to R&D funding	5.7%	25.9%	0.010
Better living conditions	28.6%	20.7%	0.151
Better earning/wage opportunities	5.7%	23.3%	0.002
More favourable tax system ²	5.7%	5.2%	0.046
Family responsibilities	40.0%	40.5%	0.630

¹ Significance of the difference between the EU-born and the US-born for each factor, based on all three response options: not important, somewhat important, and very important. Statistically significant differences ($p < .05$) are in bold font.

² The significant difference is due to 94.3% of EU-born stating that taxes are not important compared with 82.8% of the US-born.

6.7.2. No plans to return to home country

Table 26 shows the importance of each factor as a reason for not returning home from abroad. The factors refer to conditions in the current country of residence (work or study). As noted above, almost 90% of the EU-born are living in the US, but only about half of the US-born are living in Europe. Only 11 US-born respondents living abroad do not plan to return home, so the comparisons between the EU-born and US-born will be less reliable than shown in Table 24.

In contrast to the factors keeping EU-born in Europe, the most important reasons keeping EU-born abroad are related to work quality: better career advancement opportunities (cited as very important by 45.3%), broader scope of their position or activities (41.7%), better access to R&D funding (41.0%), broader job/business activities (35.8%), and better access to leading edge technologies (30.9%). The two financial factors are also more important than in Table 24, although only 14.4% cite a more favourable tax system as very important.

For US-born, the only factors keeping them abroad are better living conditions (54.5%), family responsibilities (36.4%), and a broader scope in position or activities (27.3%). All other factors were cited as very important by less than 10% of the US-born. However, the sample of US-born is very small.

Table 26. Percent of EU-born and US-born respondents working <i>abroad</i> reporting on each factor as <u>very important</u> in their decision to <i>not return</i> to their home country.			
Factor in <i>current country abroad</i>	EU-born	US-born	P value¹
Number of respondents	139	11	
Contract/agreement is extended	5.0%	9.1%	0.637
Broader scope in position/activities	41.7%	27.3%	0.315
Better career advancement opportunities	45.3%	9.0%	0.019
Broader job/business opportunities	35.8%	0.0%	0.003
Better access to leading edge technologies	30.9%	9.1%	0.041
Better access to R&D funding	41.0%	0.0%	0.022
Better living conditions	22.3%	54.5%	0.052
Better earning/wage opportunities	30.9%	9.1%	0.059
More favourable tax system	14.4%	0.0%	0.079
Family responsibilities	25.2%	36.4%	0.085
¹ Significance of the difference between the EU-born and the US-born for each factor, based on all three response options: not important, somewhat important, and very important.			
² The significant difference is due to 94.3% of EU-born stating that taxes are not important compared with 82.8% of the US-born.			

6.7.3. Plans to move again

Table 27 gives results for the percentage of respondents that are living in their home country and plan to move to another country. We do not know where the respondents are planning to move to. The main motivations for the EU-born to leave their home country concern the quality of work abroad, especially broader scope in position or activities (61.5%), better access to leading edge technology (51.3%), career advancement opportunities (38.5%), and better access to R&D funding (30.8%). In general, the EU-born are much more positive about the factors abroad than the US-born. The highest score given by the latter is only 19.1% for

broader scope in position or activities (probably a measure of a job offer at a higher level), with the next most commonly cited motivation being better living conditions (10.6%). All other factors abroad are cited by fewer than 10% of the US-born as ‘very important’.

The lack of enthusiasm for moving abroad among the US-born suggests that there could be other factors that are not covered in the list. One possibility is that the US-born transferred abroad by their employer, but this is not the case. Only 27.6% of the 47 US-born that are working in the US and which expect to move abroad in the near future are currently working in sectors where a corporate transfer is likely (e.g. business, health, or non-profit).

Table 27. Percent of EU-born and US-born respondents working <i>in their home country</i> reporting on each factor as <u>very important</u> in their decision to move.			
Factor <i>outside of home country</i>	EU-born	US-born	P value¹
Number of respondents	39	47	
Contract/agreement will end (in home country)	5.1%	4.3%	0.283
Broader scope in position/activities	61.5%	19.1%	0.000
Better career advancement opportunities	38.5%	8.5%	0.004
Broader job/business opportunities	28.2%	4.3%	0.003
Better access to leading edge technologies	51.3%	4.3%	0.000
Better access to R&D funding	30.8%	2.1%	0.000
Better living conditions	10.3%	10.6%	0.930
Better earning/wage opportunities	25.6%	0.0%	0.000
More favourable tax system ²	15.4%	4.3%	0.004
Family responsibilities	4.3%	4.7%	0.892
¹ Significance of the difference between the EU-born and the US-born for each factor, based on all three response options: not important, somewhat important, and very important. ² The significant difference is due to 94.3% of EU-born stating that taxes are not important compared with 82.8% of the US-born.			

The final table (Table 28) in this series gives results for the importance of different factors in encouraging EU-born and US-born respondents to return home from abroad. The pattern between the EU-born and the US-born respondents is the opposite of that in Table 26 above: US-born give high scores to many of the factors for returning to the US, while the EU-born are considerably less enthusiastic about returning to Europe. Only three factors are cited as very important by more than 10% of the EU-born: family responsibilities (38.9%), better living conditions (25.0%), and broader scope in position or activities (16.7%). Conversely, all but one of the factors (better living conditions) are cited by significantly more US-born as ‘very important’. Many US-born are returning because their contract has ended (39.3%). Otherwise, the most important factors for US-born to return to the US include several factors that concern work quality, such as better career advancement opportunities and better access to R&D funding (both cited by 35.7%), better job/business opportunities (32.1%), and better access to leading technologies (25.0%). Only 10.7% of US-born cite a ‘more favourable tax system’ as a very important factor for returning to the US.

Table 28. Percent of EU-born and US-born respondents working <i>abroad</i> reporting on each factor as <u>very important</u> in their decision to return to their home country.			
Factor in <i>home country</i>	EU-born	US-born	P value¹
Number of respondents	36	28	
Contract/agreement will end	8.3%	39.3%	0.011
Broader scope in position/activities	16.7%	39.3%	0.014
Better career advancement opportunities	5.6%	35.7%	0.009
Broader job/business opportunities	5.6%	32.1%	0.018
Better access to leading edge technologies	5.6%	25.0%	0.050
Better access to R&D funding	5.6%	35.7%	0.004
Better living conditions	25.0%	17.9%	0.345
Better earning/wage opportunities	2.8%	17.9%	0.045
More favourable tax system	0.0%	10.7%	0.048
Family responsibilities	38.9%	32.1%	0.040
¹ for each factor, based on all three response options: not important, somewhat important, and very important; ² Significance of the difference between the EU-born and the US-born is also due to the category 'somewhat important' which is cited by 36.1% of the EU-born versus only 14.3% of the US-born			

We reran the tables 25 through 28 for the EU-born only to determine if there were any differences by gender. There were only two reliable differences.⁹ Among respondents with no plans to leave their current country, men gave a higher rating to the importance of better living conditions in their current country. This factor was cited by 84.0% of women as not important to their decision to remain abroad, compared to only 44.6% of men ($p=.001$). Among respondents with plans to leave their current country, 34.6% of men versus zero percent of women said that family responsibilities were 'not important' to their decision.

6.8. What Helps and Hinders HRST Mobility?

Section 6.7 examined the factors that influence the respondents' future plans to either move abroad or to return home. In this section, we look at the factors that influenced EU-born respondents to return home and the characteristics of these 'returnees' compared to respondents that remain abroad.

6.8.1. Information sources and EU-born mobility

Table 29 gives the information sources that were used by respondents to either find their current employment abroad, or which were used by respondents already abroad to find employment back in Europe. The distribution of information sources differs between the two groups ($p = .021$). The main differences are that acquaintances are a more important source of information for a foreign (cited by 24.7%) than for a domestic (13.2%) job, while recruitment by the employer is a major source of information for finding employment back in Europe (cited by 36.8%). With the exception of information in newspapers or magazines, all other information sources are cited by less than 10% of the respondents.

⁹ Many of these analyses were based on very small counts for women, resulting in empty cells that reduced the reliability of the comparisons.

Table 29. Information sources used by the EU-born movers to find current employment.		
	Found employment abroad	Found employment in the EU
Number of respondents	267	114
'Passive' information sources		
Heard from an acquaintance	24.7%	13.2%
Recruited by current employer	17.6%	36.8%
Recruited by headhunter	2.2%	1.8%
Trailing spouse	1.9%	1.8%
'Active' information sources		
Newspaper/magazine	11.6%	10.5%
Another source	9.7%	6.1%
Professional association	5.2%	3.5%
Internet	3.7%	1.8%
Mobility/transfer programme	1.9%	1.8%
Employment agency	0.4%	0.9%
None of the above	21.0%	21.9%
	100.0%	100.0%

6.8.2. Mechanisms of mobility and EU-born

Table 30 provides results for the types of mechanisms used by the respondents to find their current employment. The most common mechanism was in fact none at all — the respondents' own initiative was cited by 40.0% who found employment abroad and 47.2% who found employment back in Europe. Of greater interest for policy are the differences in the mechanisms for both luring Europeans abroad and drawing them back. Post graduate positions are a major mechanism for Europeans for finding employment abroad, cited by 26.3%, compared to only 4.6% who used this mechanism to return home. Conversely, exchange programmes and national research centers are more frequently cited as the mechanism for returning to Europe than the opposite (Table 30).

Due to the small numbers, it is difficult to determine differences in the information sources or mechanisms used by gender among EU-born respondents. Women are more likely to report that they went abroad due to accompanying (trailing) their spouse (reported as a mechanism by 9.1% of women and 2.0% of men). A higher percentage of men reported a post graduate position as a mechanism for going abroad (28.3% versus 20.0%). The only notable difference in the mechanisms for returning to Europe is for 'own initiative', which is reported by 66.7% of women and 42.5% of men.

Table 30. Mechanisms used by the EU-born movers to obtain current employment.		
	Found employment abroad	Found employment in the EU
Number of respondents	255	108
Own initiative/responsibility	40.0%	47.2%
Post graduate position	26.3%	4.6%
Exchange programme ¹	8.2%	13.9%
Teaching post	4.3%	5.6%
National research centre	3.9%	11.1%
International company transfer	3.1%	1.9%
Trailing spouse	3.5%	0.0%
Centres of excellence	0.8%	1.9%
None of the above	9.8%	13.9%
	100.0%	100.0%
¹ Exchanges include industry-government (cited by 0.8% of total EU-born movers; industry-university (0.6%); university-industry (4.7%); faculty (0.8%); and, university-government (3.0%) exchanges.		

6.8.3. Skills

What skill factors are correlated with international mobility? We cannot fully address this question because the survey was not designed to obtain data on EU-born and US-born scientists and engineers that have not left home. However, we have some information on the respondents' past history, plus two questions on their reasons for moving abroad that can provide clues.

First of all, as noted earlier, respondents that studied abroad are more likely to remain abroad. Almost two in five (38.4%) respondents that have never studied abroad are currently working abroad versus almost two thirds (64.4%) of the respondents that have studied abroad ($p < .000$). This suggests that studying abroad could be a useful first step towards working abroad.

All respondents were asked about five factors that 'contributed to their mobility': languages, computer user skills, computer programming skills, communication skills, and leadership. Three response options were provided: not important, somewhat important, and very important. The questions did not refer to the value of these skills for any specific move, such as from abroad to home, or the reverse. Therefore, the results given below do not differentiate between different types of mobility. The results also exclude 12 respondents who only moved to study abroad.

Table 31 gives the percentage of men and women, by location of birth, that rate each skill as 'somewhat important' or 'very important' for their mobility. For both sexes and for regions, communication and leadership skills are cited more frequently than both types of computer skills. A higher percentage of men than women cite each skill, with the exception of languages among the US born, although the difference is only significant for three skills for the EU born (languages, computer programming and leadership) and two skills for the US

born (computer user and programming skills).

Table 31. Skills for mobility: percent rating each skill as 'somewhat' or 'very' important by country and gender.						
	EU-born			US-born		
	Men	Women	P value	Men	Women	P value
Number of respondents	295	83		248	65	
Languages	76.6%	56.6%	0.000	50.4%	50.8%	0.554
Computer user skills	56.3%	42.2%	0.060	54.0%	32.3%	0.006
Computer programming skills	25.4%	13.3%	0.023	32.7%	10.8%	0.001
Communication skills	80.3%	72.3%	0.145	79.0%	75.4%	0.252
Leadership skills	77.3%	62.7%	0.021	74.6%	64.6%	0.266

Comparisons between the EU-born and US-born respondents found only one significant difference: the EU-born place attach greater importance to language skills, with 48.7% rating this skill as 'very important', compared to only 19.0% of the US-born ($p < .000$). There are also significant differences in the importance of language skills by age (43.3% of respondents under 50 versus 27.7% of those over 50 rate language as 'very important, $p < .000$) and by gender, although differences by gender only apply to the EU-born. In this case, a much higher percentage of EU-born women than EU-born men rate language skills as not important - 43.4% versus 23.4% ($p < .000$).

Neither type of computer skill is correlated with the respondents' income, both with and without controlling for age. In contrast, the importance given by the respondents to languages has no effect on income among respondents younger than age 50, but it is positively correlated for those over age 50. The strongest correlation between skills and income is for leadership, for which there is a positive correlation for both age groups. These results indicate that the role of skills in mobility depends on the type of job that the respondent is looking for. Not surprisingly, highly paid jobs require leadership skills.

6.8.4. Reasons for moving

Another set of questions asks the respondents about the reason for the move. They were asked about what influenced their departure (or what caused them to return). There are thirteen reasons asked about and the respondents were given three response options: not important, somewhat important, and very important. There are large differences in the pattern of responses between the EU-born and US-born. For this reason, all results are given separately for these two groups (Table 32).

Differences by sex in the importance of each reason were investigated after controlling for location of birth (EU or US), resulting in 40 analyses (10 reasons by 2 directions of movement by 2 birth locations). There were only four statistically significant differences by sex. Both EU-born and US-born women were more likely than men to give a higher level of importance to the existence of a specific job before moving abroad. US-born women were more concerned than men by the salary before moving abroad, while proximity was more important to EU-born women than men for a reason to move abroad.

The set of forty (40) analyses were repeated for age (under and over 50). Again, there were only a few statistically significant differences by age. Older EU-born respondents were more

likely than younger EU-born respondents to return to Europe for education; older US-born were more likely than younger US-born to go home for professional networking, and younger EU-born were more likely than older EU-born to go abroad to advance their career.

Table 32. Reasons for moving: percent rating each reason as 'somewhat' or 'very' important by country and gender.						
	EU-born			US-born		
	Moved abroad	Moved home	p ¹	Moved abroad	Moved home	p ¹
Number of respondents	268	118		54	267	
For a specific job or position	52.2%	61.9%	0.067	53.7%	64.4%	0.324
General business/employment opportunities	56.3%	41.5%	0.004	25.9%	55.4%	0.000
Education	44.8%	58.5%	0.010	20.4%	62.9%	0.000
Salary	54.1%	33.9%	0.001	18.5%	62.2%	0.000
R&D funding	69.4%	42.2%	0.000	24.1%	60.7%	0.000
Employer's reputation/prestige	74.6%	62.7%	0.003	61.1%	67.0%	0.694
Access to leading edge technologies	73.1%	46.6%	0.000	29.6%	60.7%	0.000
Professional networking	68.7%	46.6%	0.000	46.3%	61.4%	0.116
Career advancement opportunity	78.7%	55.1%	0.000	51.9%	70.5%	0.002
Family	34.0%	71.2%	0.000	38.9%	50.9%	0.145
Living conditions	42.9%	78.0%	0.000	59.3%	65.9%	0.234
Geographic proximity	20.1%	52.5%	0.000	37.0%	47.9%	0.214
Adventure	50.4%	16.1%	0.000	53.7%	18.4%	0.000

¹ Statistical significance based on the distribution of responses across the three response categories.

6.8.5. Satisfaction from working abroad

In order to try and better understand HRST mobility and the experience, the survey asked about the respondents' satisfaction with working abroad, compared to their expectations, for seven factors. Four response options for satisfaction were given for each factor: not an issue, less than expected, as expected, and more than expected. The results given here are limited to 322 respondents that currently work abroad and to 373 respondents that previously worked abroad. Twelve respondents that only studied abroad are excluded.

By gender, there are no statistically significant differences in satisfaction with the foreign work experience for any of the seven factors, either for those who previously worked abroad, or for those who currently work abroad. The main differences are between the EU-born and US-born, although all of the differences are limited to respondents who currently work abroad, with no significant differences between the EU-born and US-born for those who previously worked abroad. The lack of significant differences between the EU-born and the US-born that previously worked abroad could be due to recall problems, or conditions in the US could have improved over time relative to the EU. A comparison between those who previously and currently work abroad shows that the US-born were more satisfied with

networks in the past, while the EU-born are more satisfied with current pay.

Table 33 gives the results on satisfaction for the EU-born and US-born currently working abroad. To simplify the presentation, the table only gives the percentages of respondents that find their satisfaction with each factor to be ‘less’ and ‘more’ than they expected before moving to their current country of work. Statistical significance, however, is based on all four response options.

Table 33. Satisfaction with conditions in the current foreign country of work compared with expectations.					
	EU-born (total of 268)		US-born (total of 54)		
	Less than expected	More than expected	Less than expected	More than expected	P value ¹
Practical work or research experience	3.4%	38.4%	11.1%	24.1%	0.310
Theoretical work/research experience	5.6%	32.5%	5.6%	20.4%	0.188
R&D resources	6.7	31.0%	20.4%	9.3%	0.000
Acquisition of new skills/knowledge	4.1%	32.5%	5.6%	25.9%	0.542
Expansion of network	7.8%	31.0%	24.1%	14.8%	0.001
Career advancement	9.0%	34.7%	20.4%	13.0%	0.003
Higher earnings	9.7%	30.6%	31.5%	7.4%	0.000
¹ Statistical significance of the difference in the distribution of responses between the EU-born and US-born across four response options. Statistically significant difference ($p < .05$) are marked in bold font.					

For every factor, a higher percentage of the EU-born are more satisfied with conditions abroad than the percentage who are less satisfied. The percentages that are more satisfied are also similar across all seven factors, ranging between 30% and 38%. In contrast, the US-born are generally less satisfied with conditions abroad than the EU-born. The percentages are higher for ‘less satisfied’ than for more satisfied for four factors: R&D resources, expansion of network, career advancement, and higher earnings. In addition, the percentages of the ‘more’ satisfied are lower, with the highest score reaching only 25.9%, compared to 38.4% for the EU-born. Not surprisingly, the differences between the EU-born and the US-born are statistically significant for five factors. For all five of these factors, the US-born are less satisfied with their work experience abroad than the EU-born.

6.8.6. Barriers identified

As with the questions on satisfaction in section 7.8.5 above, the results for five questions on barriers or problems with the respondent’s experiences abroad exclude 12 respondents that only studied abroad. Three response options were given for each problem or barrier: not an issue, somewhat problematic, and very problematic. The analyses evaluate differences by gender and birthplace.

Table 34 gives the results by gender for all EU-born and US-born respondents combined. There appears to have been a shift over time, as shown by a comparison of the results for

Table 34. Importance of barriers to working abroad by gender: percent citing each barrier as somewhat or very problematic.						
	Previously worked abroad			Currently working abroad		
	Men	Women	p ¹	Men	Women	p ¹
Number of respondents	298	73		245	75	
Lack of information prior to moving	21.8%	30.2%	0.279	24.0%	18.7%	0.029
Problems in acquiring visa	15.4%	32.8%	0.003	26.9%	26.7%	0.312
Language	14.7%	15.0%	0.222	18.8%	8.0%	0.044
Cost/availability of housing	20.1%	23.3%	0.255	21.3%	10.6%	0.121
Social system	20.5%	28.7%	0.219	26.1%	26.7%	0.066

¹ Statistical significance of the difference in the distribution of responses between men and women across the three response options. Statistically significant differences (p<.05) are marked in bold font.

respondents who previously worked abroad compared to today. In the past, although only one of the differences is statistically significant (visa problems), a lower percentage of men than women reported problems for all possible barriers. The situation is reversed for those currently working abroad today, with significantly more men reporting problems with a lack of information and with language, and more men than women, although not significant, reporting problems with housing. Perhaps women have become more adaptable over time while men have become less so.

In the past, the EU-born reported more problems than the US-born, with significant differences for acquiring a visa, language, and with the social system. Among those currently working abroad, there is only one significant difference, with US-born reporting more problems with housing, although the results for problems with the social system are very close to statistical significance, with $p = .052$ (Table 35).

Table 35. Importance of barriers to working abroad by birthplace: percent citing each barrier as somewhat or very problematic.						
	Previously worked abroad			Currently working abroad		
	EU	US	p ¹	EU	US	p ¹
Number of respondents	112	261		268	54	
Lack of information prior to moving	23.3%	23.4%	0.765	21.6%	27.8%	0.426
Problems in acquiring visa	27.7%	15.0%	0.015	28.7%	16.7%	0.123
Language	22.3%	11.5%	0.026	17.2%	11.1%	0.065
Cost/availability of housing	22.3%	20.3%	0.888	15.7%	33.3%	0.008
Social system	32.2%	18.0%	0.001	28.8%	13.0%	0.052

¹ Statistical significance of the difference in the distribution of responses between EU-born and US-born across the three response options. Statistically significant differences (p<.05) are marked in bold font.

An interesting aspect to these results is that they conflict with some preconceptions of differences in the characteristics of EU-born and US-born, especially since most EU-born have probably gone to the US, while half of the US-born have gone to countries outside of the EU. It is therefore odd that more EU-born in both time periods report problems with language,

even though EU-born scientists tend to have excellent English language skills while US-born are typically unilingual. The US-born may not experience problems with language while abroad because they continue to work and socialize in English. Similarly, more socially sensitive EU-born report more problems with the social system than US-born in the first time period, and the comparison for the second time period is very close to statistical significance.

7. Key Findings and Recommendations

7.1. Key Findings

This pilot e-survey set out with two aims in mind: (i) develop and test a survey methodology to gather information on internationally mobile HRST with an overall goal of defining or setting out guidelines for defining and measuring brain drain and (ii) gather as much timely and relevant information on international mobile HRST for policy use and public dissemination to further the discussion and measurement of this subject area..

Policy makers need reliable and timely information on internationally mobile HRST — competition for these scarce resources will continue. Without this information, policy is limited to a reactive role only. However, increasing competition for these scarce resources means EU policy must have a proactive role. While it may never be possible to settle the discussion of what is brain drain and what is brain circulation, and while it may not be possible to measure the volume of brain drain or brain circulation even once a definition(s) is agreed upon, it will be important to understand the 'push' and 'pull' factors. Proactive policy needs to have information on why EU-born HRST choose to work overseas and why they choose to return. At the same time, EU policy makers need to know what draws foreign talent to work in the EU and what keeps them away.

The analyses is limited to EU-born with the US-born included for comparative purposes. Our pilot survey was limited to AAAS members, who are unlikely to reflect the motivations, history, and characteristics of all EU-born and US-born scientists and engineers that have worked or studied abroad. In fact, EU-born members of the AAAS could differ in many ways from other EU scientists and engineers. Nevertheless, the results can be useful for looking for *patterns* among different groups, such as the characteristics and motivations of EU-born respondents that have either returned to Europe from abroad, or left Europe to go abroad. The same applies to the US-born respondents.

What have we learned from our highly qualified scientific and engineer 'movers'?

- A higher percentage of women is single compared with men and a higher share report no children compared with men. This begs the question: do women still have to choose between a career and having children?
- Among EU-born and US-born alike, there are statistical differences between men and women depending on their age: women tend to be younger. Perhaps this supports the notion suggested above and women are internationally mobile before deciding to have children.
- Most of the internationally mobile respondents were working in the education sector and public sector.

- The past study and work experience of people have a bearing on their future international mobility. EU-born persons who reported having only worked outside of the EU are more likely to be working in the EU than those who said they had only studied outside of the EU. This suggests that EU-born persons studying in the US, for example, may be at risk of remaining there. The data for the US-born also shows that the US-born who only studied abroad are less likely to return to the US than those who worked abroad.
- There is stronger financial incentive for the EU-born to go to the US than for the EU to attract foreign-born and the gaps vary by occupation. However, there are a number of influences on income such as quality and experience of the workers and income indicators must be interpreted with additional caution.
- Having children does not seem to deter EU-born from staying abroad. Our responses show that having children does not seem to increase the EU-born respondents' tendency to return home. In addition, having children is less likely to motivate EU-born to remain in the EU than is the case for the US-born.
- The effect of age is confirmed as people's intentions to move decline with age.
- **Push and Pull** factors:
 - Family responsibilities and better living conditions are the reasons given by EU-born persons planning to stay in the EU, neither of which concern quality of work or access to R&D or leading technologies in the EU. For their US-born colleagues, although family is an important reason to remain in the US, so too is better career advancement and access to leading edge technologies.
 - EU-born persons tend to cite financial conditions less than their US-born colleagues.
 - The most important reasons keeping EU-born persons abroad are related to work quality: better career advancement, broader scope of activities; better access to R&D funding, broader job activities and better access to leading technologies. This compares with the US-born who are staying abroad and most frequently cite reasons of better living conditions, family responsibilities and broader scope in activities.
 - For the EU-born, the main reasons for planning to move in the future are: broader scope in activities; better access to leading technologies; career advancement opportunities; and, better access to R&D funding. EU-born respondents tended to be more positive about factors abroad than the EU. It seems EU-born have a greater tendency to see greener fields abroad than their US-born colleagues.
 - In terms of returning to their home country, the EU-born most often indicated family responsibilities, better living conditions and broader scope of activities. For the US-born, many were planning to return because of the contract ending, better career advancement and better access to R&D funding.
- Acquaintances are more important sources of information for finding a job abroad than at home. Employer recruitment was identified by EU-born respondents as the major information source for persons finding work back in the EU.
- Post graduate positions are the key 'mechanism' for EU-born persons finding work

abroad and very few said this brought them back to the EU. Exchange programmes and national research centres are cited as mechanisms for returning to Europe rather than leaving Europe.

- EU-born placed a greater importance on language skills than their US-born colleagues. Other than this, the role of types of skills (e.g. computer skills, leadership skills) depends on the jobs the people are looking for.
- The survey also asked people about what first brought about reasons for moving and the results produced differences between the EU-born and the US-born. Among the EU-born who moved abroad, large shares reported the importance of employer's reputation, career advancement and professional networking. For those who moved home to the EU, a large share reported geographic proximity, living conditions and family. Among the US-born who had moved abroad, a large share gave reasons of living conditions and career advancement and employer's reputation; among those who moved home, a large share reported on career advancement, salary, education, R&D funding and employer's reputation.
- Were people satisfied with their experience abroad? For every factor, from R&D resources to higher earnings and expansion of network, a higher percentage of the EU-born was more satisfied than less satisfied with their experience abroad. In contrast, the US-born are generally less satisfied than expected with conditions abroad including R&D resources, expansion of network, career advancement and higher earnings.
- In the past, EU-born had more barriers to mobility than the US-born citing visa, language and social system problems. Today, the main difference between the two contingents is housing. The US-born cite the availability and cost of housing as a significant barrier whereas for the EU-born the social system in the foreign problems continues to be cited as a potential barrier. (among those who had previously worked abroad), a higher percentage of EU-born reported language, housing and social system problems. Among the EU-born currently working abroad, visa and social system barriers continue to be reported by a large share of respondents. Interestingly, the US-born working abroad reported barriers of language and social system to a lesser degree than their EU-born colleagues.

7.2. Some Recommendations

The first 'pilot' of the e-survey supports our belief of the viability and value of the survey. We put forth the following recommendations for consideration:

- 1. The e-survey content should be evaluated and updated for content, scope and coverage.**
- 2. The e-survey instrument should receive software enhancements to further improve the access and comprehension of the respondents and data base.**
- 3. The e-survey should be conducted through an intermediary who has a vested interest in the information.** An intermediary adds to the quality of the content and the validity of the results, both through the HRST reached through the intermediary and the interpretation of the results. This is supported by our experience with the AAAS. We

suggest piloting the survey with a number of organisations including private multinationals and public research bodies.

4. Based on the apparent effect of studying abroad versus working abroad for EU-born HRST, there could be great value in carrying out **a more in-depth survey of EU-born both within the EU and outside the EU based on place of study.**
5. There are significant differences among internationally mobile EU-born persons and US-born persons, for example. **The e-survey should be carried out at the international level among a number and variety of intermediaries** (e.g. business enterprise, public research organisations, education) to take into account economic, cultural and social influences on international mobility.

8. References

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9. Annex of Technical Notes

COUNTRY LIST

Americas	
North America	Other Europe
Canada	Albania
Mexico	Bosnia-Herzegovina
United States of America	Bulgaria
South America	Croatia
Argentina	Czech Republic
Bolivia	Cyprus
Brazil	Estonia
Chile	Hungary
Colombia	Iceland
Peru	Latvia
Venezuela	Liechtenstein
Other America	Lithuania
Africa	Other Europe concluded
North Africa	Macedonia
Algeria	Malta
Egypt	Moldova
Libya	Norway
Morocco	Poland
Tunisia	Romania
South Africa	Russian Federation
Other Africa	Serbia
Europe	Slovenia
European Union	Slovakia
Austria	Switzerland
Belgium	Turkey
Denmark	Ukraine
Finland	Other Europe
France	Oceania
Germany	Australia
Greece	New Zealand
Ireland	Papua NewGuinea
Italy	Philippines
Luxembourg	Other Oceania
Netherlands	Other
Portugal	
Spain	
Sweden	
United Kingdom	

Asia	Middle and West Asia
<p>Middle East</p> <ul style="list-style-type: none"> Afghanistan Iraq Iran Israel Jordan Lebanon Oman Pakistan Saudi Arabia Syria Other Middle East <p>East Asia</p> <ul style="list-style-type: none"> Azerbaijan Georgia Kazakhstan Kyrgyzstan Tajikistan Turkmenistan Uzbekistan East Asia Other 	<ul style="list-style-type: none"> China (People's Republic) Hong Kong India Indonesia Japan Malaysia Mongolia Nepal Singapore South Korea Taiwan Thailand Middle and West Asia Other

DISCIPLINE/FIELD OF STUDY

Education

Fine and Applied Arts

Humanities

History

Languages

Other Humanities

Social Sciences

Anthropology

Sociology

Economics

Law and Jurisprudence

Political Science

Psychology

Commerce/Management/Business Administration

Secretarial Science

Other Social Sciences

Agricultural and Biological Sciences

Agriculture

Biochemistry

Biology

Biophysics

Environment

Household Sciences

Other Agricultural/Biological Sciences

Engineering and Applied Sciences

Architecture
Architectural Engineering
Aeronautical/Aerospace Engineering
Biological Engineering

Chemical Engineering

Civil Engineering
Design/Systems Engineering
Electrical/Electronic Engineering
Industrial Engineering
Mechanical Engineering
Mining/Metallurgical/Petroleum Engineering
Other Engineering
Forestry
Landscape Architecture
Other Engineering and Applied Sciences

Health and Medical Sciences

Health Sciences
Biomedical Research
Clinical Medicine
Pharmacy and Pharmaceutical Sciences
Medicine (basic)
Dentistry
Other Health Sciences

Mathematics and Physical Sciences

Applied Mathematics
Chemistry
Computer Sciences
Geology and Related Fields
Mathematical Statistics
Mathematics
Metallurgy/Materials Science
Physics

Other Mathematics/Physical Sciences

Other

SECTOR

Agriculture, hunting, forestry and fishing

agriculture and hunting
forestry and logging
fishing

Mining and quarrying

coal mining
crude petroleum and natural gas production
metal ore mining
other mining

Manufacturing

manufacture of food, beverages and tobacco

textile, wearing apparel and leather
manufacture of wood and wood products (including furniture)
manufacture of paper and paper products
manufacture of chemicals and chemical petroleum, coal, rubber, plastic products
manufacture of non-metallic mineral products (except petroleum and coal)
basic metal industries

manufacture of fabricated metal products, machinery and equipment

manufacture of fabricated metal products (except machinery and equipment)
manufacture of machinery (except electrical)
manufacture of electrical machinery apparatus, appliances, supplies
manufacture of transport equipment
manufacture of professional, scientific, measuring and controlling equipment
manufacture of other fabricated metal products, machinery and equipment
other manufacturing

Electricity, gas, and water

electricity, gas and steam
water works and supply

Construction

Wholesale, retail trade, restaurants and hotels

wholesale trade
retail trade
restaurants and hotels

Transport, storage and communication

transport and storage

communication

telecommunications
post
other communication

Business services

legal services
accounting, auditing and bookkeeping services
data processing and tabulating services
computer related consultancy and technical services
engineering, architectural and technical services
advertising services
machinery and equipment rent and leasing
other business services

Financing, insurance, real estate

financial institutions
insurance
real estate

Education, community, social and personal services

education

university
non-university education services

social and related community services

research and scientific institutes
medical dental, other health and veterinary services
welfare institutions

business labour and professional associations
other social and related community services

recreational and cultural services

motion picture and other entertainment services
libraries, museums, botanical and zoological gardens and other cultural services
other amusement and recreational services

personal and household services
other community, social and personal services

Government, public administration and defence

government/public administration
defence
international/other extra terrestrial (i.e. UNESCO)
supranational (i.e. European Commission)
other government, public administration and defence

other (activities not classified above)

OCCUPATION

Legislators, senior officials and managers

Legislators and senior officials

Legislators and senior officials

Legislator
Senior government official in natural science and engineering
Senior government official in social sciences
Senior officials of special interest organizations

Other legislator or senior official

Corporate managers

Director or chief executive
Production and operations department manager
Other departmental manager

General manager

Managers, other

Information systems and data processing manager
Sales, marketing and advertising manager
Manager in retail trade, food and accommodation services
Banking, credit and investment manager
Manager in health, education, social and community services

Professionals, technicians/technologists, related associated professionals

Engineering, architecture and related

Aerospace

Aerospace engineer
Aerospace engineering technician, technologist/related associate professional

Architecture

Architect
Architecture technician, technologist/related associate professional

Civil

Civil engineer
Civil engineering technician, technologist/related associate professional

Computer

Computer engineer
Computer engineering technician, technologist/associate professional

Design/systems

Design/systems engineer
Design/systems engineer technician, technologist/associate professional

Electrical/electronics

Electrical/electronics engineer
Electrical/electronics technician, technologist/associate professional

Industrial

Industrial engineer
Industrial engineering technician, technologist/associate professional

Mechanical

Mechanical engineer
Mechanical engineering technician, technologist/associate professional

Mining

Mining engineer
Mining engineering technician, technologist/associate professional

Metallurgical

Metallurgical engineer
Metallurgical mining technician, technologist/associate professional

Petroleum

Petroleum engineer
Petroleum engineering technician, technologist/associate professional

Other

Other engineer
Other engineering, architecture related technician, technologist/associate professional

Physical, mathematical sciences and related

Astronomy

Astronomer
Astronomy technician/technologist/related associate professional

Veterinary

Veterinarian
Veterinary related technician/technologist/related associate professional

Physics

Physicist
Physics technician/technologist/related associate professional

Forestry

Forester
Forestry technician, technologist/related associate professional

Chemistry

Chemist
Chemistry technician, technologist/related associate professional

Mathematical and computer sciences

Mathematics

Mathematician
Mathematical technician, technologist/related associate professional

Actuarial

Actuary

Actuarial technician, technologist/related associate professional

Statistics

Statistician

Statistics technician, technologist/related associate professional

Computers and computer science

Computer systems analyst

Computer technician

Computer programmer

Geology

Geologist

Geology technician, technologist/associate professional

Meteorology

Meteorologist

Meteorology or related technician, technologist/associate professional

Other physical, mathematical science and related professional or technician/technologist

Life science, health and related

Biochemistry

Biochemist

Biochemistry technician, technologist/related associate professional

Biology

Biologist

Biology technician, technologist/related associate professional

Health and Life Sciences

Health (except nursing)

Health professional

Health technician, technologist/related associate professional

Dentistry

Dentist",

Dentistry technician, technologist/related associate professional

Medicine, general

Medical doctor

Medical technician/technologist/related associate professional

Nursing and midwifery professional

Other life science and health professional, technician/technologist or related associate professional

Social sciences

Anthropologist or archeologist

Demographer

Economist

Journalist

Linguist

Sociologist

Lawyer

Social worker

Other Social Scientist

Humanities

Historian

Philosopher
Writer
Creative/performing artist
Other humanities professional/associate professional

Teaching

Preprimary teacher
Primary teacher
Secondary school teacher
College teacher
University teacher
Special education expert
Other teacher

Clerical Positions

Office clerk
Data processor/Keyboard operator
Secretary
Other clerk

Business professionals and related

Finance/related professional
Securities, agents, investment dealer/trader
Administrator
Auditor
Accountant
Other business professional or related

Athlete

Armed force

Service worker, shop and market sales correspondent

Other