Study on mobility patterns and career paths of EU researchers

TECHNICAL REPORT 2 – Part II: Industrial researcher mobility study

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MAIN RESULTS OF THE INDUSTRIAL RESEARCHER MOBILITY STUDY

The mobility of researchers is a central focus of the current debate on competitiveness in developed market economies, where knowledge is the main source of comparative advantage. Since part of this resides in the people working in an organisation and is only weakly protected by property rights, the movement of knowledge holders (such as researchers) across firms and regions is one of the main mechanisms by which knowledge is spread (see Almeida and Kogut, 1999, Hoti et al, 2006 and Kaiser et al, 2008 for empirical evidence). While this may represent both a threat as well as an opportunity for individual actors in an economy, since the knowledge base of a firm or a region can be both strengthened by inward mobility but also weakened by outward mobility, existing research suggests that in aggregate higher mobility is beneficial for competitiveness.

For instance with respect to geographical mobility the economic literature has repeatedly stressed that the mobility of highly qualified workers (such as researchers) has a positive impact on the competitiveness of countries, regions and firms. In this respect a number of studies (see e.g. Zucker, Darby and Torero, 2002, Moen 2005, Rosenkopf and Almeida, 2003, Song et al 2003 Gauthier-Loiselle and Hunt, 2008) have found that mobile researchers are an important resource pool, which help to improve national and firm level R&D performance as well as helping with integration into international R&D networks and increasing entrepreneurial and patenting activity. Furthermore, a by now relative large body of empirical research (see e.g. Saxenian, 2000, Fallick, Fleischmann and Rebitzer, 2005) shows that even within a region, mobility of researchers between sectors and firms may have a positive impact on competitiveness.

This importance of the mobility of researchers is also increasingly recognised by policy makers. For instance the EC Communication "Towards a European Research Area" (EC, 2000) identified increasing the number of mobile researchers in Europe as a central objective for constructing the European Research Area (ERA) and the Commission's Green Paper on the European Research Area (EC, 2007) reinforces this by stressing the importance of a high level of mobility of researchers between countries and institutions for the realisation of the ERA (see also EC, 2008, p.119).

Despite the importance of the topic, comparable data on the mobility of researchers on a European level is hardly available. Thus recent analyses have mostly either used proxies which cover a larger sample of the population than just researchers such as the Human Resources in Science and Technology (HRST) (e.g. EC, 2009) or have focused only on a subset of the researchers such as doctoral researchers (see Idea Consult, 2009). This lack of data applies even more strongly to the mobility of researchers working outside academia as well as the mobility of researchers from academia to and from other sectors and to the more subjective issues related to the motivations for and results of mobility.

Given this paucity of comparable data on researcher mobility one of the main objectives of Work Package 7 of the MORE project was to conduct a survey on the extent, motivations and results of mobility among researchers employed outside academia (i.e. industry researchers). This study reports the results of this questionnaire. In particular we aim at answering three questions related to mobility of industry researchers:

- What is the structure and intensity of mobility among these researchers?

- What are their career paths?
- What factors hamper or facilitate mobility and what are the effects of mobility on industry researchers?

(I) Evidence from the ELFS

Before providing the results of the industry researcher survey we, however, also use data from the European Labour Force Survey to compare the mobility of those employed in research occupations and HRST. This is important because it allows us to assess (at least from the perspective of rough proportions) the validity of the results of the questionnaire.

We find that both HRST employment as well as the employed in research occupations as defined in the Frascati manual deliver only poor approximations of the number of researchers. The number of persons employed in research occupations according to the ELFS exceeds the number of researchers according to official EUROSTAT sources by a factor of over 9 and HRST employment is by a factor of 18.5 higher. This thus questions the reliability of results using these definitions as proxies for researcher employment and – from a data development perspective - underlines the importance of implementing questions allowing to identify researchers in the standard large scale household surveys of the EU (such as the Labour Force Survey) if insights into the labour market behaviour of this group of workers is sought for.

On a more substantive level our findings suggest that both HRST and employed in research occupations are groups that are not necessarily more mobile than comparable employees working in other sectors, but that for them the determinants of mobility differ from those of the overall population. In particular, we find that these groups are characterised by a lower mobility from non-employment to employment, which may be explained by the lower unemployment and higher participation rates among these highly educated groups.

Furthermore, sector mobility rates of these groups in aggregate are about comparable to those of the employed overall, with econometric evidence suggesting statistically significantly but only slightly lower sector mobility, than among other groups of the population.

This higher sector mobility is, however, associated with a quite different structure, since in these groups a larger share of sector mobility is accounted for by job changes within the market services industries and by job changes from the public sector (i.e. education or other non market services) to either market services and other sectors, while flows from market services and other sectors to the education and other non market services are of a lesser importance.

The international mobility of these groups, by contrast, is substantially higher than for the overall employed, but this advantage becomes very small (although remaining significant) once composition effects are controlled for and the marginal impacts of determinants of both regional as well as sector mobility differ substantially between those employed in the HRST and in research occupations and those employed elsewhere. In particular age-mobility and education-mobility profiles are steeper than for comparable employed elsewhere. This thus points to different (occupation specific) career paths of those employed in research occupations or as HRST.

(II) Results from the industry researcher survey

Given that the HRST and those employed in research occupations are only very imperfect proxies when one is interested in analysing the mobility behaviour of researchers, the study continues to present the results of a questionnaire conducted in 2009 among over 3000 industry researchers in Europe.

(II.a) Design of the questionnaire

The principal contact data source for this questionnaire was the contact data of applicants to the 6th and 7th Framework Programme for Research and Technological Development of the European Commission that are employed in private industry. In addition, we asked contact persons at engineering associations to forward survey invitations to their members and also implemented an option enabling respondents to forward a survey invitation to colleagues ("snowballing").

This sampling strategy raises a number of issues with respect to the representativity of the data. Although we extensively test for biases in mobility between different subsamples in the questionnaire, without being able to establish such bias, we can thus not discard the possibility that our data are biased towards excellence. In addition the companies applying for support in the context of the Framework Programmes probably have specific characteristics that are different from those not applying. Therefore, it might be assumed that, for instance, the biggest companies are overrepresented in the FP contact data. From a data development perspective our experiences thus suggest that the key problem of research on industry researchers is lacking information on population characteristics, which could in all likelihood only be provided, if regular large scale surveys increasingly also focus on identifying researchers and research firms. Thus tasks such as assessing the number of total researchers in the private industry by company, assessing the number of R&D-performing entities, assessing the number of researchers in these entities and assessing the technology fields these entities are acting in (in the best case providing the number of researchers per technology field), which would enable future research to create stratified samples, should receive increased attention in data development if more representative information on industry researchers is looked for.

In addition some of our qualitative results also suggest that the mobility concept used in our study as well as in much of the literature is becoming increasingly blurred with respect to both the timing of mobility as well as with respect to the delimitation of the boundaries of the firm. Thus future studies should also increasingly take account of different types of mobility (such as short term and incomplete migration), which are probably closely linked to organisational changes in research work (and may thus require the development of linked employer employee data) besides job changes and long-term stays abroad.

Despite these caveats at the closing of the survey, eight weeks after the launch date, the response rate was close to 20%, and the data provide slightly more than 3000 usable observations on industry researchers residing in one of the EU27 countries in 2009.

(II.b) The profile of industry researchers

The data suggests that industry researchers differ from academic researchers in a number of ways. They are more often male, slightly older, more often married and are more likely to have children. They are also less likely to have completed a postgraduate degree (PhD or equivalent) and are more likely to have a degree in engineering and/or the natural sciences. With respect to their work contract, for industry researchers fixed term contracts and part time work are much less common than in academia and many of them have a relatively long tenure with their respective firm, which reflects the fact that these workers are in high demand in their enterprises.

(II.c) What is the structure and intensity of international mobility among industry researchers?

The most important finding of this survey is arguably that industry researchers are a highly mobile group relative to the total working age population of the EU27. This finding applies to all indicators of mobility we analyse. Our data suggests that 40% of industry researchers in the EU have experience with working abroad (for a period of more than three months) and more than 18% currently live in a country other than where they completed their highest education or live in another country than the one they were born in. In addition 10.3% of our industry researchers have worked abroad at least once in the last three years and 35% of industry researchers intend to move for work to another country within the next three years.

Internationally mobile industry researchers, also, mostly had 1 stay abroad, but around 19% of all industry researchers have worked abroad (for more than 3 months) more than once in the last three years. In addition short term stays (and related return migration) seem to be a major factor contributing to mobility patterns of industry researchers residing in the EU. Over 50% of the work episodes abroad last for less than 3 years.

Flows between countries of industry researchers also suggest that Germany is the most central country in the network of industry researcher flows. In addition the group of rather central countries comprises the United Kingdom, Belgium, the Netherlands, France, Italy) and Spain, while the most peripheral of the countries in the network are the smaller EU countries. These differences, however, seem to be primarily due to factors related to (economic and geographic) country size as well as distance between countries, since differences in country size (in terms of GDP and area) and distance between origin and destination countries can explain up to 86% of the total variation in bilateral flows of industry researchers.

Industry researchers, however, also differ substantially in their mobility. The most robust of these differences are found in terms of whether the researcher has studied abroad, education, place of birth and field of study. In particular the most robust results apply to differences with respect to having studied abroad. 17.3% of the researchers that have studied abroad (as opposed to 8.6% of those that have not studied abroad) have also worked as a researcher in another country in the three years before the interview, and of the researchers that have at least once been mobile in their career 31% studied abroad for some time, while among those that have never internationally mobile this share is only 13%. In addition we also find evidence that industry researchers who studied abroad have a sig-

nificantly higher probability to have been mobile more than once, as well as a significantly higher probability of working abroad for 3 months to 1 year. This thus points to an important impact of the experience of studying abroad on mobility patterns of industry researchers and highlights the contribution towards the objective of enhancing researcher mobility that can be made by programs enhancing mobility among students.

Aside from experience abroad, however, also education has an important impact on mobility. In general, the share of researchers that have been mobile in the last three years declines steadily with education (from 12.4% for those with a completed PhD to 8.3% for university graduates to 1.8% for those with only a secondary education).

Furthermore, mobility is also higher among industry researchers born in the EU15 than among those born in the EU12. This may be an indication of a continued lower integration of the EU12 into industry researcher networks. Among those born in the EU12 only 7.7% have been internationally mobile in the three years before the interview. Among those born in the EU15 the same applies to 10.6%. In addition those born in the EU15 are also overrepresented among the industry researchers that have ever been mobile in their career, while those born in the EU12 are underrepresented.

With respect to the field of study industry researchers that completed their highest degree in the agricultural sciences, in the medical and health sciences as well as in the natural sciences are the most mobile. Those that have studied engineering and technology as well as social sciences and humanities are less mobile. Among graduates of the agricultural, medical and health as well as natural sciences the share of those that were mobile in the last three years was between 23.1% (agricultural sciences) and 11.6% (natural sciences). Among industry researchers graduating in engineering and technology, social sciences and humanities these shares range between 9.0% (engineering and technology) and 6.3% (humanities).

Finally with respect to the job characteristics of the mobile we find some evidence that the most mobile select themselves into certain jobs. Aside from average tenure being significantly lower among those that have held two or more jobs abroad mobile industry researchers with more than one stay abroad have a significantly lower probability of being self-employed, working in the research field of mechanical engineering, having a fixed term contract and having average working hours amounting to 80-100% of a full time contract. This thus suggests that a higher intensity of international mobility among industry researchers is often associated with a higher share of atypical employment and also reflects different career patterns in different types of research jobs as well as fields of research.

In addition there are also some variables for which the indication of a link with past mobility is less robust. This applies to age and having worked in industry during studies. Those that have worked in industry during their studies have an above average probability of having been mobile in the past three years of 17.3% (compared with 10.3% among all industry researchers). They are, however, not significantly overrepresented among those who have ever been internationally mobile in their career. This last finding may indicate that working in industry during studies has a positive impact on mobility in particular for researchers in their early career.

By contrast, gender specific age-mobility profiles suggest that the probability to have been mobile increases sharply in the ages between 39 to 50 after which it remain constant for men, while for the few women in our sample mobility rates

are higher than among men in the early careers and about equal for older women and men. Thus age-mobility profiles appear to be much flatter for women than for men.

In addition we find that those that intend to look for work abroad in the next three years differ from those that have been mobile in the past in a number of respects. In contrast to industry researchers with previous mobility, industry researchers intending to look for work abroad in the next three years are significantly younger, better educated, less often married, have fewer children and are more often born in the EU15 than those that are not intending to look for work abroad. Among singles 48.7% state that they intend to look for work abroad, compared with 32.5 % of married/cohabiting researchers. Furthermore, 44% of those that have studied abroad and 36.2% of those that worked in industry during studies intend to look for work abroad in the next 3 years.

Industry researchers intending to look for work abroad also have a significantly shorter tenure and significantly more often have a fixed term contract lasting for one year than those not intending to move abroad. Finally, intentions to look for work abroad fall dramatically with the age of researchers. Among the young researchers (aged 24 to 29) more than half (51.5%) intend to look for work abroad. Among the older researchers (aged 50 or more years) this percentage is only 16.5%.

(II.d) What are industry researchers' career paths?

Aside from their specifics with respect to mobility, industry researchers are also a group of employees that often start their career in the public sector (in all likelihood academia and potentially as doctoral students) to then change into more applied industry research. Round tripping (or churning) between the public and private sectors by contrast seems to be rare. The relative majority of the industry researchers (42.3%) describe their career path as one starting in the public sector and ending in the private sector. A further 37.4% have always worked in the private sector.

Also industry researchers on account of being in high demand have relatively secure jobs and thus high job stability. The average tenure of industry researchers in our sample is 10.4 years and the median researcher in our sample has held three jobs in his or her career (two of those as a researcher), but only one job in the last three years. The shares of industry researchers that held more than one job in the last three years is 19.4% for industry researchers residing in the EU15 and 18.4% for industry researchers residing in the EU12. Furthermore, evidence on the circumstances of job changes suggests that such changes are usually associated with an increase in administrative work and more applied research and thus confirm the "traditional" path of industry research careers starting as a researcher and then moving to more managerial positions.

Industry researchers – also on account of being in high demand – most often move jobs coming directly from another job or from higher education, while job accession from unemployment or inactivity is rather rare. 66.8% of the industry researchers in our sample were employed at another firm directly before starting to work at the current firm and 21% started working at their current employer directly after ending higher education. In addition there are also important flows

of industry researchers from self-employment. Around 6.2% of the industry researchers in our sample were self employed before starting to work in their current employment.

Furthermore our results also indicate a close connection between international mobility and career paths. Mobile researchers are more likely to have been mobile across sectors, have held more jobs (both in research and overall) in their career and in the last three years and are more likely to have started their job after terminating another employment relationship as well as less likely to have come directly from higher education.

In addition there are substantial differences with respect to the way individual sectors recruit industry researchers. In general, however, intrasectoral flows seem to be of a larger importance than intersector flows, and intersector flows tend to be stronger in the professional, scientific and technical activities sector than either in manufacturing and in the information and communication sector. Also with respect to these three sectors, which offer enough observations to allow for a detailed analysis, we find that:

- The strongest flow of researchers into employment in manufacturing is an intra sector flow. About 74% of the researchers in manufacturing reported a previous employer which also operated in manufacturing. The strongest intersectoral inflows into manufacturing originate from professional, scientific and technical activities, from information and communication and from other service activities.
- Also in information and communication we find strong intrasectoral mobility. About 79% of researchers report that their most recent job change originated from a previous employer in the same sector. The strongest inter-sector flows originate from manufacturing and professional, scientific and technical activities.
- In professional, scientific and technical activities about 60% of the researchers reported a previous employer within the same sector. The largest inter-sector flows targeting this sector originate from manufacturing and from information and communication.

With respect to flows between organisations by contrast we observe clear differences in the pattern of flows to the different types of organizations. 67% of the researchers taking up a position in an organization in the company sector come from another organization in the company sector; 12% originate from research organizations and 21% originate from universities.

Industry researchers having held more than one job in the last three years also differ from industry researchers that have held only one job. They are younger, better qualified, and have fewer children but studied abroad significantly more often. They also have a lower tenure, a lower share of self-employed, a larger share of fixed term contracts lasting from one to two years, a lower share of open ended contracts and higher share of work contracts that account for between 40% to 80% of a full time contract and a lower share of full-time contracts.

With respect to career paths the largest two groups of industry researchers (those that have moved from the public to the private sector and those that have always worked in the public sector) differ from each other in that industry researchers that always worked in the private sector are significantly more often male, have more seldom studied abroad but more often worked in industry during their studies, are less often born outside the EU and have a lower share of PhDs, and are also more often trained in social sciences but less often have medical or agricultural science degrees than researchers moving from the public to the private sector.

(II.e) What factors hamper or facilitate mobility and what are the effects of mobility on industry researchers?

Our questionnaire also considered the motives of international researchers for choosing a particular career and discusses the factors that motivate and hamper international mobility as well as the effects of mobility on industry researchers. With respect to motives for choosing a career path we find that:

- For industry researchers the most important motives for choosing a particular career path are job satisfaction, the challenges offered by the positions, working conditions, a good work life balance and life satisfaction of children. Thus reasons related to job and life satisfaction are more important for career decisions than high salaries. At the bottom of the list we find job security, the prospects of a scientific career, keeping in touch with friends and family, other private reasons and financial incentives other than salaries. Thus career and life satisfaction motives are the most important determinants for choosing a particular career path among industry researchers.
- Pecuniary motives, however, are important in the decision to accept a particular job. After the possibility to apply previous knowledge, which is almost a precondition for mobility, and an increase in responsibility, a high salary follows on third place among these reasons. This suggests that in the more strategic decision for a career path pecuniary motives are of secondary importance relative to issues of life satisfaction for industry researchers, while in the decision to accept a particular job (within a given career path) pecuniary motives do develop some importance.
- For a large number of industry researchers, job changes result in an increase in managerial activities, a higher work load but also results in higher autonomy. Such job changes are also often seen as a continuation of the previous career and also seem to result in a higher share of applied research and offer more flexibility. Thus most of the researchers' job changes seem to be associated with a move up in the hierarchical ladder.

For international mobility by contrast we find that there are substantial differences in the factors that motivate those that were internationally mobile in the past and that hamper international mobility for those that have not been previously mobile. Industry researchers that have previously been internationally mobile name the presence of leading experts abroad, the quality of life, the presence of external R&D structures, the recognition of educational degrees and the culture of the receiving country as the 5 most important motives for moving abroad. They thus strongly stress the research infrastructure of the receiving country as a major motivation for mobility.

In addition the motives for international mobility, although largely independent of the number of stays abroad, change substantially with the longest duration of stay abroad. In particular the importance given to the presence of leading experts in the field, cultural differences, language differences, as well as private and financial mobility support fall significantly with the duration of the stay abroad, while aspects such as the quality of life, availability of schools for children, the quality of social security and the possibility to obtain a work permit for the partner increases with the duration of stay. Thus there appear to be substantial differences in the motives of short and long term work-stays abroad among industry researchers. While short term stays seem primarily to be driven by career concerns and building human capital that can be used back home, long term stays (which account for 48% of the total number of stays) are more strongly associated with the amenities of the receiving regions.

This thus suggests a strong parallel to the factors that motivate enterprises to locate R&D facilities in a particular region in developed economies, since, as shown in the literature, next to the quality of R&D personnel and intellectual property rights the quality and accessibility of the research environment (such as that of universities) also belong to the most important factors that motivate firms to locate R&D departments in developed market economies. Both enterprises as well as industry researchers stress the importance of the research environment (also stressing external R&D structures) in their location decision, while in general putting much less emphasis on the cost aspects of their decision.

Those that have not been mobile previously give much more emphasis to factors that are not connected to the research environment such as the quality of life, the availability of schools for children, finding housing, work permits for partners and the cultural differences to other countries. These factors must thus be considered the major impediments to mobility.

Interestingly both those not internationally mobile as well as those mobile agree that administrative barriers to mobility, taxation and private as well as financial mobility support are least important in shaping industry researchers' decision to move abroad. These factors must thus be considered to be of lesser importance both as factors motivating as well as factors hampering international mobility.

This points to a certain difference with respect to the problems seen by enterprises since in a series of expert interviews conducted in preparing this study, companies place particular emphasis on the framework conditions for mobility (such as administrative barriers to mobility). This, however, seems in line with the finding of these interviews that in many cases companies take over the administrative tasks (as well as financial costs) associated with mobility (such as organizing work permits and paying mobility grants) when recruiting R&D personnel internationally, so that mobile industry researchers are often not affected by these problems.

Furthermore mobile industry researchers are significantly more likely to see their new job as a continuation of their previous career but less often find that the new job has brought with it a higher share of basic research or more flexibility. Thus international mobility of industry researchers is more closely associated with a change from basic to applied research, which, however, is often seen as a continuation of the previous career. In addition, there are some differences in the reasons for choosing a particular career path between mobile and immobile industry researchers. Mobile industry researchers put a significantly stronger emphasis on having a challenging position, good working conditions, making a contributing to society, promotion prospects, and prospects of a scientific career, while relative to the immobile, they consider the importance of keeping in touch with friends and family and job security even less important. Thus they appear even more strongly motivated by career concerns when choosing their career path than their immobile counterparts. Similarly mobile industry researchers also consider a high salary, the reputation of the new organisation (leading organisation), other career motives, the lack of career perspectives at the old employer, a good corporate culture, better job prospects in the new region, the beauty of the region, health prospects as well as dissatisfaction with the old job as more important reasons for accepting a particular job than their immobile counterparts.

Finally, we also find some evidence that for industry researchers, changing jobs across countries may be associated with different results than changing jobs within countries. Industry researchers, whose previous job was located in another country than their current one – after controlling for other variables – significantly more often find that accepting the current job had a positive impact on their job

market chances and to a lesser degree also on their output with respect to patenting activities than researchers whose previous job was in the same country as their current one. They, however, also significantly more often report a negative impact on contacts to the scientific community and to other research partners than those, whose previous job was located in the same country. This suggests that changing jobs across national borders may be associated with rather different costs and benefits than changing jobs within countries.

1 INTRODUCTION

The mobility of researchers is a central focus of the current debate on competitiveness in a knowledge society, where knowledge is one of the main sources of comparative advantage. Since part of this knowledge resides in the people working in an organisation and is only weakly protected by property rights, the movement of knowledge holders (such as researchers) across firms and regions is one of the main mechanisms by which knowledge is spread (see Almeida and Kogut, 1999, Hoti et al, 2006 and Kaiser et al, 2008 for empirical evidence). While this may represent both a threat as well as an opportunity for individual actors in an economy, since the knowledge base of a firm or a region can be both strengthened by inward mobility but also weakened by outward mobility, existing research suggests that in aggregate higher mobility is beneficial for competitiveness.[1]

For instance with respect to geographical mobility the economic literature has repeatedly stressed that the mobility of highly qualified workers (such as researchers) has a positive impact on the competitiveness of countries, regions and firms. In this respect a number of studies (see e.g. Zucker, Darby and Torero, 2002, Moen 2005, Rosenkopf and Almeida, 2003, Song et al 2003 Gauthier-Loiselle and Hunt, 2008) have found that mobile researchers are an important resource pool, which help to improve national and firm level R&D performance as well as supporting integration into international R&D networks and increasing entrepreneurial and patenting activity. Furthermore, a by now relative large body of empirical research (see e.g. Saxenian, 2000, Fallick, Fleischmann and Rebitzer, 2005) shows that even within a region, mobility of researchers between sectors and firms may have a positive impact on competitiveness.

This importance of the mobility of researchers is also increasingly recognised by policy makers. For instance the EC Communication "Towards a European Research Area" (EC, 2000) identified increasing the number of mobile researchers in Europe as a central objective for constructing the European Research Area (ERA). The Commission's Green Paper on the European Research Area (EC, 2007) reinforces this by stressing the importance of a high level of mobility of researchers between countries and institutions for the realisation of the ERA (see also EC, 2008, p.119).

Despite the importance of the topic, comparable data on the mobility of researchers on a European level is scarce. Thus recent analyses have mostly either used proxies which cover a larger sample of the population than just researchers such as the Human Resources in Science and Technology (HRST) (e.g. EC 2008) or have focused only on a subset of the researchers such as doctoral researchers (see Idea Consult, 2009). This lack of data applies even more strongly to the mobility of researchers working outside academia as well as the mobility of researchers from academia to and from other sectors and the more subjective issues related to the motivations for and results of mobility.

Given this paucity of comparable data on researcher mobility, one of the main objectives of Work Package 7 of the MORE project was to conduct a survey on the extent, motivations and results of mobility among researchers employed outside academia (i.e. industry researchers), to answer questions such as: What is the structure and intensity of mobility among these researchers? What are their ca-

[1] Negative effects of mobility on companies are likely to exist (compare ch. 8) but are not widely discussed in the literature.

reer paths? What factors hamper or facilitate mobility and what are the effects of mobility on industry researchers?

We structure our report on this work package into three parts. In the first we start our description with an overview of the evidence based on proxies of researcher mobility that can be defined from the European Labour Force Survey in Chapter 2. In this chapter our primary aim is to compare mobility of the HRST and persons employed in research occupations to the overall population and to assess the quality of these two proxies for researcher employment.

Part 2 contains the results of the industry researcher survey. Here chapter 3 describes the methodology and sampling strategy of the questionnaire used and presents some summary statistics for the sample of industry researchers. Chapter 4 presents evidence on the extent of international and sector mobility derived from the questionnaire, while chapter 5 analyses the data from a place to place perspective using network analytic methods. Chapter 6 provides a detailed analysis of the characteristics of mobile and immobile researchers, while chapter 7 analyses the evidence with respect to the motives for and the effects of mobility. Chapter 8 presents some results of the interviews conducted with research enterprises. And finally, in part 3, our main conclusions are presented.

Part 1 RESULTS FROM THE EUROPEAN LABOUR FORCE SURVEY

2 EVIDENCE BASED ON PROXIES FROM THE EUROPEAN LABOUR FORCE SURVEY

2.1 Introduction

In this chapter of the report to work package 7 of the MORE project - before providing the results of the industry researcher survey, - we focus on the information that can be obtained from official EUROSTAT data (taken from the European Labour Force Survey ELFS) to analyse the mobility of researchers in the EU27. In particular we use two proxies for defining researchers: The first are persons employed in research occupations, which in accordance with the Frascati manual (see OECD 2002, p 239) we define as the ISCO 3 digit occupations (211-214,221,222,231 241/244) in which researchers work. Second, as for instance also done by DG-Research (EC, 2008) we use the HRST (see: OECD, 1995 for a definition) in their narrowest sense (i.e. HRST-core). Both these proxies imply that we are focusing on a much larger number of persons than those working as researchers, because:

- As pointed out by the OECD (2002) the correspondence between persons employed as researcher and the ISCO occupations is only one way (i.e. it should be interpreted only as implying that researchers are found among these occupational groups but not all those employed in these occupations are researchers). As will be shown below this overestimation is indeed sizeable, with the European Labour Force Survey indicating that the number of persons employed in research occupations is by a factor of 9 higher than the number of researchers.
- As shown in report 1 of this study the number of HRST even when considering the narrowest core definition exceeds the number of researchers by a factor of almost 18.5 (see: Idea Consult (2009) p 51, table 13)

We think that despite this substantial overestimation and the important caveats involved in the use of these indicators this exercise is important for this study because: First of all, it allows us to assess (at least from the perspective of rough proportions) the validity of the results of the questionnaire. Second, because comparing the results from the ELFS to those of our questionnaire will allow future research to more accurately assess the biases that result from analysing the mobility of researchers by proxies taken from the more readily (and regularly) available datasets such as the European Labour Force Survey. Third, with access to questionnaire based methods focusing on researchers alone (such as ours) it is by definition not possible to compare researchers to other population groups – which may be a matter of interest in certain contexts (see also Moguerou and Di Petrogiacomo, 2008) and is possible with the ELFS data at our hands.

After discussing data and definitions in the next section we organise our presentation of results around the issue of comparing the mobility of those working in research occupations or HRST to the average employed in the EU27. First, in section three we compare the extent of both sector mobility as well as geographical mobility of those employed in research occupations and of those employed as HRST to the mobility of all persons employed, to determine in which respects these groups of the population are more or less mobile than the employed at large. Second, in section four we compare the demographic structure of those mobile in our two groups of interest to those who are immobile, with the aim of once more identifying differences in behavioural patterns to the employed at large.

2.2 Data & Definitions

The data we use are taken from the European Labour Force Survey (ELFS) for the years 2006 and 2007.[2] This is a regular questionnaire presented to a representative sample of households in all countries of the EU 27.[3] In this questionnaire, respondents are interviewed on a number of demographic and workplace characteristics such as occupation and branch of employment, age, gender, highest completed education and others. These data are available to us in a sufficiently detailed breakdown to allow us to calculate both the total number and structure of persons working as HRST (which we define here according to the core definition i.e. the employed in ISCO one digit occupations 2 and 3 with a tertiary-level education i.e. ISCED 5 or higher) as well as in research occupations (which we define as occupations listed in the Frascati manual[4] i.e. ISCO 3 digit occupations 211-214,221,222,231 241/244) for all employed aged 15 and older in all of the EU27 countries.[5]

Furthermore, in the ELFS questionnaire the respondents are also asked about their labour market status, region of residence and (if previously employed) sector of employment in the year preceding the interview. This allows us to calculate estimates of the international mobility of those interviewed (where we define a person that lived in a different country the year before the interview than currently as internationally mobile) and sector mobility (on a NACE 1-digit scale) as well as mobility into employment (where we define a person as mobile across sectors if he/she was employed in a different NACE 1-digit sector in the year preceding the interview than currently and as having moved into employment if he/she was not employed a year before the interview).[6] Thus in contrast to many recent studies (e.g. EC, 2008) on researcher mobility, which focus on the share of researchers residing in a different country, we focus on mobility over the last year. While this is clearly going to reduce the estimates of researcher mobility we give preference to this approach because it has the advantage to more closely focusing on a particular mobility event.

While our data thus provides the possibility to define both HRST and persons employed in research occupations as well as providing information on mobility, their analysis is also subject to a number of caveats. The first of these is country coverage. The national Labour Force Surveys of Ireland and Bulgaria do not report the retrospective information on the country of residence and sector of employment. Thus we have to exclude these two countries from the analysis. Furthermore Swedish data report information from retrospective questions only for 2007,

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2 We also have available data from 2004 and 2005. We, however, disregard these, since data for 2004 is plagued with non-response problems for the EU-member states that joined the Union in 2007 and to avoid problems arising from structural breaks in the series on HRST in 2006.

3 see: http://circa.europa.eu/irc/dsis/employment/info/data/eu_lfs/index.htm for the questionnaire and its methodology

4 Note that in principle it would be possible to also include additional criteria (for instance on educational attainment of those employed in research occupations) to proxy researcher employment. This is unlikely, however, to solve the fundamental identification problem, which arises from researchers being defined by the activities they usually perform in their job, while ISCO occupations are defined by formal job descriptions – two concepts that do not necessarily coincide. Below (in Chapter 3) we show that only 50% of the researchers sampled in the questionnaire have a PhD and 10% do not have a graduate degree. Thus since further restrictions are unlikely to solve the fundamental identification problem of researchers, but is likely to further reduce sample size, we do not restrict our sample in this way.

5 Note that thus we include in our analysis those employed that are older than 65. We, however, show below that this group is very small, so that it is unlikely to distort results in a substantial manner.

6 See Stimpson (2000) for a similar approach using ELFS data.

but even here non-response is as high as 25% for some questions, we thus also omit Swedish data from our analysis. These omissions also have implications for the presentation of our results. Since we miss data on Bulgaria we report results for only two groups of EU countries, those that joined the EU before May 1st 2004 (referred to as the EU15) and those that joined after this date (referred to as the EU12). We, however, also report data on a country by country basis wherever possible to allow for a more detailed analysis.

The second caveat applies to missing data and non-response. In our data 0.4% of the employed in the European Union did not respond to the question on their current occupational status and 0.2% did not answer to the question on their highest education. While these figures seem sufficiently small to allow representative coverage, we cannot define the status of these persons with respect to HRST (in case either education or occupation is missing) and occupation (if only occupation is missing) so that we exclude all observations where this information is missing (which results in an exclusion of 0.5% of the total observations). In addition there are also some missing data problems with respect to the retrospective questions used to define mobility, which arise primarily in Germany, the Netherlands and the UK. We, however, do not exclude these countries from our analysis on account of their data also being reported in official EUROSTAT sources, but report non-response as a separate category wherever possible to allow the reader an assessment of data quality.

A final caveat is that our data are taken from a survey which is subject to sampling error. We try to minimize this problem by aggregating data in such a way as to provide as many observations as possible without impeding too strongly on the information content. In particular we choose aggregations so as to provide statistics for each country of the EU27 (by aggregating across time periods) for at least one cross section of averages of the years 2006 and 2007, and dynamics at the level of groups of EU countries (the EU15, and EU12 as well as the EU27). Despite this in a number of cases sample sizes are below the confidence bounds provided by EUROSTAT. Thus to avoid misinterpretation, we follow the conventions of reporting suggested by Eurostat[7] by listing all figures with high standard errors of the estimates in brackets and suppressing all numbers where levels are below the lower confidence bounds suggested by EUROSTAT.

Figure 2.1 provides evidence on the share of total employment taken by HRST and employment in research occupations in 2006 and 2007. Total employment in our data amounted to around 203 million persons, which after taking into account that we excluded 0.5% of all employed on account of missing observations on education and/or occupation as well as from three EU countries (which reduces observations by a further 4.5%) matches the official figure of 214.6 million cited in EUROSTAT sources exactly.[8] Of these employed 8.2% (or around 16.8 million) were employed in research occupations. Thus relative to the researchers working in the countries of the EU27 in 2006, which amounted to almost 2.0 million according to Idea Consult (2009) and once more adjusting for the smaller sample of countries covered in this survey, focusing on the employed working in research occupations overestimates the number of researchers by a factor of about 9.

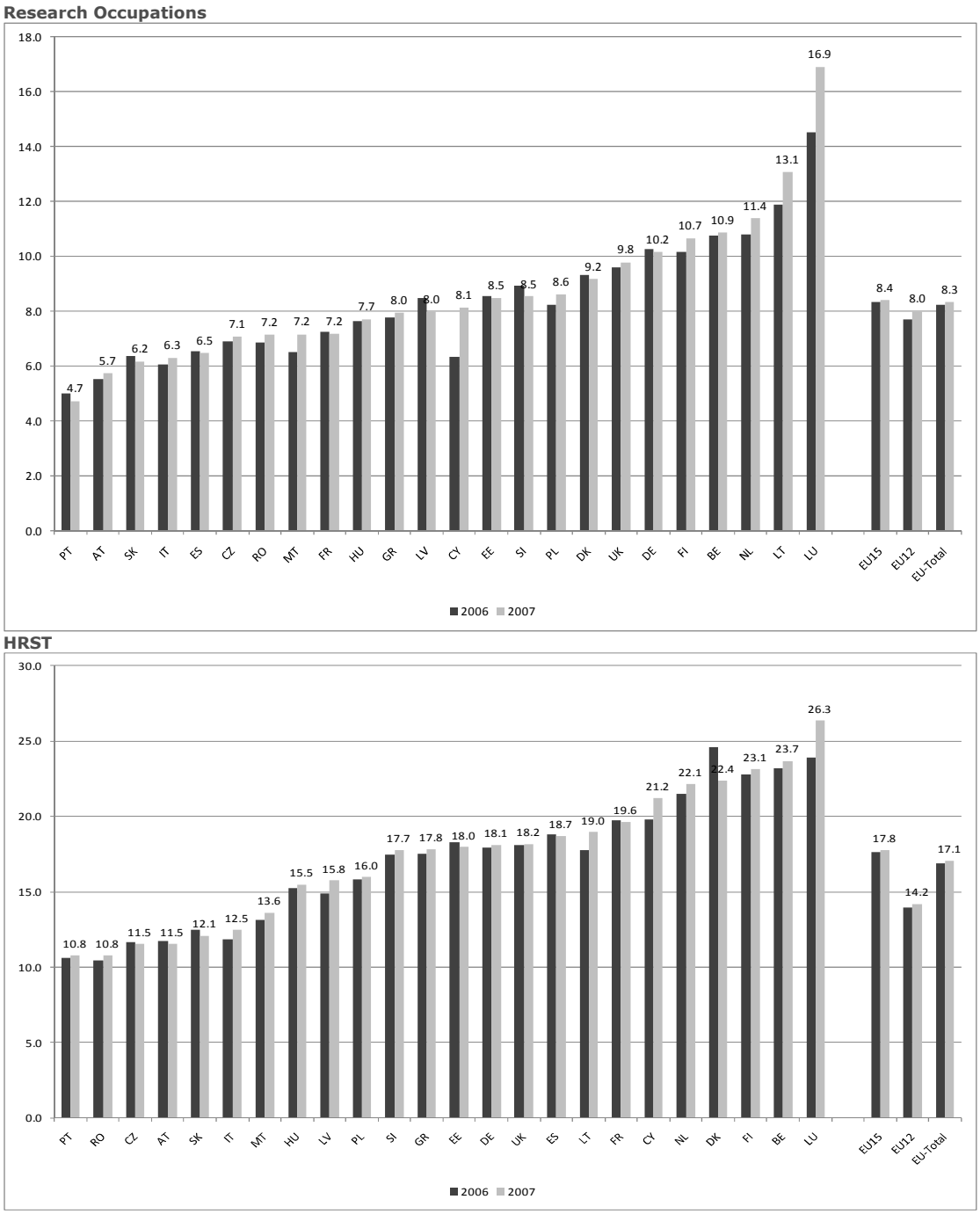
Similarly, according to our data around 16.9% of the employed (or around 35.4 million) were working as HRST in 2006. While this figure is again highly comparable to that cited in official EUROSTAT sources on HRST employment of 36.0 million (and the higher share of HRST employment is due solely to the omission of

[7] see http://circa.europa.eu/irc/dsis/employment/info/data/eu_lfs/index.htm

[8] See http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/ for EUROSTAT Data

persons with unknown education and/or occupation), it also overstates the employment of researchers by a factor of almost 18.5.

Figure 2.1: Share of occupations in total employment (Research occupations, HRST, 2006 and 2007)



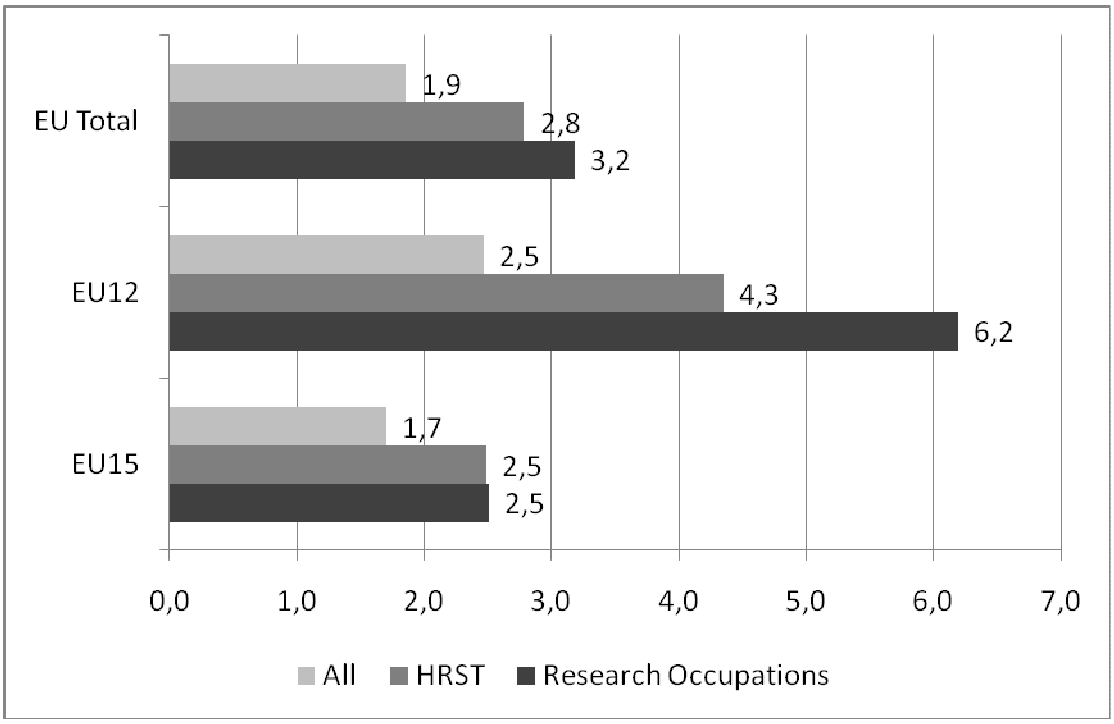
S: ELFS, Basis: employed aged 15 and older excluding Bulgaria, Ireland, and Sweden and employed with unknown education and/or occupation.

Figure 2.1, however, also provides evidence of the wide variation in the share of those employed in HRST and in research occupations among EU countries. The share of employment in HRST ranged from 10.8% in Romania to 26.8% in Luxemburg in 2007, which once more accords closely to official EUROSTAT data. Also the share of persons employed in research occupations, which is not reported in official EUROSTAT publications, ranged from 4.7% in Portugal to 16.9% in Luxemburg. In general, however, the EU15 countries have a higher share of em-

ployment in both HRST and research occupations, while the EU12 have a lower share. In addition the shares of both employment in HRST and employment in research occupations are highly correlated both amongst each other as well as over time.[9] This indicates that countries with a high share of HRST employment also have a high share of research occupation employment and that the relative position over EU countries changed only little in the time period considered.

Furthermore, the share of those working in HRST increased in all countries except for the Czech Republic, Austria, Slovakia, Estonia, Spain, France and Denmark, while the share of those working in research occupations decreased only in Portugal, Slovakia, Spain, France, Latvia, Estonia, Slovenia, Denmark and Germany. Thus in most EU27 countries both employment in HRST and employment in research occupations increased more rapidly than average employment. This is confirmed when looking at the growth rate of both HRST and research occupations employment over EU regions between 2006 and 2007 (Figure 2.2): Here research occupation employment grew by 3.2% in 2007 and HRST employment by 2.8% as compared to an overall employment growth of 1.9% in the EU27. In addition increases in both HRST and research occupations employment were substantially higher in the EU12 than the EU15, which suggests a significant catching up of the EU12 countries in terms of research occupations and HRST employment.

Figure 2.2: Growth rate of Research Occupation, HRST and Overall Employment 2006 – 2007 by EU27 regions



S: ELFS, Basis: employed aged 15 and older excluding Bulgaria, Ireland, and Sweden and employed with unknown education and/or occupation.

There are, however, also substantial structural differences between employment in research occupations and HRST to that of all employed in the EU27 (see Table 2.1). Clearly both the HRST (which are by definition highly qualified) as well as

[9] The correlation coefficient between the share of HRST employment in 2006 with that of 2007 across the EU27 countries is 0.98, and that of research occupations between these two years is also 0.98. The correlation between these two indicators is 0.96 in 2006 and 0.84 in 2007.

those employed in research occupations are more often highly qualified than the average employed in the EU27. Furthermore, on account of the longer training for these groups there are also substantially fewer employed under the age of 25 and – due to the low qualification of the foreign born in many EU countries - also the foreign born are slightly underrepresented among those employed as HRST and in research occupations.[10]

By contrast with respect to the age and gender structure of the employed there are some differences between HRST and the employed in research occupations. The former are more often female than male and much more strongly overrepresented in the education and other non-market service sector, while the later are substantially more often male than female and over-represented in market services as well as education and other non-market services.

[10] There is, however, a large variation both in the share and the skill structure of the foreign born among various EU countries (see for instance Bonin, 2009).

Table 2.1: Structure of Employment (Researchers, HRST and total employment, 2007)

	Research Occupations	HRST	All
		Gender	
Males	62.6	48.6	55.5
Females	37.4	51.4	44.5
		Age	
Under 25 years	3.4	3.6	10.2
25-34 years	13.8	14.6	11.4
35-44 years	31.2	31.3	26.6
45-64 years	45.4	45.5	46.7
65 and more years	6.2	5.0	5.1
		Country of birth	
Born in country of residence	95.4	96.3	94.1
Foreign born	4.6	3.7	5.9
		Education	
ISCED 2 or less	1.2	0.0	22.8
ISCED 3-4	14.4	0.0	51.1
ISCED 5 or more	84.3	100.0	26.0
		Sector of employment	
Agriculture, Manufacturing, Construction	21.1	14.7	33.5
Market Services	42.1	28.7	37.2
Education	8.1	23.8	6.9
Non-market Services	28.7	32.8	22.5

S: ELFS, Basis: employed aged 15 and older excluding Bulgaria, Ireland, and Sweden and employed with unknown education and or occupation.

2.3 Are researchers more mobile than the rest of the employed? – Descriptive evidence

2.3.1 Mobility between labour market states

Thus ELFS data, while clearly overestimating the number of researchers, is highly consistent with official EUROSTAT sources with respect to the ranking of individual countries and growth of HRST employment. While this is reassuring with respect to the representativity of our data, our primary interest in this chapter is with the mobility of workers in HRST and research occupations. Thus as a first indicator we calculate the share of those employed in a particular year that were unemployed, employed or out of the labour force (either because they were students or for other reasons) in the preceding year (see table 2.2).

Table 2.2: Employed in HRST, research occupations and in the overall economy by year, labour market status in the year preceding the interview and EU region

	Employed	Unemployed	Student	Inactive	No Answer
			Research Occupations		
			EU15		
2006	90.8	1.6	3.1	1.4	3.2
2007	90.1	1.3	3.3	1.2	4.0
			EU12		
2006	93.3	1.3	3.0	2.3	-
2007	94.0	1.1	3.0	1.9	-
			EU27		
2006	91.3	1.5	3.0	1.5	2.6
2007	90.8	1.3	3.2	1.4	3.3
			HRST		
			EU15		
2006	90.9	1.8	3.0	1.4	2.9
2007	90.8	1.7	3.0	1.4	3.2
			EU12		
2006	93.5	1.4	2.8	2.4	-
2007	93.8	1.3	2.9	2.0	-
			EU27		
2006	91.3	1.7	2.9	1.6	2.4
2007	91.3	1.6	3.0	1.5	2.6
			All		
			EU15		
2006	88.3	3.2	3.3	2.1	3.1
2007	88.1	3.1	3.3	2.0	3.5
			EU12		
2006	90.5	3.8	2.1	3.6	-
2007	91.2	3.4	2.1	3.2	-
			EU27		
2006	88.8	3.3	3.1	2.4	2.5
2007	88.7	3.2	3.1	2.3	2.8

S: ELFS, Basis: employed aged 15 and older excluding Bulgaria, Ireland, and Sweden and employed with unknown education and/or occupation.

As can be seen both persons employed in HRST and research occupations differ most significantly from all those employed by having a higher share of those employed in the year preceding the interview and a lower share of persons that were either inactive or unemployed. Among those employed as HRST or in research occupations in the EU27 in each of the years 2006 and 2007 around 91% were employed in the year preceding the interview and between 3% and 3.5% were either inactive or unemployed. By contrast, when considering the universe of employed in the EU27 in both years around 89% were employed one year before and between 5.5% and 6% were either inactive or unemployed. Thus moves from

unemployment and inactivity to employment are a rare event for persons employed as HRST and in research occupations than for the overall population. This may be attributed to the lower share of unemployed and higher activity rates among the more highly qualified workers in these occupations or equivalently to a higher share of mobility from one employment relationship to another, on account of the increasing demand for these occupations found in the last section.

The share of moves of students from education to employment in research occupations and into employment as a HRST, by contrast, does not differ from the overall employed at least for the EU15, but it is higher for the EU12. This suggests that flows from education to research occupations and to HRST do not differ between these professions and the overall labour market in the EU15. There are, however, large differences in the qualification level of the students recruited in the HRST and research occupations and the rest of the economy.[11]

Furthermore, table 2.2 also suggests that in the EU12 the share of employed in the year preceding the interview is somewhat (by about 2 percentage points) larger than in the EU15. This, however, seems to be primarily associated with the larger non-response rate to this retrospective question in the EU15 than in the EU12. Country differences in non-response thus seem to also primarily drive differences in mobility between labour market states.

This is also confirmed when considering data on a country by country basis (see Figure 2.3 and Table A1.1 in annex 1). In most of the EU countries between 92% and 95% of the employed in HRST or research occupations were employed a year before the interview. The notable outliers are the UK (where this percentage is 85%), Germany (88%) and Netherland (90%). In these countries, however, a large share of non-respondents reduces these shares. The only countries where these shares are substantially lower and where there are sufficient observations to allow an interpretation are Austria, Finland and the Czech and Slovak Republics[12], where a large share of the employed in HRST and research occupations was inactive the year before the interview. In these countries, however, high flows from inactivity to employment seem to be a general feature of the labour market, since also the share of transitions from inactivity to employment for all employed is much higher than in the other EU27 countries.[13]

Furthermore, the national variation in the share of transitions from education and unemployment into HRST and research occupation employment is relatively stable over countries. With respect to having been unemployed the only outlier is Italy where a large share of the employed in HRST and employed in research occupations was unemployed in the year preceding the interview. Here again this is more a general feature of the Italian labour market than of HRST or research occupation employment, since Italy also has the highest share of overall employed that transitioned from unemployment. With respect to the transition from training, by contrast, only Denmark has a substantially higher transition rate, but again this applies also to all of the employed, as well.

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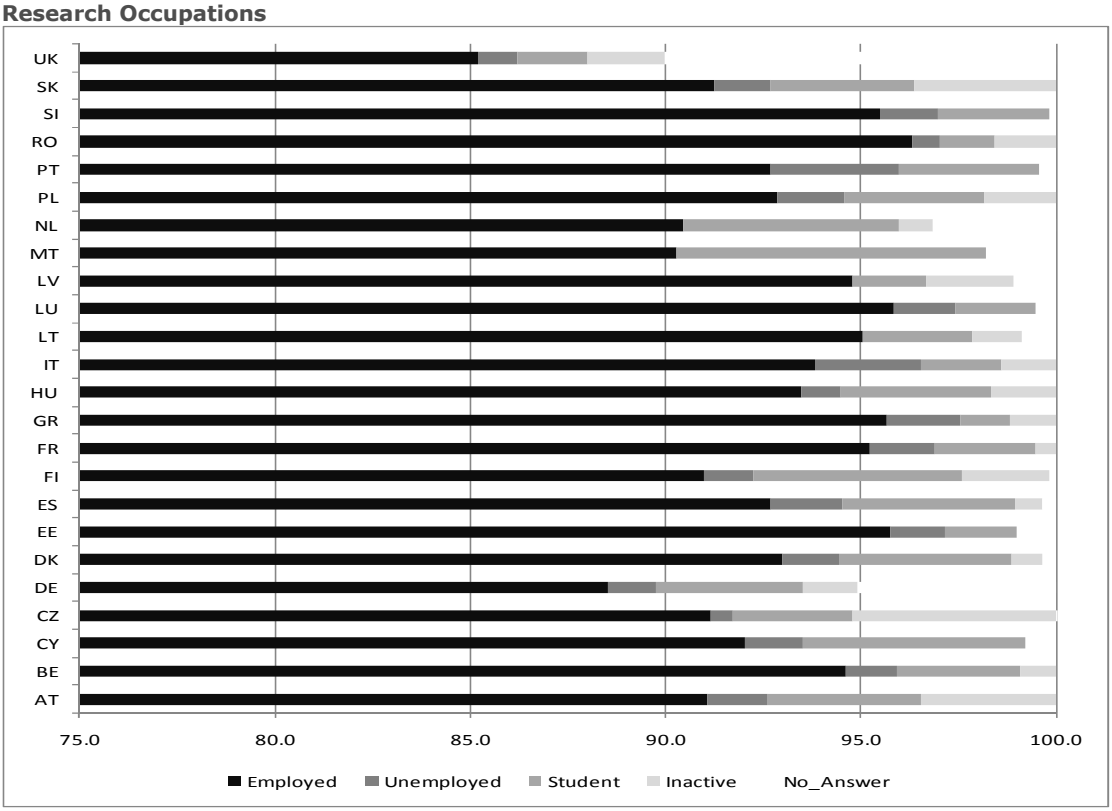
11 When considering the educational attainment of the employed moving from receiving education to employment, research occupations receive a much larger share of highly qualified students with an academic education than the overall European economy. The share of students with a tertiary education that move to employment in a research occupation is 79%, while for HRST the share of academics received is by definition is 100%. In the case of all other occupations only 21% of those that are employed and were a student a year ago have a tertiary education.

12 The share of employed the year before the interview was around 91% in all of these countries

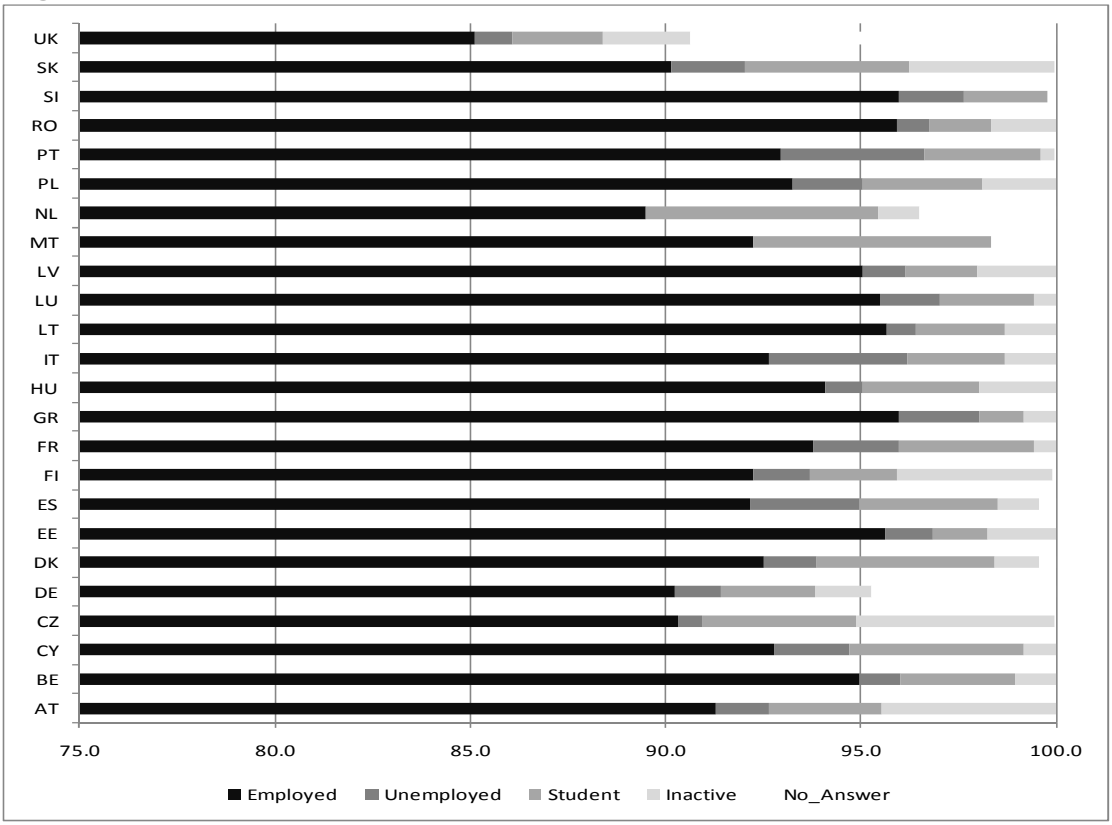
13 Among these countries the share of those employed in the previous year in HRST and research occupations is lower than that for the overall employed only in the Czech Republic.

Figure 2.3: Employed in HRST, research occupations and in the overall economy by labour market status in the year preceding the interview and country (average 2006 and 2007)

Research Occupations



HRST



S: ELFS, Basis: employed aged 15 and older excluding Bulgaria, Ireland, Sweden and employed with unknown education and/or occupation, see table A1.1 in Annex 1 for data. Shares do not add to 100% on account of missing observations, difference to 100% states share of missing observations

2.3.2 Sector mobility

In sum when considering transitions between labour market states, the employed in the HRST and in research occupations in almost all EU27 countries have a lower share of moves from inactivity and unemployment into employment and a higher probability of having been employed previously. This, however, is an indication of the lower unemployment rate and higher activity rate among the highly skilled workers in this group and cannot be taken as an indication of a lower mobility of those employed in research occupations and as HRST, since the employment relationship in the year before the interview may have been at a different firm, in a different sector or in a different region than the current one.

Table 2.3: Share of employed in HRST, research occupations and overall employed mobile across (NACE 1-digit) industries by year and EU regions (in % of employed 2006, 2007)

	Researchers	HRST	All
		EU 15	
2006	4.9	4.7	5.7
2007	5.8	5.4	6.3
		EU12	
2006	7.6	5.6	4.5
2007	9.2	6.8	11.0
		EU27	
2006	5.4	4.8	5.4
2007	6.5	5.6	7.3

S: ELFS, Basis: employed aged 15 and older excluding Bulgaria, Ireland, and Sweden and employed with unknown education and or occupation. Mobile Persons are those that are currently employed in a different NACE (rev. 2) 1 digit industry than one year ago.

In table 2.3 we thus report the share of those that changed NACE 1 digit sector of employment within one year (where this share is calculated in % of the subset of persons that were employed both at the time of interview of the ELFS as well as in the year before). As can be seen, differences in sector mobility between the employed in HRST and in research occupations and the employed overall for the EU27 in total and the EU15 are small, but in their majority point to a lower sector mobility of the employed in HRST and in research occupations with differences ranging from less than 0.05 to 1.0 percentage points.

For the EU12 (i.e. the member states joining the EU after May 2006), by contrast, results are more mixed, here sector mobility among the employed as HRST and in research occupations was higher than for all employed in the year 2006, but lower in 2007.

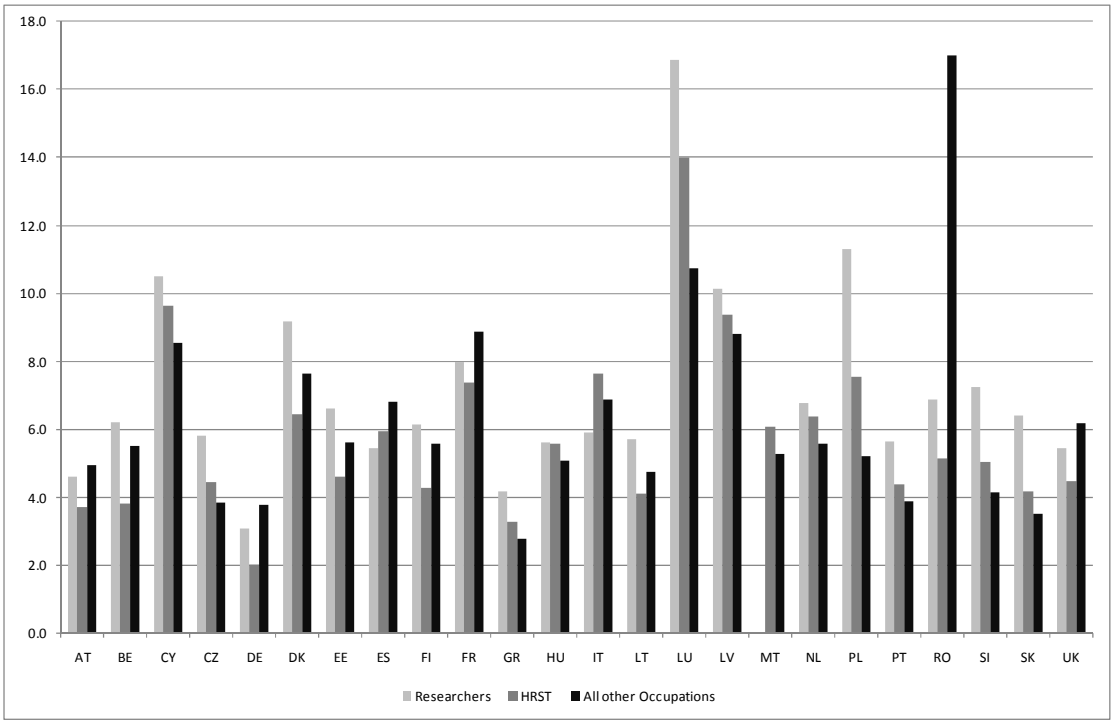
Thus the evidence for differences on sector mobility for those employed in HRST and research occupations is rather inconclusive. This is also confirmed when considering the country by country results (in figure 2.4). Here sector mobility is higher among both the employed as HRST as well as in research occupations in 11 of the 25 EU-countries considered.[14] In a further six countries[15] the share of those mobile across sectors is lower either among the HRST or the employed in

[14] These are Cyprus, the Czech Republic, Greece, Luxemburg, Latvia, Malta, the Netherlands, Poland, Portugal, Slovenia and Slovakia

[15] These include Belgium, Denmark, Estonia, Italy, and Latvia.

research occupations, while for seven countries[16] (with Romania being the obvious outlier) both HRST and research occupations are characterised by lower sector mobility than overall employment.

Figure 2.4: Share of employed in HRST, research occupations and overall employed mobile across (NACE 1-digit) industries by year and EU countries (averages 2006 to 2007, in % of employed in both years)



S: ELFS, Basis: employed aged 15 and older excluding Bulgaria, Ireland, and Sweden and employed with unknown education and/or occupation. Mobile persons are those that are currently employed in a different NACE (rev. 2) 1 digit industry than one year ago.

An alternative representation of both the sector mobility of the employed and their moves between labour market states is given in table 2.4. Here we present the employment status of the employed in the year of the interview focusing on the share of employed coming from different sectors of the economy and from labour market states other than employment.[17] Thus the second column and first row of this table implies that in the average of the years 2006 and 2007 around 1.9% of the employed in research occupations in the manufacturing, agricultural or construction sector had worked in market services the year prior to the interview. Similarly, the first row and first column implies that 0.7% of the employed in research occupations in manufacturing, agricultural or construction had worked in another one digit industry of the same sector a year before.

Aside from reconfirming our previous finding of lower rates of mobility across labour market states, and a by and large comparable sector mobility of the employed in HRST and research occupations, this table also sheds some light on the direction of sector mobility. In particular it indicates that:

16 Aside from Romania these are Austria, Germany, Spain, France, Hungary, Romania and the UK.

17 Unfortunately to conduct this analysis with representative numbers agriculture, manufacturing and construction had to be merged into one category. Furthermore, this analysis can only be conducted on the level of the EU27 as a whole on account of a large number of cells with low representativity when splitting the sample by years, EU-regions and/or countries

1. Among the employed in HRST as well as among the employed research occupations sector mobility is particularly high within the market service sector, which amongst others also encompasses the private research institutions. In this sector around 7% of the employed in research occupations and 7.9% of the HRST (as against 6% of all employed) worked in another NACE 1 digit industry of the market services sector than the one of current employment one year earlier.

Table 2.4: Share of employed in HRST, research occupations and overall employed mobile across (NACE 1-digit) industries and labour market states one year ago (averages 2006 to 2007, in % of employed)

	Employment Status one year ago							
	Employed in…							
Current employment	Manufacturing[1)]	Market Services	Education	Non market Services [2)]	Total Sector Change	N.A.	Not employed[3)]	Not Mobile[4)]
Research Occupations								
Manufacturing[1)]	0.7	1.9	0.1	0.4	3.1	0.6	8.1	88.2
Market Services	1.2	7.0	0.3	0.9	9.4	0.6	9.4	80.6
Education	0.3	0.8	0.0	0.9	2.0	0.6	10.5	86.9
Non market Services [2)]	0.3	1.0	0.3	0.6	2.3	0.4	8.4	88.9
Total	0.8	3.7	0.2	0.7	5.4	0.6	8.9	85.1
HRST								
Manufacturing[1)]	0.6	2.3	0.2	0.5	3.6	0.5	8.3	87.6
Market Services	1.2	7.9	0.3	1.0	10.5	0.6	9.7	79.3
Education	0.2	0.5	0.0	0.7	1.4	0.4	7.7	90.5
Non market Services[2)]	0.3	0.8	0.5	1.0	2.6	0.4	8.7	88.3
Total	0.6	3.0	0.3	0.9	4.7	0.5	8.7	86.1
All								
Manufacturing[1)]	2.7	1.6	0.1	0.5	4.8	0.4	9.8	85.0
Market Services	1.4	6.0	0.1	0.8	8.3	0.6	13.0	78.1
Education	0.4	0.8	0.0	1.0	2.2	0.5	9.4	87.9
Non market Services[2)]	0.7	1.2	0.3	1.3	3.5	0.5	11.1	84.9
Total	1.6	3.1	0.1	0.8	5.6	0.5	11.2	82.6

S: ELFS, Basis: employed aged 15 and older excluding Bulgaria, Ireland, Sweden and employed with unknown education and/or occupation., 1) including agriculture and construction 2) excluding education 3) inactivity and unemployment, N.A. = Not Available (non-response) 4) share of persons not mobile across labour market states or sectors. Mobile persons are those that are currently employed in a different NACE (rev. 2) (rev 2) 1 digit industry than one year ago.

2. Mobility within the agricultural, manufacturing and construction sector is lower among those employed as HRST or in research occupations than among the rest of the employed. Only 0.7% of the employed in research occupations and 0,6% of the HRST of this sector worked in another NACE 1-digit industry a year before, while for overall employment this percentage is 2.7%

3. Mobility from the education sector (i.e. NACE 1-digit P - which includes universities) and (to a lesser extent) from the non-market services to market services and the other sectors (i.e. manufacturing, agriculture and construction) is slightly more important for those employed in either research occupa-

tions or as HRST than for overall employment. This applies in particular to those employed in market services. Here 1.2% of the employed in research occupations (and 1.3% of the HRST) worked in either the non-market services or the education sector a year earlier. For the overall economy the equivalent rate is 0.9%.

4. Movement from the market services and other sectors to the non-market services and education sector, by contrast, is of a slightly lesser importance for those employed in research occupations or as HRST than for overall employment. Only 1.3% of the employed in research occupations and 1.1% of the HRST employed in the non-market services were working in either market services or the other sectors the year before. Here in the overall economy the same share is 1.9%.

In sum relative to economy wide mobility, more of the sector mobility of those employed in research occupations or as HRST, is accounted for by job changes within the market services sector – which also encompass private research institutions – and by job changes from the public sector (i.e. education or other non market services) to either market services or other sectors (manufacturing, agriculture and construction), while flows from these sectors to the education and other non-market services are of a lesser importance.

2.3.3 International mobility

Aside from sector mobility and movements from out of employment into employment, a full appraisal of the mobility of persons employed in research occupations or as HRST should, however, also focus on international mobility. In the context of ELFS data this can be accomplished by observing the share of employed in these occupations that lived in another country than they currently reside in one year ago.[18] When considering this indicator (see table 2.5) two facts emerge. The first is that (consistent with many other studies such as EC (2008), Moguerou and Di Petrogiacomo (2008) as well as Stimpson (2000)) migration across national borders is a rare event among the employed in the EU27.[19] This applies irrespective of whether the employed is counted among the employed in research occupations, as HRST or to neither of these groups. Among all employed in the European Union in 2006 only 0.2% lived in another country (irrespective of whether this was an EU country or not) a year earlier. In 2007 the respective share had increased – probably on account of increased mobility from the new member states to the EU15 - but still lay at only 0.28%. Thus mobility is low in the EU27.

The second fact that emerges is that HRST and even more strongly persons working in research occupations are more mobile across national borders than the average employed. In the years 2006 and 2007 international mobility across national borders among the employed in HRST in 2006 amounted to 0.28% and to 0.3% in 2007. For those employed in research occupations the equivalent shares were 0.3% (in 2006) and 0.5% (in 2007). In addition higher international mobility of both HRST and employed in research occupations applies to all countries (except for Spain and the UK) for which the number of observations is large

[18] Note that we thus do not capture all aspects of regional mobility (which may also cover relocation within one and the same country) in our data but only international mobility.

[19] Aside from the many policy relevant implications of the low number of migrants in the EU this also impedes on the analysis of migration flows, since in many cases sample sizes in the ELFS are too small to make reliable inferences. Thus in this section we have to limit ourselves to an analysis of the EU15 and the EU27 in total, while reliable country by country results, can only be obtained for 12 EU countries (see below).

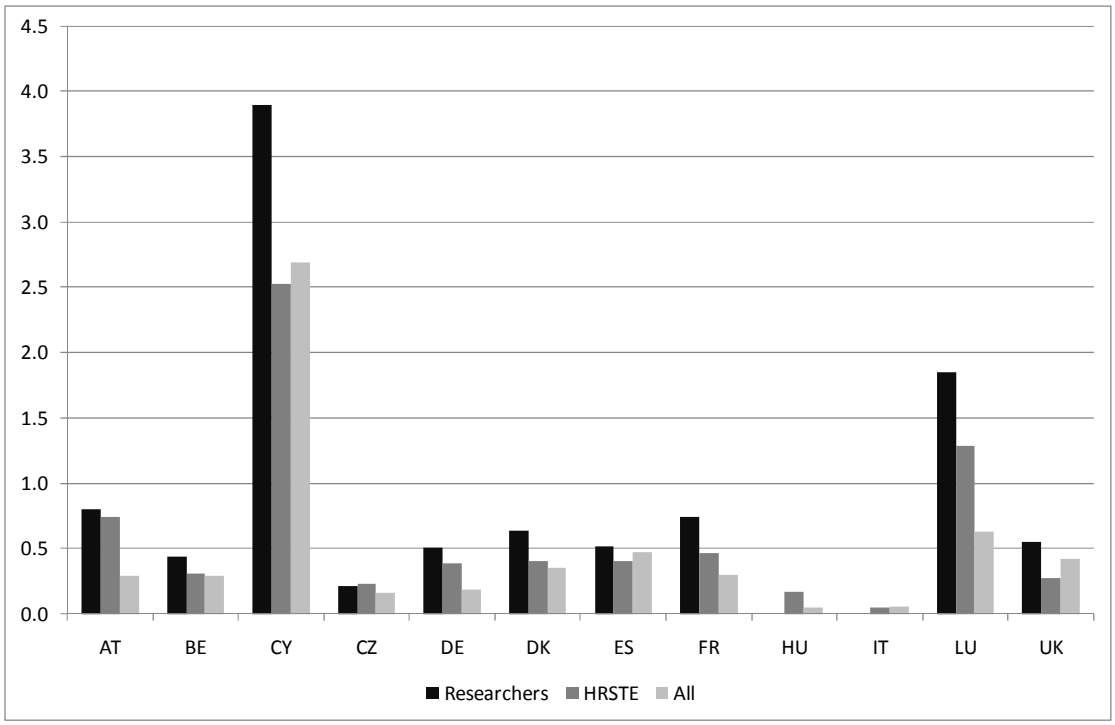
enough to allow for valid inferences (see figure 2.5).[20] Here aside from the obvious outliers of very small countries such as Cyprus and Luxemburg, France and the UK but also Austria experienced the largest inflows of employed in research occupations and HRST, while the only two EU12 countries (the Czech Republic and Hungary), for which data can be deemed sufficiently reliable, and Italy have the lowest inflows in these occupations.

Table 2.5: Share of employed in HRST, research occupations and overall employed mobile across countries by year and EU Regions (averages 2006 to 2007, in % of the employed)

	HRST	Research Occupations	All
		EU15	
2006	0.31	0.37	0.21
2007	0.33	0.53	0.31
		EU27	
2006	0.28	0.33	0.20
2007	0.30	0.46	0.28

S: ELFS, Basis: employed aged 15 and older excluding Bulgaria, Ireland, Sweden and employed with unknown education and/or occupation,

Figure 2.5: Share of employed in HRST, research occupations and overall employed mobile across countries by year and country (averages 2006 to 2007, in % of the employed)



[20] See section 2.4 for a discussion of the significance of these differences.

S: ELFS, Basis: employed aged 15 and older excluding Bulgaria, Ireland, and Sweden and employed with unknown education and or occupation. Data for remaining EU27 countries is not reliable

2.4 Who are the mobile researchers

In sum our results so far suggest a number of differences in the mobility of those working as HRST or in research occupations from the overall employed in the EU. In particular the employed in these groups are characterised by lower mobility from non-employment to employment on account of the lower unemployment and inactivity rates among these higher educated groups, while their sector mobility rates are about comparable to those of the employed overall, but their international mobility is higher. Furthermore, in these groups a larger share of sector mobility is accounted for by job changes within the market service industries – which includes private research institutions – and by job changes from the public sector (i.e. education or other non market services) to either market services and other sectors (which encompass manufacturing, agriculture and construction), while flows from these sectors to the education and other non market services sector are of a lesser importance.

Given these differences the question can be posed whether they arise due to differences in the demographic composition of these groups with respect to the determinants of the decision to be internationally or sectorally mobile (e.g. because they are better educated) or are due to innate differences in behaviour that cannot be explained by such compositional effects and may arise for instance from occupation specific career patterns (or other factors particular to research occupations and/or researchers).

To analyse this question, in table 2.6, we display the share of (either internationally – in the left-hand side panel, or sectorally – in the right-hand side panel) mobile employed in research occupations or working as HRST by different demographic characteristics and compare this to the equivalent shares for all employed. A number of differences arise. In particular the probability to be internationally or sectorally mobile decreases much faster with age for the employed in research occupations and the HRST than for the overall employed. In addition at least for those employed in research occupations gender differences in mobility are smaller, while for those employed in the education sector, the likelihood of migration is substantially higher than for the average employed. Also differences in international mobility between foreign born and native born seem to be much larger for HRST and employed in research occupations than for the overall employed.

Table 2.6: Share of employed mobile in HRST, research occupations and overall employed across countries and (NACE 1-digit) sectors by demographic groups (averages 2006 to 2007, in % of employed)

	International Mobility			Sector Mobility		
	Research Occupation	HRST	All	Research Occupation	HRST	All
Gender						
Males	0.40	0.32	0.23	5.4	5.4	6.0
Females	0.40	0.27	0.22	6.9	5.0	6.9
Age						
Under 25 years	1.23	0.95	0.58	12.8	12.6	10.8
25-34 years	0.94	0.70	0.51	9.2	8.9	8.9
35-44 years	0.42	0.30	0.25	7.1	6.1	6.7
45-64 years	0.20	0.12	0.09	4.6	3.5	5.1
65 and more years	-	0.18	0.07	2.5	2.3	5.2
Nationality of birth						
Born in country of residence	0.19	0.16	0.09	6.0	5.2	6.3
Foreign born	4.98	3.76	2.50	6.3	6.5	7.4
Highest completed Education						
ISCED_2_or_less	-		0.20	5.0		6.2
ISCED_3-4	0.43		0.20	7.6		6.2
ISCED_5_or_more	0.39	0.29	0.33	5.7	5.2	7.0
Current sector of employment						
Agriculture, Manufacturing, Construction	0.44	0.37	0.23	3.4	4.0	5.4
Market Services	0.44	0.41	0.23	10.4	11.7	9.5
Education	0.72	0.27	0.16	2.2	1.5	2.4
Non-market Services	0.21	0.16	0.24	2.5	2.9	4.1

S: ELFS, Basis: employed aged 15 and older excluding Bulgaria, Ireland, Sweden and employed with unknown education and/or occupation, empty cells in HRST column are zero due to the definition of HRST, - = data not reported on account of a low number of observations.

When, however, focusing on the migration rates by education, differences between the groups both with respect to sector as well as international mobility diminish in particular for the highest education groups. This may indicate that differences found are primarily due to the higher educational attainment of HRST and employed in research occupations, relative to the average employed.

Thus, to disentangle the effects of potential differences in composition of the HRST and employed in research occupations from potential behavioural differences, which in our context could be interpreted as results of the particularities of the jobs and industries these employed work for (e.g. with respect to industry or occupation specific career paths) we estimate two different models. First, we conduct a logit analysis of the probability of international and sector mobility for the overall sample. Here we perform one analysis including a dummy variable for whether or not a person belongs to the HRST and another one including a dummy if a person is employed in research occupations[21], controlling for gender, age, foreign born, highest educational attainment (only in the case of persons employed in research occupations), sector of work, country of residence and year effects.

[21] In both cases the reference group are thus the remaining employed.

The marginal effects on the dummy variable for HRST or employment in research occupations in the first of these regressions (shown in the bottom panel of table 2.7) have the interpretation of the percentage point difference in the probability to be internationally or sectorally mobile between an employed in HRST or in research occupations, respectively, and those employed elsewhere. These marginal effects suggest that after controlling for demographic characteristics, education, sector of employment as well as country of residence and year, those employed in a research occupations have a probability of being internationally mobile that is by about 4/10000 percentage points higher than that of a comparable person not employed in research occupations and a by 9/1000 percentage point lower probability of being mobile across sectors. For the HRST these effects are by a factor 10 larger for international mobility, while they amount to a 0.02 percentage point lower probability to be mobile across sectors. These effects are statistically significant and thus suggest that (after controlling for other influences) the HRST and employed in research occupations do have a higher international and a lower sector mobility than comparable employed elsewhere. The absolute size of these effects is very small, however, and thus implies that from an economic perspective this effect is also very small.

Second, we estimate the same logistic regression as above separately for those employed in a research occupations, as HRST and other employed (see tables 2.8 and 2.9). The results of these regressions are thus informative on the degree to which the impact of certain determinants of the propensity to be (internationally or sectorally) mobile (such as age and education which have been found to be of primary importance in the literature on sector and international mobility) differs between these groups. As can be seen from these results, such differences apply to the determinants of both international and sector mobility.

With respect to international mobility the age-mobility profiles of the HRST and employed in research occupations are steeper than those of the other employed as are the education-mobility profiles (which, however, can only be estimated for those employed in research occupations). Thus, a person aged 25 to 34 years and employed in research occupations is by 0.006 percentage points less likely to have migrated across borders in the year preceding the interview than a person aged 24 or younger employed in the same occupation. For those aged 35-44 this probability is 0.0015 percentage points lower, for those aged 45-64, 0.0025 percentage points lower, and for those older than 64, 0.0012 percentage points lower. Similarly for the HRST, these marginal effects are -0.0008 percentage points for the 25-34 year olds; -0.016 for the 35 to 44 year olds, -0.0033 for the 45-64 year olds and -0.0016 for those with an age of more than 64 years. Moreover, for both these groups these marginal effects (while small in absolute terms) are (statistically significantly) higher than for those employed outside research occupations or not employed as HRST.

Table 2.7: Regression Results for Logistic Regressions (Marginal Effects)

Dependent Variable	International Mobility		Sector Mobility	
	Coefficient	Std.Err	Coefficient	Std.Err
	Research Occupations			
Research Occupation	0.00041 ***	0.00001	-0.00969 ***	0.00004
Female	-0.00006 ***	0.00001	0.01039 ***	0.00002
Age: Under 25 years	Reference group			
25-34 years	-0.00030 ***	0.00001	-0.01304 ***	0.00004
35-44 years	-0.00069 ***	0.00002	-0.02488 ***	0.00003
45-64 years	-0.00145 ***	0.00001	-0.03775 ***	0.00004
65+ years	-0.00069 ***	0.00002	-0.02785 ***	0.00003
Foreign Born	0.01631 ***	0.00003	0.00797 ***	0.00005
Low Education	Reference group			
Medium Education	0.00029 ***	0.00001	0.00025 ***	0.00003
High Education	0.00077 ***	0.00001	0.01555 ***	0.00004
Other Sectors	Reference group			
Market Services	-0.00013 ***	0.00002	0.03571 ***	0.00003
Education	0.00002 ***	0.00001	-0.03228 ***	0.00003
Other Non-Market Services	-0.00004 ***	0.00001	-0.01457 ***	0.00003
Number of observations	776589		670565	
Pseudo-R^2	0.22		0.16	
	HRST			
HRST	0.00005 ***	0.00000	-0.01737 ***	0.00005
Female	-0.00008 ***	0.00000	0.00603 ***	0.00004
Age: Under 25 years	Reference group			
25-34 years	-0.00060 ***	0.00001	-0.00707 ***	0.00009
35-44 years	-0.00151 ***	0.00001	-0.01993 ***	0.00008
45-64 years	-0.00299 ***	0.00001	-0.03450 ***	0.00010
65+ years	-0.00122 ***	0.00000	-0.03494 ***	0.00005
Foreign Born	0.02138 ***	0.00008	0.00240 ***	0.00009
Other Sectors	Reference group			
Market Services	0.00007 ***	0.00001	0.06490 ***	0.00009
Education	0.00009 ***	0.00001	-0.02847 ***	0.00006
Other Non-Market Services	-0.00027 ***	0.00001	-0.00835 ***	0.00007
Number of observations	188597		167662	
Pseudo-R^2	0.19		0.19	

S: ELFS, *** signifies significance at the 1% level, country and year fixed effects not reported. Std.Err. = Standard error of the estimate, Basis employed aged 15 and older excluding Bulgaria, Ireland, Sweden and employed with unknown education and/or occupation.

Table 2.8: Regression Results for separate Logit Regressions for research occupations and other employed (Marginal Effects)

	Research Occupations		Other employed	
	Coefficient	Std.Err.	Coefficient	Std.Err.
	International Mobility			
Female	0.00003 ***	0.00001	-0.00006 ***	0.00001
Age: Under 25 years	Reference group			
25-34 years	-0.00057 ***	0.00001	-0.00029 ***	0.00001
35-44 years	-0.00148 ***	0.00001	-0.00062 ***	0.00001
45-64 years	-0.00254 ***	0.00002	-0.00133 ***	0.00002
65+ years	-0.00126 ***	0.00001	-0.00062 ***	0.00001
Foreign Born	0.02246 ***	0.00016	0.01571 ***	0.00016
Low Education	Reference group			
Medium Education	0.00368 ***	0.00020	0.00024 ***	0.00020
High Education	0.00131 ***	0.00002	0.00072 ***	0.00002
Other Sectors	Reference group			
Market Services	-0.00006 ***	0.00001	-0.00013 ***	0.00001
Education	0.00026 ***	0.00001	-0.00005 ***	0.00001
Other Non-Market Services	-0.00064 ***	0.00001	0.00002 ***	0.00001
Number of Observations	63441		713148	
Pseudo – R2	0.23		0.23	
	Sector Mobility			
Female	0.01256 ***	0.00007	0.01004 ***	0.00002
Age: Under 25 years	Reference group			
25-34 years	-0.01382 ***	0.00015	-0.01333 ***	0.00004
35-44 years	-0.02155 ***	0.00015	-0.02551 ***	0.00003
45-64 years	-0.03642 ***	0.00019	-0.03777 ***	0.00004
65+ years	-0.03564 ***	0.00009	-0.02689 ***	0.00004
Foreign Born	0.00069 ***	0.00017	0.00816 ***	0.00005
Low Education	Reference group			
Medium Education	0.02110 ***	0.00045	0.00033 ***	0.00003
High Education	0.00647 ***	0.00030	0.01879 ***	0.00004
Other Sectors	Reference group			
Market Services	0.05427 ***	0.00013	0.03407 ***	0.00003
Education	-0.01438 ***	0.00015	-0.03353 ***	0.00003
Other Non-Market Services	-0.01344 ***	0.00011	-0.01395 ***	0.00003
Number of Observations	57755		612810	
Pseudo – R2	0,12		0.16	

S: ELFS, *** signifies significance at the 1% level, country and year fixed effects not reported. Std.Err. = Standard error of the estimate, Basis employed aged 15 and older excluding Bulgaria, Ireland, Sweden and employed with unknown education and/or occupation,

Table 2.9: Regression Results for separate Logit Regressions for HRST and other employed (Marginal Effects)

	HRST			Other Occupations		
	Coefficient		Std.Err.	Coefficient		Std.Err.
	Dependent Variable: International Mobility					
Female	-0.00005	***	0.00001	-0.00006	***	0.00001
Age: Under 25 years	Reference Group					
25-34 years	-0.00075	***	0.00001	-0.00048	***	0.00001
35-44 years	-0.00164	***	0.00001	-0.00133	***	0.00001
45-64 years	-0.00331	***	0.00002	-0.00257	***	0.00001
65+ years	-0.00164	***	0.00001	-0.00094	***	0.00000
Foreign Born	0.02242	***	0.00011	0.01949	***	0.00010
Other Sectors	Reference Group					
Market Services	0.00011	***	0.00001	0.00002	***	0.00001
Education	-0.00086	***	0.00002	0.00000	***	0.00001
Other Non-Market Services	0.00051	***	0.00001	-0.00062	***	0.00001
Number of Observations	108304			80275		
Pseudo – R2	0.19			0.19		
	Dependent Variable: Sector Mobility					
Female	0.00769	***	0.00009	0.00513	***	0.00004
Age: Under 25 years	Reference Group					
25-34 years	0.00016	***	0.00021	-0.01196	***	0.00008
35-44 years	-0.02000	***	0.00019	-0.02222	***	0.00008
45-64 years	-0.04054	***	0.00020	-0.03527	***	0.00011
65+ years	-0.05176	***	0.00015	-0.02879	***	0.00005
Foreign Born	-0.00181	***	0.00016	0.00656	***	0.00012
Other Sectors	Reference Group					
Market Services	0.10014	***	0.00015	0.04572	***	0.00010
Education	-0.00865	***	0.00030	-0.02753	***	0.00006
Other Non-Market Services	0.00065	***	0.00017	-0.01133	***	0.00007
Number of Observations	96140			71482		
Pseudo – R2	0.12			0.08		

S: ELFS, *** signifies significance at the 1% level, country and year fixed effects not reported. Std.Err. = Standard error of the estimate, Basis employed with ISCED 5 or higher aged 15 and older excluding Bulgaria, Ireland, Sweden and employed with unknown education and/or occupation,

With respect to highest completed education, by contrast, persons with a medium (ISCED 3 or 4) education working in research occupations are 0.004 percentage points more likely to be internationally mobile than those with a low (at most ISCED 2) education and the highly (ISCED 5 or more) educated are 0.004 percentage points more likely to be mobile across national borders. Again these

marginal effects are (statistically significantly) higher than for those not working in research occupations.[22]

Similar differences also apply to the foreign born. While foreign born are always more likely to have been internationally mobile in the year preceding the interview than the native born and the size of the marginal effects suggest that being foreign born has the largest impact on mobility of all variables, marginal effects for those working in research occupations are (statistically significantly) larger for those working in research occupations and HRST than for the comparison groups of the other employed. The difference here amounts to 0.007 percentage points for those employed in research occupations and 0.003 percentage points for the HRST.

For gender differences in international mobility, results differ for employed in research occupations and HRST. Females are significantly more mobile than men when employed in research occupations but significantly less mobile than men when employed in other occupations. For the HRST, however, no significant differences are found relative to the control group.

With respect to sector of employment the employed in research occupations are more mobile when employed in the education sector and less mobile when employed in non–market services than those employed in other sectors, while for the control group the opposite applies. HRST, by contrast, are less mobile when employed in the education sector but more mobile when employed in non–market services, while for the control group once more the opposite applies.

In addition there are also differences in the marginal effects of variables with respect to sector mobility. In particular, women are always more likely to be mobile across sectors than men, but this effect is more pronounced for both employed in HRST and research occupations than in the respective control groups. Differences amount to around 0.003 percentage points for both the employed in HRST and research occupations. Similarly, for sector mobility education-mobility profiles are steeper for those employed in research occupations than for those employed in other occupations but steeper age – mobility profiles apply only to the HRST and (with the exception of the oldest age group) not to the employed in research occupations. Foreign born are actually significantly less likely to be sectorally mobile than natives when employed as HRST, while in the control group they are more likely to be mobile. For research occupations the marginal effect of being foreign born on the probability to be mobile across sectors is smaller than for the control group of those working in other occupations.

Finally, the impact of sector of employment on sector mobility implies that – relative to employed in the other sectors – both the employed in research occupations and HRST are more likely to have been sectorally mobile in the last year when working in market services (where differences amount to 0.03 percentage points for the employed in research occupations and 0.05 percentage points for the employed in HRST) as well as when working in the education and other non-market services sector (where differences amount to 0.02 and 0.005 percentage points respectively for the employed in research occupations and 0.02 and 0.01 percentage points for the HRST).

[22] Note that we cannot include the education variable in regressions for the HRST since these have completed a tertiary education by definition. Thus here the comparison is between HRST and all other employed with tertiary education.

2.5 Summary

In this chapter we use data from the European Labour Force Survey to compare the mobility of those employed in research occupations and HRST to all employed. We find that both HRST employment as well as the employed in research occupations as defined in the Frascati manual deliver poor approximations of the number of researchers according to official EUROSTAT sources. In particular the number of persons employed in research occupations according to the ELFS exceeds the number of researchers according to EUROSTAT by a factor of over 9 and HRST employment is by a factor of 18.5 higher. These findings bring into question the reliability of analyses using these definitions as proxies for researcher employment and – from a data development perspective - underline the importance of implementing questions that help identify researchers in the standard large scale household surveys of the EU (such as the Labour Force Survey) if insights into the labour market behaviour of this group of workers is desired.

On a more substantive level our findings also point to a number of interesting differences in the mobility of HRST and those employed in research occupations from the average mobility of all employed in the EU27. In particular, we find that:

- these groups have a lower mobility from non-employment to employment, which may be explained by the lower unemployment and higher participation rates among these highly educated groups.
- the sector mobility rates of these groups in aggregate are about comparable to those of the employed overall, with econometric evidence suggesting a small but statistically significantly lower sector mobility.
- judging from aggregate data the international mobility of these groups is substantially higher than for the overall employed, but this advantage becomes very small (although remaining significant) once demographic composition effects are taken into account.
- in these groups a larger share of sector mobility is accounted for by job changes within the market services industries – which also encompass private research institutions – and by job changes from the public sector (i.e. education or other non market services) to either market services and other sectors, while flows from market services and other sectors to the education and other non market services are of a lesser importance.
- the marginal impacts of determinants of both international as well as sector mobility differ substantially between those employed in the HRST and in research occupations and those employed elsewhere. In particular age-mobility and education-mobility profiles are steeper than for comparable employed elsewhere. This thus points to different (occupation specific) career paths of those employed in research occupations or as HRST.

In sum, both HRST and employed in research occupations are groups that are not necessarily more mobile than comparable employees working in other sectors, but the determinants of mobility seem to differ for these two groups. This could be indication of differences in occupation specific career paths.

Part 2 RESULTS OF THE SURVEY

3 THE DATA SET

3.1 Introduction

While the previous chapter uncovered a number of interesting "stylised facts" with respect to the mobility of HRST and those employed in research occupations it also clearly showed that these two aggregates are very imperfect proxies when one is interested in the mobility behaviour of researchers. This would not be a problem if one could assume, without doubt, that researchers and other occupational groups subsumed under the concepts of HRST and research occupations do not differ with respect to mobility behaviour. This assumption, however, has to be strongly questioned since for instance researchers are usually also very highly qualified even relative to other workers employed as HRST and in research occupations. This would lead one to expect an even higher level of geographical mobility among industry researchers than among HRST and those employed in research occupations because a substantial literature on migration (see e.g. Hunt, 2004) suggests that the propensity to migrate increases with education. Furthermore, given the scarcity of research resources in many fields, labour markets for researchers also may have a different logic of operation than other labour markets, with mobility playing a much larger role. This too would lead one to expect higher mobility among researchers.

At the same time, however, there are also arguments that could lead one to expect that researchers have a lower mobility. These apply in particular to industry researchers, which are in high demand and thus have higher job stability than unqualified workers and, in addition, often receive additional incentives to prevent them from leaving their respective employers.[23]

Unfortunately, comparable data on the mobility of this group on a European level is hardly available.[24] Thus, one of the main objectives of Work Package 7 of the MORE project was to conduct a survey on the extent, motivations and results of mobility among researchers employed outside academia (i.e. industry researchers).

In this chapter we present the methodology of this survey (in the next section) and discuss the representativeness of the sample of researchers obtained, by describing central summary statistics (in section 3). Finally, section 4 concludes by drawing some initial inferences on the population of industry researchers analysed in the rest of this report.

[23] Similar arguments apply to using doctoral students as a proxy for researcher behaviour. Since these are mostly young and migration research suggests that the propensity to migrate decreases with age, focusing on this group will in all likelihood overestimate the mobility of the average researcher.

[24] This lack of data applies even more strongly to the more subjective issues related to the motivations for and results of mobility.

3.2 Sampling method for the industrial researcher mobility survey

The basic problem for a survey of industrial researchers in private industry is sampling. The challenges here are to establish a representative sample of researchers working in the private sector, and to gain access to the researchers themselves. Data constraints limit the chance to advance a survey design that will deliver a representative sample. A representative sampling method requires information on the total size and the stratification of the population by e.g. country, industrial sector, field of science, company etc. However, this information is not available for the following reasons that were particularly relevant for the present survey (see also Idea Consult, 2009):

- We do not have any information about the exact number of researchers in private industry. Statistical offices might have such information on the basis of the bi-annual R&D surveys. However, our team did not have and could not establish access to this information. A full list of contacts to researchers is therefore missing and stratified random sampling is not possible.

- We do not know the population of R&D performing firms. This information is available neither for consolidated firm data (say at the level of multi-plant enterprises) nor at the level of R&D executing units. Hence, no comprehensive list of R&D performing firms with contact details is available. Furthermore, even if we knew the whole population of R&D performing firms, information on the total number of researchers these employ would still be missing. As a consequence a stratification of the sample by R&D performing entity is not possible.

- We do not have any information about the fields of technology the firms are acting in, neglecting that firms potentially are involved in a broader set of technology fields. Technology fields are therefore not useful for stratification.

- Since we do not know how many firms in a country perform R&D we also do not know the distribution of R&D performing firms across countries. Stratification along the country dimension is therefore also not possible.

Instead we pursued two different strategies to collect the data for the survey, which are described in the next section, both relying on convenience sampling. For this reason the reader should bear in mind that neither of the two approaches will lead to a statistically representative sample. As a consequence it is not advisable to calculate indicators for specific sample stratifications (e.g. by country or industrial sector), since these would not be representative as well.

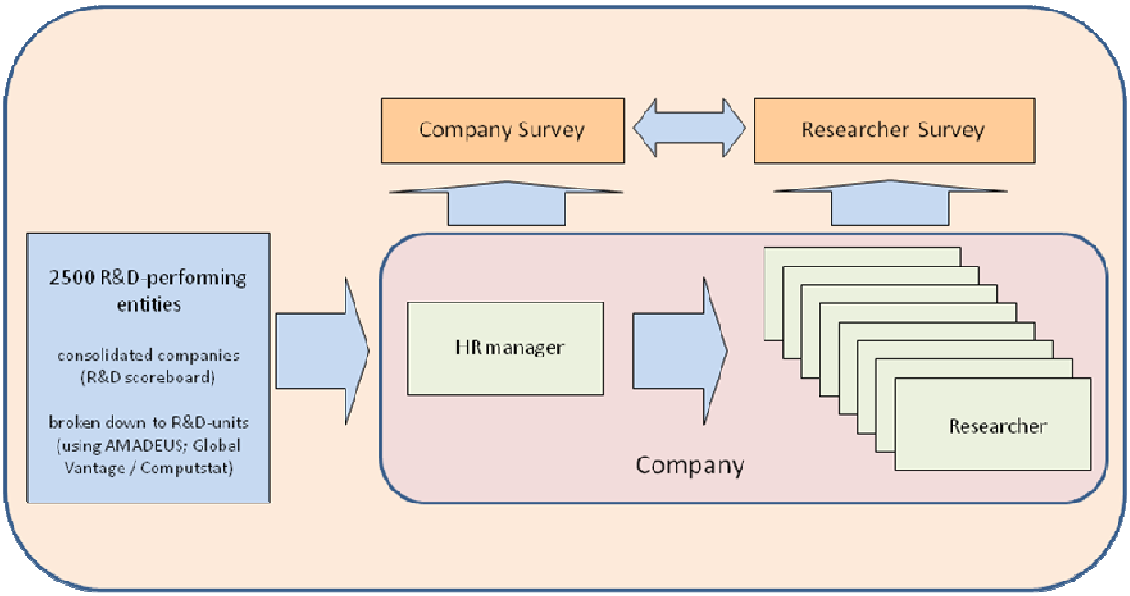
3.2.1 The indirect sampling approach

One way of approaching respondents is through their employers. This survey design is illustrated in figure 3.1. Given that industry researchers will by and large be employed by firms that are active in R&D, a starting point for collecting contact information was the list of the thousand most important R&D investors in Europe provided by the Industrial R&D Investment Scoreboard.[25] The principal

[25] http://iri.jrc.ec.europa.eu/research/scoreboard.htm

advantage of the indirect sampling method through the R&D Scoreboard is that it allows us to capture a large part of the researcher population active in the private sector in the EU. The R&D Scoreboard covers a large share of total R&D investment in the EU. This implies that these firms also employ the largest share of researchers in private industry.

Figure 3.1: The indirect sampling approach of the MORE industry researchers' survey leading to a matched employer-employee data set



However, the R&D Scoreboard presents consolidated data, i.e. the R&D investment of most of the companies listed in the Scoreboard represents an aggregate over all affiliates of a firm. In most cases these affiliates are geographically widely dispersed. In order to reach industry researchers it was therefore necessary to identify those affiliates of the companies listed in the R&D Scoreboard that are engaged in R&D and are located in the EU. Using EPO patent data, the AMADEUS data base and the Global Vantage Database we were able to identify about 2500 such research locations.[26] This list of R&D performing entities was then used to establish contact with the firms.

In order to implement the indirect design, it is also necessary to ask firms to forward the industrial researcher questionnaire to relevant employees. This implies that firms must be given an incentive to participate. For this reason we asked companies to complete a company specific questionnaire that would give managers the opportunity to draw attention to company needs in the recruitment of industry researchers. The company questionnaire asked questions about the basic challenges with regards to the recruiting and the mobility of researchers experienced by R&D-performing companies in Europe. It also asked company specific information (mostly concerning company characteristics, human resource strategies to hire researchers and the company specific R&D organisation), which would have allowed us to characterise the work environment of researchers, and as a consequence, the demand for researchers in industry. In this way the survey design would have led to a matched employer-employee data set. Both questionnaires were implemented over the internet.

[26] AMADEUS: http://www.bvdep.com/de/AMADEUS.html; COMPUSTAT Global Vantage: http://www.compustat.com/

To prepare this survey the project team carried out explorative interviews with human resource and R&D-managers as well as industry researchers. The results of these interviews[27] have been integrated in both questionnaires. The interviews confirmed the validity of the research design. They indicated that the indirect sampling approach could work and all questions asked in the questionnaires are essential. Furthermore, the interviews suggested that human resource managers should be contacted instead of R&D managers as the issue of mobility is closely related to the recruiting of highly skilled employees.

The downside of the indirect sampling approach is that its success depends on the goodwill of human resource managers. Human resource managers for the 2500 R&D performing entities were contacted by phone, with about 1000 human resource managers initially indicating their willingness to participate by providing their email address. The final response rate (approximately 1%), however, was below the limits to warrant a meaningful statistical analysis. Therefore, the project team contacted non-respondents by phone after having sent two survey invitations. Their answers indicated the following main reasons for not participating in the survey.

- It turned out that one of the main reasons for not participating in the survey was the unfavourable economic situation firms had been facing during the survey period (late spring 2009). During that period companies were not interested in recruiting researchers and as a consequence their interest in mobility issues was limited.

- *Complexity of the survey design*: While it was possible to successfully explain the survey design face-to-face in the explorative interviews, it was quite difficult to communicate by email. In general, written survey invitations should not be too long. Otherwise potential respondents are not willing to read the letter of invitation and hence do not fill in the questionnaire. Nonetheless, the emails had to include a minimum of information asking HR managers for both filling in the company questionnaire and forwarding the survey invitation to their employees. Some of the respondents indicated that the email text was too long, although the information was condensed as much as possible.

- *Lag between first contact by phone and email invitation*: The original intention foresaw sending the email invitation shortly after the first contact by phone. However, due to retardation in the compilation of the questionnaires the time lag between the first contact and the email invitation was too large. Some of the respondents did not remember the phone call and had therefore also forgotten the intention of the survey.

- Other reasons have been (i) *spam filters* that blocked the email invitation, or (ii) *confidentiality* issues. Some contacted persons feared to be asked critical questions, although they did not have a look at the questionnaire itself.

The following lessons can be learnt: First, the starting date of the survey has to be carefully chosen to avoid a low willingness to participate in the survey caused by external factors as the economic crisis has been. Second, to be able to successfully communicate what the respondent is asked to do, already the phone call should inform the respondents about these issues and clarify misunderstandings. Furthermore, the phone call must be immediately followed by the email survey

[27] Some results of these interviews are described in chapter 8.1 below.

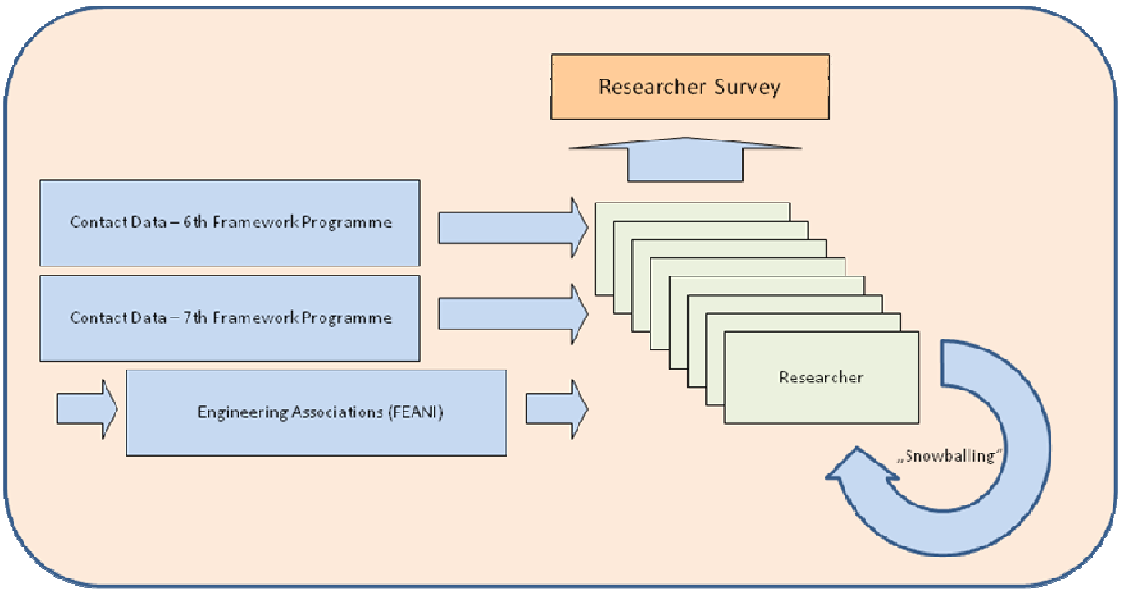
invitation. Third, a much larger sample of contact data might be needed. Otherwise the mentioned obstacles and the subsequent low response rates could produce a too small number of collected observations.

3.2.2 The direct sampling approach

In awareness of the problems related to indirect sampling an alternative approach has been devised to collect data on researchers working in the private sector. This is shown in figure 3.2. In this approach the industrial researcher survey is decoupled from the company survey. In order to reach researchers directly the principal data source was the contact data of applicants to the 6th and 7th Framework Programme for Research and Technological Development (FP6 and FP7) of the European Commission that are employed in private industry. These data were provided by the European Commission. In addition, engineering associations were contacted and asked for support in this project. More specifically, we asked contact persons at these associations to forward survey invitations to their members.[28] Finally, at the end of the online questionnaire, we also implemented an option enabling respondents to forward a survey invitation to colleagues ("snowballing").

After extensive cleaning a total of close to 36000 contacts with valid e-mail addresses (FP 6 approx. 16000; FP7 approx. 19500) were obtained in this way. These individuals were then invited via e-mail to participate in the survey. The respondents received two reminders over a period of one month starting at the end of September 2009. By closing the survey, eight weeks after the launch date, the response rate was close to 20%.

Figure 3.2: The direct sampling approach of the MORE industry researcher survey



Despite the success of data collection, the approach presents a number of potential problems. In case of FP6 contact data, the survey results might be biased towards immobile researchers. As the 6th Framework Programme was running be-

[28] We thank Marjo Hirvonen of the Finnish Association of Graduate Engineers (TEK) as well as Peter Reichel from the Austrian Association of Engineers for their support.

tween 2003 and 2006 valid contact addresses may identify researchers that have not been mobile since then. A problem related to both the contacts of the 6th and the 7th Framework Programme is that they are likely to be biased towards excellent researchers and excellent research organisations. It is well known that firms that are able to participate in the Framework Programmes are typically amongst the most advanced in their respective industries. Furthermore, addressing researchers through engineering associations may imply a potential technological bias as engineers are employed more frequently in specific industries where researchers with natural sciences or social sciences background are left out. Finally, snowballing is well known to lead to a correlated sample structure (since the interviewed are likely to pass on the questionnaire to their peers with similar personal traits and experiences as their own). In order to control for these potential biases during the analysis of the survey responses, several precautions were taken[29].

- We used both application and project data of the framework programmes to reduce the „excellence bias".
- We traced FP6 and FP7 respondents separately in order to be able to identify potential biases resulting from the data base used to construct the list of contacts.
- We traced engineering data with a unique link to identify the subpopulation and analyse the potential (technological) bias for this subpopulation (benchmark FP7).
- We traced the snowballing respondents with a unique link to identify the subpopulation and analyse the potential biases for this subpopulation (benchmark FP7).

3.2.3 Design and implementation of the questionnaires

The investigation of mobility patterns among researchers has to deal with the fact that each instance of researcher mobility is strongly contingent on the researcher's personal characteristics, traits and skills. On the other hand, each instance of researcher mobility is highly contingent on the context and the circumstances under which it occurs. The basic unit of analysis is therefore the instance of mobility, which is nested in each researcher. The researcher on the other hand is herself nested in a specific work environment (the firm) and this is again part of a larger innovation system. This kind of analysis highlights under what conditions mobility occurs, what are context factors which drive or hamper mobility, and also assesses the context factors of mobility and how they impact the direction of mobility (national vs. international, intra-sector vs. inter-sector).

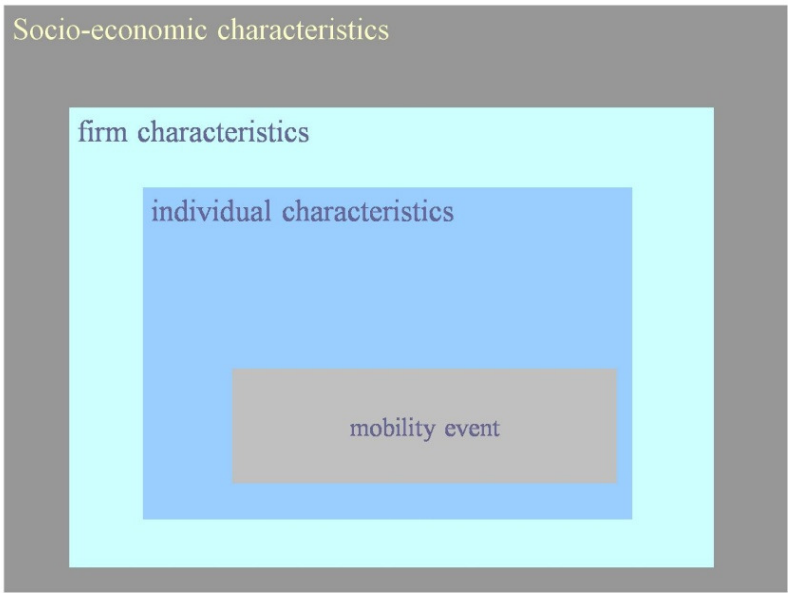
The nested character of mobility data is shown in figure 3.3. Given these considerations, the industrial researcher questionnaire implemented only questions on the last employment spell and the last job change. Therefore, the interviewees had to answer questions about their current employment, their previous employment and questions about their career path as well as their attitudes towards mobility in general. The questionnaire is described in detail below.

[29] The consequences of these precautions are described in chapter 3.3.3.

Each mobility event is a transition between adequately defined employment spells[30]. In order to be able to trace the career path of researchers adequately it would be necessary to draw data for several employment spells. Such a survey design would have the advantage of leading to a panel structure of the data allowing the analysis of mobility steps by comparing these spells. Furthermore, the panel structure would have increased the number of observations (spells) in comparison to the number of observation units (researchers). The downside of the spell-design is potentially burdensome to researchers since filling in multiple spells is more time consuming and hence the response rate can be assumed to be low.

Given these considerations the industrial researcher questionnaire implemented only questions on the last employment spell and the last job change. Therefore, the interviewees had to answer questions about their current employment, their previous employment and questions about their career path and their attitudes towards mobility in general. The questionnaire is described in detail below.

Figure 3.3: The nested character of mobility data of industry researchers



3.2.4 Content and structure of the researcher questionnaire

The questionnaire consists of eight parts. These parts are presented in table 3.1. The questionnaire and a full variable list are shown in the appendix of this report.

In **Part A**, the respondent is asked personal socio-demographic information. These aspects are important for both the career path and mobility events. This information allows the evaluation of life circumstances of the researcher such as being married or having children, on his or her decision to be mobile or not.

[30] An analysis focusing on the level of the instances of mobility allows the analyst to look at the effects of mobility as they are assessed by the individual researcher. Therefore, the industry mobility study originally intended to generate both

(i) data on the level of the researcher, and

(ii) data on the level of each instance of mobility in a researcher's professional biography.

This part of the questionnaire also contains a set of filter questions about whether the respondent is a researcher, scientist or development engineer (A1 and A2[31]), i.e. whether he carries out research or the development of new products or processes, or engages in the supervision of these activities. These questions were included to allow for the exclusion of questionnaires accidentally directed to persons, who are not researchers (see section 3.3.4 below)[32]. Furthermore, educational attainment is ascertained in questions A10-A13.

Part B focuses on the career path of the respondent. The person is asked about the number of jobs (as a researcher, B1-B2) held in the recent past and job changes between within or between the private and the public sector. Furthermore, the motivations underlying the career path of the respondent is explored in a set of questions in B4.

Part C contains questions about the geographical mobility of the respondent. Here questions focus on issues such as whether the respondent has been mobile in the past and/or intends to look for work abroad in the next three years. The respondent is also queried in which countries he or she has worked in the last three years, and what the reasons for working abroad are.

Table 3.1: Structure of the industrial researcher questionnaire

PART	CONTENT	Questions
A	SOCIODEMOGRAPHICS AND R&D ACTIVITIES	A1-A13
B	CAREER PATH – PREVIOUS JOBS AND SECTORAL MOBILITY	B1-B4
C	GEOGRAPHICAL MOBILITY	C1-C4
D	CURRENT EMPLOYMENT	D1-D7
E	MOTIVATIONS / REASONS FOR STARTING WORK AT CURRENT EMPLOYER	E1_i
F	OUTPUT-EFFECTS OF WORKING AT CURRENT EMPLOYER	F1_i
G	NETWORK-EFFECTS OF WORKING AT CURRENT EMPLOYER	G1_i
H	PREVIOUS EMPLOYMENT	H1-H6

In the second part of the questionnaire, information about the last two employment spells (the current and the previous one) are asked and compared. **Part D** asks for the country of work, the field of activity (technological field) and the contract the respondent faces at the current employer. **Part E** focuses on the reasons for starting work at the current employer. **Part F** and **Part G** reflect output and network effects of the decision to start work for the current employer.

In the last section, **Part H**, information on the interviewee's previous employment is collected. The questions in this part are comparable to those addressed in Part D which focused on current employment. The comparison of both employment spells should improve the analysis of the effects of the last job change.

[31] These questions are used to clear responses by dropping observations where the respondent is neither a researcher, nor a scientist nor a development engineer.

[32] An equivalent filter question to identify industry researchers was included in Part D (focusing on the characteristics of current employment).

3.3 Sample description

The data sample used in this study consists of 3061 observations that remain in the data set after rigorous cleaning of the original response data.[33] The responses of the industrial researcher questionnaire have been checked for inconsistencies and cleaned in a number of ways. Besides the correction of obvious logical errors committed by the respondents (e.g. the number of jobs in the last three years is larger than the number of total jobs in the career, etc.), observations have been dropped if they matched at least one of the following criteria:

- the respondent has never been a researcher, scientist or development engineer,
- the respondent is currently working in academics,
- the respondent is not currently residing in an EU-27 country,
- contradictory entries in either number of jobs, or chronology (years) of birth, graduation, and starting to work etc., or the career path description disaccords with the current or previous employer.

In general, as a rule of thumb, we have opted for dropping observations if there were any noticeable problems. The aim was to reduce the noise in the data as much as possible. The iterated application of this procedure led to a data set of 3061 valid observations.

Table 3.2: Number of observations by source of contact

source of contact	Freq.	Percent
FP6	1010	33.00
FP7	1891	61.78
Engineering Associations	29	0.95
Respondents invited by other survey participants („snowballers" – SnB)	117	3.82
Other	14	0.46
Total[34]	3061	100

Source: MORE survey data. WIFO, MCI calculations

As illustrated in table 3.2, the sample is dominated by respondents contacted through the list of applicants and participants to FP7 projects (1891 observations) and to a lesser extent by respondents drawn from FP6 contact data (1010). Another 29 responses were collected from members of European engineering asso-

[33] The original number of observations is not meaningfully available. The participant statistics of the software used for this survey also included double counts (e.g. restart of filling in the questionnaire), responses of participants that started but not completed the survey etc. When cleaning the data, no distinction has been made between dropping double counts (or other cases that should not be counted to identify the original number of observations) on the one hand and contradictory or improper observations (e.g. non-researchers, not residing in the EU, working in academia, etc.) on the other hand.

[34] Deviations in the total sum of observations in the following figures result from missing values in presented variables.

ciations, 117 observations stem from respondents that have been invited by other interviewees ("snowballers") and 14 other responses.[35]

3.3.1 Regional coverage of the sample

2262 respondents (or around 74% of the total sample) resided in the EU15 member states at the time of interview, while only 799 (26%) lived in the EU12 member states. Relative to the distribution of HRST and those employed in research occupations described in the last chapter, where the EU15 account for 80% and 81% of total EU wide employment, the share of EU15 researchers in our data is thus slightly lower. This could be attributed either to a higher share of researchers employed in these occupations in the EU12 than in the EU15 or a slight under sampling of EU15 researchers. Irrespective of the causes for this, however, the potential overrepresentation of EU12 researchers (of around 5 to 6 percentage points) does not seem to preclude analysis of the data at the level of larger EU regions.

The distribution of these observations across countries is shown in figure 3.4.[36] The countries with the highest share of observations in the sample are Germany (18.7%), the United Kingdom (12.3%), Italy (11%), France (10%) and Spain (8.1%). These five countries represent the majority (60.1%) of the overall sample. By contrast the smaller countries of the EU27 (all with the exception of Austria and Denmark) and in particular the EU12 countries account for less than 50 observations each in our sample. In particular, the new member states (NMS) show the lowest shares in the sample, i.e. Malta (0.07%), Cyprus (0.13%), Latvia (0.2%), Lithuania (0.23%), Slovakia (0.42%), Estonia (0.46%), Bulgaria (0.52%), Poland (0.95%), but also Luxembourg (0.23%) has a comparably low share.

Thus the country composition of the number of researchers in our sample reflects both the participation of researchers in the framework program as well as country size and may thus not be representative at the individual country level. Therefore in the remainder of the report we provide results on a country by country basis in a limited number of cases only,[37] and for the majority of results, separate the group of EU27 countries into the EU15 (i.e. the EU member states that were members of the Union already before May 1st of 2004) and the EU 12 (i.e. all countries joining the EU after May 1st 2004), which can be considered more representative.

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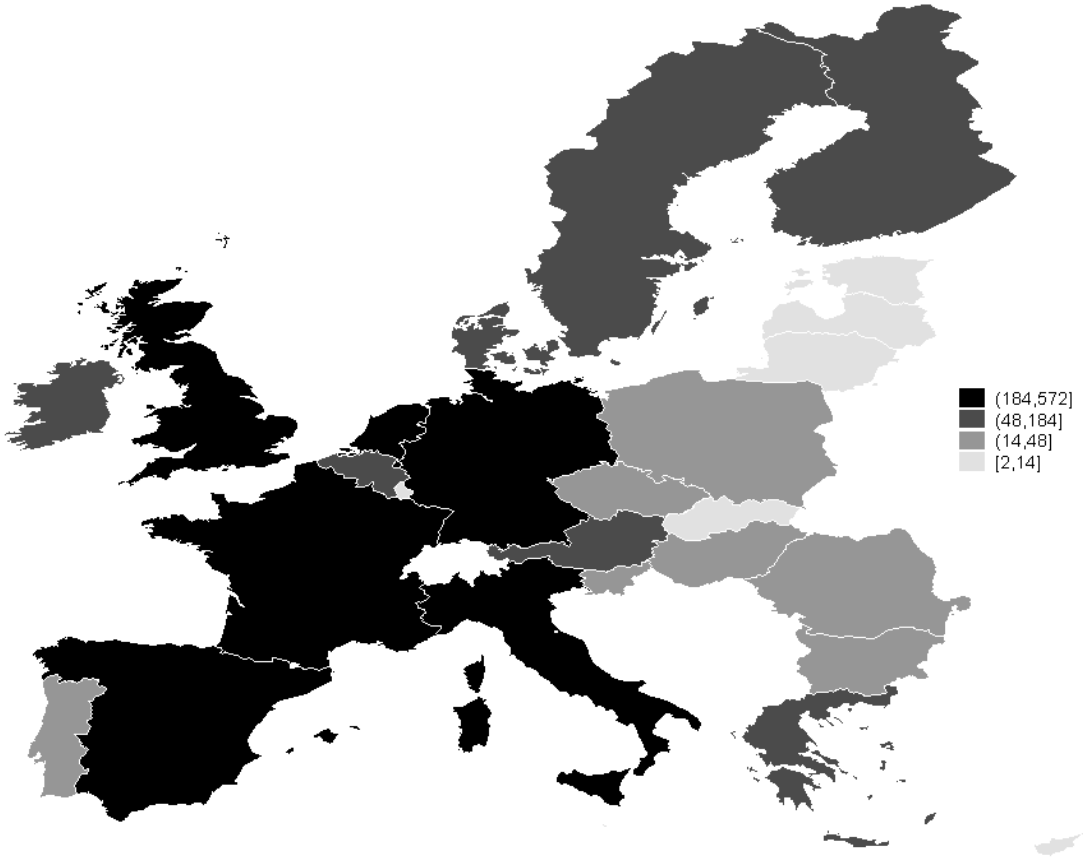
35 These responses consist of 9 employees of the companies contacted in the industry satisfaction study and 5 observations where the respondents cannot be assigned to any of these groups.

36 Before cleaning the data the contact data drawn from the list of applicants to the 6th and 7th Framework Programme also contained a large number of researchers that work and live outside the EU, since it was not possible to identify all these cases and eliminate them from the initial contact list. As a consequence, the sample before cleaning contains data, for instance, on researchers residing in the US, Switzerland or Iceland. Since the study is restricted to persons residing in the EU27 countries these respondents were dropped from the study.

37 Examples include mobility indicators by country in chapter 4 and the network analysis in chapter 5.

Figure 3.4: Country of residence



Note: The figure summarizes the country of residence of the researchers reported in the questionnaires. Shading of the countries indicates the absolute number of observations in the sample. Numbers are given in the Appendix.

Despite the concentration of observations in certain countries, we find a highly significant correlation ($r=0.95$, $p<0.01$) between the economic size of countries measured by GDP and the number of researchers in the sample. This indicates that the geographical distribution of the residence of researchers in the sample is proportionate to the economic size of their countries of residence. Even when excluding the smallest countries with a GDP of less than 100 billion US dollars we find the identical highly significant positive correlation ($r=0.95$, $p<0.01$). Comparing this to HRST statistics, this suggests that the data set's distribution of observations approximates the allocation of researchers across Europe, since the number of researchers can be assumed to increase with higher income. Nevertheless, as already mentioned, the data set is not a statistically representative sample for the total population of researchers, scientists and development engineers in the EU.

Considering the countries of birth of the researchers in our sample provides some evidence of the high level of integration of the European Research system into the international arena. In total out of the sample residing in the EU27 at the time of interview, 6.1% were born outside the EU27, and 6% completed their highest educational degree outside the EU27. Overall, there are researchers born in 83 countries that completed their highest degree in a total of 43 countries in our sample. In addition, these data also suggest that the share of those born outside the EU27 is somewhat higher in the EU12 (7.1%) than in the EU15 (5.5%) and that the mobility of researchers into the EU27 from other countries is more important than intra-EU mobility of researchers for the EU15 but slightly less important for the EU12. In our sample 3.9% of the industry researchers living in the

EU15 were born in the EU12 while 8.3% of the researchers residing in the EU12 were born in the EU 15. Similarly 6.3% of the researchers living in the EU15 graduated in the EU12 and 5.5% of the researchers living in the EU12 graduated in the EU15. By comparison 5.5% of the researchers living in the EU15 and 7.1% of those living in the EU12 were born in countries outside the EU27 and 6.0% and 6.3%, respectively, graduated outside the EU12.[38]

Table 3.3: Interviewed industry researchers by region of residence, region of birth and region of graduation (in %)

	Region of Birth			Region of Graduation			Residing outside country of birth
	EU15	EU12	Other	EU15	EU12	Total	
Residing in EU 15	90.5	3.9	5.5	87.8	6.3	6.0	18.3
Residing in EU 12	8.3	84.6	7.1	5.5	88.2	6.3	18.2
Total	69.1	25.0	5.9	66.3	27.7	6.0	18.2

S: MORE-Questionnaire on industry researchers

The distribution across countries is very similar when comparing the two FP-subsamples differentiated by the source of contact. The correlation between these two distributions is highly significant ($r = 0.97$, $p < 0.01$) While there are some shifts in the group of smaller countries (e.g. there are no entries for Latvia and Malta from FP6 contacts, but 6 and 2 respectively for FP7), the most obvious deviation between these two distributions are Germany and Italy. Germany's domination of FP6 responses decreases in the group of FP7 contacts. Indeed, while every fifth respondent (22.4%) from FP6 contacts resides in Germany, in FP7 the share is about 17.4%. On the other hand, 9.1% of FP6-respondents and 12.4% of FP7-respondents respectively live in Italy. The other subsamples (engineering associations, snowballers and others) are comparably small and therefore also differ in their distribution across countries from the larger samples.

3.3.2 Sector coverage

The researchers in our sample are employed in all of the (NACE 1 digit) sectors of the economy. But as with country of residence, researcher employment is strongly concentrated in only three (NACE 1 digit) industries: manufacturing (34.6%) professional, scientific and technical activities (29.1%) and information and communication (16.6%).

[38] This finding of migration flows from outside the EU being much more important than flows from inside the EU is consistent with recent results in Bonin et al (2008) and Huber (2009). In particular Huber (2009) focusing on the migration of high skilled suggests that the importance of high skilled migration from outside the EU27 to the EU27 relative to that within the EU is even larger than for the low skilled. In addition EC (2008), Moguerou and Di Petrogiacomo (2008) as well as Stimpson (2000) find similar stylized facts for different proxies of researchers.

Table 3.4: Distribution of sectors of current employer

sector of current employer	FP6	FP7	Eng. Assoc.	Other	SnB	Total	t-Test (p-Value) Ha: diff(FP6-FP7) ≠ 0
A-Agriculture, Forestry and Fishing	29	33	0	0	2	64	0.0471 **
	3.51	*2.14*	*0*	*0*	*2.47*	*2.58*	
B-Mining and quarrying	8	9	0	0	1	18	0.2919
	0.97	*0.58*	*0*	*0*	*1.23*	*0.73*	
C-Manufacturing	314	508	9	5	21	857	0.0143 **
	38.01	*32.99*	*42.86*	*50*	*25.93*	*34.58*	
D-Electricity, gas, steam and air conditioning supply	20	52	0	0	3	75	0.1974
	2.42	*3.38*	*0*	*0*	*3.7*	*3.03*	
E-Water supply, sewerage, waste management & remediation activities	8	25	0	0	1	34	0.1956
	0.97	*1.62*	*0*	*0*	*1.23*	*1.37*	
F-Construction	13	30	0	0	2	45	0.5162
	1.57	*1.95*	*0*	*0*	*2.47*	*1.82*	
G-Wholesale and retail trade repair of motor vehicles & motorcycles	5	4	0	0	0	9	0.1932
	0.61	*0.26*	*0*	*0*	*0*	*0.36*	
H-Accommodation and food service activities	24	70	0	0	0	94	0.0516 *
	2.91	*4.55*	*0*	*0*	*0*	*3.79*	
I-Transportation and storage	3	4	0	0	0	7	0.6589
	0.36	*0.26*	*0*	*0*	*0*	*0.28*	
J-Information and communication	131	257	7	0	16	411	0.6040
	15.86	*16.69*	*33.33*	*0*	*19.75*	*16.59*	
K-Financial and insurance activities	4	3	0	0	0	7	0.2167
	0.48	*0.19*	*0*	*0*	*0*	*0.28*	
M- Professional, scientific and technical activities	229	450	3	4	34	720	0.4432
	27.72	*29.22*	*14.29*	*40*	*41.98*	*29.06*	
N-Administrative and support service activities	3	5	1	0	0	9	0.8778
	0.36	*0.32*	*4.76*	*0*	*0*	*0.36*	
O-Public administration & defence; compulsory social security	1	7	0	0	0	8	0.1830
	0.12	*0.45*	*0*	*0*	*0*	*0.32*	
P-Education	3	4	0	0	0	7	0.6589
	0.36	*0.26*	*0*	*0*	*0*	*0.28*	
Q-Human health and social work activities	21	37	0	1	1	60	0.8341
	2.54	*2.4*	*0*	*10*	*1.23*	*2.42*	
R-Arts, entertainment and recreation	0	9	0	0	0	9	0.0277 **
	0	*0.58*	*0*	*0*	*0*	*0.36*	
S-Other service activities	8	31	1	0	0	40	0.0572 *
	0.97	*2.01*	*4.76*	*0*	*0*	*1.61*	
T-Activities of households as employers	2	0	0	0	0	2	0.0534 *
	0.24	*0*	*0*	*0*	*0*	*0.08*	
U-Activities of extraterritorial organizations and bodies	0	2	0	0	0	2	0.3003
	0	*0.13*	*0*	*0*	*0*	*0.08*	
Total	826	1540	21	10	81	2478	

Note: Table contains the number of observations for the sectors of the current employer reported in the questionnaire. The t-Tests evaluate differences in the distribution of observations between the subsamples drawn from FP6 and FP7 contacts. Numbers in Italic show the share within a column in percent (Total = 100%).

These sectors in total account for more than 80% of the employment of the researchers in our sample (Table 3.4). When considering that researchers working in academia have been excluded from this sample results are consistent with ear-

lier findings on the sector distribution of industry researchers (see for instance Idea Consult, 2009).

The share of researchers in each of the other sectors defined by the NACE rev.2 sections is well below 4%. Again, the distribution between the FP-subsamples is very similar and highly correlated ($r = 0.99$, $p < 0.01$). Moreover, the respondents within the smaller subsamples (engineering associations, snowballers and others) are mainly working in these sectors.

3.3.3 Coverage of mobile industry researchers

Our sample also suggests that a substantial part of the industry researchers in Europe were already mobile during their studies. A total of 20.9% of them indicate that they have studied abroad and for 16.1% of them the country of birth is different from the country in which they completed their highest education. The percentage of researchers who were mobile prior to graduation is slightly higher in the EU15 than in the EU12, which can probably be attributed to the shorter time period for which researchers from the EU12 were able to benefit from integration in the European Union and mobility enhancing subsidies among students such as the ERASMUS program.[39]

Mobility after graduation from outside the EU27 also seems to be of about equal importance as mobility within the EU. Around 6% of the industry researchers residing in the EU graduated in a country outside the EU, while approximately an equal share of those residing in the EU15 graduated in the EU12. Similarly about 5.5% of the researchers residing in the EU12 graduated in the EU 15.

Table 3.5: Interviewed industry researchers by region of residence and region of work

Works in…	Resident in EU15	Resident in EU12
Own Country EU15	93.8	-
Other Country of EU15	2.0	1.6
Own Country EU12	-	93.7
Other Country of EU12	0.2	0.5
other Region	4.0	4.1
Total	2262	799

S: MORE-Questionnaire on industry researchers, values in brackets = based on less than 30 observations.

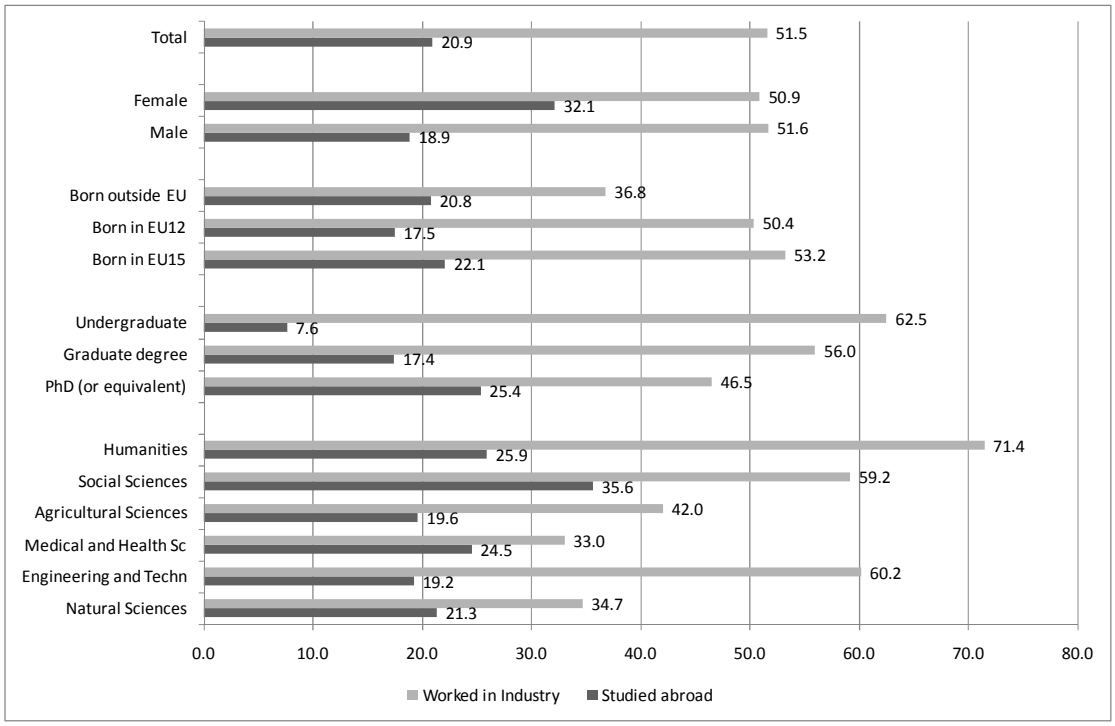
In addition, the data also suggest that, while apparently low, cross-border commuting is substantially higher among researchers than among the overall European population, and that cross border commuting to non-EU27 countries is more important than commuting within the EU27.[40] In our sample almost 94% of the researchers residing in the EU27 live and work in the same country, while 2% of the industry researchers living in the EU15 or the EU12 in our sample work in another country of the EU15. Cross-border commuting to EU12 countries is only of very minor importance, 4% of these researchers commute to non-EU countries (see Table 3.5), with about half the researchers commuting to Switzerland, Norway or Liechtenstein, and the majority of the rest to very distant countries lo-

[39] See Parey and Waldinger (2007) for a description of the participation in the ERASMUS program and an evaluation of the mobility enhancing effects of this program.

[40] It should, however be noted that these findings are based on a relatively small sample. In total there are only 190 commuters in our data.

cated in other continents. This suggests that cross-border commuting is more important among industry researchers than among the population at large, since evidence from the European Labour Force survey implies that only about 0.6% of the total employed in the EU commute across borders (see: Huber, 2008)

Figure 3.5: Share of industry researchers that studied abroad or worked in industry during their studies by gender, country and birth, highest completed education and field of highest degree



S: MORE-Questionnaire on industry researchers, values in brackets = based on less than 30 observations. Note: Share of those studying abroad and working in industry is zero for persons with a completed secondary or vocational education only.

Finally, since industry researchers that studied abroad or worked in industry during their studies are groups of own interest and since as will be shown both having worked in industry during studies as well as having worked abroad are an important correlate of the mobility behaviour of industry researchers figure 3.5 displays the share of industry researchers in our sample that have been working in industry during their studies or have studied abroad by various demographic characteristics. As can be seen aside from a large share of our industry researchers having studied abroad, also working in industry during studies is a common phenomenon among industry researchers. More than half of the industry researchers (51.5%) sampled state that they worked in industry during their studies. In particular among industry researchers, who ended their studies with an undergraduate degree, studied humanities or engineering and technology the share of those that worked in industry during their studies exceeds 60%. Among industry researchers that studied natural sciences, medical and health sciences as well as agricultural sciences and among industry researchers that completed a PhD this share is somewhat lower than average.

Furthermore the share of industry researchers that worked during their studies is also higher among males and industry researchers born in the EU12 than among females or industry researcher in the EU12 or in countries outside the EU.

With respect to studying abroad, by contrast, the highest shares of those that studied abroad are found among females (32.1%) and social scientists (35.6%) as well as among PhDs (25.4%) and students of humanities (25.9%) and the lowest shares of those studying abroad are registered among undergraduates (7.6%) those born in the EU (17.5%), males (18.9%) and persons that studied agricultural sciences or engineering and technology (19.2%).

Table 3.6: Mobility – comparing FP6 and FP7 subsamples

M							
FP6	EU15	EU12	total	FP7	EU15	EU12	total
non-mobile	457	161	618	non-mobile	796	310	1106
	45%	*16%*	*61%*		*42%*	*16%*	*59%*
Mobile	290	102	392	mobile	596	187	783
	29%	*10%*	*39%*		*32%*	*10%*	*41%*
total	747	263	1010	total	1392	497	1889
	74%	*26%*	*100%*		*74%*	*26%*	*100%*
M1							
FP6	EU15	EU12	total	FP7	EU15	EU12	total
non-mobile	676	238	914	non-mobile	1242	447	1689
	67%	*24%*	*90%*		*66%*	*24%*	*89%*
mobile	71	25	96	mobile	151	51	202
	7%	*2%*	*10%*		*8%*	*3%*	*11%*
total	747	263	1010	total	1393	498	1891
	74%	*26%*	*100%*		*74%*	*26%*	*100%*
M2							
FP6	EU15	EU12	total	FP7	EU15	EU12	total
non-mobile	528	186	714	non-mobile	948	362	1310
	52%	*18%*	*71%*		*50%*	*19%*	*69%*
mobile	219	77	296	mobile	445	136	581
	22%	*8%*	*29%*		*24%*	*7%*	*31%*
total	747	263	1010	total	1393	498	1891
	74%	*26%*	*100%*		*74%*	*26%*	*100%*

	reg	EU15	EU12	total
t-Test: H1 => M(FP6,reg)-M(FP7,reg)≠0	M	0.0739	0.7549	0.1681
t-Test: H1 => M1(FP6,reg)-M1(FP7,reg)≠0	M1	0.3345	0.7481	0.3199
t-Test: H1 => M2(FP6,reg)-M2(FP7,reg)≠0	M2	0.2105	0.5658	0.4285

S: MORE-Questionnaire on industry researchers. The table illustrates the numbers of (non-)mobile researchers in the subsamples drawn from FP6 and FP7 contact data by region. The shares of the respective numbers in the total sub-sample (FP6, FP7) are shown in italic. The definitions of mobility (M, M1 and M2) are based on the question "Have you ever been mobile since graduation?" conditional the country of citizenship ≠country of highest diploma (M1) or country of citizenship = country of highest diploma (M2). The t-tests is based on the comparison of shares of mobile researchers in the respective region (reg = EU15 or EU12) in the subsamples (FP6 versus FP7).

We have already mentioned that the different sources from which the respon-dents were drawn might cause a bias in the data. In particular, there is danger that the mobility of researchers in the last three years is severely underestimated due to the respondents from the contact data drawn from the FP6 list which should be expected to have been immobile in the past three years if we are able to contact them. However, Table 3.6 shows that the indicators for mobility differ only slightly between FP6 and FP7 respondents. The difference is insignificant in all except one case. The share of researchers residing in the EU15 countries that have been mobile since their graduation is significantly higher within the FP7 sub-

sample when compared to the FP6 subsample. On the other hand, the mobility indicators referring to mobility in the past three years are not statistically different between FP6 and FP7 respondents. Therefore, the suspected bias that non-mobile researchers are overrepresented in the FP6 contact list cannot be confirmed.

To summarise the comparison between the subsamples by source of contact, the analysis shows that the subsamples of respondents drawn from FP6 and FP7 contact data are very similar[41]. A bias in the data leading to an underestimation of mobility in the FP6 subsample cannot be established. However, it is not possible to control whether our data are biased towards excellence as it is not possible to establish a control group of non-applicants to the Framework Programmes. The companies applying for support in the context of the Framework Programmes probably have specific characteristics that are different from those not applying. Therefore, it might be assumed that, for instance, the biggest companies are overrepresented in the FP contact data. Further research is needed to evaluate the representativity (i.e. specific characteristics) of a sample drawn from Framework Programme contacts in comparison to the overall industry researcher population in Europe.

3.3.4 Tasks of researchers in their jobs

In the questionnaire respondents were asked whether their current jobs encompass carrying out research, improving products or processes, developing new products or processes, supervising research or supervising improvement & development of products or processes. In addition all respondents were asked whether their job-related activities include the development and application of new techniques or knowledge. We use the answers to these inquiries to define four types of industry researchers (Table 3.7):

1. Researchers in the broadest sense are those that have a job which encompasses one of the following activities: carrying out research, improving products or processes, developing new products or processes, supervising research or supervising improvement of products & development of new products and processes or whose job-related activities include the development and application of new techniques or knowledge.

2. Supervisors are those that have a job which only encompasses supervising research or supervising improvement of products & development of new products and processes. Their job does not include any other research activities.

3. Researchers in a narrow sense are those whose jobs encompass carrying out research, improving products or processes, developing new products or processes. No supervising activities are included.

4. Other researchers are those whose job encompasses activities that are both supervisory as well as the narrowly defined research tasks.

These definitions point to the relatively diverse structure of activities that are engaged in by industry researchers. Nearly all of those sampled have tasks that encompass both the supervision (supervising research, supervising product improvement & development of new products and processes) as well as the re-

[41] Further statistical comparisons of FP6 and FP7 subsamples by country and sector are shown in the appendix.

search role (carrying out research and development and improving products and processes). Only 239 of our researchers work exclusively in the supervision of research, and only 200 are solely involved in conducting research. More than 85% of the industry researchers have jobs that encompass both supervision and research tasks. From the point of view of presenting results in this study this suggests, that a further differentiation between research supervisors and researchers in a narrow sense is not possible. Thus for the remainder of this study we focus on the definition of researchers in the broadest sense.

Table 3.7: Researchers by activities required in their job

	EU15	EU12	Total	EU15	EU12	Total
Does your current job encompass		In %			Total	
Carrying out Research	61.9	66.1	63.0	1132	433	1565
Improving Products or Processes	76.3	80.7	77.5	1411	527	1938
Developing new Products or Processes	74.6	80.3	76.1	1410	555	1965
Supervising Research	77.5	76.1	77.1	1503	506	2009
Supervising Improvement & Development	80.7	82.9	81.3	1558	557	2115
Type of Researcher						
Supervisors only*	8.4	6.3	7.8	189	50	239
Researchers only**	6.7	6.0	6.5	152	48	200
Do your job-related activities include the development and application of new techniques or knowledge?						
Yes	94.7	95.1	94.8	2118	744	2862
Total Sample	100.0	100.0	100.0	2262	799	3061

S: MORE-Questionnaire on industry researchers * Supervisors only: Current job encompasses supervising activities, but neither carrying out research, nor improving nor developing new products or processes. ** Researchers only: Current job encompasses carrying out research, improving, or developing new products or processes, but none of the supervising activities.

Furthermore, the data also suggest that around 6% of the researchers in the broadest sense consider themselves as having jobs that do not include the development and application of new techniques or knowledge, although by definition our data only covers researchers, who perform research tasks as defined by the Frascati manual (OECD, 2002)

3.3.5 Personal and job characteristics of researchers

Aside from their tasks and their mobility researchers were also asked questions on a number of personal characteristics and job characteristics. Results concerning these questions (shown in tables 3.8 and 3.9 below) suggest that industry researchers are mostly male. Indeed, only 15.1% of the interviewed researchers are female, likely because the degree fields were primarily engineering and technology or the natural sciences, disciplines which are known to be disciplines by male students in most of the EU27 countries as well as the fact that – all else equal - women are less likely to take jobs in industry than men, at least in many countries. [42] Most of the researchers in our sample are also married, have a PhD or a graduate degree, are about 45 years old, on average, have graduated

[42] For instance, according to the "She Figures 2009" in 2009 (see: http://www.eumonitor.net/) the share of female researchers in the higher education and government sector was 37% and 39%. In the business and enterprise sector it, however, amounted to only 19%. This figure compares well to the figure in the present study of 15.1%. The remaining differences may be related to different data collection methods.

around 16 years ago, and have, on average, two children of which the oldest is aged around 15.[43]

In addition there are also some interesting differences between regions of residence in the demographic characteristics of the researchers. In particular, industry researchers in the EU12 are even more often male than those in the EU15. They are also more likely to have a degree in social sciences and to be slightly older than their EU15 counterparts. They are more likely to have completed a PhD than industry researchers in the EU15, but in accordance with their higher age, they have obtained their highest degree at an earlier date.

With respect to job and firm characteristics, researchers in our sample overwhelmingly work in full time jobs, have an open-ended contract and work at a private company. Furthermore, the average tenure of an industry researcher is 10 years in our sample. Thus, in contrast to academic researchers, for industry researchers fixed term contracts and part time work are much more seldom and many of them have a relatively long tenure with their respective firm, which is indicative of lower mobility rates. Both these stylised facts may be explained by the fact that a large share of these researchers work in manufacturing and financial services, where in general the shares of atypical work (both with respect to part time and fixed term contracts) are low and average tenure is long.

This later finding of longer tenure applies in particular when comparing industry researchers to researchers in academia and arises primarily on account of a substantially lower share of very short employment spells of less than 2 years. For instance according to the academic survey (Idea Consult 2009a p 35) "42% of the academic researchers have been employed by their principal employer for more than 10 years, 16% for 7 to 10 years, 22% for 3-6 years and 20% for 2 years or less". With respect to the industry researchers these shares are comparable for the long duration spells over 10 years, in which 43% of the industry researchers are employed, but substantially higher for the 7-10 year spells (22.7%) at the expense of the very short spells of 2 years or less, which account for only 13% of our sample.[44]

[43] Relative to researchers in academia the industry researchers sampled in this questionnaire - as was to be expected – are more often male. Among the academic researchers the share of males is 63% (see: Idea Consult 2009a). Furthermore, researchers in industry are slightly older with only about 48% of the researchers being younger than 45 as opposed to over 50% for the academic researchers, are more often married and are more likely to have children. Furthermore, the industry researchers are also much less likely to have completed a postgraduate degree (PhD or equivalent) and are much more likely to have a degree in engineering and/or the natural sciences (see Idea consults, 2009a).

While we cannot be sure that these results are due to an oversampling of in particular older and married industry researchers they are not unexpected. Given that (as will also be shown in chapter 4 below) industry researchers often start their career in academia and then move on to industry research, industry researchers must be older than academic researchers almost by definition. Furthermore, age closely correlates with the probability to be married.

[44] The share of a length of 3 to 6 years is 22% in our sample and thus also comparable to that found in the academic survey

Table 3.8: Personal characteristics of researchers by region of residence

	EU15	EU12	Total
		Gender	
Male[1)]	84.4	86.3	84.9
Female[1)]	15.6	13.7	15.1
Age	44.7	47.7	45.5
Year since graduation	16.5	18.6	17.0
		Marital Status	
Married/cohabitating[1)]	84.5	84.5	84.5
Single[1)]	10.3	9.8	10.2
Widowed[1)]	(0.2)	(1.1)	(0.5)
Divorced[1)]	4.2	4.0	4.1
Other[1)]	(0.8)	(0.5)	(0.7)
		Highest Completed Education	
PhD (or equivalent) [1)]	50.6	51.9	51.0
Graduate degree[1)]	42.3	32.0	39.6
Undergraduate[1)]	5.0	13.0	7.1
Secondary Education[1)]	1.6	2.4	1.8
Vocational Education[1)]	(0.1)	(0.4)	(0.2)
Other[1)]	(0.3)	(0.3)	(0.3)
		Children	
Children[1)]	72.7	78.8	74.3
Number of Children[2)]	2.1	2.1	2.1
Age of Oldest Child	14.6	18.6	15.7
		Field of highest degree	
Natural Sciences[1)]	29.1	29.2	29.1
Engineering and Technology[1)]	60.6	56.5	59.5
Medical and Health Sciences[1)]	3.3	4.2	3.5
Agricultural Sciences[1)]	1.7	(1.8)	1.7
Social Sciences[1)]	4.2	7.4	5.0
Humanities[1)]	(1.1)	(0.9)	1.1
		Age Groups	
24 to 29	2.1	2.3	2.2
30 to 34	10.1	7.8	9.5
35 to 39	18.2	12.1	16.6
40 to 44	21.3	15.5	19.8
45 to 49	18.6	17.3	18.2
50 to 54	14.7	18.3	15.6
55 to 59	9.5	15.6	11.1
50+	5.5	11.1	7.0

S: MORE-Questionnaire on industry researchers 1) in % of total 2) average among those with children, values in brackets = based on less than 30 observations.

Table 3.9: Firm and Job Characteristics of researchers by region of residence

	EU15	EU12	Total
Tenure (Years)	10.1	11.3	10.4
	Organisation Type		
Company/Self Employed[1)]	86.4	81.3	85.1
Research Lab/Organisation[1)]	9.6	13.2	10.5
Other[1)]	4.0	5.5	4.4
	Field of Technonlogy[3)]		
Human Necessities[1)]	6.4	5.1	6.1
Performing Operations[1)]	6.4	4.2	5.8
Chemistry, Metalurgy[1)]	12.3	13.0	12.5
Textiles, Paper[1)]	1.5	1.3	1.4
Fixed Constructions[1)]	1.8	0.9	1.6
Mechanical Engineering [1), 2)]	16.5	15.7	16.3
Physics[1)]	8.3	11.9	9.2
Electricity[1)]	6.8	8.1	7.1
Unknown/no answer[1)]	40.1	39.7	40.0
	Type of Contract		
Fixed term, < 1 years[1)]	(1.0)	(1.0)	(1.0)
Fixed term, 1-2 years[1)]	1.5	(0.9)	1.3
Fixed term, > 2 years[1)]	8.0	3.7	6.9
Open ended contract[1)]	76.9	82.3	78.3
Non-employment[1)]	(0.5)	(0.3)	(0.4)
Self-employed[1)]	9.8	9.1	9.6
Other[1)]	2.4	2.7	2.5
	Working time (in % of full time contract)		
0-20%[1)]	(0.2)	(0.5)	(0.3)
20-40%[1)]	(0.1)	(0.5)	(0.2)
40-60%[1)]	1.6	(2.3)	1.8
60-80%[1)]	1.3	(1.7)	1.4
80-100%[1)]	2.6	(1.6)	2.3
100%[1)]	94.2	93.4	94.0

S: MORE-Questionnaire on industry researchers¸1) in % of total 2) including: Lighting, Heating, Weapons, Blasting 3) includes only researchers working in companies, values in brackets = based on less than 30 observations.

A large share of the industry researchers (almost 10%) are self employed. Although the sample of self-employed researchers is too small to allow a detailed analysis of this group, the results of the survey suggest that many of these self-employed researchers - even more strongly than overall researchers - are working in the financial services sector (over 45%),. In addition these researchers are overwhelmingly male (92%) and slightly older (around 50 years) but have less often completed a PhD (43%) than other industry researchers.[45]

As with data on personal characteristics, there are also some important differences in job and firm characteristics by region of residence. In particular we find a higher share of researchers working in research labs and in open-ended con-

[45] In addition they also more often than other industry researchers have completed a degree in natural sciences or engineering and technology.

tracts in the EU12. This can probably be attributed to differences in the organisation of industry research in the EU12 and the EU15.

Table 3.10: Industry researchers by field of highest degree and technological field of work

	Natural Sciences	Engineering and Technology	Medical and Health sciences	Agricultural Sciences	Social Sciences	Humanities
Human Necessities	9.7	2.8	30.3	9.4	9.8	4.8
Performing Operations	3.2	7.0	0.0	3.1	13.7	4.8
Chemistry, Metallurgy	20.7	9.8	6.1	3.1	3.9	4.8
Textiles, Paper	0.8	1.8	0.0	0.0	2.0	0.0
Fixed Constructions	1.0	2.1	0.0	0.0	0.0	0.0
Mechanical Engineering	4.6	24.7	1.5	0.0	3.9	4.8
Physics	18.1	6.2	1.5	0.0	1.0	4.8
Electricity	2.4	9.9	0.0	0.0	4.9	4.8
Unknown/no answer	39.6	35.6	60.6	84.4	60.8	71.4
Total	629	1270	66	32	102	21

S: MORE-Questionnaire on industry researchers

Finally, table 3.10 indicates that natural scientists often work in chemistry and metallurgy and engineers in mechanical engineering. Social scientists and the few industry researchers that completed their highest degree in the humanities are much more evenly spread across the technology fields. Agricultural scientists are the most likely to not give a concrete answer as to their field of research, possibly indicating the relatively wide spectrum of their research.

3.3.6 Summary

In sum the data collected on industry researchers from the questionnaire seems to represent a reliable data source on the structure and mobility behaviour of industry researchers. In particular our original fear that drawing from various different sampling populations may lead to substantial differences between researchers depending on the groups from which they were sampled seems to be unwarranted.[46]

In addition our data – by comparison to the results of the academic survey conducted in the MORE project - suggest that relative to researchers in academia the industry researchers sampled in this questionnaire are more often male slightly older, more often married and are more likely to have children. They are also much less likely to have completed a postgraduate degree (PhD or equivalent) and are much more likely to have a degree in engineering and/or the natural sciences. In addition for industry researchers fixed term contracts and part time work are much more seldom and many of them have a relatively long tenure with their respective firm.

[46] This thus points towards internal consistency of the sample but – as already explained above not necessarily to representativeness of the population under study.

4 EVIDENCE ON THE MOBILITY OF RESEARCHERS

4.1 Introduction

As indicated earlier, the primary focus of this study is the mobility of industry researchers in the EU. In this chapter we provide evidence on the extent and intensity (as measured by the number of stays and the duration of stay of migrants abroad) of international mobility among industry researchers in the EU27. To the extent that our sample allows, we will also examine differences in the extent and intensity of mobility among EU regions (i.e. the EU12 and the EU15) and will compare indicators of international mobility among industry researchers with the mobility of academic researchers as well as the population at large.

Furthermore, we will present indicators concerning job changes, types of career paths and the flows between different labour market states among industry researchers in our sample. Aside from providing quantitative estimates on the extent of each of these different indicators of career paths of industry researchers, and comparing results to those from the literature on academic researchers and the overall population, we also illustrate the strong association between international mobility and industry researchers' career paths.

We classify researchers into those who are internationally mobile and those who are immobile. Based on question no. 39 in the master questionnaire, a researcher is classified as mobile if he/she agreed to the following statement: "Since your graduation have you ever worked as a researcher, scientist or development engineer in a country other than the country you graduated in for more than three months"

The next section of this chapter discusses the extent and intensity of international mobility, section three focuses on career paths and job changes, and conclusions are drawn in section four.

4.2 International mobility

4.2.1 Types of international mobility

Around 41% of the industry researchers residing in the EU27 state that they have once worked as researchers abroad. 10.3% have been internationally mobile in the last three years. 18% are currently residing in another country than that in which they received their highest degree (including their PhD) and 18.3% of the industry researchers live in another country than the one they were born in. Furthermore for 34% of those who worked previously at a different job, this previous job was located in a different country than the one they currently work in (see table 4.1).

Compared to the total European population industry researchers residing in the EU27 are characterised by high mobility rates. For instance, Bonin et al. (2008) find that among all residents in the EU15 only 12.9% were born in another coun-

try than the one they currently live in. In the EU12 this share is just 6%. Compared to academic researchers industry researchers are, however, less mobile. According to the Academic Survey over 50% of the academic researchers residing in the EU27 had once worked abroad (see Idea Consult 2009a).

Table 4.1: Indicators of international mobility among industry researchers

	Current Region of Residence					
	EU 15	EU 12	Total	EU 15	EU 12	Total
	Respondents			In % of Total		
Have never worked as researcher abroad[1)]	1,308	487	1795	57.9	61.0	58.7
Have worked as researcher abroad[1)]	953	311	1264	42.1	39.0	41.3
Not worked abroad in last 3 years[8)]	2,019	726	2745	89.3	91.0	89.7
Worked abroad in last 3 years[8)]	243	73	316	10.7	9.1	10.3
Currently live in country of highest education[2)]	1,805	685	2490	79.8	85.7	81.3
Currently live elsewhere[2)]	457	114	571	20.2	14.3	18.7
Currently live in country of birth[3)]	1,849	654	2503	81.7	81.9	81.8
Currently live elsewhere[3)]	413	145	558	18.3	18.1	18.2
Mobile before and after graduation[4)]	248	81	329	11.0	10.1	10.7
Mobile only after graduation [5)]	705	230	935	31.2	28.8	30.5
Previous Employer in Same Country[6)]	1,414	549	1963	62.5	68.7	64.1
Previous Employer in other Country[6)]	779	226	1005	34.4	28.3	32.8
Do not Plan to be mobile[7)]	1,449	556	2005	64.1	69.7	65.5
Plan to be mobile[7)]	812	242	1054	35.9	30.3	34.5

S: MORE-Questionnaire on industry researchers 1) Based on question: Since your graduation have you ever worked as a researchers, scientist or development engineer in a country other than the country you graduated in for more than three months? 2) Based on question on country of graduation and country of residence 3) Based on question on country of birth and country of residence 4) Country of nationality/citizenship is not the country of highest diploma (including PhD) and have been mobile 5) Country of nationality/citizenship is the country of highest diploma (including PhD) and have been mobile 6) Only for the subsample of those previously employed, based on questions on country of current employment and the country of previous employment 7) Based on question: Do you intend to look for work (lasting for more than 3 months) in another country in the next 3 years? 8) Researcher that have been mobile (see note 1) and have at least one spell abroad in the last three years

High mobility also applies to migration plans. Around 35% of the industry researchers intend to look for work abroad in the next three years. Here, however, mobility intentions are substantially lower than found in few available European data sets that examined this issue. In particular, Fourage and Ester (2007) using a similar question from the EUROBAROMETER find that 5.4% of the interviewed intend to move across national borders. Intended mobility among industrial researchers also seems to be substantially lower than among academic researchers, where 66% have actively considered being mobile in the future (see IDEA Consult, 2009a)

There are also some important differences in the mobility of industry researchers by region of residence. Industry researchers residing in the EU12 are generally less mobile than those in the EU 15. This applies both to past mobility and inten-

tions to look for work abroad. Only 39% of the industry researchers residing in the EU12 (as opposed to 42.1% of the industry researchers residing in the EU15) have ever worked as a researcher in another country, 10.7% of those residing in the EU15 relative to 9.1% residing in the EU12 have worked abroad in the last three years, and only 14.1% (as opposed to 20.2% of the EU15 researchers) currently live in another country than that in which they received their highest degree. Similarly the share of previously employed industry researchers that moved to their new job from another country is 28.3% among the residents of the EU12 but 34.4% among the residents of the EU15.

Furthermore, only 30.3% of the EU12 industry researchers (as opposed to 35.9% of the EU15 industry researchers) intend to look for work in another country in the next three years.

The only indicator for which differences between these regions are smaller is the share of industry researchers which live in a country other than that of their birth. This applies to 18.1% of the industry researchers residing in the EU12 and 18.3% of the industry researchers residing in the EU15.

We also calculated the share of mobile researchers[47] in the sample broken-down by the country of residence[48]. For most of the EU12 countries as well as for Luxemburg, however, we have less than 30 observations, which makes us sceptical concerning the conclusions with respect to this indicator. We thus report the results to the appendix (see table A3.1 in Appendix3). Disregarding all countries with less than 30 observations in this table we see that the share of mobile researchers is highest in Ireland (63%). Belgium ranks second with its 58% share of mobile researchers, a figure significantly higher than in Germany, Finland, the UK and Italy. Third in the sample is France (49%). By contrast at the lower end of the spectrum, we find the Baltic countries and Italy, where the share of the internationally mobile industry researchers is less than a third.

4.2.2 Number of stays abroad and duration of stay

Internationally mobile industry researchers living in the EU27 tend to have only one stay abroad (table 4.2) in the last three years. Only 2.5% of them have worked abroad 2 or more times in the last three years. Regional differences in the number of stays abroad are small. In the EU15 the share of researchers with 2 or more episodes of working abroad is 2.6%, in the EU12 the share is 2.1%.

[47] Mobile researchers are considered to be those, who worked in a country other than the country they graduated in (as a researchers, scientist or development engineer) for more than three months

[48] Figure A3.1 and tables A3.1 and A3.4 (in appendix 3) provide information on the share of mobile and the mobile in the last three years by nationality

Table 4.2: Number of Stays abroad among industry researchers in the last three years

No. Of stays abroad	EU15	EU12	Total
0	89.3	90.9	89.7
1	8.1	7.1	7.9
2	1.9	(1.4)	1.8
3	(0.5)	(0.4)	(0.5)
4 or more	(0.2)	(0.3)	(0.2)

S: MORE-Questionnaire on industry researchers, based on question: Please provide the name of the countries you worked in as a researcher, scientist or development engineer for a minimum of 3 months in the last 3 years and indicate the duration of your stays beginning with your longest stay (max. No. of entries 5 stays), values in brackets = based on less than 30 observations.

Table 4.3: Duration of longest stay among industry researchers in the last three years

	EU15	EU12	Total
>=3 and < 6 months	16.1	(20.1)	17.3
>=6 and <12 months	17.1	(12.3)	15.8
>=1 year and < 2 year	16.0	(16.4)	16.1
>=2 years and < 3 yea	(11.1)	(17.8)	12.7
>=3 years	39.6	(33.3)	38.2

S: MORE-Questionnaire on industry researchers Based on question: Please provide the name of the countries you worked in as a researcher, scientist or development engineer for a minimum of 3 months in the last 3 years and indicate the duration of your stays beginning with your longest stay (max. No. of entries 5 stays), values in brackets = based on less than 30 observations.

Many of the stays abroad, as table 4.3 indicates, are of a relatively long duration. About 38% of these researchers who ever worked abroad had stays of 3 or more years. This thus implies that in terms of the longest stay abroad, almost 62% of the industry researchers return home or move on to another country within 3 years. In particular, as often found in migration research (see e.g. Dustman, 1996), the distribution of the longest work-stay abroad is bimodal with a large proportion (17.3%) of the working stays abroad lasting from 3-6 months.[49]

Once more with respect to this indicator regional differences between the EU15 and the EU12 are much lower than with respect to total mobility, although data on the EU12 is unreliable due to a low number of observations. In general, the duration of stays seems to be shorter (on account of a larger share of industry researchers working abroad for less than 1 to 2 years) among industry researchers residing in the EU12 than in the EU15. In addition – although there are only very few observations available in this cross tabulation - there seem to be some indication that there is a positive correlation between the length of stays and the number of stays (see table 4.4)

[49] Shorter stays abroad were intentionally excluded from the questionnaire to avoid excessive estimates of researcher mobility on account of short term research stays or sabbaticals abroad.

Table 4.4: Industry researchers by duration of longest stay abroad and number of stays abroad

	>=3 and < 6 months	>=6 and <12 months	>=1 year and < 2 years	>=2 years and < 3 years	>=3 years
1	83.1	79.2	72.5	75.0	70.8
2	(16.9)	(17.0)	(21.6)	(15.0)	(15.7)
3	0.0	(1.9)	(5.9)	(7.5)	(7.9)
4 or more	0.0	(1.9)	0.0	(2.5)	(5.6)

S: MORE-Questionnaire on industry researchers. Based on question: Please provide the name of the countries you worked in as a researcher, scientist or development engineer for a minimum of 3 months in the last 3 years and indicate the duration of your stays beginning with your longest stay (max. No. of entries 5 stays) values in brackets = based on less than 30 observations

To sum up, our results with respect to international mobility of industry researchers suggest that, relative to the total population of the EU27, industry researchers are highly mobile, with 41% of them having experienced working abroad and with more than 18% currently living in a country other than where they completed their highest education. Furthermore, short term stays (and related return migration) seems to be of major importance for industry researchers with over 50% of the work episodes abroad lasting less than 3 years, but only around 19% of all industry researchers have worked abroad for more than 3 months in more than one foreign country in the last three years.

In addition, our data suggests some important regional differences in international mobility among industry researchers. In particular, industry researchers residing in the EU12 have been somewhat less mobile than their counterparts in the EU12 and are also less inclined to become internationally mobile in the future.

4.3 Career paths of industry researchers

4.3.1 Types of career paths

The data collected from our questionnaire also allows us to assess the career paths of industry researchers in the EU27. The questionnaire asked the respondents which type of career path (described in table 4.5) best described their own career. The responses confirm our expectation of a substantial flow of researchers from the public to the private sector. Indeed, 42% of the respondents indicated that a career path which started in the public sector and ended in the private sector best described their own careers.[50]

What is perhaps a little more surprising is that a substantial number (37%) of the industry researchers has always worked in the private sector. The number reporting this career path is, however, still lower than the number of individuals, who moved from the public to the private sector. This suggests that in many instances, employment in the public sector (in all likelihood academia) is a precondition to starting a career as an industry researcher.

[50] It should be noted here, however, that while our question refers explicitly to the career path, we cannot preclude that - given the diversity of status of PhD "students" across countries and fields - in some instances the beginning of the career (which was interpreted by the respondent) may include the PhD period.

By contrast, round-tripping between the private and the public sectors, and a career only in the public sector seem to be of a lower importance. Only between 5% and 6% of the industry researchers have career paths that involve such round tripping (in either direction) and less than 5% of those interviewed have moved from the private to the public sector or work only in the public sector. [51]

Table 4.5: Career paths of industry researchers by region of residence

Path	Region of Residence					
	EU15	EU12	Total	EU15	EU12	Total
	Respondents			In % of total		
always public sector	42	26	68	2.2	3.8	2.6
always private sector	723	238	961	38.2	35.1	37.4
public to private	802	285	1,087	42.4	42.0	42.3
public to private and back	27	12	39	1.4	1.8	1.5
private to public	28	8	36	1.5	1.2	1.4
private to public and back	80	30	110	4.2	4.4	4.3
Other	189	79	268	10.0	11.7	10.4
Total	1,891	678	2,569	100	100	100

S: MORE-Questionnaire on industry researchers Based on question: As a summary of your career path, which one of the following career paths describes your situation best (please consider only changes of employer not research visits)

Table 4.6: Career paths of industry researchers by previous mobility

Path	Immobile	Mobile	Immobile	Mobile
always public sector	24	44	1.7	3.8
always private sector	593	367	41.8	31.9
public to private	535	551	37.8	47.9
public to private and back	16	23	1.1	2.0
private to public	21	15	1.5	1.3
private to public and back	57	53	4.0	4.6
Other	171	97	12.1	8.4
Total	1417	1150	100.0	100.0

S: MORE-Questionnaire on industry researchers, internationally mobile researcher: If question: Since your graduation have you ever worked as a researchers, scientist or development engineer in a country other than the country you graduated in for more than three months? is answered with yes, career path is based on question: As a summary of your career path, which one of the following career paths describes your situation best (please consider only changes of employer not research visits)

Furthermore, in contrast to data on international mobility, the career paths of industry researchers residing in the EU15 and the EU12 differ little. In this respect, the most notable difference is a higher share of "other" career paths among industry researchers residing in the EU12 than in the EU15, which comes at the expense of a lower share for those that have worked only in the private sector. This could in part be attributed to the substantial organisational changes (e.g. privatisation) that have occurred in the EU12 in the last two decades, which may make it difficult for those interviewed to identify whether a particular employer in the past was part of the public or the private sector.

[51] The later finding is, however, also due to our sample selection. Since in this study we were interested only in industry researchers, we exclude all workers currently working in academia, which is probably the most important receiving sector in the public sector. This reduces our chances of finding private to public sector flows.

Differences in the career paths of internationally mobile industry researchers (i.e. those that at least once have lived in a country different than their country of graduation) and immobile industry researchers (i.e. those that have always lived in the same country as their country of graduation) seem to be more important. The latter group more often than the former group of mobile industry researchers followed a career path in which they always worked in the private sector.[52] On the other hand, the former group of mobile researchers more often moved from the public to the private sector than the latter group. International mobility thus seems to be closely associated with career paths from the public to the private sector.

4.3.2 Number of jobs

With respect to the number of jobs, industry researchers were asked how many jobs they held in total and in research over their career and in the last three years, respectively. As illustrated in table 4.7, the median researcher in our sample held three jobs in total in his/her career. This applies both to the industry researchers residing in the EU15 and the EU12. Despite this, industry researchers residing in the EU15 have held slightly fewer jobs. There is a larger share of industry researchers that held four or more jobs in the sample residing in the EU12 than in the EU15 but fewer industry researchers that held two or less jobs. This stylised fact carries over to the number of research jobs held in a career. Here the median industry researcher residing in the EU15 held two research jobs over the career but the median industry researcher residing in the EU12 held three.

[52] For all other career paths in table 4.6 the number of observations seems to be too small to allow for interpretation

Table 4.7: Number of jobs held by industry researchers in their career by region of residence (in % of total respondents)

	Region of Residence					
	EU15	EU12	Total	EU15	EU12	Total
		Overall			As Researcher	
0	0.0	0.0	0.0	3.6	6.6	4.4
1	15.7	13.9	15.2	28.8	23.1	27.3
2	23.6	17.5	22.0	29.0	26.7	28.4
3	24.4	23.2	24.1	20.2	19.5	20.0
4	15.2	18.2	16.0	9.9	12.3	10.5
5	10.0	11.2	10.3	4.8	5.8	5.1
6	5.3	5.8	5.4	2.5	(3.0)	2.6
7	2.3	4.0	2.8	(0.6)	(1.1)	0.7
8	1.7	(3.3)	2.1	(0.3)	(0.9)	(0.5)
9	(0.4)	(1.0)	(0.6)	(0.1)	(0.3)	(0.1)
10	(0.4)	(0.5)	(0.4)	(0.0)	(0.6)	(0.2)
>10	(0.9)	(1.5)	1.1	(0.2)	(0.1)	(0.2)
Total	100.0	100.0	100.0	100.0	100.0	100.0

S: MORE-Questionnaire on industry researchers, Based on question: How many jobs did you hold since your graduation (please also include episodes of self-employment)? and How many of these as a researcher scientist or development engineer? values in brackets = based on less than 30 observations

This, however, is not necessarily a confirmation of a large number of job changes among industry researchers in the EU12, but may also be associated with the higher age of the industry researchers residing in the EU12 (see last chapter). Indeed when considering only the number of jobs held in the last three years (see table 4.8), there are few differences between industry researchers from these two regions. The median researcher in both regions held only one job (both as a researcher and overall) in the last three years, which is a reflection of the high average tenure of the industry researchers.[53] Furthermore, the shares of industry researchers that held more than one job in the last three years is 19.4% for industry researchers residing in the EU15 and 18.4% for industry researchers residing in the EU12 for overall jobs, and 11.9% for EU15 industry researchers and 10.9% for the industry researchers in the EU12.

[53] Interestingly also 14.4% of the industry researchers residing in the EU15 and 16.4% of those residing in the EU12 claim not to have held any job (including the current one) in research in the last three years, although by the way our data are constructed at least their current job involves activities that make them researchers in the definition of the Frascati manual (OECD, 2002).

Table 4.8: Number of jobs held by industry researchers in the last three years by region of residence

	Region of Residence					
	EU15	EU12	Total	EU15	EU12	Total
	Overall			As Researcher		
0	0.0	0.0	0.0	14.4	16.4	14.9
1	80.6	81.6	80.8	73.7	72.7	73.4
2	16.6	15.8	16.4	10.2	9.1	9.9
3	2.4	(1.9)	2.2	1.5	(1.3)	1.4
4	(0.4)	(0.5)	(0.4)	(0.2)	(0.4)	(0.2)
5	(0.0)	(0.1)	(0.1)	(0.0)	(0.0)	(0.0)
6	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
7	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
8	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
9	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
10	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
>10	(0.0)	(0.1)	(0.0)	(0.0)	(0.1)	(0.0)
Total	100.0	100.0	100.0	100.0	100.0	100.0

S: MORE-Questionnaire on industry researchers; Based on question: How many jobs did you hold in the last three years? and How many of these as a researcher scientist or development engineer? values in brackets = based on less than 30 observations

Differences in the number of jobs held are much clearer with respect to the division between internationally mobile and immobile industry researchers. Internationally mobile industry researchers held a larger number of jobs than immobile industry researchers. This applies to the number of jobs held in the last three years as well as to the number of jobs held over the entire career irrespective of whether jobs as researchers or overall are considered (see table 4.9). In particular over their total career 30.5% of the mobile industry researchers in our sample held 5 or more jobs overall and 15% held more than 5 jobs as researchers. This thus indicates a strong correlation between job changes and international mobility among industry researchers.

Table 4.9: Number of jobs held by industry researchers by international mobility

	All Jobs		As Researchers	
	Internationally Immobile	Internationally Mobile	Internationally Immobile	Internationally Mobile
	In the last three years			
1	84.5	75.6	91.4	84.0
2 or more	15.5	24.4	8.6	16.0
	In career			
1	20.2	8.4	41.1	18.4
2	24.6	18.3	29.8	26.4
3	23.4	25.2	16.7	24.7
4	14.8	17.6	7.0	15.5
5 or more	17.1	30.5	5.5	15.0

S: MORE-Questionnaire on industry researchers, internationally mobile researcher: If question "Since your graduation have you ever worked as a researchers, scientist or development engineer in a country other than the country you graduated in for more than three months?" is answered with yes, No. of Jobs based on Questions How many jobs did you hold since your graduation (please also include episodes of self-employment)? and How many of these as a researcher scientist or development engineer? How many jobs did you hold in the last three years? and How many of these as a researcher scientist or development engineer?

4.3.3 Labour market status before obtaining the current job and characteristics of the previous job

Finally, the questionnaire also asked respondents to state their labour market status before obtaining their current job. While not directly comparable to the figures reported in chapter 1 of this report,[54] the response to this question confirms the high share of job to job flows (i.e. from employment to employment) among industry researchers. In our total sample around 66.8% of the industry researchers were employed at another firm before starting to work at the current firm. In contrast to the findings of chapter 2, this data, however, also suggests that a substantial proportion of the industry researchers in the sample (around 21%) started working at their current employer directly after ending higher education and that there are also important flows of industry researchers from self-employment. Around 6.2% of the industry researchers in our sample were self-employed before starting to work in their current employment. As with data on HRST and persons employed in research occupations, flows of researchers from non-employment (i.e. either unemployment or out of the labour force) account for only a minor share (around 4%) of total hiring of industry researchers.

Again there are important differences among the regions of the EU27. Industry researchers from the EU15 more often obtained a research job in industry directly from higher education (which may be attributed to them being younger). They are more likely to have been self-employed before the current job, and are more likely to be among the non-employed. As a result, the share of industry researchers that obtained their current job from another (dependent) employment relationship is substantially lower in the EU 15 than EU12.

[54] In chapter 1 the reference time point for measuring this mobility is one year ago, here it is the beginning of the current employment spell.

Table 4.10: Labour Market Status of industry researchers before accession to the current jobs

	From higher education	From non-employment	From employment	From self employment	Other
			Region of residence		
EU15	21.4	3.9	65.6	6.5	2.5
EU12	18.8	(2.8)	70.2	5.4	(2.8)
			Internationally mobile		
Immobile	26.1	3.4	62.1	5.8	2.6
Mobile	13.1	3.9	73.5	7.0	2.5
Total	20.7	3.6	66.8	6.2	2.6

S: MORE-Questionnaire on industry researchers, Based on question When starting to work for your current employer, where did you come from? internationally mobile researcher: If question Since your graduation have you ever worked as a researchers, scientist or development engineer in a country other than the country you graduated in for more than three months? is answered with yes,

In addition there are also some differences in this indicator between those that have been internationally mobile and the internationally immobile. The internationally mobile are much less likely to have entered their current job directly from school. This - in conjunction with larger number of jobs held by mobile researchers - indicates that the first job after graduation of industry researchers is often found in the same country as the country of graduation and that more experienced industry researchers have a higher probability of having been mobile in the past. Similarly internationally mobile industry researchers are more likely to have entered the current job from self-employment and non-employment, and also substantially more likely to have come directly from another job.

4.4 Conclusions

In sum, our findings suggest that industry researchers – relative to the total population of the EU27 – are highly mobile,

- 41% of them have worked abroad as a researcher (10.3% in the last three years).
- More than 18% currently live in a country other than where they completed their highest education or live in a country different than the one they were born in.
- 35% of the respondents intend to look for work to another country within the next three years.

Internationally mobile industry researchers, however, mostly had only 1 stay abroad with only around 19% of all industry researchers having worked abroad for more than 3 months more than once. Short term stays (and related return migration) seems to be a major factor contributing to mobility patterns of industry researchers residing in the EU27. Over 50% of the work episodes abroad last for less than 3 years. Our data also suggest that industry researchers residing in the EU12 have been somewhat less mobile than their counterparts in the EU15 in the past and are also less inclined to look for work abroad in the next three years.

With respect to career paths of researchers we find that

- the relative majority of the industry researchers (42.3%) describe their career path as one starting in the public sector and ending in the private sector, a further 37.4% have always worked in the private sector.

- the median researcher in our sample has held three jobs in his/her career (two of those as a researcher), but only one job in the last three years.

- the questionnaire also confirms the high share of job to job flows (i.e. from employment to employment) among industry researchers. In our total sample around 66.8% of the industry researchers were employed at another firm before starting to work at the current firm.

- in addition, a substantial part of the industry researchers in the sample (around 21%) started working at their current employer directly after completing higher education and

- there are also important flows of industry researchers from self-employment. Around 6.2% of the industry researchers in our sample were self employed before starting to work in their current employment.

Furthermore, our results also indicate a close connection between mobility and career paths of industry researchers. Mobile researchers in our sample are more likely to have a career starting in the public and ending in the private sector, have held more jobs (both in research and overall) in their career and in the last three years, and are more likely to have started their job after terminating another employment relationship and less likely to have come directly from (higher) education.

5 REPRESENTATION OF FLOWS – A NETWORK BASED ANALYSIS

5.1 Introduction

Aside from providing descriptive evidence on the extent of mobility of industry researchers, our questionnaire also allows us to draw some conclusions on the direction of these flows. In this section we elaborate on mobility flows from a network perspective.[55] In particular we illustrate the structure of flows between sectors and between countries.

In contrast to the previous (and subsequent) analysis (except for part of chapter 7), the analysis of this section is thus based on an analysis of mobility events: we focus on the researcher's movement from the previous employment spell to the current one. This is possible because our questionnaire contains detailed information about the sector affiliation of the current employer as well as the previous employer. It also contains information about the geographical location of the employers on a country level-basis.

With respect to the international mobility of industry researchers, by contrast, we compare the country of employment at the current employer to that of the previous employer. If these two differ we consider the industry researcher to have been internationally mobile the last time he/she changed jobs. Thus implicitly we assume that the location of the employer is also the location where majority of the research work is carried out. This assumption, however, seems innocuous since the country of employment determines the country of residence to a large degree as about 94% of the researchers in the sample report that they currently live in the country of their current employer. It should, however, be pointed out that - in contrast to our definition of international mobility in most of this report – here we define international mobility as a change in the place of work of the researchers[56].

In the following section we analyze sector flows. Section 3 focuses on flows between different types of organizations and section 4 describes international mobility. Section 5 examines the determinants of flows of industry researchers across countries and conclusions are drawn in section 6.

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[55] In doing this in a number of instances we rely on information based on relatively small sample sizes. We deal with this problem by – as far as possible - highlighting the number of observations on which conclusions are based, and in our interpretation focusing on countries and sectors for which sample sizes are large enough to allow drawing conclusions. Furthermore as above for the representation of flows we analyze the responses of residing in EU27, not working in the academics sector and also exclude implausible observations.

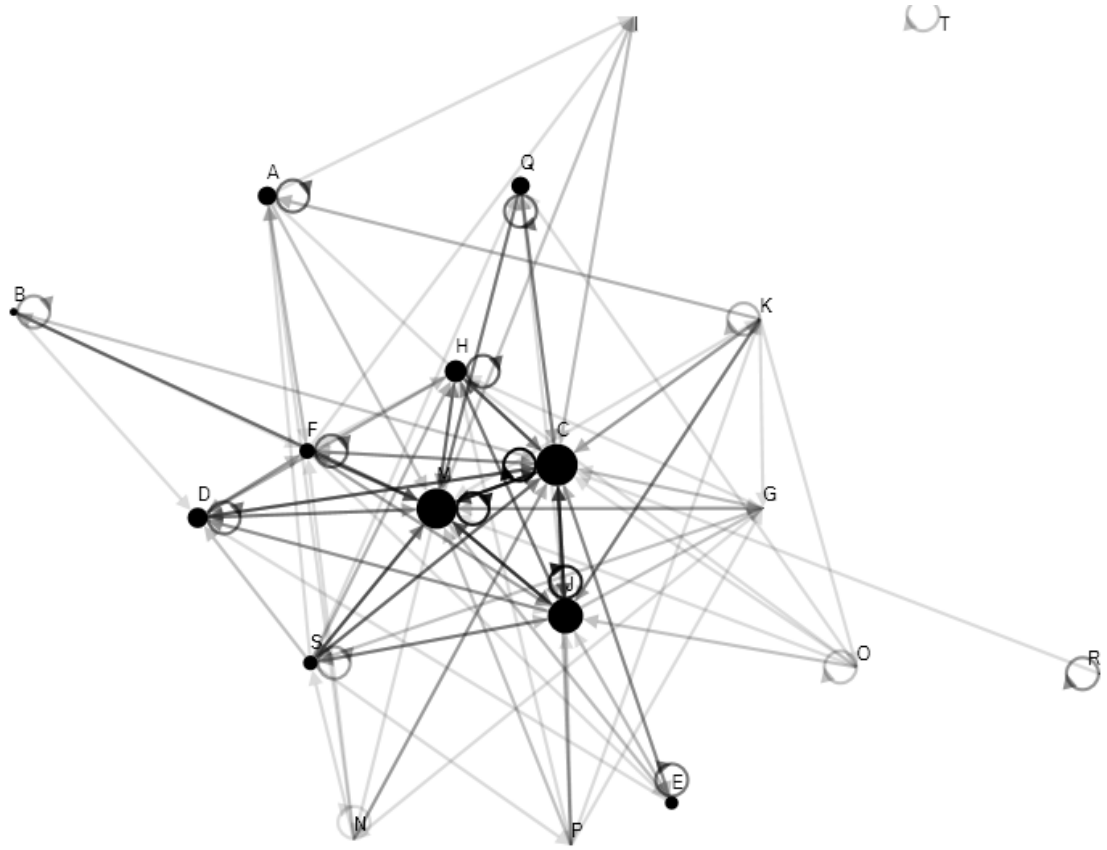
[56] We do not use other locational information contained in the survey, e.g. inference of mobility flows by relating the country where the highest educational attainment has been received to the current country of current residence or employment, since such a presentation would suggest mobility flows which do not relate to a specific event or to a clearly defined job change or mobility event. As the survey does not cover the whole individual history of job changes of researchers we have no information about how many job changes occurred between graduation and the current employment.

5.2 Sectoral flows

First we analyze the flows of researchers between sectors focusing on the recent event of job change.[57] Figure 5.1 illustrates this flow within and between the sectors based on the NACE rev.2 definition of sectors. The letter code labels the sectors represented by the nodes in the diagram. The size of the nodes indicates the size of the sector based on the distribution of researchers' previous employers. The arrows indicate the flow where the tail of the arrow depicts the source and the head of the arrow points to the receiving sector. Opacity of the arrows indicates the intensity of the flow where higher opacity indicates a higher intensity of flows.

[57] Note that this representation of flows does not capture the whole career path of researchers. It may be at odds with the characterization of the career paths in the previous and subsequent sections as the measures of flows only refer to changing employment relations. It does not capture the educational part of the career path.

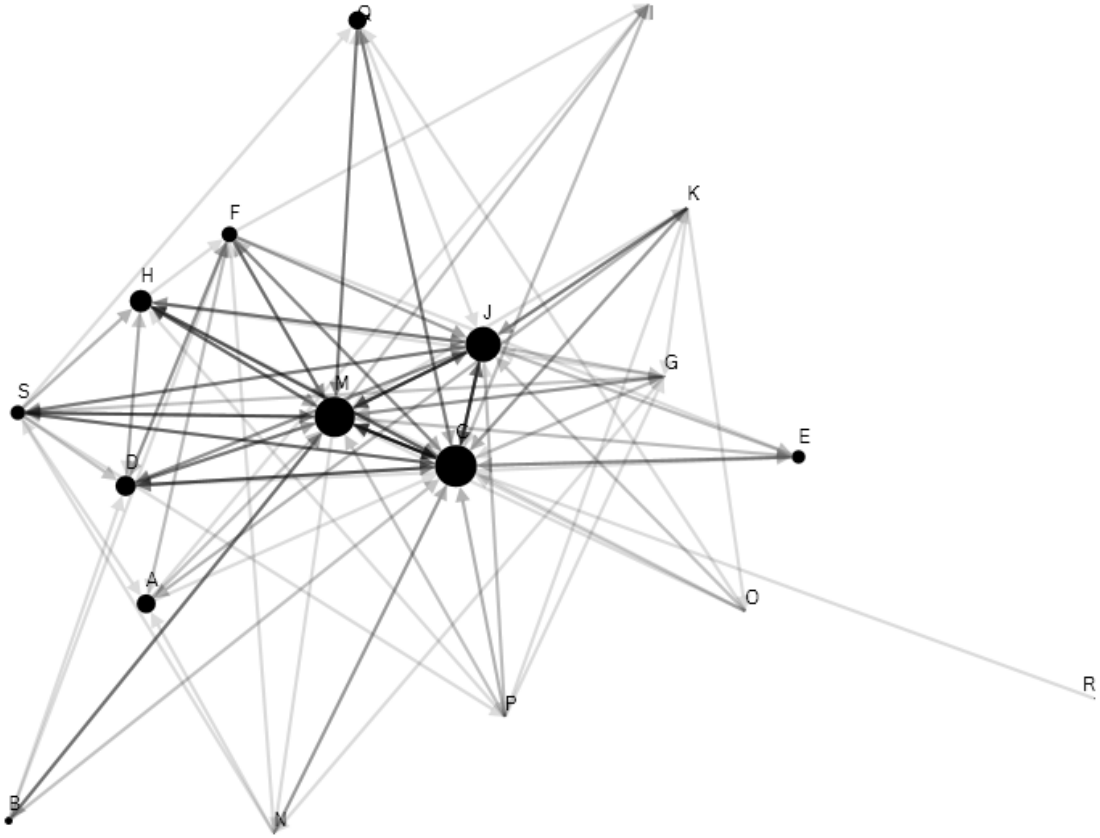
Figure 5.1 Sector flows of mobility



Note: Figure visualizes the flow of researchers between the sectors in the economy based on the sector affiliation of the current and the previous employer including mobility flows within the same sector. Sector classification bases on NACE rev.2 sections. A: Agriculture, Forestry and Fishing; B: Mining and quarrying; C: Manufacturing; D: Electricity, gas, steam and air conditioning supply; E: Water supply, sewerage, waste management and remediation activities; F: Construction; G: Wholesale and retail trade; repair of motor vehicles and motorcycles; I: Accommodation and food service activities; H: Transportation and storage; J: Information and communication; K: Financial and insurance activities; L: Real estate activities; M: Professional, scientific and technical activities; N: Administrative and support service activities; O: Public administration and defence; compulsory social security; P: Education; Q: Human health and social work activities; R: Arts, entertainment and recreation; S:Other service activities; T: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; U: Activities of extraterritorial organizations and bodies. Raw data for the visualization can be found in Table A4.1 in Annex 4.

We observe first that flows within the sectors make up a large share of the changes of workplaces in the sample. These flows are indicated by the circular arrows in the above diagram. Second we see that there is considerable variation in the direction of the flows.

Figure 5.2 Sector flows of mobility between sectors



Note: Figure visualizes the flow of researchers between the sectors in the economy based on the sector affiliation of the current and the previous employer including mobility flows within the same sector. Sector classification bases on NACE rev.2 sections. A: Agriculture, Forestry and Fishing; B: Mining and quarrying; C: Manufacturing; D: Electricity, gas, steam and air conditioning supply; E: Water supply, sewerage, waste management and remediation activities; F: Construction; G: Wholesale and retail trade; repair of motor vehicles and motorcycles; I: Accommodation and food service activities; H: Transportation and storage; J: Information and communication; K: Financial and insurance activities; L: Real estate activities; M: Professional, scientific and technical activities; N: Administrative and support service activities; O: Public administration and defence; compulsory social security; P: Education; Q: Human health and social work activities; R: Arts, entertainment and recreation; S:Other service activities; T: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; U: Activities of extraterritorial organizations and bodies. Raw data for the visualization can be found in table A4.1 in Annex 4.

This can also be seen from figure 5.2, which illustrates the flows between sectors disregarding the circular flows within the sectors. Here we observe that most active mutual inter-sector mobility in terms of the absolute number of inter-sector mobility events takes place between sectors C (manufacturing), M (professional, scientific and technical activities) and J (information and communication), which are also the most important sectors of employment of industry researchers in our sample.

In general, however, inter-sector flows are more important in the mobility of industry researchers than flows between sectors. This can also be inferred from table 5.1 which shows the intersectoral fraction of flows of selected sectors. Here a job change is considered intersectoral when the previous employer is affiliated with a different sector than the current employer. Take for example a researcher changing from a manufacturing company (sector C) to a company in the transportation sector (sector H). This change contributes to the intersectoral outflows of sector C and to the intersectoral inflows of sector H. In the case a researcher changes from a company in sector M to another company in the same sector it is not considered being intersectoral at the current level of sector aggregation.

Table 5.1: Intersectoral flows of selected sectors [interSectoralFlows]

	Intersectoral inflows		Intersectoral outflows	
Sector	N	Percent	N	Percent
C	116	26%	103	23%
J	46	21%	77	31%
M	140	40%	78	27%

Note: Number and share of intersectoral flows among the sectors. Sector classification bases on NACE rev.2 sections. C: Manufacturing; H: Transportation and storage; J: Information and communication; M: Professional, scientific and technical activities; A complete tabulation of intersectoral inflows and outflows from the sectors can be found in table A4.3 in Annex 4.

The analysis shows that among the selected sectors, the one with the strongest intersectoral inflow is sector M (professional, scientific and technical activities). Indeed, it draws strongly on intersectoral inflows to recruit its researcher base. Two out of five researchers which start in sector M (Professional, scientific and technical activities) originate from sectors other than M. By contrast, the manufacturing (sector C) and information and communication (sector J) sectors show much smaller intersectoral inflow of researchers, about 26% and 21%, respectively. These sectors thus rely to a much lesser extent on the recruiting of industry researchers from other sectors.[58]

In addition, the sectors also differ substantially in their heterogeneity with respect to their previous sector in which their researchers were employed. This may indicate differences in the diversity of the knowledge base and competencies required within a given sector. Table 5.2 reports the heterogeneity of researchers flowing into a particular sector with respect to the sector of previous employment as measured by Shannon's entropy index.[59] A higher entropy index indicates a more diverse structure of inflows. If all source sectors contribute equally to the researchers in a given sector the entropy measure takes a maximum value while when only one sector contributes – usually the sector itself by only having intra-sector mobility – the entropy index attains a value of 0. This implies that a lower entropy index is associated with a more concentrated structure of source sectors for inflows.

According to this index, the most concentrated inflow of researchers can be found in sectors R (arts, entertainment and recreation) and T (Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use), both of which, however account for only a small share of industry researcher employment in our data. In these sectors all of the researchers originate from within the sector and the entropy index takes a value of 0.

The most diverse inflow by contrast is observed for sectors D (i.e. electricity, gas, steam and air conditioning supply which has an entropy index of 1.71), S (other service activities; entropy=1.63), H (transportation and storage, entropy=1.56) and G (Wholesale and retail trade; repair of motor vehicles and motorcycles, entropy=1.55).

[58] This conclusion is also confirmed, when considering the intersectoral outflows, since here professional, scientific and technical activities hardly differ from manufacturing and from information and communication sector

[59] The Shannon entropy index e is used to measure diversity in categorical data. The index e_j for sector j is given by $e_j = -\sum_{i=1}^{S} p_{ij} \ln(p_{ij})$, with S the number of sectors, N_j ... the total number of all inflowing researchers in sector j (including researchers staying in sector j), p_{ij} the proportion of inflowing researchers from sector i to sector j to the total number of inflowing researchers in sector j ($p_{ij} = n_{ij}/N_j$).

Table 5.2 Diversity of inflows [interSectoralFlows]

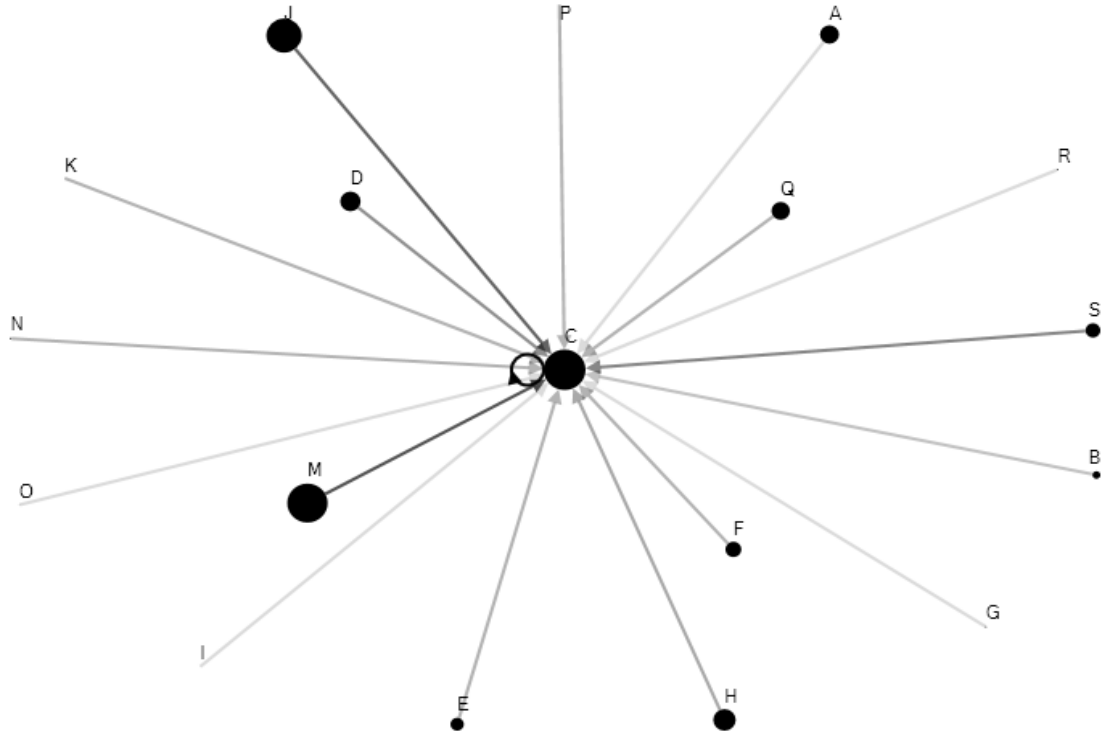
Sector	Diversity of inflows
A	0.75
B	0.66
C	1.10
D	1.71
E	0.90
F	1.24
G	1.55
H	1.56
I	1.33
J	0.92
K	1.28
M	1.42
N	1.39
O	0.64
P	0.69
Q	0.87
R	0.00
S	1.63
T	0.00

Note: Heterogeneity of inflows into sectors is captured by the Shannon entropy index for the source sectors. Sector classification bases on NACE rev.2 sections. A: Agriculture, Forestry and Fishing; B: Mining and quarrying; C: Manufacturing; D: Electricity, gas, steam and air conditioning supply; E: Water supply, sewerage, waste management and remediation activities; F: Construction; G: Wholesale and retail trade; repair of motor vehicles and motorcycles; I: Accommodation and food service activities; H: Transportation and storage; J: Information and communication; K: Financial and insurance activities; L: Real estate activities; M: Professional, scientific and technical activities; N: Administrative and support service activities; O: Public administration and defence; compulsory social security; P: Education; Q: Human health and social work activities; R: Arts, entertainment and recreation; S:Other service activities; T: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; U: Activities of extraterritorial organizations and bodies.

The sectors with the largest absolute number of researchers – sectors C (manufacturing), M (professional, scientific and technical activities) and J (information and communication) - exhibit a medium level of diversity of inflows. For these sectors, we also analyse researcher inflows from other sectors on a sector by sector basis (see figures 5.3, 5.4 and 5.5). This analysis suggests that:

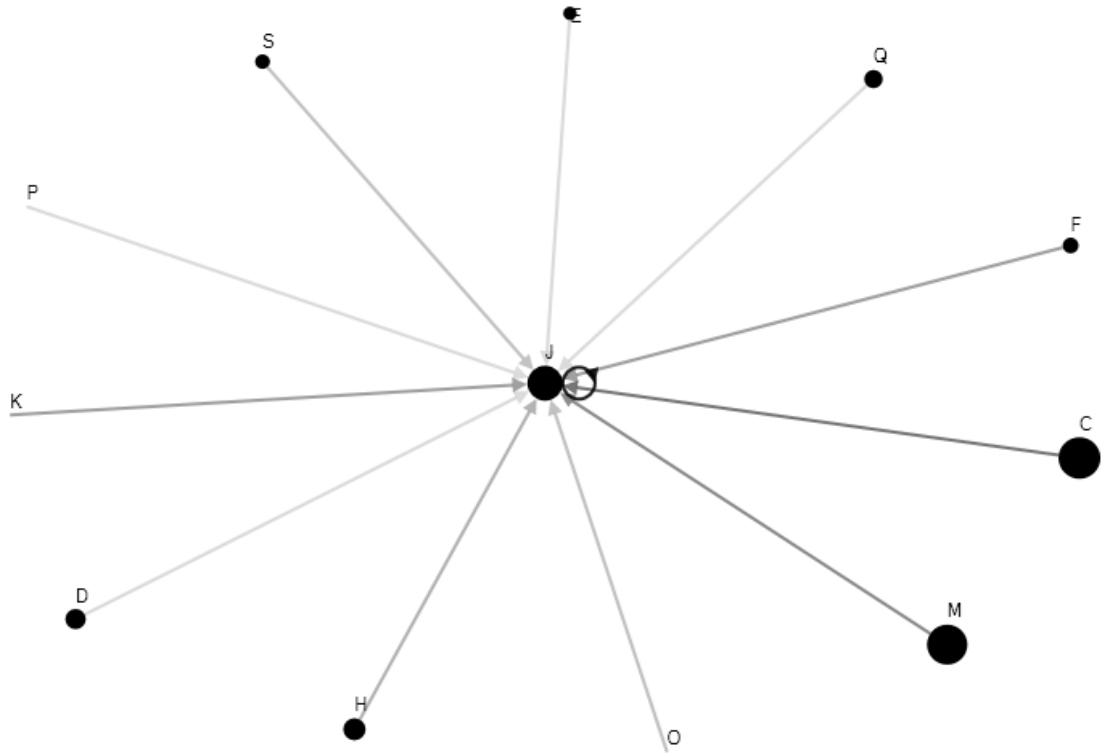
- The strongest flow of researchers into employment in the manufacturing sector is an intra sector flow. About 74% of the researchers in the manufacturing sector reported a previous employer that also operated in the manufacturing sector. The strongest intersectoral inflows into the manufacturing sector originate from professional, scientific and technical activities (sector M), information and communication (sector J) and other service activities (sector S).

Figure 5.3 Sources of inflows into sector C (manufacturing)



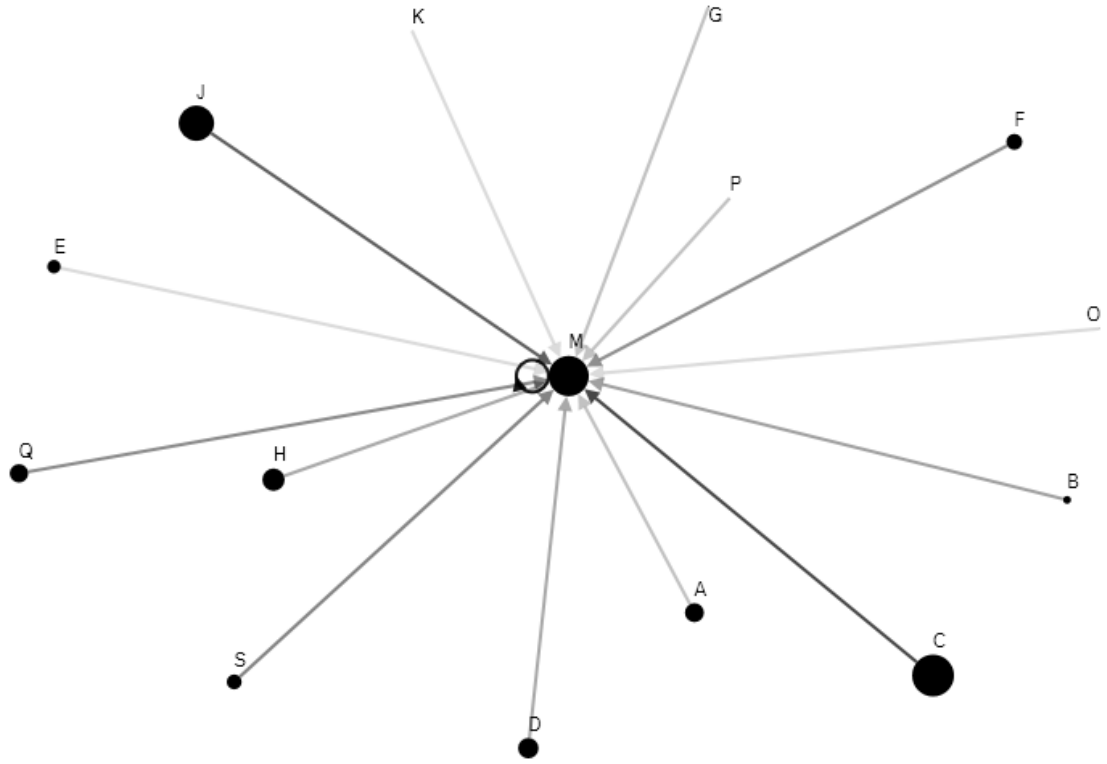
Note: Figure shows the flow of researchers into sector C (manufacturing).Opacity of the arrows indicates the intensity of the flow where higher opacity indicates higher intensity of the flows. Raw data for the visualization can be found in table A4.1 in Annex 4.

Figure 5.4 Sources of inflows into sector J (information and communication)



Note: Figure shows the flow of researchers into sector J (information and communication). Opacity of the arrows indicates the intensity of the flow where higher opacity indicates higher intensity of the flows. Raw data for the visualization can be found in table A4.1 in Annex 4.

Figure 5.5 Sources of inflows into sector M (professional, scientific and technical activities)



Note: Figure shows the flow of researchers into sector M (professional, scientific and technical activities). Opacity of the arrows indicates the intensity of the flow where higher opacity indicates higher intensity of the flows. Raw data for the visualization can be found in table A4.1 in Annex 4.

- In the information and communication sector (sector J), we find strong intrasectoral mobility. About 79% of researchers report that their most recent job change originated from a previous employer in the same sector. The strongest inter-sector flows originate from manufacturing (sector C) and professional, scientific and technical activities (sector M).

- In the sector of professional, scientific and technical activities (sector M), about 60% of the researchers reported a previous employer in the same sector. The strongest inter-sector flows targeting this sector originate from the manufacturing (sector C) and from the information and communication sector (sector J). Moreover, the intra-sector flow within sector M is markedly lower than in the other sectors discussed above.

5.3 Flows between organization types

Flows between different organization types are analyzed in this section. Once again these flows are based on the researchers' most recent change in employment relationships. As the survey design was split along organizational categories the representation of flows in this section is only a rough approximation of the real flows between different types of organizations. To make the point clear: one may differentiate different institutional sectors based on the type of organization where researchers work. The most prominent is to associate universities and other higher research organizations (UNIV) as one sector, companies and self employment as another (COMP) and research laboratories or research organizations – either public or private – with yet another (RESO). Since our analysis is

based on a questionnaire among industry researchers the analysis for all other sections of the report excludes researchers, who are currently employed in the university sector (UNIV). Here, however, we also include these researchers, although by research design, the number of researchers currently employed in the university and the research organizations sectors are in all likelihood underrepresented as are the flows to these sectors. The inflows in these sectors are thus excluded from the analysis[60]. To at least partially account for this bias, table 5.3 only reports the inflow in shares.

Table 5.3 Flow between organization types (sectors) [orgFlows]

Inflow		from		
	COMP	RESO	UNIV	Total
COMP	67%	12%	21%	100%

Note: COMP: Companies and self employment; RESO: Research laboratory and research organization; UNIV: Universities and higher education organizations;

We observe clear differences in the pattern of flows to the different types of organizations. 67% of the researchers taking up a position in the company sector (COMP) come from another organization in the company sector; 12% originate from research organizations and 21% originate from universities. In sum, although university to company sector flows are important the majority of flows to the company sector originates in this sector.

5.4 International flows

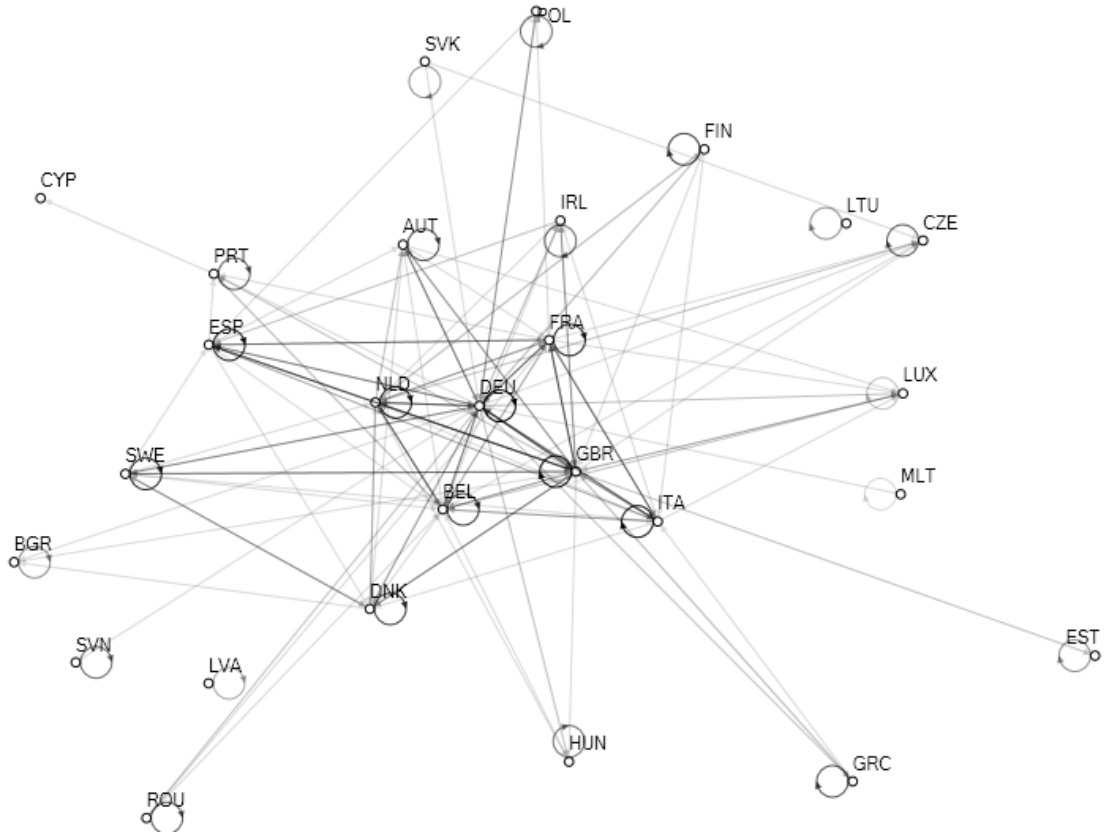
Aside from flows between sectors and organization types a central focus of this study are the national and international flows of industry researchers. The international flows most obviously pick up the notion of geographic mobility. Here we use the country information for the previous and current employer of the researcher to characterize the geographic mobility regardless of the time when this most recent change of jobs occurred. [61]

Reference to the most recent event of job change in the researchers' professional biography allows us to chart flows between countries within the EU27 giving rise to an approximation of the structure of the flows.

[60] A separate survey for academic researchers in the university and higher education sector was conducted in a separate work package of the MORE project (see: Idea Consult, 2009a)

[61] Due to the properties of the sampling process the aim of this section is not to estimate the researchers' propensity to be geographically mobile. Rather we intend to highlight the structure of researcher mobility. Even if the sample cannot claim to be representative in a statistical sense it does – nevertheless – show that there is considerable mobility among researchers. The intensity to which different countries are integrated into the network of researcher mobility also differs.

Figure 5.6: National and international flows of researchers within the EU27

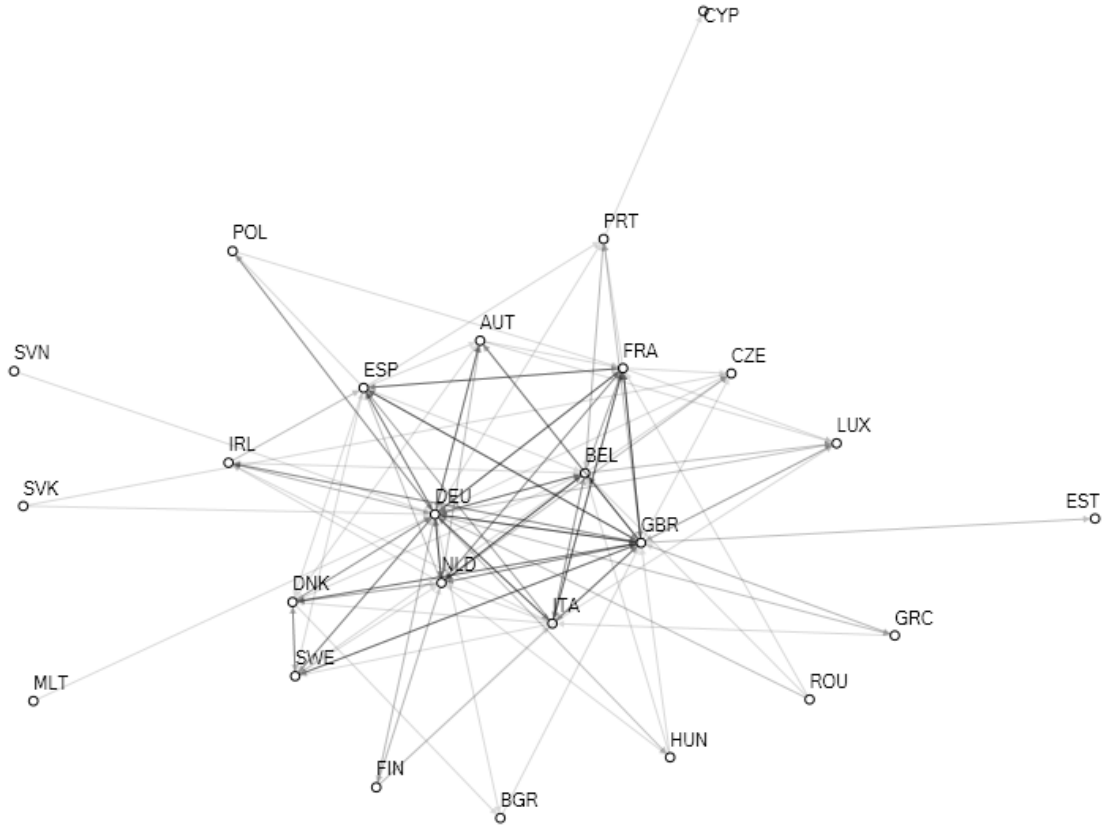


Note Graph illustrates the national and international flows of researchers within the EU27. Three letter codes designate countries based on ISO 3166-1 alpha-3: AUT: Austria; BEL: Belgium; BGR: Bulgaria; CYP: Cyprus; CZE: Czech Republic; DNK: Denmark; EST: Estonia; FIN: Finland; FRA: France; DEU: Germany; GRC: Greece; HUN: Hungary; IRL: Ireland; ITA: Italy; LVA: Latvia; LTU: Lithuania; LUX: Luxembourg; MLT: Malta; NLD: Netherlands; POL: Poland; PRT: Portugal; ROU: Romania; SVK: Slovakia; SVN: Slovenia; ESP: Spain; SWE: Sweden; GBR: United Kingdom. The opacity of the arrows indicates the intensity of the flow where higher opacity indicates higher intensity of the flows. Raw data for the visualization can be found in table A4.4 in Annex 4.

Overall the sample contains 2,375 researchers where both the country of the current employer and the country of the previous employer can be identified of which 440 have been internationally mobile. While this suggests a substantial degree of international mobility, national boundaries still play a crucial role when researchers change their workplace. This is illustrated in figure 5.6 where the circular arrows pointing from and to the same country are visually the most striking components. More accurately, tables A4.4 and A4.5 in Annex 4 verify that for each of the EU27 countries no international flow of researchers to or from any other country exceeds the respective national flow of researchers. Not even the aggregate of the flows to and from all other countries exceeds the national flow of researchers.

Figure 5.7 shows only the international flow of researchers within the EU27. In contrast to figure 5.6, flows within a country – originating from and targeting to the same country – are excluded here.

Figure 5.7 International flows of researchers within the EU27



Note Graph illustrates the international flows of researchers within the EU27. Three letter codes designate countries based on ISO 3166-1 alpha-3: AUT: Austria; BEL: Belgium; BGR: Bulgaria; CYP: Cyprus; CZE: Czech Republic; DNK: Denmark; EST: Estonia; FIN: Finland; FRA: France; DEU: Germany; GRC: Greece; HUN: Hungary; IRL: Ireland; ITA: Italy; LVA: Latvia; LTU: Lithuania; LUX: Luxembourg; MLT: Malta; NLD: Netherlands; POL: Poland; PRT: Portugal; ROU: Romania; SVK: Slovakia; SVN: Slovenia; ESP: Spain; SWE: Sweden; GBR: United Kingdom. The opacity of the arrows indicates the intensity of the flow where higher opacity indicates higher intensity of the flows. Raw data for the visualization can be found in table A4.4 in Annex 4.

The overall density of the graph is 0.2 indicating that 20% of the potential country-country combinations are realized in the data, i.e. 146 country-country relations out of the potential 729 country-country relations are present in the data.

The diagram of the researcher flow network – as well as the more detailed, yet less intuitive table A4.4 in Annex 4 – shows that all EU27 countries (except Latvia and Lithuania[62]) participate in the network of researcher flows which span the experiences in the current sample of researchers. However, the visualization also suggests that some countries obtain a more peripheral position than other countries. In the literature on social network analysis, a number of measures are suggested to capture the centrality of the position of the nodes, here EU27 countries. Table 5.4 reports the indegree, the outdegree, the betweeness and the closeness as measures of centrality.

[62] Due to the sample limitations of the survey – discussed above - one cannot infer from this observation that Latvia and Lithuania do not play a part in the EU27 network of international researcher mobility. However, we can infer that given the small size of both countries they play a comparably small role as origin or target countries for researcher mobility.

Table 5.4 Measure of positions in the researcher flow network [flow_network]

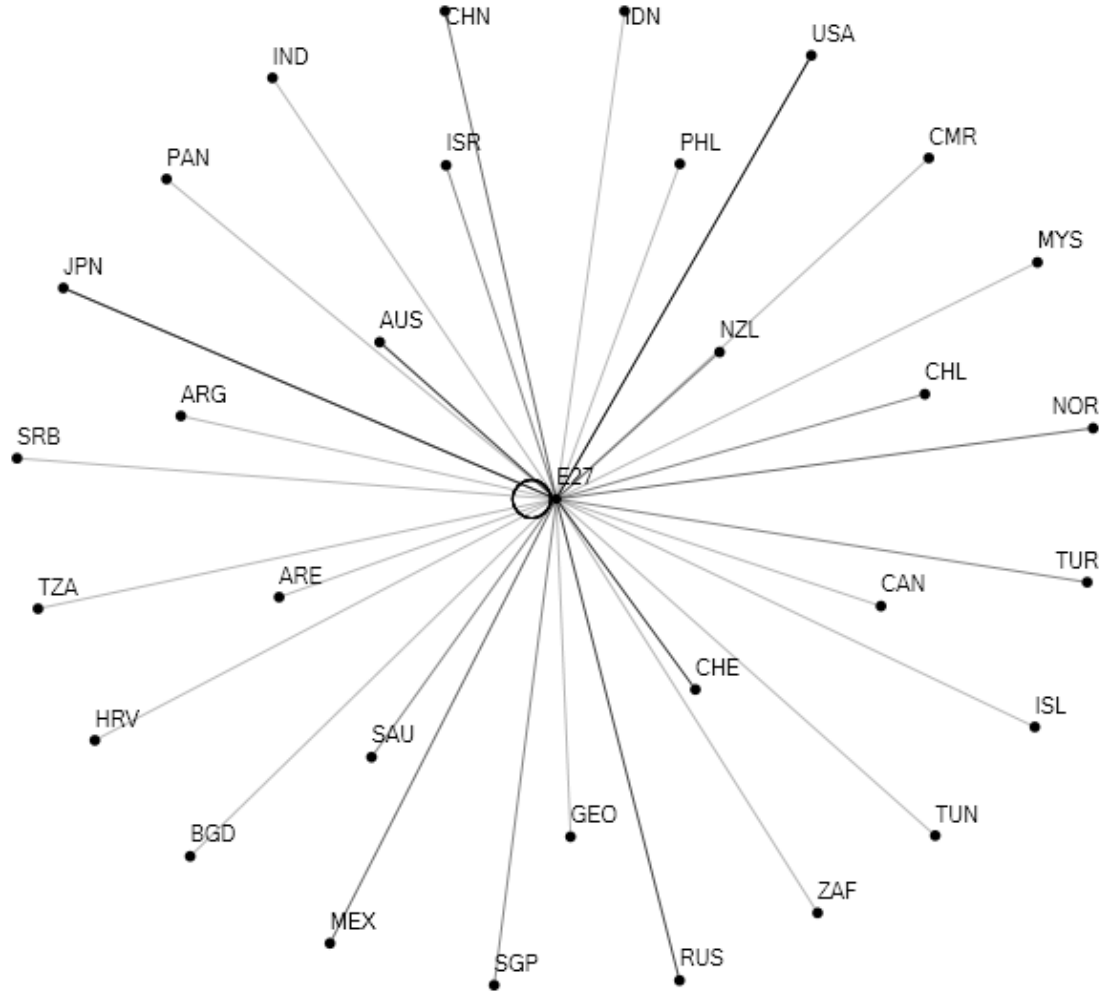
	Indegree	Outdegree	Betweeness	Closeness
AUT	6	4	0.006	1.708
BEL	10	9	0.149	1.375
BGR	2	1	-	1.917
CZE	6	0	0.023	1.792
DEU	16	18	1.000	1.083
DNK	6	7	0.021	1.667
ESP	7	8	0.076	1.500
FIN	2	4	-	1.875
FRA	9	8	0.103	1.500
GBR	14	15	0.462	1.250
GRC	2	2	-	1.917
HUN	2	2	-	1.875
IRL	5	3	-	1.792
ITA	6	10	0.062	1.542
LUX	6	1	0.001	1.792
NLD	8	11	0.067	1.500
POL	2	2	-	1.958
PRT	5	2	0.215	1.750
ROU	0	3	-	1.958
SVK	0	2	-	2.000
SVN	0	1	-	2.042
SWE	4	6	-	1.750

Note: Measures of centrality of the countries' position in the network of researcher flows. Three letter codes designate countries based on ISO 3166-1 alpha-3: AUT: Austria; BEL: Belgium; BGR: Bulgaria; CZE: Czech Republic; DNK: Denmark; FIN: Finland; FRA: France; DEU: Germany; GRC: Greece; HUN: Hungary; IRL: Ireland; ITA: Italy; LVA: Latvia; LTU: Lithuania; LUX: Luxembourg; NLD: Netherlands; POL: Poland; PRT: Portugal; ROU: Romania; SVK: Slovakia; SVN: Slovenia; ESP: Spain; SWE: Sweden; GBR: United Kingdom. The opacity of the arrows indicates the intensity of the flow where higher opacity indicates higher intensity of the flows. Cyprus, Estonia and Malta omitted. Raw data for the network and the computation of the centrality measures can be found in table A4.4 in Annex 4.

The indegree and the outdegree share a common rather intuitive interpretation. Both give the number of countries a given country is directly linked to in the network. The indegree captures the number of incoming connections and the outdegree the number of outgoing connections. Based on both the indegree and the outdegree measures of centrality, Germany (DEU) is the most central country in the network. It is linked to 18 other countries through the outflow of researchers. Germany is also linked to 16 countries through the flow of incoming researchers. In addition to Germany - based on the degree measures - the group of relatively central countries comprising the network include the United Kingdom (GBR), Belgium (BEL), the Netherlands (NLD), France (FRA), Italy (ITA) and Spain (ESP). The most peripheral of the countries in the network are Malta (MLT), Cyprus (CYP) and Estonia (EST). For the last group of countries, however, the number of observations is too small to allow firm conclusions.

Furthermore, the betweeness measure also indicates the central role of Germany (DEU) in the network. The higher the betweeness the more central is the country. The direction of the closeness indicator is the opposite. The more central a country is the smaller is the value of the closeness index. Applying this measure we also find that Germany is the most central country in the network of researcher flows and the group of the most central countries in the network remains unchanged.

Figure 5.8 International flows of researchers into the EU27



Note: Figure illustrates countries of origin of researchers' inflow into the EU27 from outside the EU27. The opacity of the arrows indicates the intensity of the flow where higher opacity indicates higher intensity of the flows. Raw data for the visualization can be found in table A4.5 in Annex 4.

Figure 5.8 displays the countries of origin of the researchers flowing into the EU27, where the country of origin is the country of the previous employer regardless of the researchers' nationality. We observe a diverse set of countries outside the EU27 contributing to the inflow of researchers into the EU27 countries. The strongest inflow among originates from the US, Japan (JPN) and Switzerland (CHE) followed by Russia (RUS).

5.5 Explaining researcher flows

Given the evidence of substantial differences in the flows of industry researchers between sending and receiving countries, the question arises as to what are the factors which explain the integration of a particular country into the network of industry researcher flows. A simple – yet powerful – workhorse model that can explain such flows which has been often applied to migration data as well as to international flows of goods and services or knowledge, is the gravity model (see box 1 for a description). Generally, and in its simplest form, gravity models assume that aggregate flows between countries can be explained by the size of both the sources and the target economy of the flow and the distance between

the economies. In accordance with theoretical predictions, the size of the economies has been found to exert a positive effect on the size of the flow. The distance on the other hand has a negative impact on the intensity of the flow. We estimate this model focusing on the flows within and among the EU27 countries only. The aim of this analytical exercise is to explain the intensity of the in- and outflows of researchers to and from the EU27 countries.

Box1: Gravity models

The overall idea of the gravity models derives as the term 'gravity model' already suggests from Sir Isaac Newton's law of universal gravity. This law explains that the force between two objects increases proportionally with the mass of each of the objects and decreases with the square of the distance of these objects. In 1962 Jan Tinbergen suggests that a model structure similar to Newton's can be used to explain international trade flows. The model structure has been applied ever since to a whole range of social and economic interactions.

In particular it has been used to explain international knowledge flows, co-inventing, co-patenting as well as international co-operation in a number of applications.

The model structure suggested by Tinbergen is:

$F_{ij} = G\, M_i^{\alpha}\, M_j^{\beta}\, D_{ij}^{-\theta}$

where G is a constant, M_i and M_i are the masses of the involved countries and D_{ii} the distance between the countries.

Taking the logarithm of the equation yield a model which can be analyzed by ordinary least square regression.

$Ln(F_{ij}) = Ln(G) + \alpha\, Ln(M_i)\ \beta\, Ln(Mj) + \theta\, Ln(Dij)$

To investigate whether size of the economies and geographical distance between them affect the intensity of researchers mobility flows, we use the logarithm of the GDP of the countries to capture the size. The distance is approximated by the logarithm of the Euclidean distance between the projected centroids of the country surface.

Table 5.5 presents the results of a set of regressions that explain the size of the flows of researchers between countries. The first five columns report the OLS. To check for the robustness of the estimated parameters, we report various configurations of the exogenous variables. First, we regress the number of researchers on the sum of the economic sizes of the involved countries and their distances. We find that the exogenous variables jointly and individually determine the size of the researcher flows. About 86% of the total variance of the flow of researchers can be explained by this model. Furthermore the coefficient estimates of nearly all models suggest that countries that are about 1% larger experience both an inflow as well as an outflow of industry researchers that is by 0.35% to 0.4% higher, and that increasing the distance between two countries by 1% reduces the extent of bilateral migration by between -0.4% to -0.45%.

Table 5.5: Determinants of researcher flows [flow_network]

	OLS				Negative binomial regression		
Dependent variable	LN(Size of the flow)				Size of the flow		
Combined size of	0.398**		0.398**	0.35**			0.351**
both countries (Ln)	(0.024)		(0.024)	(0.023)			(0.023)
Size of target		0.366**			0.329**	0.33**	
Country (Ln)		(0.044)			(0.032)	(0.032)	
Size of origin		0.433**			0.373**	0.375**	
Country (Ln)		(0.046)			(0.034)	(0.035)	
Distance (Ln)	-0.421**	-0.422**	-0.453**	-0.397**	-0.398**	-0.383**	-0.385**
	(0.012)	(0.013)	(0.061)	(0.014)	(0.014)	(0.041)	(0.041)
Distance(Ln)-			-0.007			0.004	0.003
Squared			-0.013			-0.009	-0.009
Constant	1.901**	1.896**	2.018**	1.747**	1.744**	1.682**	1.696**
	(0.056)	(0.056)	(0.224)	(0.053)	(0.053)	(0.165)	(0.165)
Observations	146	146	146	146	146	146	120
pseudo – R^2	0.86	0.38	0.38	0.86	0.86	0.86	0.44
Chi^2 / F	376.84**	377.61**	377.13*	424.07**	282.70**	210.81**	37.09
Sample							
National flows	Yes	Yes	Yes	No	Yes	Yes	Yes
International flows	Yes	Yes	Yes	Yes	Yes	Yes	No

Note: Standard errors in parentheses, **(*) indicate 1% (5%) level of significance.

The second column in the table also includes the square of distance to investigate whether there are any non-linear effects of distance on the flow of researchers. The statistical insignificance of the squared distance term indicates the absence of non-linear distance effects. Integrating both the size of the target country and the size of the origin country in the regression, as done in column 2, does not change the overall picture. The significance and the explanatory power of the model remain unchanged compared to the first model. Equality of the coefficients of the target country and the origin country cannot be rejected ($F(1,142)=0.85$, $p=0.375$) suggesting that there is a symmetrical influence of the flow of researchers of both the size of the target and the origin country. Finally, including the squared distance once again has little effect on the results.

The fifth column disregards the national flows and only regresses the international flows of researchers on the aggregate size of the target and the origin country and the distance. We observe that the structure of the findings is maintained and the size of the parameter estimates are similar.

In addition the OLS regressions of the logarithm of the size of the flows, table 5.5 also contains negative binomial regressions of the absolute number of researchers flowing between the countries. The regression results show the same structure of findings as the OLS regressions above. The overall economic size of the involved countries and the distance between the countries jointly and individually determine the size of the flow. The square size – to pick up non linear influences of the size – does not affect the size of the flow.

5.6 Conclusions

In sum, our analysis of both the sector and international flows of migrants suggests that there are substantial differences with respect to the way individual sec-

tors and/or countries recruit industry researchers. In general, however, intrasector flows seem to be of a larger importance than intersector flows, and intersector flows tend to be stronger in the professional, scientific and technical activities sector than either in manufacturing and in the information and communication sector In addition with respect to these three sectors which offer enough observations to allow for a detailed analysis we also find that (based on our sample of researchers):

- the strongest flow of researchers into employment in the manufacturing sector is an intra sector flow. About 74% of the researchers in the manufacturing sector reported a previous employer in the same sector. The strongest intersector inflows into the manufacturing sector originate from professional, scientific and technical activities (sector M), information and communication (sector J) and other service activities (sector S).

- In the information and communication sector (sector J), we find strong intrasector mobility. About 79% of researchers report that their most recent job change originated from a previous employer in the same sector. The strongest inter-sector flows originate from manufacturing (sector C) and professional, scientific and technical activities (sector M).

- In the sector of professional, scientific and technical activities (sector M), about 60% of the researcher reported a previous employer within the same sector. Strongest inter-sector flows targeting sector M originate from the manufacturing (sector C) and from the information and communication sector (sector J). We observe that an intra-sector flow within sector M is markedly lower than in the other sectors discussed above.

We also observe clear differences in the pattern of flows to the different types of organizations. 67% of the researchers taking up a position in an organization in the company sector come from another organization in the company sector; 12% originate from research organizations and 21% originate from universities.

As to the flows between countries based on both the indegree and outdegree measures, we find that Germany is the most central country in the network of industry researcher flows. It is linked to 18 other countries through outflows of researchers and to 18 countries through incoming researchers. The United Kingdom, Belgium, the Netherlands, France, Italy and Spain are also found to be relatively central to the network. The smaller EU countries of Malta, Cyprus and Estonia are most peripheral in the network. We find that the differences in flows between countries seem to be primarily due to factors related to (economic) country size and the distance between countries. Indeed, a basic gravity model explains up to 86% of the total variation in the bilateral flows of industry researchers. According to the parameter estimates, an increase in country size by 1% increases the inflow as well as the outflow of industry researchers by about 0.35% to 0.4%, and increasing the distance between two countries by 1% reduces bilateral migration flows by between -0.4% to -0.45%.

6 WHO ARE THE MOBILE RESEARCHERS AND WHERE DO THEY WORK?

6.1 Introduction

Since industry researchers are a highly mobile group, this chapter investigates who they are. We consider to what degree internationally mobile and immobile industry researchers differ with respect to demographic characteristics, with the aim of identifying those groups who are the most strongly inclined to be internationally mobile. More formally we test the hypothesis that among those who are mobile, the share of a certain group differs from the share of the same group among those who are immobile (for group variables). Similarly, for continuous variables – such as age and time since graduation[63] - we test whether the mean of a certain variable for the mobile in our sample differs from that for the immobile.

We are interested in the personal, job and employment characteristics of the mobile. Specifically, we would like to determine:

1. Who are the mobile in our sample in terms of personal characteristics such as age, education, gender and others?

2. Where in terms of industry or type of organisation do they work, and how do their employment relationships differ from the immobile?

3. Who are the researchers that are internationally most mobile in terms of number of stays and the duration of stays abroad and to what degree do their job and employment relationships differ from those of the immobile?

In addition, we also want to examine the same issues with respect to those who intend to look for work abroad in the next three years, those following different career paths, those exhibiting a large number of jobs in the last two years, and those having obtained their current employment relationship coming from different labour market states.

Thus we focus on both international mobility overall as well as on the intensity of mobility measured by the number of stays abroad and the duration of the longest stay. Furthermore, since previously we found a close association between international mobility and career paths, here we consider type of career path, the number of jobs held and the moves between different labour market statuses.

In the remaining sections of this chapter we first discuss the characteristics of those who are internationally mobile as well as the characteristics of those intending to look for work in the next three years. Section four analyses the number of jobs, career paths and previous labour market status of internationally mobile and immobile researchers. Conclusions are presented in section five.

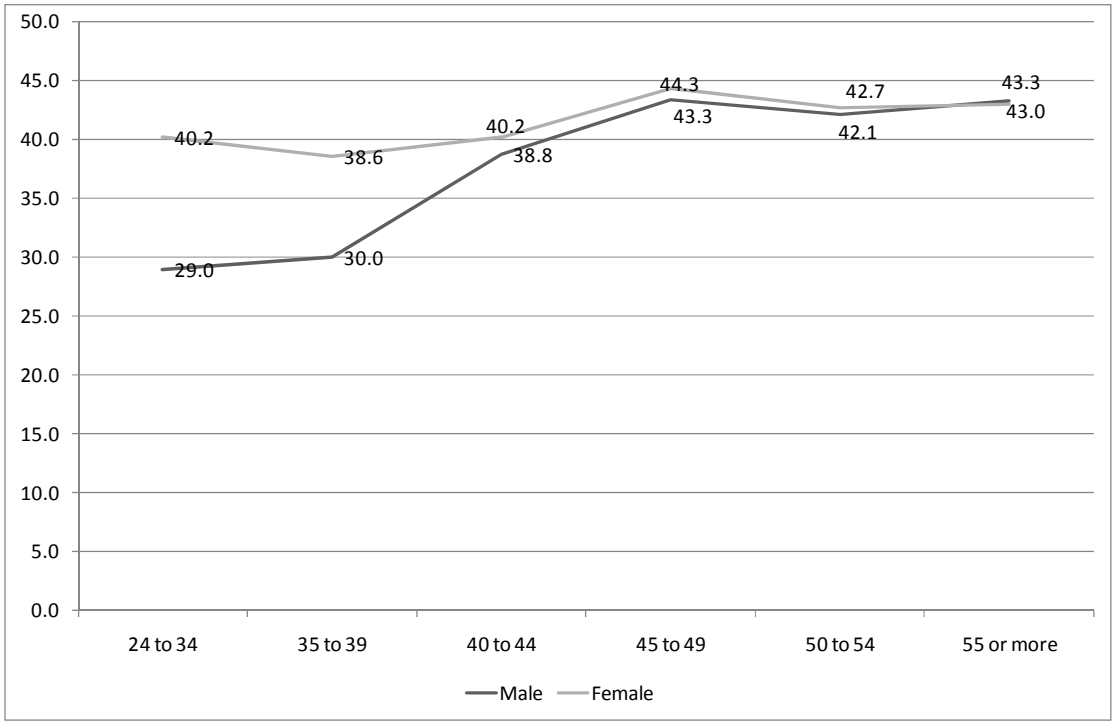
[63] This is done by running univariate logistic regressions on the variables considered. This test allows us to identify significant differences in characteristics between groups in our sample.

6.2 International mobility

6.2.1 Personal characteristics of the internationally mobile

Considering first the overall international mobility of industry researchers, the most robust differences between mobile and immobile researchers are found in terms of field of study, place of birth, age and whether the researcher has studied abroad (table 6.1). Industry researchers in our sample that have at least once worked in another country than their country of graduation for more than three months (i.e. the mobile) are significantly older (and thus have a significantly longer time elapsed since graduation). This suggests that the internationally mobile are the more experienced industry researchers and points to a difference between the international mobility of industry researchers and that of the population overall, since a substantial part of the migration research (e.g. Westerlund 1997, Decressin 1994, Jackman and Savouri 1992) finds that migrants tend to be younger than the resident (immobile) population.[64]

Figure 6.1: Share of mobile industry researchers by age and gender



S: MORE-Questionnaire on industry researchers, internationally mobile=industry researchers that have worked in another country than their country of graduation, internationally immobile=industry researchers that have always worked in the same country as their country of graduation,

As evidenced in figure 6.1 there are, however, important differences in the mobility by age and gender among the researchers sampled.[65] They suggest that mobility is below average for males up to the age group of the 35 to 39 year olds,

[64] Note, however, that in our data we do not observe the age at migration.

[65] In this figure unfortunately we have to aggregate age groups, since we have too few observations for a more detailed analysis. Furthermore data for females has to be interpreted with great care. Although we took care to analyse age groups that encompass more than 30 observations for females of all age groups only 15% of the researchers are female. This creates very low numbers of observations in all age groups for females.

but then rapidly increases in the age group of the 40 to 44 year olds and remains high also in later periods. For females, where, however, we have only very few observations and conclusions that can be drawn must be considered rather tentative, mobility appears to be substantially higher than among men in the early years of their careers – falls slightly between 35-45 (i.e. the child bearing age) and then remains comparable to that of male industry researchers for the older age groups.

Furthermore, in accordance with much of the literature on migration (see: e.g. Hunt, 2008), we find that mobile researchers in our sample are also better educated than the immobile. Here, in particular, those having completed postgradual education (or PhD) are disproportionately more mobile than persons, who have completed only a graduate, undergraduate or secondary education. International mobility also differs by field of study. Among the internationally mobile, those with a degree in the natural, health and medical, and agricultural sciences are significantly overrepresented, while those with a degree in engineering or the technical sciences are underrepresented. This suggests some differences in the typical career paths of those trained in different subject fields.[66]

[66] The distribution of field of research among industry researchers in our sample may, however, be influenced by differences in the participation in the framework program.

Table 6.1: Characteristics of internationally mobile and immobile industry researchers by region of residence

	Total		Resident of EU 15		Resident of EU 12	
	Immobile	Mobile	Immobile	Mobile	Immobile	Mobile
			Gender			
Male[1)]	85.3	84.2	85.2	83.3	85.7	87.1
Female[1)]	14.7	15.8	14.8	16.7	14.3	12.9
Age	44.9	46.3***	44.1	45.6***	47.1	48.5*
Studied Abroad[1)]	13.4	31.4***	13.5	32.2***	12.9	28.9***
Worked in Industry[1)]	51.1	52.1	52.1	52.6	48.6	50.5
Year since graduation	16.7	17.5**	16.1	17.0**	18.4	18.9
			Region of birth			
Born in EU15[1)]	70.3	66.8**	95.7	83.4***	2.6	17.0
Born in EU12[1)]	26.1	23.3	1.1	7.7***	92.6	77.1***
Born outside EU[1)]	3.6	9.9***	3.2	9.6***	4.7	10.9***
			Marital Status			
Married/cohabitating[1)]	84.7	84.2	85.4	83.3	82.9	87.1
Single[1)]	10.7	9.5	10.3	10.3	11.6	7.1**
Widowed[1)]	0.6	0.2	0.2	0.3	1.9	0.0
Divorced[1)]	3.5	5.1**	3.6	4.9	3.1	5.5
Other[1)]	0.6	1.0	0.5	1.2	0.6	0.3
			Highest Completed Education			
PhD (or equivalent) [1)]	42.1	63.5***	41.4	63.2***	43.7	64.6***
Graduate degree[1)]	47.0	29.3***	50.8	30.7***	36.8	24.8***
Undergraduate[1)]	7.8	6.1*	5.0	4.9	15.2	9.6**
Secondary Education[1)]	2.6	0.7***	2.4	0.6***	3.3	1.0**
Vocational Education[1)]	0.2	0.2	0.1	0.2	0.6	0.0
Other[1)]	0.3	0.2	0.3	0.3	0.4	0.0
			Children			
Children[1)]	73.6	75.2	72.4	73.0	76.8	81.9*
Number of Children[2)]	2.1	2.1	2.1	2.1	2.1	2.1
Age of Oldest Child	15.4	16.1	14.1	15.2**	18.6	18.4
			Field of highest degree			
Natural Sciences[1)]	26.1	33.5***	25.3	34.3***	28.2	30.9
Engineering and Technology[1)]	64.0	53.1***	66.4	52.5***	57.4	55.0
Medical and Health Sciences[1)]	2.4	5.1***	2.2	4.9***	3.1	5.9*
Agricultural Sciences[1)]	1.2	2.4**	1.2	2.4**	1.5	2.3
Social Sciences[1)]	5.1	4.9	3.9	4.7	8.6	5.5
Humanities[1)]	1.1	1.0	1.1	1.2	1.3	0.3

S: MORE-Questionnaire on industry researchers, internationally mobile=industry researchers that have worked in another country than their country of graduation, internationally immobile=industry researchers that have always worked in the same country as their country of graduation, 1) measured in % of total sample, *** (**) (*) signify significance of a logistic regression for differences in group means at the 1% (5%), (10%) level, respectively, 2) average among those with children

The most important difference between the internationally mobile and immobile in our sample is, however, found with respect to having studied abroad. 31% of the internationally mobile in the sample have studied abroad for some time. By con-

trast, among those that have not been internationally mobile this share is only 13%. This points to an important effect on international mobility from the experience of studying abroad.

In addition, those industry researchers in our sample born outside the EU27 are more mobile than those born in the EU27. Family variables (such as marital status) also seem to have an impact on international mobility only among industry researchers in the EU12. This first finding, however, is consistent with the fact that industry researchers born outside the EU are also more likely to have graduated outside the EU. For the family variables, by contrast, somewhat contrary to the research on international mobility for the overall population which finds that the married are least likely to be mobile (e.g. Westerlund, 1997), we find that in the EU12 the divorced are more likely to be mobile while the single and widowed are significantly less mobile.[67]

Focusing only on those that were mobile in the last three years (and thus restricting our sample with respect to the mobile substantially) reconfirms many of these findings (table 6.2). In particular, as above, the field of study, the place of birth and whether a researcher has studied abroad remain to be the most important differences between the mobile and the immobile. Among education groups for instance the share of mobile researchers in the last three years (ignoring the obvious outlier of the others category as well as persons with vocational education, which are both based on very few observations only) ranges from 12.2% among the PhDs to 1.2% among persons with secondary education. Similarly, the share of mobile industry researchers having completed a degree in agricultural sciences is as high as 23.1%, while among those having studied in the humanities it is 6.3% (as compared to an average "mobility rate" of 10.3%).

The only findings that differ with respect to this indicator are the following: First, those mobile in the last three years are not significantly older than those immobile. Second, those mobile in the last three years also have significantly more often worked in industry during their studies. Third, the structure of mobility with respect to place of birth changes slightly (with those born in the EU12 being the least mobile), and fourth, the hard to explain but significant difference of the mobile and immobile with respect to divorce disappears, but those mobile in the last three years significantly more often have an "other" marital status. While the first finding is simply a result of the fact that the probability of lifetime mobility is more dependent on age than the probability of mobility over the last three years and the last of these findings is hard to explain (given the other marital status category is a residual category), the significant impact of employment in industry during studies suggests that practical work experience during studies increases the chances of being internationally mobile among industry researchers in particular in their early career.

[67] The positive impact of divorce could, however, also reflect a consequence rather than a cause of mobility.

Table 6.2: Characteristics of researchers that have been mobile and immobile in the last three years

	Not mobile	Mobile	Share Mobile[3)]
		In last three years	
		Gender	
Male[1)]	84.7	86.7	10.5
Female[1)]	15.3	13.3	9.1
Age	45.1	46.5	
Studied Abroad[1)]	19.3	34.7***	17.3
Worked in Industry[1)]	50.6	59.2**	12.0
Year since graduation	17.0	17.0	
		Region of Birth	
Born in EU15[1)]	68.9	70.6	10.6
Born in EU12[1)]	25.7	18.7**	7.7
Born outside EU[1)]	5.4	10.8**	18.7
		Marital Status	
Married/cohabitating[1)]	84.8	82.3	10.1
Single[1)]	10.1	10.8	11.0
Widowed[1)]	0.5	0.0	0.0
Divorced[1)]	4.1	4.4	11.1
Other[1)]	0.5	2.5**	36.4
		Highest Completed Education	
PhD (or equivalent) [1)]	49.8	61.4***	12.4
Graduate degree[1)]	40.5	32.0***	8.3
Undergraduate[1)]	7.2	5.7	8.3
Secondary Education[1)]	2.0	0.3**	1.8
Vocational Education[1)]	0.2	0.0	0.0
Other[1)]	0.3	0.6	22.2
		Children	
Children[1)]	74.6	71.5	10.0
Number of Children[2)]	2.1	2.0	
Age of Oldest Child	15.7	15.8	
		Field of highest Degree	
Natural Sciences[1)]	28.7	33.1**	11.6
Engineering and Technology[1)]	60.3	52.3***	9.0
Medical and Health Sciences[1)]	3.3	5.8**	16.8
Agricultural Sciences[1)]	1.5	3.9***	23.1
Social Sciences[1)]	5.1	4.2	8.6
Humanities[1)]	1.1	0.6	6.3

S: MORE-Questionnaire on industry researchers, internationally mobile=industry researchers that have worked in another country than their country of graduation and have at least one spell abroad in the last three years, internationally immobile=industry researchers that have always worked in the same country as their country of graduation or have no spell abroad in the last three years, 1) measured in % of total sample 2) average among those with children 3) measured in % of total row group (e.g. Row 1: 10.5% of all males in the sample were mobile in the last three years; overall share = 10.3%), *** (**) (*) signify significance of a logistic regression for differences in group means at the 1% (5%), (10%) level, respectively,

Results with respect to the number of times a person has worked abroad (table 6.3)[68] also confirm many of these findings: In our sample both industry researchers that have worked abroad once or two or more times differ significantly from those that never have worked abroad by having a higher level of education, by more often having a degree in the natural sciences, medical and health sciences, by having studied abroad much more often.

This analysis, however, also suggests that in our sample there are few differences between industry researchers that have worked abroad as researchers only once and those that have done so two times or more. Indeed, the only significant differences between these two groups is that those with only one stay abroad are slightly older, are less likely to have also worked in industry during their studies and are significantly less likely to have completed their degree in agricultural sciences, and are less likely to have an "other" marital status than those that worked abroad as a researcher more than one time.

In addition, industry researchers that worked abroad as researchers two or more times are more likely to have worked in industry during their studies than those that never worked abroad as a researcher. 59.2% of those that worked abroad two or more times in our sample worked in industry during their studies. This is significantly higher than the 51.1% among industry researchers that never worked abroad and also than the 49.7% among those that worked abroad only once. Due to the low share of industry researchers that worked abroad two or more times this, however, translates into a relatively low increase in the share of those having worked abroad twice or more among those that have worked in industry during studies relative to those that have not. Among those having worked in industry during studies 2.8% worked abroad twice or more. Among those that did not work in industry during studies this share is 2.1%.

Evidence on the longest duration of stay among those industry researchers that have worked abroad as researchers at least once, by contrast, is somewhat inconclusive (table 6.4).[69] Here persons whose longest work stay abroad was between 3 months to 1 year differ from those with an intermediate duration (1-3 years) by more often having completed a graduate degree in medical and health sciences. The results suggest, however, only marginal significance for a number of other variables including marital status and the presence and number of children.[70] The only additional insight here is that persons with a short stay abroad are also the ones that have most often studied abroad.

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[68] In this table to provide for a large enough number of observations we collapsed those that worked abroad as researchers two or more times in their career into one category. Furthermore in column 1 we also provide results of a test for differences in means between industry researchers that never worked abroad (as researchers) and researchers that worked abroad only once, column two reports tests for significant differences between those working abroad only once and those working abroad two times or more and column three reports the same test for differences between those that never worked abroad and those that worked abroad two times or more.

[69] In this table to provide for a large enough number of observations we collapsed the duration of the longest (work) stay of researchers into three categories (3 months to 1 year, 1-3 years and more than 3 years). Furthermore in column 1 we also provide results of a test for differences in means between industry researchers whose longest stay abroad was between 3 months and 1 year and researchers whose longest stay abroad was 1-3 years, column two reports tests for differences between those working abroad 1-3 years and those working abroad more than three years and column three reports the same test for differences between those that worked abroad for 3 months to one year and those that worked abroad for more than three years.

[70] This low level of significance may be a result of the much smaller number of observations with respect to this indicator, since it focuses only on those that have worked as researchers abroad at least once, which applies to only 41% of our sample.

Table 6.3: Characteristics of industry researchers by number of stays abroad 2)

	0	1	2 or more
		Gender	
Male[1)]	85.3	83.4	86.7
Female[1)]	14.7	16.6	13.3
Age	44.9***	46.5*	45.5
Studied Abroad[1)]	13.4***	30.3	34.7***
Worked in Industry[1)]	51.1	49.7***	59.2**
Year since graduation	16.7**	17.7**	17.0
		Region of birth	
Born in EU15[1)]	70.3**	66.8	66.9
Born in EU12[1)]	26.1	23.8**	21.9***
Born outside EU[1)]	3.6***	9.5*	11.3***
		Marital Status	
Married/cohabitating[1)]	84.7	84.9	82.3
Single[1)]	10.7	9.1	10.8
Widowed[1)]	0.6	0.3	0.0
Divorced[1)]	3.5**	5.3	4.4
Other[1)]	0.6	0.4***	2.5***
		Highest Completed Education	
PhD (or equivalent) [1)]	42.1***	64.2	61.4***
Graduate degree[1)]	47.0***	28.4	32.0***
Undergraduate[1)]	7.8	6.2	5.7
Secondary Education[1)]	2.6***	0.8	0.3**
Vocational Education[1)]	0.2	0.2	0.0
Other[1)]	0.3	0.1***	0.6
		Children	
Children[1)]	73.6	76.4*	71.5
Number of Children[3)]	2.1	2.1	2.0
Age of Oldest Child	15.4	16.2	15.8
		Field of highest degree	
Natural Sciences[1)]	26.1***	33.6	33.1**
Engineering and Technology[1)]	64.0***	53.4	52.3***
Medical and Health Sciences[1)]	2.4***	4.9	5.8***
Agricultural Sciences[1)]	1.2	1.9**	3.9***
Social Sciences[1)]	5.1	5.1	4.2
Humanities[1)]	1.1	1.1	0.6

S: MORE-Questionnaire on industry researchers, 1) measured in % of total sample, *** (**) (*) signify significance of a t-test for differences in group means at the 1% (5%), (10%) level, respectively. In column 1 tests refer to differences in means between industry researchers never working abroad (as researchers) and researchers working abroad once, column two reports tests for differences between those working abroad only once and those working abroad two times or more and column three reports the same test for differences between those that never worked abroad and those that worked abroad two times or more. 2) Based on question: Please provide the name of the countries you worked in as a researcher, scientist or development engineer for a minimum of 3 months in the last 3 years and indicate the duration of your stays beginning with your longest stay (max. No. of entries 5 stays), 3) average among those with children

Table 6.4: Characteristics of industry researchers by duration of stay abroad2)

	3 months to 1 year	1 to 3 years	3 or more
		Gender	
Male[1)]	86.4	84.4	83.3
Female[1)]	13.6	15.6	16.7
Age	46.4	45.6	46.1
Studied Abroad[1)]	35.5**	27.4*	32.0
Worked in Industry[1)]	57.4	52.9	51.2
Year since graduation	17.2	16.9	17.7
		Region of birth	
Born in EU15[1)]	72.9	67.5	63.7*
Born in EU12[1)]	23.1	25.1	21.2
Born outside EU[1)]	4.0*	7.4***	15.1***
		Marital Status	
Married/cohabitating[1)]	83.8	84.1	83.3
Single[1)]	9.4	9.7	10.2
Widowe[1)]	0.0	0.6	0.2
Divorced[1)]	6.8	4.4	5.1
Other[1)]	0.0	1.3	1.3
		Highest Completed Education	
PhD (or equivalent) [1)]	60.9	66.7	62.8
Graduate degree[1)]	33.0**	25.2	30.1
Undergraduate[1)]	5.0	6.9	6.2
Secondary Education[1)]	0.7	0.6	0.5
Vocational Education[1)]	0.0	0.3	0.2
Other[1)]	0.4	0.3	0.2
		Children	
Children[1)]	77.6	73.4	74.0
Number of Children[3)]	2.0*	2.1	2.1*
Age of Oldest Child	16.1	15.3	16.4
		Field of highest degree	
Natural Sciences[1)]	30.3	31.7	35.1
Engineering and Technology[1)]	57.7	53.3	52.2
Medical and Health Sciences[1)]	2.6**	7.0	4.4
Agricultural Sciences[1)]	0.7*	2.5	3.1**
Social Sciences[1)]	6.9	4.1	4.6
Humanities[1)]	1.8	1.3	0.6*

S: MORE-Questionnaire on industry researchers, * measured in % of total sample *** (**) (*) signify significance of a t-test for differences in group means at the 1% (5%), (10%) level, respectively. Column 1 provides tests for differences in means between industry researchers whose longest stay abroad was between 3 month to 1 year and researchers whose longest stay abroad was between 1 to 3 years, column two reports tests for significant differences between those working abroad for 1-3 years once and those working abroad more than three years and column three reports the same test for differences between those that worked for 3 months to 1 year and those that worked abroad for 3 years or more. 2) Based on question: Please provide the name of the countries you worked in as a researcher, scientist or development engineer for a minimum of 3 months in the last 3 years and indicate the duration of your stays beginning with your longest stay (max. No. of entries 5 stays) 3) average among those with children

Those with an intermediate duration of the longest work stay (1-3 years) as a researcher abroad differ from those with a long (longer than three years) duration of stay primarily through a lower share of persons having studied abroad and a lower share of those born outside the EU. Significant differences with respect to industry researchers with a long stay abroad from those with a short stay abroad apply mostly to a larger share of those born outside the EU.

6.2.2 Job and employment characteristics of the internationally mobile

A similar analysis can be conducted with regards to the job and employment characteristics of industry researchers who are internationally mobile or immobile. Here we ask where the mobile industry researchers in our sample work? We find a number of differences in the job and employment characteristics of the internationally mobile and immobile researchers (table 6.5). In particular:

- As may have been expected internationally mobile industry researchers have a significantly lower tenure than immobile workers. This arises because as shown earlier mobile industry researchers usually do not come to their new job from education but rather from another job. This by definition biases their tenure downward.
- Mobile industry researchers are more often employed in fixed term contracts lasting from 1 to 2 years. In the EU15 this comes at the expense of a lower share of industry researchers employed in longer term fixed term contracts (lasting more than two years). In the EU12 mobile industry researchers are less often employed in open ended contracts. Other contracts, by contrast, are significantly more numerous among the mobile industry researchers residing in the EU15 but less numerous among those residing in the EU12.
- Among the mobile industry researchers the share of part time employment contracts with a short working time is greater among the immobile researchers in the EU15. Here the share of industry researchers working 40-60% of a full time contract (which amounts to 2.6%) is significantly higher among the mobile than among the immobile (1.3%) at the expense of those working for between 80-100% of a full time contract (1.5% for mobile relative to 3.4 for immobile industry researchers). This, difference, however, applies only to the EU15 since in the EU12 no significant differences between mobile and immobile industry researchers with respect to work times can be found.
- Industry researchers that do not indicate a specific field of research are significantly over-represented among the mobile researchers, but researchers working in the technology field of mechanical engineering are underrepresented. This, however, applies only to the industry researchers residing in the EU15

As before these results do not change substantially when focusing only on those internationally mobile in the last three years (table 6.6). Here, significant differences between the mobile and those not mobile within the last three years exist with respect to the same variables as for those mobile and immobile overall. In particular the share of those that have been mobile in the last three years is 20.5% among researchers that have a fixed term contract (relative to an average of 10.3%), while it is 17.7% among researchers that work 40-60% of a full time employment but only 3% for those working 80-100% of a full time employment.

Table 6.5: Job and employment characteristics of internationally mobile and immobile industry researchers' jobs by region of residence

	Total		Resident of EU 15		Resident of EU 13	
	Immobile	Mobile	Immobile	Mobile	Immobile	Mobile
Tenure (years)	11.2	9.1***	10.8	9.1***	12.5	9.4***
			Type of Organisation			
Company/Self Employed[1)]	86.4	83.1**	88.2	84.0***	81.8	80.5
Research Lab/Organisation[1)]	8.7	13.1***	7.8	12.1***	11.3	16.2*
Other[1)]	4.8	3.8	4.1	3.9	6.9	3.4**
			Field of Technology			
Human Necessities[1)]	5.6	6.7	6.0	7.0	4.5	5.6
Performing Operations[1)]	6.0	5.5	6.9	5.5	3.3	5.6
Chemistry, Metalurgy[1)]	12.4	12.6	11.9	12.8	13.8	11.8
Textiles, Paper[1)]	1.8	0.9*	1.9	0.9	1.5	1.0
Fixed Constructions[1)]	1.6	1.6	1.6	2.1	1.5	0.0
Mechanical Engineering [1); 2)]	17.8	14.1**	18.7	13.4**	15.3	16.4
Physics[1)]	9.3	9.0	8.0	8.7	12.9	10.3
Electricity[1)]	7.6	6.4	7.3	6.1	8.7	7.2
Unknown/no answer[1)]	37.9	43.1**	37.7	43.4**	38.4	42.1
			Type of Contract			
Fixed term, < 1 years[1)]	1.0	1.0	1.1	0.8	0.6	1.7
Fixed term, 1-2 years[1)]	0.8	2.1***	1.0	2.1**	0.2	2.0**
Fixed term, > 2 years[1)]	7.9	5.5**	9.5	6.1**	3.6	3.7
Open ended contract[1)]	78.8	77.7	76.8	77.2	84.1	79.3*
Non-employment[1)]	0.5	0.3	0.5	0.4	0.4	0.0
Self-employed[1)]	9.3	10.0	9.8	9.7	8.1	10.8
Other[1)]	1.8	3.4***	1.4	3.7***	3.0	2.4***
			Working time (in% of full time contract)			
0-20%[1)]	0.3	0.3	0.2	0.2	0.6	0.3
20-40%[1)]	0.1	0.4	0.0	0.3*	0.4	0.7
40-60%[1)]	1.2	2.5**	0.9	2.6**	2.2	2.4
60-80%[1)]	1.3	1.5	1.1	1.6	1.9	1.4
80-100%[1)]	3.0	1.3***	3.4	1.5***	2.2	0.7
100%[1)]	94.0	94.0	94.5	93.9	92.7	94.5

S: MORE-Questionnaire on industry researchers, internationally mobile=industry researchers that have worked in another country than their country of graduation, internationally immobile=industry researchers that have always worked in the same country as their country of graduation , 1) measured in % of total sample, 2) including Lighting, Heating, Weapons, Blasting *** (**) (*) signify significance of a logistic regression for differences in group means at the 1% (5%), (10%) level, respectively

Table 6.6: Job characteristics of researchers that have been mobile and immobile in the last three years

	Not mobile	Mobile	Share Mobile[2)]
		In last three years	
Tenure (years)	10.6	8.1***	
		Type of Organisation	
Company/Self Employed[1)]	85.5	81.3**	10.0
Research Lab/Organisation[1)]	10.1	14.2**	14.1
Other[1)]	4.4	4.5	10.7
		Field of Technology	
Human Necessities[1)]	6.0	6.5	10.7
Performing Operations[1)]	6.0	4.2	7.2
Chemistry, Metalurgy[1)]	12.4	13.0	10.5
Textiles, Paper[1)]	1.6	0.0	0.0
Fixed Constructions[1)]	1.6	1.4	8.8
Mechanical Engineering [1)]	16.7	13.0	8.0
Physics[1)]	9.4	7.4	8.1
Electricity[1)]	7.1	7.4	10.5
Unknown/no answer[1)]	39.2	47.0**	11.8
		Type of Contract	
Fixed term, < 1 years[1)]	1.0	1.3	13.8
Fixed term, 1-2 years[1)]	1.2	2.6**	20.5
Fixed term, > 2 years[1)]	7.2	4.5*	6.9
Open ended contract[1)]	78.7	75.1	10.1
Non-employment[1)]	0.4	0.3	8.3
Self-employed[1)]	9.3	11.7	12.8
Other[1)]	2.2	4.5**	19.4
		Working time (in% of full time contract)	
0-20%[1)]	0.3	0.0	0.0
20-40%[1)]	0.2	0.3	14.3
40-60%[1)]	1.6	2.9*	17.7
60-80%[1)]	1.4	1.6	12.2
80-100%[1)]	2.5	0.7**	3.0
100%[1)]	93.9	94.5	10.7

S: MORE-Questionnaire on industry researchers, internationally mobile=industry researchers that have worked in another country than their country of graduation and have at least one spell abroad in the last three years, internationally immobile=industry researchers that have always worked in the same country as their country of graduation or have no spell abroad in the last three years, 1) measured in % of total sample 2) measured in % of total row group (e.g. Row 3: 10.0% of all those employed in companies in the sample were mobile in the last three years; overall share = 10.3%), *** (**) (*) signify significance of a logistic regression for differences in group means at the 1% (5%), (10%) level, respectively,

With respect to the number of stays abroad (see table 6.7), in contrast to the results for personal characteristics, we find a number of variables measuring employment and job characteristics that differ significantly between those that have never been mobile, those that have worked abroad as a researcher only once and those that have worked abroad more often. In particular as was to be expected average tenure, declines significantly with the number of stays abroad as does the probability of being employed in a company or as a self-employed, working in the research field of mechanical engineering, having a fixed term contract with a

duration in excess 2 years and having average working hours amounting to 80-100% of a full time contract.

Table 6.7: Characteristics of industry researchers' jobs by number of stays abroad in the last three years

	0	1	2 or more
Tenure	11.2***	9.5***	8.1***
	Type of Organisation		
Company/Self Employed[1)]	86.4*	83.7	81.3***
Research Lab/Organisation[1)]	8.7***	12.7	14.2***
Other[1)]	4.8	3.5	4.5
	Field of Technology		
Human Necessities[1)]	5.6	6.8	6.5
Performing Operations[1)]	6.0	6.0	4.2
Chemistry, Metalurgy[1)]	12.4	12.5	13.0
Textiles, Paper[1)]	1.8	1.2	0.0
Fixed Constructions[1)]	1.6	1.7	1.4
Mechanical Engineering [1); 2)]	17.8*	14.5	13.0*
Physics[1)]	9.3	9.5	7.4
Electricity[1)]	7.6	6.0	7.4
Unknown/no answer[1)]	37.9*	41.8	47.0**
	Type of Contract		
Fixed term, < 1 years[1)]	1.0	0.9	1.3
Fixed term, 1-2 years[1)]	0.8**	1.9	2.6**
Fixed term, > 2 years[1)]	7.9*	5.8	4.5**
Open ended contract[1)]	78.8	78.6	75.1
Non-employment[1)]	0.5	0.3	0.3
Self-employed[1)]	9.3	9.4	11.7
Other[1)]	1.8**	3.0	4.5***
	Working time (in% of full time contract)		
0-20%[1)]	0.3	0.3	0.0
20-40%[1)]	0.1	0.5*	0.3
40-60%[1)]	1.2**	2.4*	2.9**
60-80%[1)]	1.3	1.5	1.6
80-100%[1)]	3.0**	1.5	0.7**
100%[1)]	94.0	93.9	94.5

S: MORE-Questionnaire on industry researchers, 1) measured in % of total sample, *** (**) (*) signify significance of a t-test for differences in group means at the 1% (5%), (10%) level, respectively. In column 1 tests refer to differences in means between industry researchers never working abroad (as researchers) and researchers working abroad once, column two reports tests for significant differences between those working abroad only once and those working abroad two times or more and column three reports the same test for differences between those that never worked abroad and those that worked abroad two times or more. 2) including Lighting, Heating, Weapons, Blasting , 3) Based on question: Please provide the name of the countries you worked in as a researcher, scientist or development engineer for a minimum of 3 months in the last 3 years and indicate the duration of your stays beginning with your longest stay (max. No. of entries 5 stays)

On the other hand, the share of those employed in a research organisation or research lab, those working in undisclosed technological fields, those employed in a fixed term contract with a duration of more than two years and those working for 40 to 60% of a full time contract significantly increases with the number of times an industry researcher has worked abroad.

Table 6.8: Characteristics of industry researchers' jobs by duration of longest stay abroad in the last three years

	3 months to 1 year	1 to3 years	3 or more years
Tenure	9.5	8.5	9.0
	Type of Organization		
Company/Self Employed[1)]	84.7	85.4	80.8
Research Lab/Organisation[1)]	12.0	10.7	15.1
Other[1)]	3.3	3.9	4.1
	Field of Technology		
Human Necessities[1)]	6.5	6.2	5.9
Performing Operations[1)]	7.0	5.3	5.1
Chemistry, Metalurgy[1)]	8.5*	13.7	14.8**
Textiles, Paper[1)]	0.5	0.9	1.1
Fixed Constructions[1)]	2.0	2.2	0.8
Mechanical Engineering [1); 2)]	14.9	12.4	14.5
Physics[1)]	9.5	6.6*	10.8
Electricity[1)]	10.0**	4.0	5.6*
Unknown/no answer[1)]	41.3*	48.7*	41.4
	Type of Contract		
Fixed term, < 1 years[1)]	2.6*	0.7*	0.4**
Fixed term, 1-2 years[1)]	1.8	3.3	1.9
Fixed term, > 2 years[1)]	4.8	5.9	5.9
Open ended contract[1)]	75.6	76.0	78.8
Non-employment[1)]	0.4	0.3	0.2
Self-employed[1)]	11.1	8.9	10.4
Other[1)]	3.7*	4.9*	2.5
	Working time (in% of full time contract)		
0-20%[1)]	0.4	0.0	0.2
20-40%[1)]	0.7	0.3	0.2
40-60%[1)]	1.9	2.7	2.1
60-80%[1)]	1.5	2.7	1.1
80-100%[1)]	2.6*	0.7*	1.1
100%[1)]	92.9	93.6	95.2

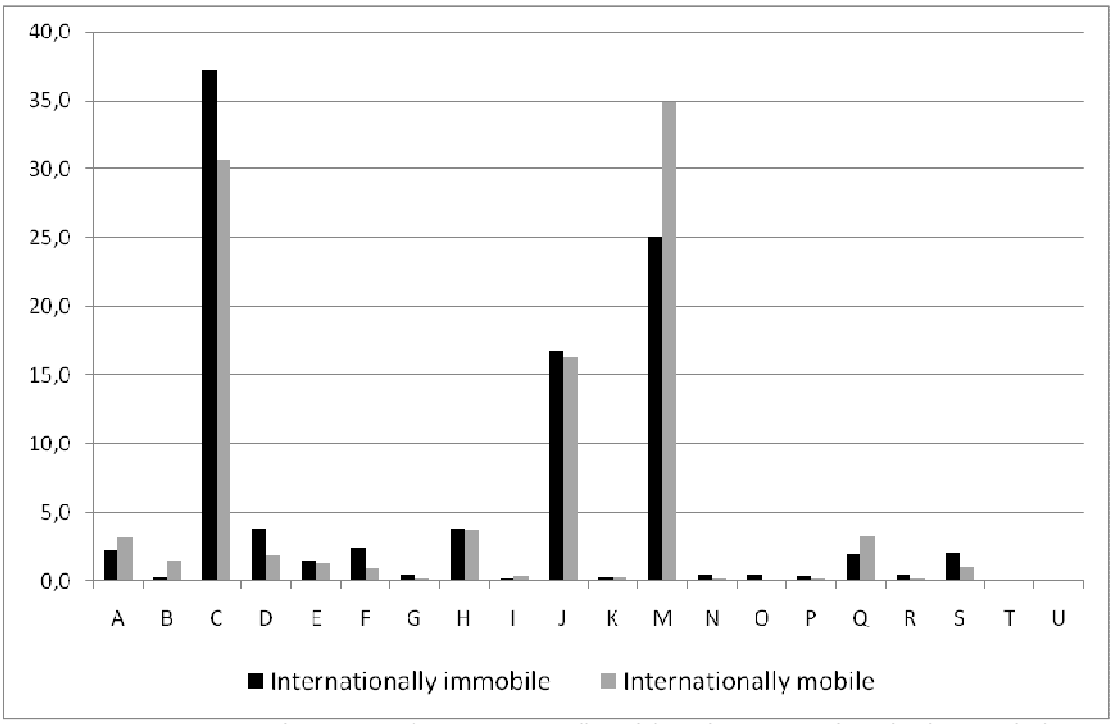
S: MORE-Questionnaire on industry researchers, 1) measured in % of total sample *** (**) (*) signify significance of a t-test for differences in group means at the 1% (5%), (10%) level, respectively. Column 1 provides tests for differences in means between industry researchers whose longest stay abroad was between 3 months to 1 year and researchers whose longest stay abroad was between 1 to 3 years, column two reports tests for significant differences between those working abroad for 1-3 years and those working abroad more than three years and column three reports the same test for differences between those that worked for 3 months to 1 year and those that worked abroad for 3 years or more. 2) including Lighting, Heating, Weapons, Blasting , 3) Based on question: Please provide the name of the countries you worked in as a researcher, scientist or development engineer for a minimum of 3 months in the last 3 years and indicate the duration of your stays beginning with your longest stay (max. No. of entries equals 5 stays).

This result, aside from corroborating the results with respect to overall mobility above, also suggests that the number of mobility events that industry researchers experience in the course of their career is closely linked to different career patterns that are associated with different types of organisation and that this increased mobility is also closely linked with the type of employment contract (e.g.

duration of contract and working time) the highly mobile segments among the industry researchers can obtain.[71]

With respect to the longest duration of stay abroad we, however, once more find very few significant differences between internationally mobile and immobile researchers. Most of the results of our tests imply that statistically industry researchers in our sample whose longest stay abroad was 3 months to 1 year (i.e. a short stay), researchers with a duration of stay between 1 and 2 years (medium stay) and researchers with a stay in excess of 3 years (long stay) cannot be easily distinguished, and the few results that do indicate some differences, do so only at low significance levels.[72] This suggests that there are only few differences among the internationally mobile industry researchers by duration of longest stay abroad, both with respect to personal as well job and employment characteristics.

Figure 6.2: Sector of employment of internationally mobile and immobile industry researchers



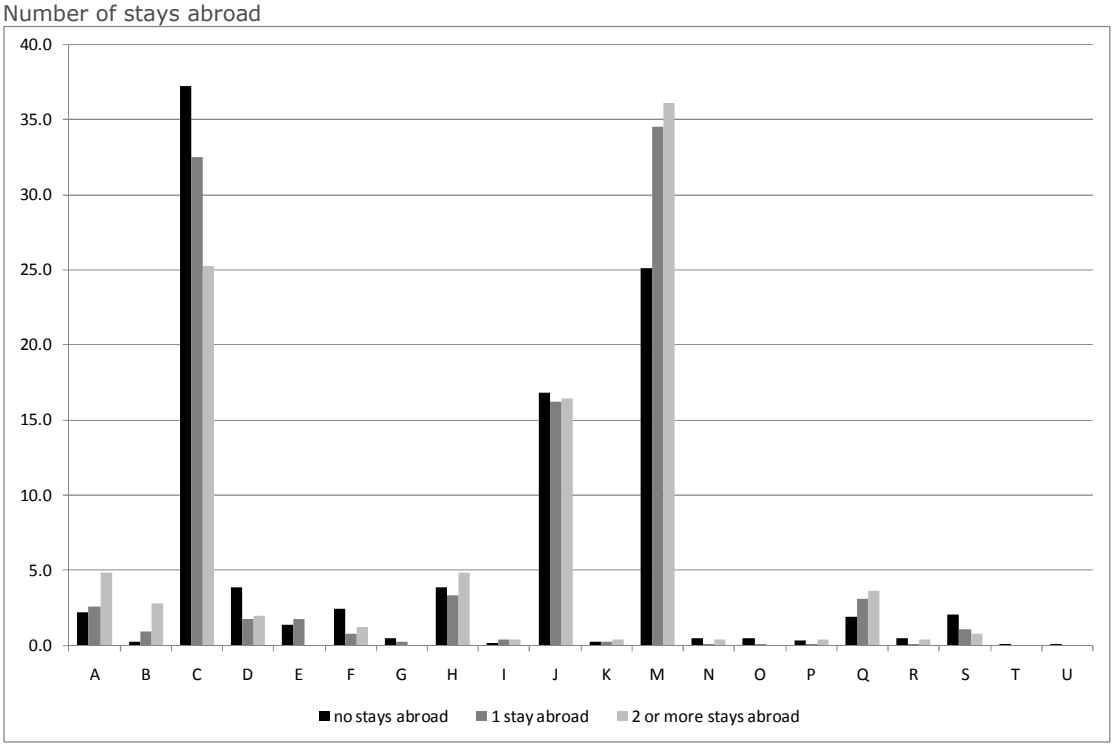
S: MORE-Questionnaire on industry researchers, internationally mobile=industry researchers that have worked in another country than their country of graduation, internationally immobile=industry researchers that have always worked in the same country as their country of graduation, Sector classification bases on NACE rev.2 sections. A: Agriculture, Forestry and Fishing; B: Mining and quarrying; C: Manufacturing; D: Electricity, gas, steam and air conditioning supply; E: Water supply, sewerage, waste management and remediation activities; F: Construction; G: Wholesale and retail trade; repair of motor vehicles and motorcycles; I: Accommodation and food service activities; H: Transportation and storage; J: Information and communication; K: Financial and insurance activities; L: Real estate activities; M: Professional, scientific and technical activities; N: Administrative and support service activities; O: Public administration and defence; compulsory social security; P: Education; Q: Human health and social work activities; R: Arts, entertainment and recreation; S:Other service activities; T: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; U: Activities of extraterritorial organizations and bodies. See table A3.2 in Annex for data

[71] Note, however, that with the data at our hands it is not possible to distinguish the direction of causality between type of employment contract and mobility.

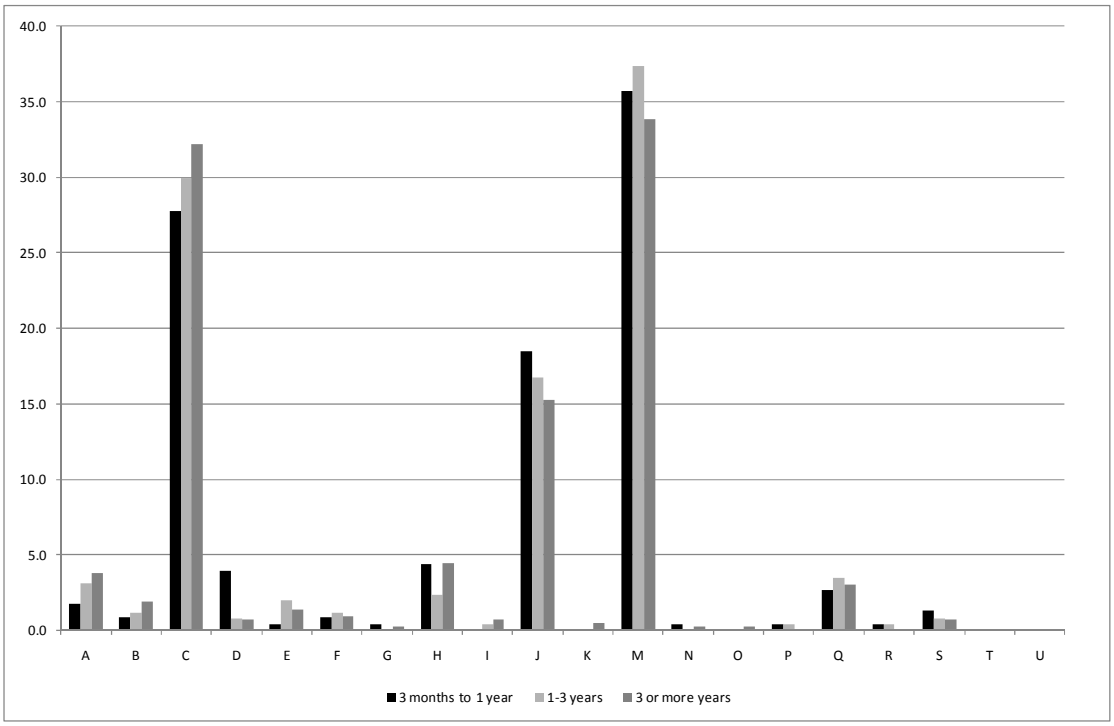
[72] The variables for which this does not apply are mobile industry researchers working in physics, who are significantly underrepresented among the internationally mobile industry researchers with a duration of stay of 1 to 3 years and the low share of internationally mobile researchers with a duration of stay of 3 years or more with a fixed term contract for only one year.

Figure 6.3: Sector of employment of internationally mobile and immobile industry researchers by number of stays abroad and duration of longest stay abroad

Number of stays abroad



Durations of longest stay abroad



S: MORE-Questionnaire on industry researchers, Sector classification bases on NACE rev.2 sections. A: Agriculture, Forestry and Fishing; B: Mining and quarrying; C: Manufacturing; D: Electricity, gas, steam and air conditioning supply; E: Water supply, sewerage, waste management and remediation activities; F: Construction; G: Wholesale and retail trade; repair of motor vehicles and motorcycles; I: Accommodation and food service activities; H: Transportation and storage; J: Information and communication; K: Financial and insurance activities; L: Real estate activities; M: Professional, scientific and technical activities; N: Administrative and support service activities; O: Public administration and defence; compulsory social security; P: Education; Q: Human health and social work activities; R: Arts, entertainment and recreation; S:Other service activities; T: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; U: Activities of extraterritorial organizations and bodies. Based on question: Please provide the name of the countries you worked in as a researcher, scientist or development engineer for a minimum of 3 months in the last 3 years and indicate the duration of your stays beginning with your longest stay (max. No. of entries equals 5 stays). . See table A3.2 in Annex for data

Finally, with respect to sector of employment (see Figures 6.2 and 6.3) those industry researchers that have been internationally mobile in the past disproportionately often work in professional, scientific and technical activities (i.e. NACE rev.2 section – M), which also encompasses the private research labs and organizations. In manufacturing (i.e. NACE rev.2 section – C) and to a lesser degree in information and communication (i.e. NACE rev.2 section – J), the other two important sectors of employment for industry researchers, those who had been previously mobile are underrepresented.

This impression of higher international mobility in professional, scientific and technical activities relative to manufacturing and financial services also applies when considering the number of stays abroad. We find that industry researchers employed in the manufacturing sector only rarely have had more than one stay of working abroad (as as researcher).

When considering the duration of the longest stay abroad among researchers in our sample that have at least worked abroad (as a researcher) once, however, we find that those (few) industry researchers that have experience with working abroad and are currently employed in manufacturing, are overrepresented among those with long stays abroad but underrepresented in financial services. This points to some differences in the previous mobility behaviour of industry researchers by branch of employment, when considering the sectors with the highest shares of industry researchers employed: Those that work in manufacturing tend to have a lower international mobility, but stay abroad for a longer period of time, when they move. Those working in professional, scientific and technical activities on average are the most mobile, while those working in financial services tend to have slightly fewer and often also shorter stays abroad.

6.3 Intentions to look for work abroad

So far our analysis has focused only on past international mobility of industry researchers. This could be criticised because current job characteristics as well as some individual characteristics are in all likelihood the consequence rather than the cause of the decision to become internationally mobile. To circumvent this problem of our analysis at least to some degree - in tables 6.9 and 6.10 - we present a similar analysis for those industry researchers who intend to look for work abroad in the next three years.[73]

[73] This is based on the question in the questionnaire in which respondents were asked to identify whether they "…intend to look for work (lasting for more than three months) in another country in the next three years". Here we classify respondents who answered "yes" as intending to migrate and those who answered "no" as not intending to migrate

Table 6.9: Characteristics of industry researchers by intentions to look for work abroad in the next three years[2)]

	Intending to look for work abroad	Not intending to look for work abroad	Share intending to look for work abroad [4)]
		Gender & Age	
Male[1)]	85.5	83.7	34.0
Female[1)]	14.5	16.3	37.3
Age	46.8	43.1***	
		Experience	
Studied Abroad[1)]	17.8	26.7***	44.0
Worked in Industry[1)]	50.2	54.1***	36.2
Year since graduation	18.5	14.2***	
		Region of Birth	
Born in EU15[1)]	67.7	71.2**	35.9
Born in EU12[1)]	27.0	21.1***	28.5
Born outside EU[1)]	5.3	7.7**	42.9
		Marital Status	
Married/cohabitating[1)]	87.1	79.5***	32.5
Single[1)]	8.0	14.4***	48.7
Widowed[1)]	0.6	0.3	21.4
Divorced[1)]	3.9	4.6	38.1
Other[1)]	0.5	1.2**	59.1
		Highest Completed Education	
PhD (or equivalent) [1)]	51.2	50.5	34.2
Graduate degree[1)]	38.3	42.2**	36.7
Undergraduate[1)]	8.0	5.4***	26.3
Secondary Education[1)]	2.0	1.5	28.6
Vocational Education[1)]	0.2	0.1	16.7
Other[1)]	0.3	0.3	33.3
		Children	
Children[1)]	77.9	67.4***	31.4
Number of Children[3)]	2.1	2.0***	
Age of Oldest Child	16.6	13.8***	
		Field of highest Degree	
Natural Sciences[1)]	31.6	24.4***	28.9
Engineering and Technology[1)]	57.4	63.5***	36.8
Medical and Health Sciences[1)]	3.4	3.7	36.5
Agricultural Sciences[1)]	2.0	1.2***	23.1
Social Sciences[1)]	4.6	5.8	40.1
Humanities[1)]	0.9	1.4	46.9

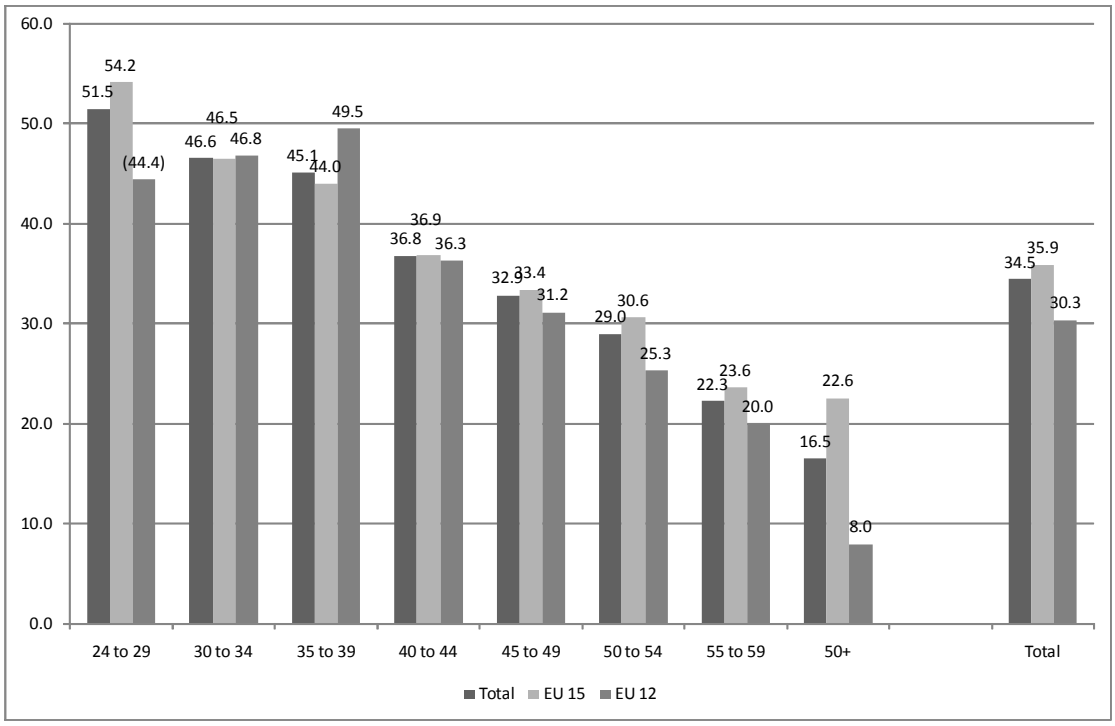
S: MORE-Questionnaire on industry researchers, 1) measured in % of total sample, *** (**) (*) signify significance of a logistic regression for differences in group means at the 1% (5%), (10%) level, respectively 2) Based on the question: "Do you intend to look for work (lasting for more than three months) in another country in the next three years" 3) average among those with children 4) measured in % of total row group (e.g. Row 3: 34.0% of all males in the sample are willing to be mobile)

As can be seen from these tables this change of focus has a number of impacts on findings. When focusing on industry researchers that intend to look for work abroad rather than on those that previously have been internationally mobile, we find that, in accordance with most of the results of the migration literature, industry researchers intending to look for work abroad are significantly younger, less often married, and have fewer (and older) children than those that are not intending to look for work abroad. Furthermore, we also see that among those intending to look for work abroad, those born in the EU15 and in other countries constitute a significantly larger share than among those not intending to look for work abroad. The share of those that intend to look for work abroad in the next three years is 35.9% among those born in the EU15 but only 28.5% among those born in the EU12. Again this highlights the higher mobility among those born in EU15 countries. The highest share of those intending to look for work abroad (of 42.9%) is however found among researchers born outside the EU.

In addition (as can be seen from figure 6.4) intentions to look for work abroad fall dramatically with the age of researchers. Among the young researchers (aged 24 to 29) more than half (51.5%) intend to look for work abroad. Among the older researchers (aged 50 or more years) this percentage is only 16.5%.

We also find that the higher educated are more likely to intend to look for work abroad. Significant differences here apply to a higher share of those in our sample with a completed graduate education and a lower share of undergraduates intending to look for work abroad. The share of those intending to look for work abroad is 36.7% among holders of a graduate degree but only 26.3% among undergraduates. The lowest share of those intending to look for work abroad (16.7%) is, however, found among the few researchers that have completed a vocational training only.

Figure 6.4: Share of industry researchers by intentions to look for work abroad and age group



S: MORE-Questionnaire on industry researchers, Based on the question: "Do you intend to look for work (lasting for more than three months) in another country in the next three years". Values in brackets are based on fewer than 30 observations. Figure displays share of those with intentions to look for work abroad

Also relative to the evidence on previous mobility, the ranking by field of study is reversed: The share of industry researchers intending to look for work abroad in our sample is significantly higher among those with a degree in engineering (among whom 36.8% intend to look for work abroad) and significantly lower for those with a degree in natural and agricultural sciences (among whom 29.9% intend to look for work abroad). Here, however, also the highest shares of those intending to look for work abroad are found among graduates of the humanities (46.9%) and the social sciences (40.1%).

Finally, considering the results with respect to the intentions of industry researchers to look for work abroad reconfirms the important role of student mobility in determining these intentions to look for work abroad. 26.7% of those intending to look for work abroad in our sample have also studied abroad. By contrast the share among those not intending to look for work abroad is 17.8%. Thus in sum 44% of those that studied abroad in our sample state that they intend to look for work abroad in the next three years.

Table 6.10: Job and employment characteristics of industry researchers by intentions to look for work abroad in the next three years

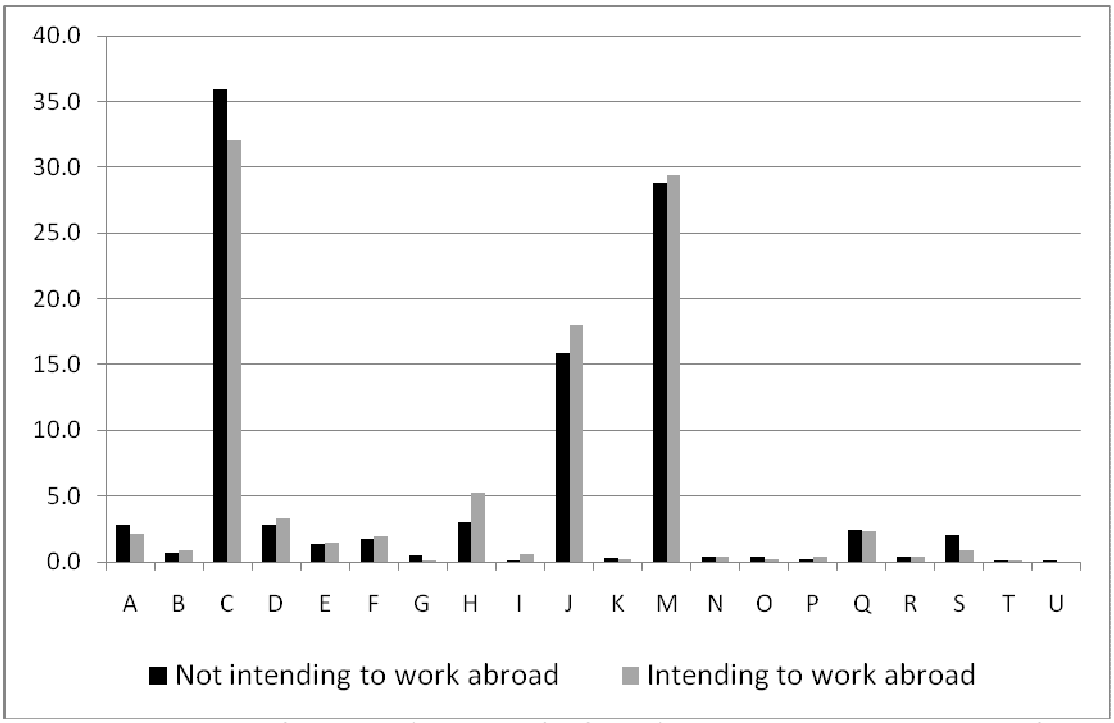
	Intending to look for work abroad	Not intending to look for work abroad	Share intending to look for work abroad
Tenure	11.5	8.3**	
		Type of Organisation	
Company/Self Employed[1)]	86.1	83.1***	33.6
Research Lab/Organisation[1)]	9.7	12.0*	39.3
Other[1)]	4.2	4.9	38.2
		Field of Technology	
Human Necessities[1)]	6.2	5.8	32.3
Performing Operations[1)]	4.8	7.9***	45.6
Chemistry, Metalurgy[1)]	13.0	11.4	30.6
Textiles, Paper[1)]	1.5	1.2	29.0
Fixed Constructions[1)]	1.2	2.4**	50.0
Mechanical Engineering [1); 2)]	16.1	16.9	34.8
Physics[1)]	10.2	7.2**	26.4
Electricity[1)]	7.4	6.6	31.4
Unknown/no answer[1)]	39.7	40.6	34.1
		Type of Contract	
Fixed term, < 1 years[1)]	0.9	1.1	37.9
Fixed term, 1-2 years[1)]	0.9	2.2***	56.4
Fixed term, > 2 years[1)]	7.6	5.5**	39.2
Open ended contract[1)]	77.6	79.6	35.0
Non-employment[1)]	0.5	0.3	25.0
Self-employed[1)]	10.1	8.5	30.6
Other[1)]	2.3	2.8	38.9
		Working time (in % of full time contract)	
0-20%[1)]	0.4	0.0	0.0
20-40%[1)]	0.3	0.1	14.3
40-60%[1)]	1.7	1.8	35.3
60-80%[1)]	1.6	1.0	24.4
80-100%[1)]	2.9	1.2***	17.9
100%[1)]	93.0	95.9***	36.0

S: MORE-Questionnaire on industry researchers, internationally mobile=industry researchers that worked in another country than their country of graduation,, internationally immobile=industry researchers that always worked in the same country as their country of graduation , 1) measured in % of total sample, *** (**) (*) signify significance of a t-test for differences in group means at the 1% (5%), (10%) level, respectively, 2) including Lighting, Heating, Weapons, Blasting , 3) Based on the question: "Do you intend to look for work (lasting for more than three months) in another country in the next three years"

When, by contrast, considering the job and employment characteristics of those intending to look for work abroad we find - as with those that have previously been internationally mobile - that they have a significantly shorter tenure, more often work in research organisations and labs (but less often in companies or self-employment), and significantly more often have a fixed term contract lasting for one year (at the expense of fixed term contracts lasting more than two years) than those not intending to look for work abroad. In particular the share of those intending to look for work abroad is 39.2% among researchers with fixed term contracts with duration of more than 2 years, and is also high among all other

researchers with fixed term contracts (reaching a maximum of 56.4% for researchers with fixed term contracts with duration of 1 to 2 years).

Figure 6.5: Sector of employment of industry researchers intentions to look for work abroad



S: MORE-Questionnaire on industry researchers, Sector classification bases on NACE rev.2 sections. A: Agriculture, Forestry and Fishing; B: Mining and quarrying; C: Manufacturing; D: Electricity, gas, steam and air conditioning supply; E: Water supply, sewerage, waste management and remediation activities; F: Construction; G: Wholesale and retail trade; repair of motor vehicles and motorcycles; I: Accommodation and food service activities; H: Transportation and storage; J: Information and communication; K: Financial and insurance activities; L: Real estate activities; M: Professional, scientific and technical activities; N: Administrative and support service activities; O: Public administration and defence; compulsory social security; P: Education; Q: Human health and social work activities; R: Arts, entertainment and recreation; S:Other service activities; T: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; U: Activities of extraterritorial organizations and bodies. Based on the question: "Do you intend to look for work (lasting for more than three months) in another country in the next three years". See table A3.3 in Annex for data

In contrast to the results on those that have been previously internationally mobile those intending to look for work abroad in the next three years are also more often researching in performing operations and fixed constructions than those not intending to look for work abroad (with 45.6% of them intending to look for work abroad in the next three years), but less often in physics (where 26.4% intend to look for work abroad), and those intending to look for work abroad significantly more often have a full time work contract, than those not intending to look for work abroad (36% of these researchers want to look for work abroad).

Similarly also those intending to look for work abroad are somewhat overrepresented among the industry researchers employed in professional, scientific and technical activities (i.e. NACE rev.2 section – M) and information and communication (i.e. NACE rev.2 section – J), while they are underrepresented in manufacturing (i.e. NACE rev.2 section – C) (Figure 6.5).

6.4 Career paths

6.4.1 Types of career paths

With regards to career paths[74] a comparable analysis to that on international mobility shows that in comparison to researchers that have moved from the public to the private sector:

- Industry researchers that always worked as a researcher in the private sector are significantly more often male, have more seldom studied abroad but more often worked in industry during their studies, are less often born outside the EU and have a lower share of PhDs (but higher shares of undergraduate and secondary as well as graduate degree holders), and are also more often trained in social sciences as well as engineering and technology but less often in medical, natural or agricultural sciences than researchers moving from the public to the private sector. These researchers also have a higher tenure and a significantly higher share of fixed term and non-employment contracts but a smaller share of open ended contracts.
- Industry researchers that have moved from the private to the public sector and back have on average less often completed a PhD degree, but more often hold a graduate or undergraduate degree in engineering and technology. They also have worked in industry during their studies more often than industry researchers that moved from the public to the private sector but have less often studied natural sciences. For them also the share of open ended contracts is statistically significantly smaller than for researchers moving from the public to the private sector since this group has a higher share of self-employed.

[74] In contrast to the analysis in chapter 4, in the analysis below we consider here only career paths involving the private sector as an end point and drop all those with the public sector as an end point. The reason for this is that, since our survey design was geared towards industry researchers, we are likely to have undersampled these career paths (on account of not sampling academic researchers). As shown in table 4.5 (chapter 4) by omitting these career paths we lose only 5.5% of the researchers sampled. Furthermore in contrast to the analysis for internationally mobile researchers in the analysis below, due to the large number of potential comparison groups we compare all other groups to the largest group (i.e. those that have moved from the public to the private sector).

Table 6.11: Characteristics of industry researchers by career path [2)]

	always private	public to private	private public and back	other
		Gender		
Male[1)]	89.5***	83.3	84.5	83.2
Female[1)]	10.5***	16.7	15.5	16.8
Age	46.2	46.0	46.7	47.9***
Studied Abroad[1)]	16.3***	23.1	22.4	23.9
Worked in Industry[1)]	58.7***	44.9	57.4**	49.8
Year since graduation	19.1***	16.4	16.8	20.1***
		Region of birth		
Born in EU15[1)]	71.2	67.8	62.9	65.9
Born in EU12[1)]	24.1	24.7	26.7	27.6
Born outside EU[1)]	4.7***	7.6	10.5	6.5
		Marital Status		
Married/cohabitating[1)]	85.1	85.3	81.7	84.7
Single[1)]	9.0	9.8	11.0	9.7
Widowed[1)]	0.8*	0.2	0.0	0.7
Divorced[1)]	4.7	4.1	5.5	3.7
Other[1)]	0.4	0.6	1.8	1.1
		Highest Completed Education		
PhD (or equivalent) [1)]	29.7***	74.6	56.4***	36.6***
Graduate degree[1)]	55.5***	23.0	38.2***	46.3***
Undergraduate[1)]	10.6***	2.1	5.5**	10.4***
Secondary Education[1)]	3.9***	0.1	0.0	4.5***
Vocational Education[1)]	0.2	0.1	0.0	1.1**
Other[1)]	0.2	0.1	0.0	1.1**
		Children		
Children[1)]	77.6	76.1	73.4	73.4
Number of Children[3)]	2.1	2.1	2.2	2.2*
Age of Oldest Child	16.1	15.8	15.8	18.5**
		Field of highest degree		
Natural Sciences[1)]	20.7***	39.4	25.9***	20.8***
Engineering and Technology[1)]	71.2***	49.1	61.1**	56.1**
Medical and Health Sciences[1)]	1.7***	5.8	3.7	3.4
Agricultural Sciences[1)]	1.2**	2.5	1.9	0.4*
Social Sciences[1)]	4.8**	2.8	5.6	14.4**
Humanities[1)]	0.4	0.5	1.9*	4.9**

S: MORE-Questionnaire on industry researchers, 1) measured in % of total sample, *** (**) (*) signify significance of a logistic regression for differences in group means relative to industry researchers moving from the private to the public sector at the 1% (5%), (10%) level, 2) based on question : As a summary of your career path, which one of the following career paths describes your situation best (please consider only changes of employer not research visits) 3) average among those with children

Table 6.12: Characteristics of industry researchers' jobs by career path[2)]

	always private	public to private	private public an back	other
Tenure (years)	10.9***	8.9	7.9	10.0**
		Type of Organisation		
Company/Self Employed[1)]	90.1	91.1	86.2*	79.9***
Research Lab/Organisation[1)]	6.9	6.3	11.9**	10.4**
Other[1)]	3.0	2.6	1.8	9.7***
		Type of Contract		
Fixed term, < 1 years[1)]	0.5	1.1	0.0	2.0
Fixed term, 1-2 years[1)]	0.9	0.7	1.9	2.0*
Fixed term, > 2 years[1)]	8.2***	3.9	4.7	8.2***
Open ended contract[1)]	78.3**	82.4	72.9**	62.9***
Non-employment[1)]	0.9**	0.1	0.9	0.0
Self-employed[1)]	9.6	8.9	17.8***	19.5***
Other[1)]	1.6*	2.8	1.9	5.5**
		Working time (in% of full time contract)		
0-20%[1)]	0.3	0.4	0.0	0.0
20-40%[1)]	0.1	0.2	1.0	0.8
40-60%[1)]	1.3	2.0	2.9	4.0*
60-80%[1)]	1.5	1.2	1.9	2.0
80-100%[1)]	3.0	2.0	1.9	1.6
100%[1)]	93.7	94.2	92.3	91.6

S: MORE-Questionnaire on industry researchers, 1) measured in % of total sample, *** (**) (*) signify significance of a logistic regression for differences in group means relative to industry researchers moving from the private to the public sector at the 1% (5%), (10%) level, 2) based on question : As a summary of your career path, which one of the following career paths describes your situation best (please consider only changes of employer not research visits)

- Finally industry researchers following other career paths[75] (which is the residual category) differ most significantly from industry researchers moving from the public to the private sector though educational differences (having lower shares of PhD, but higher shares of all other degrees), a higher age and a disproportionately larger share of degrees in the fields of social sciences, humanities and engineering and technology (at the expense of the natural and agricultural sciences). For them, the share of self employed and also of those employed in fixed term contracts lasting two or more years is higher than for the reference group.

6.4.2 Number of jobs

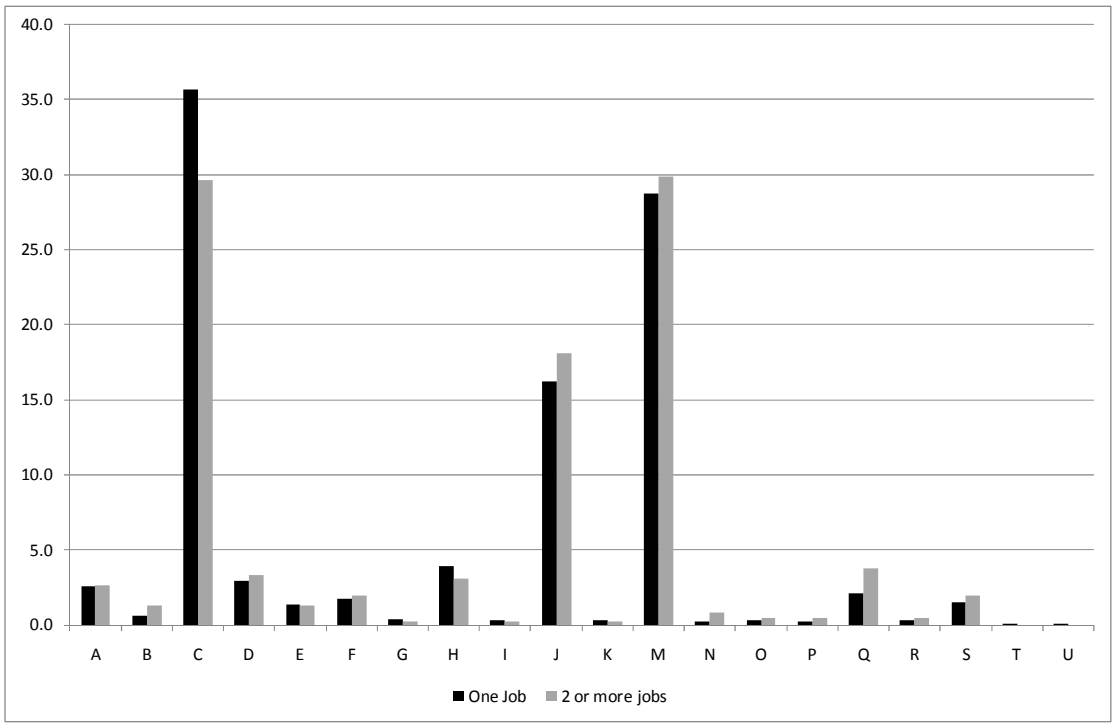
Industry researchers that have held at least two jobs in the last three years[76] differ from industry researchers that have held only one job in the last three years most significantly with respect to education, age, household characteristics and experience in studying abroad (see table 6.13). These researchers (with an average age of 44.0 years) are younger than industry researchers which held only one job in the last three years (which have an average age of 45.9 years). Thus as in

[75] These researchers did not permanently work as a researcher in their career as researchers in the other categories did.

[76] Once more in the analysis in this section – to provide a sufficient number of observations - we have collapsed the number of jobs held by industry researchers in the last three years into two categories (those with exactly one job and those with at least two jobs).

the overall population (see e.g. Farber, 1999) job changes of industry researchers primarily occur in the early phases of a career.

Figure 6.6: Number of jobs held by industry researchers in the last three years by sector of employment



S: MORE-Questionnaire on industry researchers, Sector classification bases on NACE rev.2 sections. A: Agriculture, Forestry and Fishing; B: Mining and quarrying; C: Manufacturing; D: Electricity, gas, steam and air conditioning supply; E: Water supply, sewerage, waste management and remediation activities; F: Construction; G: Wholesale and retail trade; repair of motor vehicles and motorcycles; I: Accommodation and food service activities; H: Transportation and storage; J: Information and communication; K: Financial and insurance activities; L: Real estate activities; M: Professional, scientific and technical activities; N: Administrative and support service activities; O: Public administration and defence; compulsory social security; P: Education; Q: Human health and social work activities; R: Arts, entertainment and recreation; S:Other service activities; T: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; U: Activities of extraterritorial organizations and bodies. Based on question: How many jobs did you hold in the last three years?. See table A3.3. in Annex for data
.

Industry, researchers with two or more jobs in the last three years are also better qualified, since they are also more likely to have completed a PhD (58.5% relative to 49.3%) and significantly less likely to hold a graduate or an undergraduate degree. They also have fewer children and have studied abroad significantly more often than those with no job mobility in the last three years.

With respect to their job and employment characteristics industry researchers with two or more jobs in the last three years differ significantly from those with only one job by having a lower share of employment in manufacturing, a lower tenure (6.0 years as opposed to 11.4 years for the immobile), a lower share of employment in companies or self-employment (80.7% as opposed to 86.1%), a higher share of employed in research labs (13.4% as opposed to 9,.9%), a larger share of fixed-term contracts lasting from one to two years (3.7% as opposed to 0.8%), a lower share of open ended contracts (74.2% to 79.4%) and a higher share of work contracts that account for between 40% to 80% of a full-time contract (5.2% to 2.6%) as well as a lower share of full-time contracts (92.1% to 99.5%).

Table 6.13: Characteristics of industry researchers by number of jobs held in last three years[2)]

	One	2_or_more
	Gender	
Male[1)]	85.4	82.2*
Female[1)]	14.6	17.8*
Age	45.9	44.0**
Studied Abroad[1)]	19.4	26.9***
Worked in Industry[1)]	50.9	53.8
Years since graduation	17.5	15.0***
	Region of birth	
Born in EU15[1)]	68.8	69.3
Born in EU12[1)]	25.2	24.2
Born outside EU[1)]	6.1	6.5
	Marital Status	
Married/cohabitating[1)]	85.0	82.4
Single[1)]	9.5	12.9***
Widowed[1)]	0.5	0.3
Divorced[1)]	4.4	3.3
Other[1)]	0.7	1.0
	Highest Completed Education	
PhD (or equivalent) [1)]	49.3	58.5***
Graduate degree[1)]	40.5	35.5**
Undergraduate[1)]	7.8	3.8***
Secondary Education[1)]	1.8	1.9
Vocational Education[1)]	0.2	0.3
Other[1)]	0.4	0.0
	Children	
Children[1)]	75.3	70.4**
Number of Children[3)]	2.1	2.0
Age of Oldest Child	15.8	15.4
	Field of highest degree	
Natural Sciences[1)]	29.4	28.0
Engineering and Technology[1)]	60.0	57.0
Medical and Health Sciences[1)]	3.3	4.3
Agricultural Sciences[1)]	1.5	2.8**
Social Sciences[1)]	4.8	6.4
Humanities[1)]	1.0	1.4

S: MORE-Questionnaire on industry researchers, 1) measured in % of total sample, *** (**) (*) signify significance of a logistic regression for differences in group means at the 1% (5%), (10%) level. 2) Based on question: How many jobs did you hold in the last three years? 3) average among those with children

Table 6.14: Characteristics of industry researchers' jobs by number jobs in the last three years[3)]

	One	2 or more
Tenure	11.4	6.0***
	Type of Organisation	
Company/Self Employed[1)]	86.1	80.7***
Research Lab/Organisation[1)]	9.9	13.4**
Other[1)]	4.0	5.8*
	Field of Technology	
Human Necessities[1)]	5.9	7.0
Performing Operations[1)]	6.3	3.9*
Chemistry, Metalurgy[1)]	12.5	11.2
Textiles, Paper[1)]	1.7	0.3*
Fixed Constructions[1)]	1.7	1.0
Mechanical Engineering [1); 2)]	16.4	15.9
Physics[1)]	9.3	8.6
Electricity[1)]	6.8	7.6
Unknown/no answer[1)]	39.4	44.4*
	Type of Contract	
Fixed term, < 1 years[1)]	0.8	1.9**
Fixed term, 1-2 years[1)]	0.8	3.7***
Fixed term, > 2 years[1)]	6.8	6.5
Open ended contract[1)]	79.4	74.2***
Non-employment[1)]	0.3	0.7
Self-employed[1)]	9.7	9.4
Other[1)]	2.2	3.5*
	Working time (in% of full time contract)	
0-20%[1)]	0.3	0.4
20-40%[1)]	0.2	0.4
40-60%[1)]	1.5	2.9**
60-80%[1)]	1.1	2.3**
80-100%[1)]	2.4	2.0
100%[1)]	94.5	92.1**

S: MORE-Questionnaire on industry researchers, 1) measured in % of total sample, *** (**) (*) signify significance of a t-test for differences in group means at the 1% (5%), (10%) level, 2) including Lighting, Heating, Weapons, Blasting 3) Based on question: How many jobs did you hold in the last three years?

6.4.3 Labour market states

Finally, when considering the demographic, job and employment related characteristics of those entering their respective jobs from different labour market states (tables 6.15 and 6.16) we see that those that entered their current job directly from higher education are unsurprisingly (with an average age of 41.7 years) the youngest and have the highest share of engineers (63.3%) but the lowest share of agricultural (0.7%) and health and medical (2.2%) scientists amongst them. This group, however, is also the group with the longest average tenure among the industry researchers and the highest share of employed in research labs. This suggests that these industry researchers aside from being composed of relatively young graduates also encompass those that have only rarely

changed jobs in their career. Many of the industry researchers in this group work in mechanical engineering, have open-ended contracts and are full time employees.

Table 6.15: Characteristics of industry researchers by labour market status before job accession[2)]

	From…				
	School	Unemployment	Employment	Self-employment	Other
			Gender		
Male[1)]	82.6	75.2	86.2	86.2	83.8
Female[1)]	17.4	24.8	13.8	13.8	16.2
Age	41.7	41.9	46.5	49.4	45.7
Studied Abroad[1)]	23.5	24.3	20.2	18.8	22.1
Worked in Industry[1)]	53.5	44.7	51.8	54.2	44.9
Year since graduation	13.3	13.3	18.0	21.4	19.2
			Region of birth		
Born in EU15[1)]	72.7	73.8	67.2	72.6	64.8
Born in EU12[1)]	22.5	20.4	26.2	22.9	26.8
Born outside EU[1)]	4.8	5.8	6.6	4.6	8.5
			Marital Status		
Married/cohabitating[1)]	82.4	76.2	85.5	82.7	77.0
Single[1)]	13.5	20.0	8.8	9.5	18.9
Widowe[1)]	0.3	1.0	0.6	0.0	0.0
Divorced[1)]	2.8	2.9	4.5	6.1	2.7
Other[1)]	0.8	0.0	0.6	1.7	1.4
			Highest Completed Education		
PhD (or equivalent) [1)]	48.8	58.1	52.9	41.4	37.8
Graduate degree[1)]	42.1	37.1	37.7	43.1	54.1
Undergraduate[1)]	8.0	4.8	6.8	9.4	6.8
Secondary Education[1)]	1.0	0.0	2.0	5.0	1.4
Vocational Education[1)]	0.0	0.0	0.2	1.1	0.0
Other[1)]	0.2	0.0	0.4	0.0	0.0
Children[1)]	66.6	60.0	77.1	79.3	60.8
Number of Children[3)]	2.0	2.1	2.1	1.9	2.0
Age of Oldest Child	12.9	12.5	16.3	19.4	18.3
			Field of highest degree		
Natural Sciences[1)]	29.3	41.0	29.2	28.1	24.3
Engineering and Technology[1)]	63.3	48.6	58.6	57.3	63.5
Medical and Health Sciences[1)]	2.2	2.9	4.0	3.9	2.7
Agricultural Sciences[1)]	0.7	3.8	1.9	1.7	2.7
Social Sciences[1)]	3.9	2.9	5.3	6.2	5.4
Humanities[1)]	0.7	1.0	1.0	2.8	1.4

S: MORE-Questionnaire on industry researchers, 1) measured in % of total sample 2) Based on question When starting to work for your current employer, where did you come from? 3) average among those with children

Table 6.16: Characteristics of industry researchers' jobs by labour market status before accession to the job[3)]

	From… School	Unem-ployment	Employment	Self-employment	other
Tenure	14.0	7.7	9.6	8.1	10.8
			Type of Organisation		
Company/Self Employed[1)]	83.5	85.7	85.4	83.4	83.8
Research Lab/Organisation[1)]	13.0	9.5	10.0	11.6	9.5
Other[1)]	3.5	4.8	4.6	5.0	6.8
			Field of Technology		
Human Necessities[1)]	5.1	2.6	6.8	6.5	3.8
Performing Operations[1)]	6.4	6.6	5.7	4.3	3.8
Chemistry, Metalurgy[1)]	16.8	18.4	11.4	8.7	11.3
Textiles, Paper[1)]	0.5	1.3	1.6	2.2	1.9
Fixed Constructions[1)]	1.8	3.9	1.4	1.4	0.0
Mechanical Engineering [1); 2)]	18.6	15.8	15.7	15.2	15.1
Physics[1)]	9.2	17.1	8.9	5.1	13.2
Electricity[1)]	8.3	2.6	7.3	5.8	7.5
Unknown/no answer[1)]	33.3	31.6	41.2	50.7	43.4
			Type of Contract		
Fixed term, < 1 years[1)]	1.2	0.0	1.0	1.1	0.0
Fixed term, 1-2 years[1)]	1.8	1.9	0.9	3.3	2.7
Fixed term, > 2 years[1)]	8.3	9.7	6.1	8.3	4.1
Open ended contract[1)]	83.5	78.6	79.3	52.5	79.7
Non-employment[1)]	0.0	1.0	0.5	0.6	0.0
Self-employed[1)]	3.2	6.8	9.8	28.7	8.1
Other[1)]	2.0	1.9	2.2	5.5	5.4
			Working time (in% of full time contract)		
0-20%[1)]	0.0	0.0	0.3	1.1	0.0
20-40%[1)]	0.2	0.0	0.2	0.6	2.7
40-60%[1)]	1.0	0.0	1.6	5.6	2.7
60-80%[1)]	0.8	2.9	1.4	3.4	0.0
80-100%[1)]	2.7	4.8	2.2	1.7	1.4
100%[1)]	95.3	92.3	94.4	87.7	93.2

S: MORE-Questionnaire on industry researchers. 1) measured in % of total sample including Lighting, Heating, Weapons, Blasting 3) Based on question When starting to work for your current employer, where did you come from?

Those that entered their current job from unemployment have most often studied abroad but have only rarely worked in industry during their studies. They are also - most often among all groups – female. Somewhat surprisingly this group is also marked by a large share of PhDs (and accordingly also has the lowest shares of graduates and undergraduates) as well as the highest share of natural scientists (but the lowest share of engineers and social scientists).[77] In terms of job characteristics this group of industry researchers has the lowest tenure, the highest

[77] This high share of PhDs in this group could be a reflection of the fact that these highly qualified industry researchers take a longer time searching for jobs

share of employed at companies but is also characterised by a high share of fixed term contracts and the largest share of those working 80% to 100% of a full time contract.

Industry researchers that were employed before starting their current job have the highest share of males as well as of those that have worked in industry during their studies among all groups. They are also most often married (and least often single). Furthermore, they have a high share of persons working in engineering and medical and health sciences. In terms of job and employment characteristics they have a slightly below average tenure and also perform about average with respect to most other indicators. [78]

Those coming to their current employment from self-employment again have a high share of males. They are on average the oldest group among the industry researchers, and are thus also more likely than other groups to have children. They have studied abroad least often but worked in industry during their studies most often. Only few of them are born outside the EU and a high share of them has an undergraduate, secondary or vocational degree. In addition a large share of them has a degree in social sciences or humanities. They also often work in companies, but have the lowest share of open ended contracts and the highest share of self-employed among them. In addition they also have the lowest share of employed working in full time contracts.

Finally, industry researchers coming from other states of the labour market are most often among all groups born in the EU12 or in non-EU countries, rarely have a PhD and also very rarely studied natural sciences. In terms of employment and job characteristics these researchers are seldom working in research labs and have the second highest share of open ended contracts among all groups.

6.5 Conclusions

This chapter analyses the differences between internationally mobile and immobile industry researchers in terms of demographic and job characteristics. In addition it also focuses on the differences between researchers that intend to look for work abroad in the next three years and those that are not intending to do so in this time period as well as on differences among researchers following different career paths

Findings with respect to international mobility

We find that the most robust differences between mobile and immobile researchers are found in terms of whether the researcher has studied abroad, education, place of birth and field of study.

In particular the most robust results apply to differences with respect to international mobility among industry researchers that have studied abroad and those that have not. 17.3% of the researchers that have studied abroad (as opposed to 8.6% of those that have not studied abroad) have also worked as a researcher in another country in the three years before the interview, and of the researchers that have at least once been mobile in their career 31% studied abroad for some time, while among those that have never internationally mobile this share is only

[78] This is, however, not surprising given that this is also the largest group among all industry researchers

13%. In addition we also find evidence that industry researchers that studied abroad have a significantly higher probability to have been mobile more than once, as well as a significantly higher probability of working abroad for 3 months to 1 year. This thus points to an important impact of the experience of studying abroad on mobility patterns of industry researchers.

Aside from experience abroad, however, also education has an important impact on mobility. In general the share of researchers that have been mobile in the last three years declines steadily with education (from 12.4% for those with a completed PhD to 8.3% for university graduates to 1.8% for those with only a secondary education or 0 for the few industry researchers that have completed a vocational training only). This higher mobility for the better educated applies to almost all indicators of mobility analysed. Industry researchers with a completed PhD are also significantly more likely to have ever worked abroad in their career and also significantly more often have worked abroad more than once, while industry researchers with secondary or undergraduate education are significantly less likely to have ever worked abroad and also less likely to have worked abroad more than once. Thus there is broad evidence of increasing mobility with increasing educational attainment.

Furthermore, we also find that evidence that mobility is substantially higher among industry researchers born in the EU15 than among those born in the EU12, which may be an indication of a lower integration of the EU12 into industry researcher networks. Among those born in the EU12 only 7.7% have been internationally mobile in the three years before the interview. Among those born in the EU15 the same applies to 10.6%. In addition those born in the EU15 are also significantly overrepresented among the industry researchers that have ever been mobile in their career, while those born in the EU12 are significantly underrepresented among those that have worked abroad more than once.

With respect to the field of study, by contrast, the survey suggests that industry researchers that completed their highest degree in the agricultural sciences, in the medical and health sciences as well as in the natural sciences are most mobile, while those that have studied engineering and technology as well as those that have studied social sciences and humanities are less mobile. Among graduates of the agricultural, medical and health as well as natural sciences the share of those that were mobile in the last three years was between 23.1% (agricultural sciences) and 11.6% (natural sciences). Among industry researchers graduating in engineering and technology, social sciences and humanities these shares range between 9.0% (engineering and technology) and 6.3% (humanities), with statistical tests indicating a significantly different behaviour for engineering and technology graduates, but remaining insignificant on account of a small number of observations for the social sciences and humanities.

In addition there are also some variables for which the indication of a link with past mobility is less robust. This applies to age and having worked in industry during studies. While those that have worked in industry have an above average probability (of 17.3%) of having been mobile in the past three years and are also overrepresented among those that worked abroad twice or more, they are not significantly overrepresented among those that have ever been internationally mobile in their career. This last finding may, however, indicate that working in industry during studies has a positive impact on mobility in particular for researchers in their early career.

By contrast, the older are only more likely to have ever been mobile in the past and gender specific age-mobility profiles suggest that the probability to have been mobile increases sharply in the ages between 39 to 50 for men after which

it remain constant, while for the few women in our sample we find higher mobility rates than among men in the early careers and about equal mobility rates for older women as well as much flatter age-mobility profiles.

Finally with respect to the job characteristics of the mobile we find some evidence that the most mobile select themselves into certain jobs. Aside from average tenure being significantly lower among those that have held two or more jobs abroad we find that the mobile industry researchers with more than one stay abroad have a significantly lower probability of being self-employed, working in the research field of mechanical engineering, having a fixed term contract with a duration in excess 2 years and having average working hours amounting to 80-100% of a full time contract. By contrast, the share of those employed in a fixed term contract with duration of more than two years and working for 40 to 60% of a full time contract is significantly increasing in the number of times an industry researcher has worked abroad. This thus suggests that a higher intensity of international mobility among industry researchers is often associated with a higher share of atypical employment and also reflects different career patterns in different types of research jobs as well as fields of research.

Findings with respect to migration intentions

Industry researchers intending to look for work abroad in the next three years are significantly younger, better educated, less often married, have fewer children and are more often born in the EU15 than those that are not intending to look for work abroad. Among singles 48.7% of the industry researchers state that they are intending to look for work abroad, among industry researchers born in the EU12 this share is 36.2%. Furthermore, as with previous migration also those that have studied abroad significantly more often intend to look for work abroad. 44% of those that studied abroad intend to look for work abroad. In addition here, however, also previous experience of working in industry during studies is positively associated with the intentions to look for work abroad. 36.2% of those that worked in industry during studies intend to look for work abroad in the next 3 years.

Interestingly also in contrast to results for past mobility, the intentions to look for work abroad, are highest among graduates of humanities (where 46.9% want to migrate) and social sciences (where the percentage is 40.1%). Although these results are based on only few observations and cannot be considered statistically significant this - in conjunction with low rates of previous mobility among industry researchers graduating in these disciplines - may be indication of lacking opportunities for mobility of industry researchers graduating in these disciplines.

Finally industry researchers intending to look for work abroad also have a significantly shorter tenure and significantly more often have a fixed term contract lasting for one year (at the expense of fixed term contracts lasting more than two years) than those not intending to look for work abroad.

Findings with respect to career paths

With respect to the career paths followed by industry researchers, results suggest the largest two groups of types of career path (those that have moved from the public to the private sector and those that have always worked in the private sector) differ from each other in that industry researchers that always worked in the private sector are significantly more often male, have more seldom studied abroad but more often worked in industry during their studies, are less often born outside the EU and have a lower share of PhDs, and are also more often trained

in social sciences but less often medical or agricultural science degrees than researchers moving from the public to the private sector.

In addition industry researchers that have held more than one job in the last three years differ from industry researchers that have held only one job. They are younger, better qualified, and have fewer children but studied abroad significantly more often. They also have a lower tenure, a lower share of self-employed, a larger share of fixed term contracts lasting from one to two years, a lower share of open ended contracts and a higher share of work contracts that account for between 40% to 80% of a full time contract and a lower share of full-time contracts.

7 THE EFFECTS AND MOTIVATIONS FOR MOBILITY

7.1 Introduction

Another objective of the questionnaire was to provide evidence on the more subjective issues related to the motivations and impediments as well as the effects of mobility on researchers to answer such questions as: What factors hamper or facilitate mobility? And what are the effects of mobility on those mobile?

We focus on three different aspects. First, in the next section, we look at the circumstances of a job change and see how job changes impact the career and job attributes of the internationally mobile and immobile researchers. Next in section 3, we focus on the factor motivating and hampering international mobility, while in section 4 we look at the reasons given by industry researchers for a) choosing a particular career path and b) starting work at the current employer. Here again our focus is on whether those mobile across countries or sectors in the past differ from those that have been immobile. Finally, in section 5, again with the aim of identifying differences among the mobile and the immobile, we look at the effects of mobility across and within countries in terms of research output as well as the network effects.

One of the recurrent themes of this chapter is identifying differences in attitudes and motivations between the internationally mobile and immobile researchers. Methodologically we do this by performing a series of t-tests, which test the hypothesis of difference in means between mobile and immobile researchers.[79] We also distinguish between those researchers which in the last three years held more than one job and those that held only one job and perform similar t-tests for these two groups of industry researchers. This is important in the context of this study since – as shown in chapter 3 – international mobility is closely linked to job changes among industry researchers.

7.2 Circumstances of job changes

In the questionnaire industry researchers were asked a number of questions concerning the circumstances of their job changes. We queried how taking up work at the current employer was related to geographic and sector mobility, and how this change impacted various job attributes (such as the autonomy, flexibility and workload experienced by the researchers) as well as on whether this was a change of career path.

With respect to the first of these issues, the evidence provided in chapter 3 of this study suggests that international mobility is closely linked to job changes. This is also confirmed by the answers to the first set of questions relating to the impact of taking up the current job (table 7.1). 52.7% of the industry researchers that have been internationally mobile in the past say that one result of taking up the job at the current employer was a relocation of the current place of residence and

[79] We, however, augment this by a logit analysis in the last section of this chapter.

35.4% of the internationally mobile industry researchers state that taking up this job resulted in a change of working language, which indicates that this relocation was also often across national borders. For the internationally immobile researchers the respective percentages are 34.9% and 11.2% respectively and are substantially lower.[80]

Table 7.1: Results of taking up the job at the current employer by international mobility and region of residence of industry researchers

When starting to work for your current employer did the position require/result in…				
	Relocation	Commuting	Using a different working language	A change from public to private sector
			International Mobility	
Internationally Immobile	34.9	32.6	11.2	29.6
Internationally Mobile	52.7	36.1	35.4	34.0
			Region of Residence	
EU15	43.7	34.1	23.0	31.9
EU12	38.7	34.0	16.7	30.0
Total	42.4	34.1	21.3	31.4

S: MORE-Questionnaire on industry researchers. Internationally mobile=industry researchers that have worked in another country than their country of graduation, internationally immobile=industry researchers that have always worked in the same country as their country of graduation, EU15 = member states before May 1st 2004, EU12=member states joining after May 1st 2004, EU27 measured in % of affirmative answers in total sample

Table 7.1 also indicates that job changes of internationally mobile researchers are also more closely related to changes from the public to the private sector. Here 34% of the internationally mobile but only 29.6% of the immobile researchers state that starting to work for the current employer involved such a change. In addition internationally mobile researchers are also slightly more likely to commute than immobile researchers after starting their new job. Here the difference in the proportion of respondents, who experienced such a change, however, is slightly smaller; with 36% of the mobile industry researchers and 33% of the immobile stating that starting to work for the current employer also resulted in commuting.

These differences among internationally mobile and immobile researchers are accompanied by substantial difference in the circumstances of taking up a job by region of residence. Here differences pertain especially to relocation and using a different language. Both of these are substantially lower (with 39% and 17% respectively) in the EU12 than in the EU15 (where the equivalent percentages are 44% and 23% respectively,) and thus once more confirm the lower mobility levels in the EU12.

[80] Note that the mobility question does not refer to the last move. Thus not every instance of starting to work at the current employer of those that were internationally mobile in the past has to be associated with relocation. Also changes of language can occur for the immobile when starting to work at an employer using a different language.

Table 7.2: Results of taking up the job at the current employer (% distribution of answers)

Relative to your position at your previous employer your current position…	strongly disagree	disagree	indifferent	agree	strongly agree
Is a continuation of career	11.2	13.8	12.8	31.6	30.6
Involves a higher share of managerial activities	3.0	4.9	10.1	26.4	55.5
Involves a higher share of applied research	3.4	9.3	21.9	32.1	33.3
Involves a higher share of basic research	14.8	21.3	27.4	20.0	16.4
Offers more autonomy	3.2	8.3	19.1	27.7	41.7
Offers more flexibility	3.5	9.4	21.8	27.9	37.3
Involves a lower workload	38.8	24.5	21.7	8.6	6.4

S: MORE-Questionnaire on industry researchers. Row sum=100%, Sample = only researchers that held a previous job.

Table 7.3: Results of taking up the job at the current employer by international mobility

Relative to your position at your previous employer your current position	Internationally Immobile	Internationally Mobile
is a continuation of career	3.51	3.64**
involves a higher share of managerial activities	4.29	4.23
involves a higher share of applied research	3.86	3.79
involves a higher share of basic research	3.09	2.93**
Offers more autonomy	4.04	3.87
Offers more flexibility	3.93	3.78***
Involves a lower workload	2.18	2.21

S: MORE-Questionnaire on industry researchers. internationally mobile=industry researchers that have worked in another country than their country of graduation, internationally immobile=industry researchers that have always worked in the same country as their country of graduation , Table presents means of answers on a 5 point scale , 5=I fully agree, 1= I strongly disagree, *** (**) (*) signify significance of a t-test for differences in group means at the 1% (5%), (10%) level, respectively, Sample = only researchers that held a previous job.

The subsample of industry researchers, that held a job before starting to work at their current employer, were also asked to compare various job attributes of their job with the previous employer to those at the current employer (see Tables 7.2 and 7.3). We find that for a large number of industry researchers, job changes result in an increase in managerial activities (72% agree or strongly agree that their job change resulted in an increase in the managerial activities), a higher workload (only 15% of the respondents disagree or strongly disagree that the workload reduced due to the job change) and in greater autonomy (68% agree or strongly agree with this statement). Furthermore such job changes are often seen as a continuation of the previous career (62% agree or strongly agree) and seem to result in a higher share of applied research (65% agree or strongly agree) and offer more flexibility (65% agree or strongly agree). The impact on basic research activities although apparently positive is less clearly positive (with only 36% agreeing or strongly agreeing and an about equal share disagreeing or strongly disagreeing). Thus job changes often seem to be associated with a move up the hierarchical ladder since they imply more managerial activities, higher workloads and a higher share of applied research but also more autonomy.

Interestingly, when comparing means over these response categories internationally mobile researchers significantly more often see their new job as a continuation of their previous career but less often find that the new job has brought with it a higher share of basic research or more flexibility. Thus international mobility of industry researchers is more closely associated with a change from basic to

applied research, which, however, is often seen as a continuation of the previous career.

7.3 Reason for international mobility

To determine which factors motivate industry researchers to become internationally mobile, those that had been internationally mobile were asked how important certain aspects were for the latest decision to work abroad, while those industry researchers that have never worked abroad were asked how the same factors impact on their willingness to work abroad.

Table 7.4: Importance of different reasons for working abroad by international mobility of and number of jobs in the last three years by industry researchers

	International Mobility[1)]		Number of moves[2)]		Duration of stay[2)]		
	Immobile[3)]	Mobile[4)]	one move[4)]	2 or more moves[4)]	3 months - 1 year[4)]	1-2 years[4)]	3 or more years[4)]
Leading Experts in Region	3.41	3.64	3.63	3.66	3.76	3.74***	3.46***
Quality of Life	4.03	3.58	3.56	3.64	3.31***	3.56**	3.74***
External R&D Infrastructure	3.52	3.45	3.42	3.54	3.54	3.43	3.38
Recognition of Educational degrees	3.63	3.35	3.34	3.40	3.25	3.31	3.41
Culture	3.68	3.27	3.25	3.33	3.39	3.24	3.23*
Attitudes towards Foreigners	3.57	3.17	3.15	3.23	3.08	3.17	3.21
Availability of Schools for Children	3.91	3.15	3.13	3.20	2.83	3.08*	3.30***
Finding adequate Housing	3.81	3.14	3.12	3.17	2.97	3.08*	3.25***
Quality of Social Security	3.66	3.06	3.06	3.08	2.74**	2.99***	3.25***
Language	3.55	3.06	3.07	3.02	3.09	3.18**	2.91*
Existence of alternative Jobs	3.41	3.00	2.96	3.11	3.09	2.93	3.01
Work Permission for partner	3.77	2.89	2.89	2.90	2.67	2.84	3.02***
Administrative Barriers	3.35	2.86	2.82	2.97	2.74	2.80	2.94
Taxes	3.17	2.67	2.63	2.81**	2.62	2.71	2.69*
Private Support	3.05	2.50	2.47	2.58	2.66	2.52	2.38***
Financial Support	2.94	2.28	2.29	2.23	2.41	2.25	2.15**

S: MORE-Questionnaire on industry researchers. Table presents means of answers on a 5 point scale , 5=I fully agree, 1= I strongly disagree, *** (**) (*) signify significance of a t-test for differences in group means at the 1% (5%), (10%) level, respectively, Column 5 tests for equality across number of moves, columns 6 for equivalence of columns 6 and 7, column 7 for equivalence of columns 7 and 8 and column 8 for equivalence of columns 6 and 8, 1) internationally mobile=industry researchers that have worked in another country than their country of graduation, internationally immobile=industry researchers that have always worked in the same country as their country of graduation . 2) Based on question: Please provide the name of the countries you worked in as a researcher, scientist or development engineer for a minimum of 3 months in the last 3 years and indicate the duration of your stays beginning with your longest stay (max. No. of entries 5 stays) 3) Question: Please indicate how important the following aspects are for your willingness to work abroad 4) Question: How important have the following aspects been for your latest decision to work abroad?

Table 7.4 highlights substantial differences in the factors that motivate those that have been internationally mobile and that hamper geographical mobility for those

that have never been mobile. Industry researchers that have previously been internationally mobile name the presence of leading experts abroad, the quality of life, the presence of external R&D structures, the recognition of educational degrees and the culture of the receiving country as the 5 most important motives for moving abroad. Thus they strongly stress the research infrastructure of the receiving country as a major motivation for mobility. By contrast, those that have not been mobile give much more emphasis to factors that are not connected to the research environment such as the quality of life, the availability of schools for their children, finding housing, securing work permits for partners and the cultural differences found in other countries. These factors must thus be considered the major impediments to mobility.

Interestingly both those not internationally mobile and those who have been immobile agree that administrative barriers to mobility, taxation and private as well as financial mobility support are least important in shaping the decision to move abroad. These factors must thus be considered to be of lesser importance both as factors motivating as well as factors hampering international mobility.[81]

In addition the motives for international mobility, although largely independent of the number of stays abroad, change substantially with the longest duration of stay abroad. In particular the importance given to the presence of leading experts in the field, cultural differences, language differences, as well as private and financial mobility support fall significantly with the duration of the stay abroad, while aspects such as the quality of life, availability of schools for children, the quality of social security and the possibility to obtain a work permit for the partner increases with the duration of stay.

Thus there appear to be substantial differences in the motives of short and long term work-stays abroad among industry researchers. While short term stays seem primarily to be driven by career concerns and building human capital that can be used back home, long term stays (which account for 48% of the total number stays) are more strongly associated with the amenities of the receiving regions.

7.4 Reasons for choice of career path and current job

7.4.1 Decision for choice of career path

Considering first the reasons for choosing a particular career path (table 7.5), we see that overall, for industry researchers, the most important motives for choosing a particular career path are job satisfaction, the challenges offered by the position, working conditions, a good work life balance and life satisfaction of children. Thus the reasons related to job and life satisfaction are more important for the career path decision than are high salaries, which only rank 8th among the reasons for choosing a particular career path. At the bottom of the list we find job security, the prospects of a scientific career, keeping in touch with friends and family, other private reasons and financial incentives other than salaries.

[81] By contrast, the presence of leading experts in the receiving region can be considered a factor that is strongly motivating for the internationally mobile but not hampering to mobility, since those immobile rank it fifth last in importance among the aspects impacting on their willingness to work abroad

While this hierarchy of motives for individual career paths is highly stable among industry researchers following different career paths[82] (see table 7.5) there are some important differences. In particular for industry researchers that have always worked in the private sector a high salary is slightly more important, while contributing to society is less important. Industry researchers that moved from the public to the private sector (which make up the majority of our sample) closely follow the aggregate structure but give a slightly smaller weight to job stability relative to the prospects for a scientific career. While industry researchers that round trip between the two sectors after starting their career in the private sector consider promotion prospects (5th place) more important and life satisfaction of their children (10th place) less important. Finally, those that follow other career paths also give much stronger emphasis to the prospects in a scientific career.

Table 7.5: Importance of different reasons for choosing a career path by different career paths[1)]

How important have the following criteria /motivations been for your job decision/your career path?

	Career Path…			
	always private	public to private	private public and back	other
Job satisfaction	4.69	4.70	4.72	4.67
Challenging position	4.15	4.21	4.30	4.21
Good working conditions	3.97	4.03	3.96	4.04
Good work life balance	3.76	3.70	3.70	3.75
Life satisfaction of children	3.55	3.59	3.40	3.52
Contribution to society	3.44	3.56	3.52	3.61
Promotion prospects	3.51	3.52	3.55	3.37
High salary	3.50	3.44	3.49	3.44
Job change of partners	3.38	3.40	3.52	3.44
High job security	3.41	3.35	3.21	3.21
Prospects in scientific career	3.08	3.48	3.43	2.82
Keeping in touch with friends and family	3.16	3.14	2.92	3.16
Other private reasons	2.88	2.73	2.79	3.01
Other financial incentives	2.62	2.49	2.44	2.58

S: MORE-Questionnaire on industry researchers. Table presents means of answers on a 5 point scale, 5=I fully agree, 1= I strongly disagree. 1) based on question: As a summary of your career path, which one of the following career paths describes your situation best (please consider only changes of employer not research visits), sorted by average agreement in full sample.

In addition to these differences in motives for choosing different career paths, there are some differences in the reasons for choosing a particular career path between those that have been internationally mobile and those that have not. Here the internationally mobile put a significantly stronger emphasis on having a challenging position, good working conditions, making a contributing to society, promotion prospects, and prospects of a scientific career, while relative to the immobile, they consider the importance of keeping in touch with friends and family and job security even less important (table 7.6). Thus they appear even more strongly motivated by career concerns when choosing their career path than their immobile counterparts.

[82] Correlation coefficients in mean values among groups range between 0.70 and 0.98

Those that have held more than one job in the last three years by contrast differ from those that have held only one job in the last three years through a significantly higher emphasis on the prospects of a scientific career and having a challenging position, while they consider the importance of a good work life balance and a high job security less important.

Table 7.6: Importance of different reasons for choosing a career path by international mobility of and number of jobs in the last three years by industry researchers[1)]

How important have the following criteria /motivations been for your job decision/your career path?

	International Mobility[1)]		No. of Jobs[3)]		Total
	Immobile	Mobile	1 job	2 or more jobs	
Job satisfaction	4.66	4.72*	4.68	4.71	4.69
Challenging position	4.10	4.28***	4.16	4.24***	4.18
Good working conditions	3.99	4.09***	4.04	4.03	4.03
Good work life balance	3.81	3.74*	3.80	3.68***	3.78
Life satisfaction of children	3.58	3.62	3.61	3.52	3.59
Contribution to society	3.47	3.62***	3.52	3.60*	3.53
Promotion prospects	3.44	3.57***	3.48	3.51	3.49
High salary	3.46	3.48	3.47	3.42	3.46
Job change of partners	3.39	3.52***	3.44	3.43	3.44
High job security	3.50	3.32***	3.47	3.19***	3.43
Prospects in scientific career	3.16	3.53***	3.28	3.44***	3.31
Keeping in touch with friends and family	3.25	3.10***	3.21	3.12*	3.19
Other private reasons	2.87	2.90*	2.88	2.90	2.88
Other financial Incentives	2.51	2.54	2.52	2.52	2.52

S: MORE-Questionnaire on industry researchers. Table presents means of answers on a 5 point scale , 5=I fully agree, 1= I strongly disagree, *** (**) (*) signify significance of a t-test for differences in group means at the 1% (5%), (10%) level, respectively, 1) based on question : As a summary of your career path, which one of the following career paths describes your situation best (please consider only changes of employer not research visits) 2) internationally mobile=industry researchers that have worked in another country than their country of graduation, internationally immobile=industry researchers that have always worked in the same country as their country of graduation . 3) Based on questions: How many jobs did you hold in the last three years? sorted by average agreement in full sample.

7.4.2 Reasons for starting work at the current employer

Finally, respondents to the industry survey were also asked about important reasons for starting work at their current employer. Here we find that while, as shown in the previous section, pecuniary motives are of a lesser importance in the decision for a particular career path and the decision to work abroad, these motives are somewhat more important in the decision to accept a particular job. The possibility to apply previous knowledge and an increase in responsibility were considered important elements in deciding to work for an employer for 65% and 51% of the respondents, respectively. In third place was a high salary which 47% of the respondents considered important for the decision to work at their current employer.

Other factors, considered important by more than 40% of the respondents, are the internal career perspectives at the new employer, assistance provided in moving to the new employer, higher autonomy at the new employer and the reputation of the employer as a leading organisation in their respective field. Factors such as other career motives, lacking career perspectives at the old em-

ployer, a good corporate culture at the new employer, job security, the job prospects in the region of work for the new employer, chances of further education and the presence of experts in the new environment were considered important in this current job placement by between 33% and 20% of the respondents. For 23% of the respondents the change in job was a direct result of a change in ownership, which suggests that industry researchers are strongly affected by such changes.

Those that were internationally mobile in the past differ from those that were not, by having a significantly higher proportion of those who considered a high salary, the reputation of the new organisation (leading organisation), other career motives, the lack of career perspectives at the old employer, a good corporate culture, better job prospects in the new region, the beauty of the region, health prospects as well as dissatisfaction with the old job than their immobile counterparts.

Despite this long list of variables considered significantly more important by the internationally mobile, the ranking of individual motives is hardly changed, (only the corporate culture at the new firm and the job prospects have a higher priority for the mobile). This suggests that the internationally mobile have similar priorities when choosing a job as immobile, but that the mobile are more critical since they give a higher score to almost all factors.

Table 7.7: The Importance of different reasons for starting work at the current employer by international mobility and number of jobs in the last three years by industry researchers

Please tick if the following reasons/motivations have been important for starting to work for your current employer

	International Mobility[1)]		No. of Jobs[2)]		Total
	Mobile	immobile	one	2 or more	
Ability to apply previous knowledge	0.64	0.67*	0.65	0.66	0.65
More responsibilities in the new job	0.50	0.51	0.50	0.55**	0.51
High salary	0.46	0.49***	0.47	0.48	0.47
Internal career perspectives	0.45	0.47	0.45	0.50***	0.46
Assistance in moving	0.46	0.46	0.46	0.47	0.46
Higher autonomy	0.45	0.46	0.44	0.49**	0.45
Leading organisation	0.38	0.45***	0.41	0.42	0.41
Other career motives	0.32	0.35**	0.34	0.28	0.33
Lacking career perspectives at old employer	0.21	0.26***	0.23	0.27**	0.23
Direct result of change in ownership	0.23	0.23	0.21	0.31***	0.23
Good corporate culture in new firm	0.19	0.27***	0.23	0.19**	0.22
Job security	0.21	0.23	0.21	0.27***	0.22
Job prospects in new region	0.19	0.26***	0.22	0.23	0.22
Chances for further education	0.20	0.22	0.20	0.24***	0.21
Presence of experts in new environment	0.19	0.24***	0.21	0.22	0.21
Other financial incentives	0.19	0.19	0.18	0.20	0.19
Research possibilities at new firm	0.18	0.18	0.18	0.20**	0.18
Health reasons	0.14	0.19***	0.16	0.15	0.16
To end unemployment	0.14	0.16	0.15	0.15	0.15
Private/Family reasons	0.10	0.09	0.09	0.11	0.10
Previous business contacts with the new firm	0.08	0.10	0.09	0.08	0.09
Dissatisfied with old job	0.06	0.11***	0.08	0.07	0.08
Temporary contract expired	0.05	0.04*	0.05	0.03	0.04
Nice region	0.01	0.02**	0.01	0.02	0.02

S: MORE-Questionnaire on industry researchers. Table presents the share of industry researchers considering the respective reason important for choosing the current job, *** (**) (*) signify significance of a t-test for differences in group means at the 1% (5%), (10%) level, respectively, 1) internationally mobile=industry researchers that have worked in another country than their country of graduation, internationally immobile=industry researchers that have always worked in the same country as their country of graduation . 2) Based on question: How many jobs did you hold in the last three years?

When comparing industry researchers that held two or more jobs in the last three years to those that held only one, as shown in table 7.7, the former on average evaluate higher responsibilities in the new job, internal career perspectives, higher autonomy, the lack of career perspectives in the old firm, a higher job security, chances for further education and research possibilities as significantly more important in their decision to work for a particular employer, but again the ranking of motives remains robust. The only exception to this is that those with two or more jobs in the last three years give a higher priority to internal career perspectives and higher autonomy in the new firm. This suggests that career motives are more important for those mobile across jobs. In addition for this group, changing jobs as a direct result of an ownership change is more important. Than for those who held only one job in the last three years.

Table 7.8: The Importance of different reasons for starting work at the current employer by labour market status prior to the current job

Please tick if the following reasons/motivations have been important for starting to work for your current employer

	From[1)]...				
	School	unem-ploymen	employment	self em-ployment	other
Ability to apply previous knowledge	0.64	0.65	0.70	0.64	0.74
More responsibilities in the new job	0.45	0.38	0.57	0.44	0.45
High salary	0.51	0.35	0.51	0.43	0.43
Internal career perspectives	0.47	0.36	0.50	0.42	0.47
Assistance in moving	0.55	0.43	0.47	0.46	0.43
Higher autonomy	0.38	0.33	0.52	0.40	0.39
Leading organisation	0.52	0.38	0.42	0.34	0.35
Other career motives	0.32	0.38	0.35	0.43	0.26
Lacking career perspectives at old employer	0.27	0.19	0.24	0.28	0.20
Direct result of change in ownership	0.17	0.14	0.26	0.36	0.20
Good corporate culture in new firm	0.22	0.18	0.25	0.18	0.24
Job security	0.07	0.14	0.30	0.15	0.16
Job prospects in new region	0.22	0.23	0.23	0.28	0.28
Chances for further education	0.19	0.16	0.23	0.24	0.27
Presence of experts in new environ-ment	0.25	0.25	0.21	0.19	0.23
Other financial incentives	0.16	0.07	0.21	0.25	0.20
Research possibilities at new firm	0.29	0.17	0.17	0.12	0.24
Health reasons	0.17	0.16	0.17	0.15	0.20
To end unemployment	0.14	0.10	0.15	0.23	0.26
Private/Family reasons	0.02	0.06	0.12	0.16	0.09
Previous business contacts with the new firm	0.09	0.13	0.10	0.02	0.05
Dissatisfied with old job	0.08	0.05	0.09	0.04	0.05
Temporary contract expired	0.04	0.57	0.02	0.04	0.03
Nice region	0.01	0.01	0.02	0.02	0.00

S: MORE-Questionnaire on industry researchers. Table presents the share of industry researchers considering the respective reason important for choosing the current job. 1) Based on question: When starting to work for your current employer, where did you come from?

Table 7.8 summarises the motives for choosing the current employer by one's previous labour force status. We find that for all groups the ability to apply previous knowledge is by far the most important determinant for having chosen the current employer. Indeed this almost seems to be a precondition for choosing an employer. Other than that there are some differences among the groups with respect to the most important reasons for choosing the current employer:

- Those coming directly from school rely more strongly on assistance in moving (which is the second most important reason for choosing the current employer among this group) and put more emphasis on the reputation of the employer (leading organisation is the third most important reason) than the average industry researcher.

- Those coming from unemployment by contrast more often state the expiry of a fixed term contract as a reason for choosing the current job (this is

the second most important reason for this group) and also rank assistance with moving on third place.

- Those coming from employment (which is also the largest group) follow the average ranking quite closely. Here only job security (9th most important reason) has a higher priority than on average.

- Persons coming from self-employment put particularly strong emphasis on assistance in moving (2nd rank) and other career motives (4th rank) in their decision to work for the current employer.

- Industry researchers that were in "other" states before employment at the current employer, finally, put stronger emphasis on the internal career perspectives (2nd most important factor) when choosing their employer.

7.5 Effects of mobility

A final set of questions in the questionnaire refers to the effects of mobility. Here respondents were asked to indicate in hindsight how working for the current employer affected certain outcomes of their work on a five point scale (with 5 indicating a strong improvement and 1 a strong decrease in this output).[83] In particular we are interested in the effect of accepting a job in a different country than the one of prior employment relative to the effect of accepting a job in the same country as that of prior employment. We think that this difference is interesting because such a change across national borders involves a more dramatic change in the environment a researcher is exposed to than a job change within a country. This may potentially be associated both with positive effects (e.g. learning effects) as well as negative effects (for instance if moving jobs across borders is associated with de-qualification as often found in the migration literature). Our interest is thus primarily with the impact of the nature of a mobility event on the self-assessed outcome of accepting the current job.

Accordingly - in contrast to the previous analysis, (but in accordance with the analysis of chapter 5) we focus on the researcher's movement from the previous employment spell[84] to the current one and (as in Chapter 5) encode a researcher as mobile if the previous job was located in a different country than the current one and as immobile if the previous job was located in the same country as the current one. Furthermore, to reduce bias from potential intermittent spells of unemployment (or non-participation) between two employment episodes, we focus only on those industry researchers that moved to the current job directly from either employment or self employment.[85]

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[83] Note thus that in contrast to much of the literature on the effects of mobility on mobile researchers which focuses on objective outcomes, here we focus exclusively on a subjective evaluation of those that have been mobile.

[84] This is possible because our questionnaire contains detailed information about the sector affiliation of the current employer as well as the previous employer. It also contains information about the geographical location of the employers on a country level-basis.

[85] Note that by focusing on only this group we also substantially restrict our sample (to only 2005 observations).

7.5.1 Effects on output

Table 7.9 presents some descriptive results with respect to the questions posed on potential output effects of accepting the current job. This table summarises the average value of the responses to a series of questions in which industry researchers were asked to assess the impact of starting to work at the current employer on their publication, invention and patent output as well as on their job market chances on a five point scale (with 5 meaning strongly increased and 1 meaning strongly decreased).[86]

We see that on average starting work at the current employer (in the self-assessment of the employees) had a mostly neutral effect on the publication output of industry researchers with the average researcher indicating that the output remained unchanged (i.e. with an average value of close to 3), but that patent output as well as chances on the job market and invention output (most strongly of all) increased on average, at least in the self assessment of the industry researchers.[87] This thus suggests that the effects of job changes are on average positively assessed by industry researchers.[88]

Table 7.9: The Effects of working for the current employer on output indicators by international mobility in the past and by number of jobs held in the last three years

Please indicate in hindsight how working for your current employer affected certain outcomes of your work

	Publication Output	Invention Output	Patent Output	Chance on job Market
	International Mobility[1)]			
Previous job same country	3.10	4.00	3.52	3.78
Previous job different country	2.90***	3.99	3.64*	3.93***
Total	3.06	4.00	3.54	3.81

S: MORE-Questionnaire on industry researchers. Table presents means of answers on a 5 point scale, 5= strongly increased, 1= strongly decreased, *** (**) (*) signify significance of a t-test for differences in group means at the 1% (5%), (10%) level, respectively,

There are, however, also differences between those industry researchers moving directly from one job to the next, whose last job was in the same country as the current one and industry researchers moving directly from one job to the next, whose last job was a different country as the current one. In particular, for those that whose previous job was in another country starting work at the current employer had more negative impacts on publication output but a more positive effect on patent output and chances on the job market, while the self assessment of the effects on invention output is virtually the same. Furthermore a t-test of the hy-

86 In detail this question read "Due to starting work for your current employer your [output type] [answer], where [output type] is a place holder for publication, invention, patent output and job market chances, respectively and [answer] is place holder for the respondents assessment of the impact on a five point scale.

87 Note that no closer definition of any of these output types was undertaken in the question, so that we do not know exactly what respondents considered publications, inventions or patents. Furthermore the question was based on the self assessment of the researchers and thus is purely subjective. Due to the confidentiality of the questionnaire we have no possibility to check on whether the self-assessment of the industry researcher corresponds to actual developments reflected in objective data such as provided in publication and patent data bases.

88 This may, however, be due to selectivity since bad matches resulting in poor output would probably lead to either the industry researcher or his/her employer terminating the job, which would lead to bad matches lasting only shortly and being observed less often than good matches.

pothesis of equal means across these two groups suggests that the differences between these groups with respect to publication and invention output as well as with respect to job market chances are statistically significant.

This may however be due to the correlation between other variables that drive the outcome of starting work at the current employer and mobility. Thus to disentangle these other factors from the impact of past mobility table 7.10 shows the results of an ordered logistic regression of a large number of variables on the subjective evaluation of the individual outcomes of starting work at the current employer. In these regressions we control for a number of demographic characteristics of the respondent (such as gender, age, age squared, time since graduation and the presence of children) as well as for the highest completed education (where to avoid working with very small groups we merged all education groups below undergraduate degrees to one single group), the field of the degree. In addition we also control for the current employer characteristics (company, research lab, other) and the type of contract at the current employer (fixed term contracts open ended contract, self employment, other full time contract) as well as the same indicators for the same characteristics of the previous employer by a set of indicator variables. These variables thus control for any co-linearity between moving jobs across borders and say moving from a part time to a full time employment. Furthermore, we also include tenure at the current employer since we expect this to be highly correlated with unobserved match quality.[89]

Looking at the results with respect to these control variables we see that age and age squared have a significant impact on the subjective assessment of the effects of starting work at the current employer on publication and invention output as well as on job market chances. The coefficient estimates for these variables suggest that up to the ages of 45 to 55 the probability of assessing the impact of starting work at the current employer positively decreases, while after this age this probability starts increasing again.[90] Similarly a longer time since graduation reduces the likelihood of assessing the impact of starting work at the current employer on publication output and job market chances, while females and married persons are more likely to find improved invention output and females and persons children significantly more often find that starting work at the current employer increased their job market chances. In addition females are also significantly less likely to find a positive impact of starting work at the current employer on patent output.

Results with respect to the education variables by contrast imply that those with lower educational degrees in general have a more optimistic assessment of the impact of their last job change on publication output (where coefficients for all educational groups suggest a significantly more positive assessment relative to PhDs) and invention output (where significance applies only to the other education group[91]), but that persons with completed graduate education assess the impact on patent output more negatively.

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89 We checked on a number of robustness issues with respect to this specification. In these checks we also included tenure squared to check for non-linear impacts of this variable. Tenure squared remains insignificant throughout. In addition we also checked (as far as possible with limited number of observations for groups) that by collapsing groups we do not net out significant parameter differences.

90 Note that age squared was divided by 100 in our estimates (to avoid having to report excessive output). Thus the turning points with respect to age are at the age of 44 for publication output, and 55 for both invention output and job market chances.

91 This includes persons with secondary and vocational education.

Table 7.10: Results for determinants of evaluation of output indicators

	Publication Output		Invention Output		Patent Output		Job Market Chances	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Previous job different country	-0.12	0.12	0.01	0.12	0.23*	0.13	0.33***	0.12
Female	-0.06	0.14	0.25*	0.14	-0.35**	0.16	0.27*	0.14
Age	-0.14***	0.05	-0.12***	0.05	-0.05	0.06	-0.20***	0.06
Age squared/100	0.16***	0.05	0.11**	0.05	0.05	0.06	0.18***	0.06
Time since graduation	-0.02*	0.01	-0.01	0.01	0.00	0.01	-0.02**	0.01
Married	0.12	0.15	0.29**	0.14	-0.09	0.17	-0.09	0.15
Tenure	0.05***	0.01	0.05***	0.01	0.04***	0.01	0.03**	0.01
Children	0.04	0.13	0.08	0.12	-0.07	0.14	0.35***	0.13
Education: PhD	Reference category							
Graduate education	0.44***	0.12	0.08	0.12	-0.31**	0.13	0.09	0.12
Undergraduate education	0.50**	0.22	0.02	0.21	-0.20	0.24	0.09	0.21
Other education	0.78**	0.36	0.85 **	0.35	0.08	0.39	0.58	0.37
Degree: Natural Science	Reference category							
Engineering & Technology	0.03	0.11	-0.17	0.11	-0.28	0.12	-0.09	0.11
Medical & Health Sciences	0.02	0.24	-0.12	0.24	0.26	0.26	0.01	0.24
Agricultural Sciences	-0.35	0.34	0.24	0.33	-1.01***	0.39	0.30	0.34
Social Sciences	0.41*	0.24	-0.08	0.23	0.00	0.29	0.39*	0.23
Humanities	0.88	0.60	1.07*	0.58	-0.32	0.72	-0.10	0.52
Current employer: Company	Reference category							
Research Lab	1.12***	0.15	-0.22	0.15	-0.27	0.17	-0.42***	0.15
Other	0.49*	0.27	-0.40	0.25	-0.47	0.32	-0.21	0.26
Current Contract: Fixed term	Reference category							
Open ended	-0.27	0.17	0.22	0.17	0.06	0.19	0.19	0.17
Self-employment	-0.44**	0.22	0.30	0.22	-0.45*	0.25	-0.31	0.23
Other	-0.16	0.32	0.35	0.32	-0.54	0.35	-0.21	0.33
Full time	-0.09	0.19	0.39**	0.19	0.06	0.21	0.23	0.19
Previous employer: University	Reference category							
Company	1.00***	0.15	-0.15	0.14	-0.19	0.16	-0.63***	0.15
Research Lab	-0.22	0.16	-0.22	0.16	0.01	0.18	-0.54***	0.17
Other	0.98***	0.25	0.17	0.25	-0.06	0.30	-0.55**	0.25
Previous contract: Fixed term	Reference category							
Open ended	0.20	0.12	0.12	0.12	-0.12	0.13	0.07	0.12
Self-employment	0.47*	0.25	0.34	0.25	0.35	0.29	0.75**	0.27
Other	0.17	0.30	0.72	0.29	0.32	0.33	0.33	0.31
Full Time	0.13	0.23	-0.29	0.22	0.19	0.26	-0.21	0.22
Observation	1570		1719		1356		1625	
Chi2 (29)	318.95		98.06		96.35		134.70	

S: MORE-Questionnaire on industry researchers. Table presents coefficients of an ordered logit regression, with answers from 5= strongly improved to 1= strongly deteriorated, *** (**) (*) signify significance of a t-test on coefficients being different from 0 at the 1% (5%), (10%) level, respectively,

Differences with respect to field of study by contrast seem to be rather small. Social scientists tend to assess the impact on publication output and job market

chances more positively and persons, who studied humanities, report a significantly more positive impact on invention output. In addition patent output reduces significantly more for agricultural scientists.

While these demographic variables serve purely as control variables and it is hard to formulate expectations on their signs from a theoretical perspective, other variables, for which such expectations can be more easily formulated, are in line with theoretical predictions. In particular as expected tenure has a significantly positive impact on the assessment of all output indicators. This implies that, as argued above, persons with a longer tenure are also more likely to be satisfied with their current job.

Similarly, the coefficients on the type of the current and previous employer are rather intuitive: Relative to starting work at a company, starting work at a research lab or with other employers is likely to have a significantly more positive impact on publication output, but (also relative to starting work at a company) starting work at a research lab is less likely to have a positive impact on job market chances. In addition relative to persons whose previous job was at a university those that previously worked in companies or other institutions are less likely to experience a negative impact on publication output but also less likely to experience a positive impact on job market chances.

By contrast, the type of the current and previous employment contract only rarely has a significant impact on the output indicators. The significant effects, however, imply that working in an open ended contract reduces both publication and patent output (relative to working in a fixed term contract) and working in a full time job (relative to a part time job) increases invention output, while those that were previously self employed are likely to experience improved publication output and better job market chances after changing jobs.

The variable of central interest in these regressions, however, is the dummy variable that captures whether the respondents previous job was in another country than the current one (in the first line of table 7.10). Here we find that among industry researchers moving directly from one job to the next, those, whose last job was in a different country as the current one, are significantly more likely to report a positive impact on job market chances than those whose job was in the same country even after controlling for other variables. In addition we also find a positive effect on patent output, which is, however, significant only at the 10% level, while the effect on publication output and invention output remains insignificant throughout.

For industry researchers moving directly from one job to the next thus, international mobility has a significantly positive impact on their assessment of job market chances, which can be found both when using univariate statistics as well as when controlling for other covariates. In addition there is also a (weakly) significant positive impact of international mobility on patent output, which is, however, much less robust to inclusion of other covariates, while, the negative effect of international mobility on publication output found in univariate analysis disappears once other covariates are included and effects on invention output are insignificant irrespective of method used. Summarising this thus suggests that - at least for researchers moving directly from one job to the next, - there is some evidence of a positive impact of international mobility on job market chances and potentially also on patent output.

7.5.2 Effects on networks

A slightly different picture emerges when considering the impact of international mobility on networks. Table 7.11 reports the results with respect to the questions posed on potential network effects of accepting the current job.[92] These results suggest that when considering all industry researchers the average industry researcher reports a strongly positive effect of accepting a job at the current employer on both the diversity of networks and capabilities to work inter disciplinarily. Similarly effects on contacts with the scientific community and to other research partners are also assessed positively, but, as could be expected, the impact on contacts to former colleagues and former external partners is assessed more negatively.

When, however, splitting the sample into industry researchers whose previous job was in another country than the current one and industry researchers whose current job is in the same country as the previous one there seem to be few differences between these two groups. Only the positive effects on contacts to the scientific community and to other research partners are significantly lower for those industry researchers whose previous job was in another country than the current one, while no significant differences can be found for the other network effects.

Table 7.11: The Effects of working for the current employer on network indicators by international mobility in the past and by number of jobs held in the last three years

Please indicate in hindsight how working for your current employer affected certain networking and socials aspects of your work

	Contacts to former colleagues	Contacts to former external partners	Diversity of networks	Contact to the Scientific community	Contacts to other research partners	Ability to work interdisciplinary
Previous job same country	2.52	2.72	4.13	3.82	3.96	4.17
Previous job different country	2.48	2.63	4.13	3.67***	3.85**	4.13
Total	2.51	2.70	4.13	3.79	3.94	4.17

S: MORE-Questionnaire on industry researchers. Table presents means of answers on a 5 point scale , 5= strongly improved, 1= strongly deteriorated , *** (**) (*) signify significance of a t-test for differences in group means at the 1% (5%), (10%) level, respectively, 1) internationally mobile=industry researchers that have worked in another country than their country of graduation, internationally immobile=industry researchers that have always worked in the same country as their country of graduation . 2) Based on questions: How many jobs did you hold in the last three years?

When running regression as in the previous section we, however, find that these effects are also significantly negative after controlling for other potential covariates (see tables 7.12 and 7.13). Thus international mobility has a negative and significant impact on researchers that move directly from one job to the next, (that is also robust) on contacts to the scientific community and contacts to other research partners, while the impact of such mobility on other network indicators does not differ between industry researchers whose previous job was in the same country, and industry researchers, whose previous job was in another country. This thus suggests that the substantially more severe changes in the environment of researchers associated with changing country of work, which inter alia may necessitate a change of working language as well as a cultural change, aside from

[92] Once more in this table we focus exclusively on industry researchers that move directly from one job to the next, and define internationally mobile researchers to be those whose previous job was in another country than the current one.

causing an increase in job market chances and potentially patent output, also impacts negatively on contacts to the scientific community and other research partners.

Table 7.12: Results for determinants of evaluation of network indicators I

	Contacts to former colleagues		Contacts to former external partners		diversity of networks	
	Coefficient	S.E	Coefficient	S.E	Coefficient	S.E
Previous job different country	-0.16	0.11	-0.17	0.11	-0.04	0.11
Female	-0.01	0.14	0.09	0.14	0.12	0.14
Age	-0.05	0.05	0.01	0.05	-0.03	0.05
Age squared/100	0.06	0.05	0.02	0.05	0.02	0.05
time since graduation	0.01	0.01	0.00	0.01	-0.02	0.01
Married	0.04	0.14	0.01	0.14	0.11	0.14
Tenure	-0.03***	0.01	-0.02***	0.01	0.04***	0.01
Children	0.10	0.12	0.21*	0.12	0.14	0.12
Education: PhD	Reference category					
Graduate education	-0.15	0.12	-0.03	0.11	-0.03	0.11
Undergraduate education	-0.56***	0.21	-0.30	0.21	0.07	0.20
Other education	-0.35	0.35	0.13	0.35	-0.21	0.33
Degree: Natural Science	Reference category					
Engineering & Technology	0.22**	0.11	0.22**	0.10	-0.20*	0.11
Medical & Health Sciences	-0.07	0.24	0.09	0.23	0.08	0.24
Agricultural Sciences	0.33	0.32	0.42	0.30	0.23	0.32
Social Sciences	0.36	0.22	0.33	0.22	0.54	0.23
Humanities	0.71	0.49	1.05**	0.50	0.62	0.55
Current employer: Company	Reference category					
Research Lab	0.10	0.15	0.01	0.15	-0.11	0.15
Other	-0.02	0.24	0.08	0.23	-0.17	0.23
Current Contract: Fixed term	Reference category					
open ended	-0.41***	0.17	-0.20	0.17	0.05	0.17
Self-employment	-0.53***	0.22	0.39*	0.21	0.45*	0.22
Other	-0.29	0.31	0.62**	0.30	0.10	0.32
Full time	0.37**	0.18	0.38**	0.18	0.70**	0.18
Previous employer: University	Reference category					
Company	-0.24*	0.14	-0.10	0.14	-0.17	0.14
Research Lab	-0.14	0.16	-0.10	0.16	-0.29*	0.16
Other	-0.04	0.24	-0.07	0.23	-0.01	0.24
Previous contract: Fixed term	Reference category					
open ended	0.08	0.12	0.04	0.12	0.07	0.12
self employment	0.46*	0.26	0.30	0.24	0.31	0.25
Other	0.04	0.29	-0.36	0.31	0.26	0.29
Full Time	0.05	0.22	0.17	0.22	0.01	0.22
Obs	1767		1726		1793	
Chi2 (29)	56.32		76.45		87.89	

S: MORE-Questionnaire on industry researchers. Table presents coefficients of an ordered logit regression, with answers from 5= strongly improved to 1= strongly deteriorated, *** (**) (*) signify significance of a t-test on coefficients being different from 0 at the 1% (5%), (10%) level, respectively,

Table 7.13: Results for determinants of evaluation of network indicators II

	Contacts to scientific Community		Contacts to other Res. Partners		Ability to work interdisciplinary	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Previous job different country	-0.24 **	0.11	-0.23**	0.11	-0.16	0.12
Controls						
Female	0.08	0.14	0.25*	0.14	0.10	0.14
Age	-0.12**	0.05	-0.07	0.05	-0.06	0.05
Age squared/100	0.12**	0.05	0.06	0.05	0.03	0.05
time since graduation	-0.01	0.01	0.00	0.01	0.01	0.01
married	-0.08	0.14	0.00	0.14	-0.04	0.14
tenure	0.05***	0.01	0.04***	0.01	0.04***	0.01
Children	0.30**	0.12	0.27**	0.12	0.25**	0.12
Education: PhD			Reference category			
Graduate education	-0.01	0.11	-0.14	0.11	-0.23**	0.11
Undergraduate education	0.12	0.20	0.02	0.20	-0.17	0.20
Other education	-0.10	0.33	-0.26	0.34	-0.89**	0.35
Degree: Natural Science			Reference category			
Engineering & Technology	0.05	0.10	-0.06	0.11	-0.18*	0.11
Medical & Health Sciences	0.43*	0.23	0.07	0.23	-0.23	0.24
Agricultural Sciences	0.14	0.31	0.03	0.32	-0.42	0.31
Social Sciences	0.43**	0.22	0.51**	0.22	0.28	0.22
Humanities	0.94	0.56	1.10*	0.58	1.11**	0.56
Current employer: Company			Reference category			
Research Lab	0.76	0.15	0.32**	0.15	0.32**	0.15
Other	-0.03	0.23	-0.29	0.24	-0.17	0.24
Current Contract: Fixed term			Reference category			
open ended	0.03	0.17	-0.11	0.17	0.13	0.17
self-employment	0.09	0.21	-0.10	0.22	0.25	0.22
Other	0.53*	0.31	0.08	0.31	0.43	0.32
Full time	0.42**	0.17	0.41**	0.18	0.04	0.18
Previous employer: University			Reference category			
Company	0.75***	0.14	0.48***	0.14	0.03	0.14
Research Lab	-0.25	0.16	-0.16	0.16	-0.20	0.17
Other	0.55**	0.24	0.39*	0.24	0.08	0.24
Previous contract: Fixed term			Reference category			
open ended	-0.05	0.12	-0.16	0.12	-0.28**	0.12
self employment	0.01	0.24	0.27	0.25	-0.07	0.24
Other	0.09	0.28	0.17	0.29	0.29	0.30
Full Time	0.01	0.21	-0.25	0.22	0.12	0.22
Obs	1777		1775		1795	
Chi2 (29)	174.74		110.06		92.54	

S: MORE-Questionnaire on industry researchers. Table presents coefficients of an ordered logit regression, with answers from 5= strongly improved to 1= strongly deteriorated, *** (**) (*) signify significance of a t-test on coefficients being different from 0 at the 1% (5%), (10%) level, respectively,

The results reported in table 7.12 and 7.13, however, also point to a number of other interesting "correlates" of the impact of a job change on researcher networks. In particular:

- Tenure has an important impact on all network effects. According to our results persons, who have been with their current firm for a longer period of time, are more likely to assess the impact of starting work at this firm on the contacts to the scientific community, to other researchers and on the diversity of their networks as well as on their ability to work interdisciplinary more positively while they assess the impact on their contacts to former colleagues and research partners significantly more negatively. While the second finding seems intuitive the first reconfirms those workers that assess the impact of starting at a firm more positively are also likely to stay longer with that firm (and thus also are more likely to reach a longer tenure).

- Other individual characteristics such as gender, age, years since graduation and having children, by contrast only occasionally have a significant impact on the assessment of the network effects of starting work at the current employer for industry researchers. The older assess the impact on contacts to the scientific community more pessimistically. Females are significantly more optimistic with respect to contacts to other research partners, while the presence of children has a significant positive impact on the assessment of contacts to former research partners, to the scientific community and other research partners as well as on the ability to work interdisciplinary.

- Education variables have a much weaker association with the assessment of networks effects than with the assessment of output indicators. Undergraduate degree holders are significantly less optimistic about the impact of starting work at the current employer on contacts to former colleagues and the less qualified in general also assess the impact of a job change on the ability to work interdisciplinary more negatively.

- Those that have completed a degree in engineering and technology are more likely to report a significantly more positive impact of starting work at the current employer on contacts to former colleagues and external partners than natural scientists, but a more negative impact on diversity of networks. Medical and health scientists more often than natural scientists improve contacts to the scientific community, while social scientists experience an increase contacts to the scientific community and to other research partners. Graduates with degrees in humanities, by contrast, experience significantly improved contacts to other researchers and in their ability to work interdisciplinary, relative to natural scientists.

- The current and previous employers have important effects on the assessment of the effects of a job change. Starting to work in a research lab improves the effects on contacts to other research partners and to work interdisciplinary, relative to starting work at a company and having previously worked at a company (as well as other organizations) significantly improves contacts to the scientific community and to other research partners relative to those that have previously worked at universities.

- Industry researchers starting a job with an open ended contract on average have a significantly more positive impact on contacts to former colleagues than those starting work in fixed term contracts. Those that start work as self-employed feel improved contacts to former external partners as well as an increase in the diversity of networks relative to those on short fixed term contracts. By contrast having previously worked in an open ended contract re-

duces the ability to work interdisciplinary, relative to someone who has worked in a fixed term contract

- Industry researchers starting on full time contracts are more likely to have a positive impact of starting to work at the current employer on contacts to former external partners, former colleagues, the scientific community and other research partners and are thus also more likely to increase the diversity of their networks.

7.5.3 Conclusions

This chapter considers the motives of international researchers for choosing a particular career. Furthermore it also discusses the factors that motivate and hamper international mobility as well as the effects of mobility on industry researchers. With respect to motives for choosing a career path we find that:

- For industry researchers the most important motives for choosing a particular career path are job satisfaction, the challenges offered by the positions, working conditions, a good work life balance and life satisfaction of children. Thus reasons related to job and life satisfaction are more important for the career decision than high salaries. At the bottom of the list we find job security, the prospects of a scientific career, keeping in touch with friends and family, other private reasons and financial incentives other than salaries.

- Pecuniary motives are important in the decision to accept a particular job. After the possibility to apply previous knowledge, which is almost a precondition for mobility, and an increase in responsibility, a high salary follows on third place among these reasons. For the internationally mobile, the priorities given to certain motives for choosing a certain job are very similar to those of the internationally immobile industry researchers, but they are in general more critical in the sense that they give more weight to almost all factors.

- For a large number of industry researchers, job changes result in an increase in managerial activities, a higher work load but also results in higher autonomy. Such job changes are also often seen as a continuation of the previous career and also seem to result in a higher share of applied research and offer more flexibility. The impact on basic research activities by contrast is less clear. Thus most of the researchers' job changes seem to be associated with a move up in the hierarchical ladder.

For international mobility by contrast we find that there are substantial differences in the factors that motivate those that were internationally mobile in the past and that hamper geographical mobility for those that have not been previously mobile. Industry researchers that have previously been mobile name the presence of leading experts abroad, the quality of life, the presence of external R&D structures, the recognition of educational degrees and the culture of the receiving country as the 5 most important motives for moving abroad. They thus strongly stress the research infrastructure of the receiving country as a major motivation for mobility.

This thus suggests a strong parallel to the factors that motivate enterprises to locate R&D facilities in a particular region in developed economies, since as for instance shown in a recent report by Thursby and Thursby (2006) next to the quality of R&D personnel and intellectual property rights the quality and accessibility of the research environment (such as of universities) also belong to the most important factors that motivate firms to locate R&D departments in devel-

oped market economies. Both enterprises as well as industry researchers stress the importance of the research environment in their location decision, while in general putting much less emphasis on the financial aspects of their decision.

Those that have not been mobile previously give much more emphasis to factors that are not connected to the research environment such as the quality of life, the availability of schools for children, finding housing, work permits for partners and the cultural differences to other countries. These factors must thus be considered the major impediments to mobility.

Interestingly both those not internationally mobile as well as those mobile agree that administrative barriers to mobility, taxation and private as well as financial mobility support are least important in shaping industry researchers' decision to move abroad. These factors must thus be considered to be of lesser importance both as factors motivating as well as factors hampering international mobility.

This points to a certain difference with respect to the problems seen by enterprises since (as will be discussed below) in the expert interviews conducted in this study, companies do put particular emphasis on the framework conditions for mobility (such as administrative barriers to mobility). This, however, seems in line with the finding of these interviews that in many cases companies take over the administrative tasks (as well as financial costs) associated with mobility (such as organizing work permits and paying mobility grants) when recruiting R&D personnel internationally, so that mobile industry researchers are often not affected by these problems.

Finally, we also find some evidence that for industry researchers changing jobs across countries may be associated with different results than changing jobs within countries. Industry researchers, whose previous job was located in another country than their current job – after controlling for other variables – significantly more often find that accepting the current job had a positive impact on their job market chances and to a lesser degree also on their output with respect to patenting activities than researchers whose previous job was in the same country as their current job. They, however, also significantly more often report a negative impact on contacts to the scientific community and to other research partners than those, whose previous job was located in the same country.

While this thus suggests that changing jobs across national borders may be associated with rather different costs and benefits than changing jobs within countries, these results are, also rather tentative due to the nature of our data. This does not allow us to observe more than one job change for each industry researcher, which rules out controlling for unobserved individual heterogeneity among researchers with respect to the results of mobility by fixed effects. Furthermore, it allows us only to analyze the impact of mobility in terms of subjective assessments of the researchers themselves.

8 INDUSTRY SATISFACTION STUDY

The relevant scientific literature argues that mobility of researchers between sectors (academia and industry) and between organisations within a given sector is a strong indicator and determinant of knowledge flows between these components in an innovation system (Graversen 2004). The knowledge transfer effects of researcher mobility have to be interpreted as knowledge generation, diffusion and application within the context of innovation systems, regardless of how the innovation is delimited; national, regional, technological or even international. The theory of innovation systems is based on the understanding that the overall performance of the system, i.e. the system's capability to innovate, strongly depends on the system's ability to generate, diffuse and apply knowledge.

The linkages of the organizations within the innovation system are crucial for performance. In this regard mobility of researchers affects the innovation system's performance in two ways:

- Researcher mobility transfers tacit knowledge between the two involved organizations. Researcher mobility can have both positive and negative effects on industrial innovation activities. Economists have long assumed that the mobile researchers transmit technological know-how across sectors and across firms and thereby generate positive effects for the receiving institutions (Angel 1989, 1991, Arrow 1962, Stephan 1996). On the other hand organizations fear that researcher mobility will lead to knowledge-drain which bears negative effects on firms' innovation activities and competitiveness (Edler 2007).

- Researcher mobility creates linkages within the innovation system which can be utilized in the future for knowledge creation, diffusion and application. This assumes that personal bonds are stronger than pure colleagueship. Researchers will maintain (at least) some relationships to their previous colleagues even when changing across sector or national boundaries (Beckert, Bührer and Lindner 2008, Ebersberger, Beckert and Bührer 2007).

Eventually, the knowledge generation, diffusion and application effects of researcher mobility will have to be measured within industry as the locus of innovation in an innovation system. The aim of the industry satisfaction study was to investigate how researcher mobility is viewed upon by industrial actors. The company survey on researcher mobility was not successful for reasons expounded in Chapter 3 of this report. It yielded a response that was below the limits warranting a statistical analysis of the data. However, the information and insights gained during the exploratory and pilot phases of this part of the survey are very valuable and shall be summarised here.[93]

[93] A list of the interview partners is attached in the Annex.

8.1 Main findings of explorative interviews with HR-managers, R&D-executives and stakeholders

Mobility is relevant along three different dimensions for firms: Inward mobility – outward mobility – previous mobility as a signalling device

Mobility of researchers and engineers has two important direct (inflow in and outflow of researchers out of the company) and one indirect (mobility prior to the entry in the company) dimension for companies. Additionally, in case of large companies the mobility / exchange of researchers between R&D-locations are also an issue. Temporary exchange of researchers or engineers (e.g. research visits, sabbaticals, etc.) with other companies or academia seems to play a subordinate and negligible role.

- **Inflow:** Companies are mainly interested in filling vacancies with employees showing the required capabilities and competences. While research performing companies compete in their field of science and try to introduce new products on the market ("first-mover"), they are limited in their knowledge base depending on their internal resources (including staff). Hence the companies' incentives to recruit researchers, scientists or development engineers are connected to improve the firm's knowledge pool quickly.

  Mobility is therefore often a means to an end of meeting the company's needs (the mobility step here is the recruitment of the researcher / engineer), but not a per-se-value. However, the mobility's value increases with the scarcity of necessary skills. Especially in countries or regions with insufficient human capital, mobility (among others) can mitigate this shortage. Increasing mobility means shifting key workers to where they are most needed.

  Additionally, the recruiting of new researchers / engineers has further positive impacts on the company: inflow of tacit knowledge embodied in the employees; the researcher's contacts can be used to establish (cooperation) networks. Previously mobile researcher might also be used as key agents in coordinating cooperation using their network competences.

- **Outflow:** Leaving researchers and engineers are potentially harmful for companies. Competitors might benefit from the researchers' knowledge and experience made in the own company. Former employees could also found new companies exploiting the company's research results. While companies are interested in inward mobility, they are not in outward mobility.

  On the other hand, in some industries research output can be easily and effectively protected from imitation and illegal copying. If this is the case, companies are far less affected by outward mobility than comparable companies in branches without efficient intellectual property rights protection systems. The leaving researcher cannot use the research results of his previous employer in his new company which causes damage for the company he left. Nevertheless the previous company still loses the researchers' workforce, skills and knowledge as well as his or her experience.

  In general, research performing companies actively seek to keep key researchers in their company, while others (the "replaceables") are committed to competition clauses because companies try to avoid that their for-

mer employees directly move to (keen) competitors. These competition clauses are however of limited effectiveness. In hardship cases it is not so easy to prove which company has been the original inventor. Summarising, leaving researchers and therefore outward mobility tend to have negative effects on companies.

- **Mobility in previous career and / or during education as a signalling device**: Mobility is seen as one (but not the only) potential way to acquire competences and experience (e.g. experience in different corporate cultures, etc.) and to make contacts. Mobility of researchers is therefore seen as an indicator of their competences and flexibility. On the other hand, if jobs are to short in their duration (shorter than 3-5 years), the positive effects of an affiliation are negligible.

  While the core value of a researcher for companies is his capability to meet the needs of the company in terms of skills and knowledge, it is not important how the researcher achieved these skills. Former mobility steps are not relevant if the researcher has been able to exploit other learning opportunities. The mobility step of interest for the company is the researcher's mobility step of joining the company. Prior job changes are not relevant itself, but they indicate specific competencies and also flexibility. The latter is in particular important if researchers move from academia to private industry, since the duration of research projects in private industry is often far shorter than in academia. The researcher must be able to flexibly adapt his capabilities to new challenges.

The importance of mobility increases with the scarcity of human resources

The importance of (geographical) mobility of researchers / engineers for companies increases with the degree of scarcity of specialized researchers / engineers. The fewer researchers / engineers are locally as well as globally available in a specific technological field, the more important is their willingness to accept those jobs they are primarily specialized in (regardless of the location of the job).

Mobility can have negative effects on companies

The value of mobility of researchers / engineers has to be seen differently in industry than in academia. Incentives of companies completely differ from public R&D. Universities are not profit maximising institutions. Hence they do not face competition if their researchers leave for other universities or companies. On the contrary, from the company's point of view previous employees might become competitors using the experience and skills learned in the company and mobility can therefore also have negative impacts. (compare the description of the three different dimensions of mobility for firms above)

Framework conditions for mobility are considered to be very relevant for companies

Framework conditions (e.g. migration law, working permission, attractiveness of a location etc.) are a very important issue for companies to be able to recruit needed researchers internationally (in particular these highly specialised researchers / engineers). The framework conditions gain importance whenever the stock of human resources in the home country of the company does not provide the required competences forcing the companies to "import" them. The scarcity increases the more specialised the field of technology is. In these cases, the lack of human resources can be assumed to appear far more often within a geographic

region and therefore international search for the right candidates is needed. Administrative barriers to recruit researchers are therefore seen as a problem by companies.

The following framework conditions (incl. administrative barriers) for attracting highly skilled researchers have been mentioned by stakeholders and companies:

- The existence of scientific stars in the local environment of the enterprise
- External R&D infrastructure of the enterprise's location (e.g. existence of universities, advanced companies in the same field, etc.)
- The (geographical) location (e.g. appeal of the city / region) of the enterprise
- The specification of the country's migration law
- The specification of the country's labour permission law
- The specification of the country's law of residence permission
- The work permission for marriage partners (and other family members) of foreign scientists, researchers or development engineers
- The country's tax system
- A good social security system (including health care, unemployment, etc.)
- The compatibility of the country's social security system with other national systems
- The availability of adequate (e.g. international) schools for children
- The general attitude towards foreigners in the country
- The language in the country / the language capabilities of the people in the country
- The country's educational system

The company specific R&D-model (organisation of own R&D activities) determines companies' needs towards mobility

The R&D-model of companies is a very important determinant of their attitude towards mobility.

- The quantity and also the type of researchers and engineers needed by the company depend on whether it does R&D in-house or purchases external knowledge. Hiring the researchers needed for in-house R&D is eased if researchers are more mobile. On the other hand, companies doing external R&D need network competences (embodied in previously mobile researchers) for planning and coordinating their innovation projects.

- As already discussed above, companies which are able to effectively protect their knowledge / technologies / products etc. have minor problems with leaving researchers or engineers. On the other hand, companies which base their IPR-protection on secrecy or lead-time-advantage etc. are heavily damaged when its former researchers leave for competitors.

- Multinational enterprises often have a broad spectrum of researcher types (with respect to mobility) needed. On the one hand, they can hire new employees where needed or shift their employees from one to another location. On the other hand, they can move their locations to regions where the necessary resources (including human capital) are placed, but they also can employ researchers that are permanently employed in one of the enterprise's location and regularly work at the other locations. This kind of mobility is not captured by a mobility concept in terms of job changes, but does lead to a transfer of knowledge from one place to another.

> *„In amongst the enquiries about working in countries outside of that in which I reside you did not allow the opportunity to tell you that although based in the UK, I work for an American privately owned company with manufacturing facilities all round the world and I currently offer technical and research support for two sites in the USA, two sites in China, one in Egypt, and one in the UK. I spent 18 weeks abroad last year at these facilities and this continues in 2009 and 2010. I am the interface between academic centres of excellence in both Universities and industrial centres based in Europe, China and the USA. I am not constrained to working in a single country, but operate globally because the world is short of good quality metallurgists!" (MORE – industrial researcher questionnaire, comment)*

These issues have strong implications for the assessment of researchers' mobility in private industry. While the first two points have been considered in the questionnaires prepared for this study, the last one is a by-product of the survey itself and should be kept in mind for future studies. The quoted comment of the survey participant indicates that the mobility concept used in our study becomes blurred at least with respect to the following dimensions:

- Time: How long does it take for researchers to effectively transfer knowledge from one place to another? What is the minimum duration of stays abroad enabling knowledge diffusion?

- Company / Employment: As the quoted comment points out, a mobility step has to include neither a change of the employer nor the location of work permanently. A researcher might work for one and the same company – a multinational company for instance – but in various locations in different countries for a limited period of time. The mentioned kind of mobility is therefore incomplete in the sense of the definition used in this study.

- Virtual research labs: Modern telecommunication technology allows people to cooperate internationally on a world wide scale without the need to relocate. However, cooperation in these "virtual" research labs has similar effects as physical mobility by researchers in terms of knowledge flows and spill-overs.

Assuming that the quoted researcher is not a unique case, future studies should take account of different types of mobility. Beside job changes and long-term stays abroad – as analysed in this study – follow-up studies could include questions and concepts focusing on 'incomplete' or 'irregular' types of mobility that in all likelihood have to take into account the changing work organisation in research (and would thus potentially require the development of matched employer employee data for empirical analysis). Hence, exact defini-

tions on irregular mobility have to be developed. At the same time, mobility concepts should not be mixed up so that these alternative concepts should probably complement rather than substitute the more conventional concepts used in this study and in much of the literature on mobility of researchers so far.

Mobile researchers are gatekeepers for research networks and the exchange of researchers between firms and with academia

Cooperation between companies (and public research institutions) is an important precondition for direct exchange of research personnel. As it is for the research cooperation itself, trust is important to intensify any cooperation by exchanging researchers or development engineers with partners. If research results or scientific staff are planned to be exchanged, the partner has to be seen fair and reliable. Personal contacts are of central importance for both establishing networks and exchanging researchers.

Part 3 SUMMARY

9 SUMMARY OF MAIN RESULTS

One of the main objectives of Work Package 7 of the MORE project was to conduct a survey on the extent, motivations and results of mobility among researchers employed outside academia (i.e. industry researchers). This study reports the results of this questionnaire. In particular we aim at answering three types of questions related to mobility of industry researchers:

- What is the structure and intensity of mobility among these researchers?
- What are their career paths?
- What factors hamper or facilitate mobility and what are the effects of mobility on industry researchers?

9.1 Evidence from the ELFS

Before providing the results of the industry researcher survey we, however, also used data from the European Labour Force Survey to compare the mobility of those employed in research occupations and HRST. This is important because it allows us to assess (at least from the perspective of rough proportions) the validity of the results of the questionnaire.

We find that both HRST employment as well as the employed in research occupations as defined in the Frascati manual deliver only poor approximations of the number of researchers. In particular the number of persons employed in research occupations according to the ELFS exceeds the number of researchers according to official EUROSTAT sources by a factor of over 9 and HRST employment is by a factor of 18.5 higher. This thus questions the reliability of results using these definitions as proxies for researcher employment and – from a data development perspective - underlines the importance of implementing questions allowing to identify researchers in the standard large scale household surveys of the EU (such as the Labour Force Survey) if insights into the labour market behaviour of this group of workers is sought for.

On a more substantive level our findings, suggest that both HRST and employed in research occupations are groups that are not necessarily more mobile than comparable employees working in other sectors, but that the determinants of mobility differ from those of the overall population for these two groups on account of differences in occupation specific career paths. In particular, we find that:

- these groups are characterised by a lower mobility from non-employment to employment, which may be explained by the lower unemployment and higher participation rates among these highly educated groups.
- the sector mobility rates of these groups in aggregate are about comparable to those of the employed overall, with econometric evidence suggesting a small but statistically significantly lower sector mobility of these groups.
- the international mobility of these groups is substantially higher in aggregate than for the overall employed, but this advantage becomes very small (although remaining significant) once composition effects are controlled for.
- in these groups a larger share of sector mobility is accounted for by job changes within the market services industries and by job changes from the

public sector (i.e. education or other non market services) to either market services and other sectors, while flows from market services and other sectors to the education and other non market services are of a lesser importance.
- the marginal impacts of determinants of both regional as well as sector mobility differ substantially between those employed in the HRST and in research occupations and those employed elsewhere. In particular age-mobility and education-mobility profiles are steeper than for comparable employed elsewhere. This thus points to different (occupation specific) career paths of those employed in research occupations or as HRST.

9.2 Results from the industry researcher survey

Given that the HRST and those employed in research occupations are only very imperfect proxies when one is interested in analysing the mobility behaviour of researchers, the study continues to present the results of a questionnaire conducted among over 3000 industry researchers in Europe.

9.2.1 Design of the questionnaire

The principal data source for this questionnaire was the contact data of applicants to the 6th and 7th Framework Programme for Research and Technological Development of the European Commission that are employed in private industry. In addition, engineering associations were contacted and asked for support in this project. More specifically, we asked contact persons at these associations to forward survey invitations to their members. Finally, at the end of the online questionnaire, we also implemented an option enabling respondents to forward a survey invitation to colleagues ("snowballing").

Although a bias in the data leading to an underestimation of mobility between different subsamples in the questionnaire cannot be established, it is not possible to control whether our data are biased towards excellence. The companies applying for support in the context of the Framework Programmes probably have specific characteristics that are different from those not applying. Therefore, it might be assumed that, for instance, the biggest companies are overrepresented in the FP contact data. Further research is needed to evaluate the representativity (i.e. specific characteristics) of a sample drawn from Framework Programme contacts in comparison to the overall industry researcher population in Europe.

From a data development perspective our experiences thus suggest that the key problem of research on industry researchers is lacking information on population characteristics, which could in all likelihood only be provided, if using regular large scale surveys increasingly also focus on identifying researchers and research firms. Thus tasks such as assessing the number of total researchers in the private industry by company, assessing the number of R&D-performing entities, assessing the number of researchers in these entities and assessing the technology fields these entities are acting in (in the best case providing the number of researchers per technology field), that would enable future research to create stratified samples should receive increased attention in data development if more representative information on industry researchers is looked for.

In addition some of our qualitative results suggest that the mobility concept used in our study as well as in much of the literature is becoming increasingly blurred with respect to both the timing of mobility as well as with respect to the delimitation of the boundaries of the firm. Thus future studies should also increasingly

take account of different types of mobility (such as short term and incomplete migration) aside from job changes and long-term stays abroad.

Despite these caveats at the closing of the survey, eight weeks after the launch date, the response rate was close to 20%, and the data provide slightly more than 3000 usable observations on industry researchers residing in one of the EU27 countries. These data – by comparison to the results of the academic survey conducted in the MORE project - suggests that industry researchers are more often male slightly older, more often married and are more likely to have children. They are also less likely to have completed a postgraduate degree (PhD or equivalent) and are more likely to have a degree in engineering and/or the natural sciences. With respect to their work contract for industry researchers fixed term contracts and part time work are much more seldom and many of them have a relatively long tenure with their respective firm.

With respect to the three central questions posed in this study the main insights gained from this questionnaire can be summarised as follows:

9.2.2 What is the structure and intensity of international mobility among industry researchers?

Industry researchers– relative to the total population of the EU27 – are a highly mobile group: 40% of them have experience with working abroad as a researcher and more than 18% currently live in a country other than where they completed their highest education or live in another country than the one they were born in. In addition 10.3% of our industry researchers have worked abroad at least once in the last three years and 35% of the industry researchers intend to look for work in another country within the next three years

Internationally mobile industry researchers, however, mostly had only 1 stay abroad with only around 19% of all industry researchers having worked abroad for more than 3 months more than once in the last three years. Short term stays (and related return migration), however, seems to be a major factor contributing to mobility patterns of industry researchers residing in the EU27. Over 50% of the work episodes abroad last for less than 3 years. In addition industry researchers residing in the EU12 have been somewhat less mobile than their counterparts in the EU15 in the past and are also are less likely to look for work in another country in the next three years.

Flows between countries of industry researchers also suggest that Germany is the most central country in the network of industry researcher flows. In addition the group of rather central countries comprises the United Kingdom, Belgium, the Netherlands, France, Italy and Spain, while the most peripheral of the countries in the network are the smaller EU countries. These differences, however, seem to be primarily due to factors related to (economic and geographic) country size as well as distance between countries, since a simple gravity model can explain up to 86% of the total variation in bilateral flows of industry researchers.

We find that the most robust differences between mobile and immobile researchers are found in terms of whether the researcher has studied abroad, education, place of birth and field of study.

In particular the most robust results apply to differences with respect to international mobility among industry researchers that have studied abroad and those that have not. 17.3% of the researchers that have studied abroad (as opposed to 8.6% of those that have not studied abroad) have also worked as a researcher in

another country in the three years before the interview, and of the researchers that have at least once been mobile in their career 31% studied abroad for some time, while among those that have never internationally mobile this share is only 13%. In addition we also find evidence that industry researchers that studied abroad have a significantly higher probability to have been mobile more than once, as well as a significantly higher probability of working abroad for 3 months to 1 year. This thus points to an important impact of the experience of studying abroad on mobility patterns of industry researchers and highlights the contribution towards the objective of enhancing researcher mobility that can be made by programs enhancing mobility among students.

Aside from experience abroad, however, also education has an important impact on mobility. In general, the share of researchers that have been mobile in the last three years declines steadily with education (from 12.4% for those with a completed PhD to 1.8 for those with only a secondary education).

Furthermore, we also find that evidence that mobility is higher among industry researchers born in the EU15 than among those born in the EU12, which may be an indication of a lower integration of the EU12 into industry researcher networks. Among those born in the EU12 only 7.7% have been internationally mobile in the three years before the interview. Among those born in the EU15 the same applies to 10.6%. In addition those born in the EU15 are also overrepresented among the industry researchers that have ever been mobile in their career, while those born in the EU12 are underrepresented.

With respect to the field of study, by contrast, the survey suggests that industry researchers that completed their highest degree in the agricultural sciences, in the medical and health sciences as well as in the natural sciences are most mobile, while those that have studied engineering and technology as well as those that have studied social sciences and humanities are less mobile. Among graduates of the agricultural, medical and health as well as natural sciences the share of those that were mobile in the last three years was between 23.1% (agricultural sciences) and 11.6% (natural sciences). Among industry researchers graduating in engineering and technology, social sciences and humanities these shares range between 9.0% (engineering and technology) and 6.3% (humanities), with statistical tests indicating a significantly different behaviour for engineering and technology graduates, but remaining insignificant, on account of a small number of observations, for the social sciences and humanities.

Finally with respect to the job characteristics of the mobile we find some evidence that the most mobile select themselves into certain jobs. Aside from average tenure being significantly lower among those that have held two or more jobs abroad mobile industry researchers with more than one stay abroad have a significantly lower probability of being self-employed, working in the research field of mechanical engineering, having a fixed term contract with a duration in excess 2 years and having average working hours amounting to 80-100% of a full time contract. By contrast, the share of those employed in a fixed term contract with duration of more than two years and working for 40 to 60% of a full time contract is significantly increasing in the number of times an industry researcher has worked abroad. This thus suggests that a higher intensity of international mobility among industry researchers is often associated with a higher share of atypical employment and also reflects different career patterns in different types of research jobs, which are closely associated with the type of organisation employing researchers as well as fields of research.

Industry researchers intending to move abroad in the next three years are significantly younger, better educated, less often married, have fewer children and are

more often born in the EU15 than those that are not intending to move abroad. Among singles 48.7% of the researchers state that they are willing to migrate, among industry researchers born in the Eu12 this share is 36.2%. Furthermore, as with previous migration also those that have studied abroad are also significantly more often willing to move abroad. 44% of those that studied abroad are willing to migrate. In addition here, however, also previous experience of working in industry during studies is positively associated with the willingness to migrate. 36.2% of those that worked in industry during studies intend to migrate in the next 3 years.

9.2.3 What are industry researchers' career paths?

Results also suggest that industry researchers are a group of employees that often start their career in the public sector (in all likelihood academia and potentially as doctoral students) to then change into more applied industry research, round tripping (or churning) between the public and private sectors by contrast seems to be rare. The relative majority of the industry researchers (42.3%) describe their career path as one starting in the public sector and ending in the private sector, a further 37.4% have always worked in the private sector.

Also industry researchers on account of being in high demand have relatively secure jobs and thus high job stability. The average tenure of industry researchers in our sample is 10.4 years and the median researcher in our sample has held three jobs in his or her career (two of those as a researcher), but only one job in the last three years. The shares of industry researchers that held more than one job in the last three years is 19.4% for industry researchers residing in the EU15 and 18.4% for industry researchers residing in the EU12. Furthermore evidence on the circumstances of job changes suggests that such changes are usually associated with an increase in administrative work and more applied research and thus confirm the "traditional" path of private research careers starting as a researcher and then moving to more managerial positions.

Industry researchers – also on account of being in high demand – most often move jobs coming directly from another job or from higher education, while job accession from unemployment or inactivity are rather rare. 66.8% of the industry researchers in our sample were employed at another firm directly before starting to work at the current firm and 21% started working at their current employer directly after ending higher education. In addition there are, however, also important flows of industry researchers from self-employment. Around 6.2% of the industry researchers in our sample were self employed before starting to work in their current employment.

Furthermore our results also indicate a close connection between international mobility and career paths. Mobile researchers are more likely to have been mobile across sectors, have held more jobs (both in research and overall) in their career and in the last three years and are more likely to have started their job after terminating another employment relationship and less likely to have come directly from higher education.

In addition there are substantial differences with respect to the way individual sectors recruit industry researchers. In general, however, intrasectoral flows seem to be of a larger importance than intersector flows, and intersector flows tend to be stronger in the professional, scientific and technical activities sector than either in manufacturing and in the information and communication sector. Also with respect to these three sectors, which offer enough observations to allow for a detailed analysis, we find that:

- The strongest flow of researchers into employment in the manufacturing sector is an intra sector flow. About 74% of the researchers in the manufacturing sector reported a previous employer which also operated in the manufacturing sector. The strongest intersectoral inflows into the manufacturing sector originate from professional, scientific and technical activities, from information and communication and from other service activities.

- Also in the information and communication sector we find strong intrasectoral mobility. About 79% of the industry researchers report that their most recent job change originated from a previous employer in the same sector. The strongest inter-sector flows originate from manufacturing and professional, scientific and technical activities.

- In the sector of professional, scientific and technical activities about 60% of the researchers reported a previous employer within the same sector. Strongest inter-sector flows targeting this sector originate from the manufacturing and from the information and communication sector. We observe that an intra-sector flow within manufacturing is markedly lower than in the other sectors discussed above.

With respect to flows between organisations by contrast we observe clear differences in the pattern of flows to the different types of organizations. 67% of the researchers taking up a position in an organization in the company sector come from another organization in the company sector; 12% originate from research organizations and 21% originate from universities.

Industry researchers having held more than one job in the last three years also differ from industry researchers that have held only one job. They are younger, better qualified, and have fewer children but studied abroad significantly more often. They also have a lower tenure, a lower share self-employed, a larger share of fixed term contracts lasting from one to two years, a lower share of open ended contracts and higher share of work contracts that account for between 40% to 80% of a full time contract and a lower share of full-time contracts.

With respect to career paths the largest two groups (those that have moved from the public to the private sector and those that have always worked in the public sector) differ from each other in that industry researchers that always worked in the private sector are significantly more often male, have more seldom studied abroad but more often worked in industry during their studies, are less often born outside the EU and have a lower share of PhDs, and are also more often trained in social sciences but less often medical or agricultural science degrees than researchers moving from the public to the private sector. These researchers also have a higher tenure and (to a lesser degree than those always working in the public sector) a significantly higher share of fixed term and non-employment contracts but a smaller share of open ended contracts.

9.2.4 What factors hamper or facilitate mobility and what are the effects of mobility on industry researchers?

Our questionnaire also considered the motives of international researchers for choosing a particular career and discusses the factors that motivate and hamper international mobility as well as the effects of mobility on industry researchers. With respect to motives for choosing a career path we find that:

- For industry researchers the most important motives for choosing a particular career path are job satisfaction, the challenges offered by the positions, working conditions, a good work life balance and life satisfaction of children. Thus reasons related to job and life satisfaction are more important for the career decision than high salaries. At the bottom of the list we find job security, the prospects of a scientific career, keeping in touch with friends and family, other private reasons and financial incentives other than salaries.

- Pecuniary motives, however, are important in the decision to accept a particular job. After the possibility to apply previous knowledge, which is almost a precondition for mobility, and an increase in responsibility, a high salary follows on third place among these reasons. For the internationally mobile, the priorities given to certain motives for choosing a certain job are very similar to those of the internationally immobile industry researchers, but they are in general more critical in the sense that they give more weight to almost all factors.

- For a large number of industry researchers, job changes result in an increase in managerial activities, a higher work load but also results in higher autonomy. Such job changes are also often seen as a continuation of the previous career and also seem to result in a higher share of applied research and offer more flexibility. The impact on basic research activities by contrast is less clear. Thus most of the researchers' job changes seem to be associated with a move up in the hierarchical ladder.

We, however, also find that there are substantial differences in the factors that motivate those that were internationally mobile in the past and that hamper geographical mobility for those that have not been previously mobile. Industry researchers that have previously been internationally mobile name the presence of leading experts abroad, the quality of life, the presence of external R&D structures, the recognition of educational degrees and the culture of the receiving country as the 5 most important motives for moving abroad. They thus strongly stress the research infrastructure of the receiving country as a major motivation for mobility.

This thus suggests a strong parallel to the factors that motivate enterprises to locate R&D facilities in a particular region in developed economies, since as for instance shown in the literature next to the quality of R&D personnel and intellectual property rights the quality and accessibility of the research environment (such as of universities) also belong to the most important factors that motivate firms to locate R&D departments in developed market economies. Both enterprises as well as industry researchers stress the importance of the research environment (and external R&D structures) in their location decision, while in general putting much less emphasis on the cost aspects of their decision.

Those that have not been mobile previously give much more emphasis to factors that are not connected to the research environment such as the quality of life, the availability of schools for children, finding housing, work permits for partners and the cultural differences to other countries. These factors must thus be considered the major impediments to mobility.

Interestingly both those not internationally mobile as well as those mobile agree that administrative barriers to mobility, taxation and private as well as financial mobility support are least important in shaping industry researchers' decision to move abroad. These factors must thus be considered to be of lesser importance both as factors motivating as well as factors hampering international mobility. This points to a certain difference with respect to the problems seen by enter-

prises since in a series of expert interviews conducted in the framework of the current project, companies did put particular emphasis on the framework conditions for mobility (such as administrative barriers to mobility). This, however, seems in line with the finding of these interviews that in many cases companies take over the administrative tasks (as well as financial costs) associated with mobility (such as organizing work permits and paying mobility grants) when recruiting R&D personnel internationally, so that mobile industry researchers are often not affected by these problems.

Finally, we also find some evidence that for industry researchers, changing jobs across countries may be associated with different results than changing jobs within countries. Industry researchers, whose previous job was located in another country than their current job – after controlling for other variables – significantly more often find that accepting the current job had a positive impact on their job market chances and to a lesser degree also on their output with respect to patenting activities than researchers whose previous job was in the same country as their current one. They, however, also significantly more often report a negative impact on contacts to the scientific community and to other research partners than those, whose previous job was located in the same country.

While this suggests that changing jobs across national borders may be associated with rather different costs and benefits than changing jobs within countries, these results are, also rather tentative due to the nature of our data. This does not allow us to observe more than one job change for each industry researcher, which rules out controlling for individual heterogeneity among researchers with respect to the results of mobility. Furthermore it allows us only to analyze the impact of mobility in terms of subjective assessments of the researchers themselves.

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ANNEX 1 ADDITIONAL TABLES FOR CHAPTER 2

Table A1.1: Employed in HRST, research occupations and in the overall economy by labour market status in the year preceding the interview and country (average 2006 and 2007)

	Research Occupation				
	Employed	Unemployed	Student	Inactive	No Answer
AT	91.1	1.5	3.9	3.5	0.0
BE	94.6	1.3	3.2	0.9	0.0
CY	92.0	(1.5)	5.7	-	0.0
CZ	91.2	0.6	3.1	5.2	0.0
DE	88.5	1.2	3.8	1.4	5.1
DK	93.0	1.5	4.4	0.8	-
EE	95.8	(1.4)	(1.9)	-	0.0
ES	92.7	1.9	4.4	0.7	0.4
FI	91.0	1.3	5.3	2.2	-
FR	95.2	1.7	2.6	0.5	0.0
GR	95.7	1.9	1.3	1.2	0.0
HU	93.5	1.0	3.9	1.7	0.0
IT	93.8	2.7	2.0	1.4	0.0
LT	95.1	-	2.8	(1.3)	0.0
LU	95.8	(1.6)	2.0	-	0.0
LV	94.8	-	(1.9)	(2.2)	0.0
MT	90.3	-	(8.0)	-	0.0
NL	90.5	0.0	5.5	0.9	3.2
PL	92.9	1.7	3.6	1.8	0.0
PT	92.7	3.3	3.6	-	-
RO	96.3	(0.7)	1.4	1.6	0.0
SI	95.5	(1.5)	2.8	-	0.0
SK	91.2	(1.5)	3.7	3.6	0.0
UK	85.2	1.0	1.8	2.0	10.0

S: ELFS, Basis: employed aged 15 and older excluding Bulgaria, Ireland, Sweden and employed with unknown education and/or occupation,

Table A1.1 (cont'd): Employed in HRST, research occupations and in the overall economy by labour market status in the year preceding the interview and country (average 2006 and 2007)

			HRST		
AT	91.3	1.3	2.9	4.5	0.0
BE	95.0	1.1	2.9	1.0	0.0
CY	92.8	1.9	4.5	(0.8)	0.0
CZ	90.3	0.6	3.9	5.1	-
DE	90.2	1.2	2.4	1.5	4.7
DK	92.5	1.4	4.5	1.1	0.4
EE	95.6	1.2	1.4	1.7	0.0
ES	92.1	2.8	3.5	1.1	0.4
FI	92.3	1.4	2.2	4.0	0.1
FR	93.8	2.2	3.5	0.6	0.0
GR	95.9	2.1	1.1	0.8	0.0
HU	94.1	1.0	3.0	2.0	0.0
IT	92.6	3.6	2.5	1.3	0.0
LT	95.7	0.7	2.3	1.3	0.0
LU	95.5	1.5	2.4	(0.6)	0.0
LV	95.0	(1.1)	1.8	2.0	0.0
MT	92.2	-	(6.1)	-	0.0
NL	89.5	-	6.0	1.0	3.5
PL	93.3	1.8	3.1	1.9	0.0
PT	92.9	3.7	3.0	0.4	(0.0)
RO	95.9	0.8	1.6	1.7	-
SI	95.9	1.7	2.1	-	0.0
SK	90.1	1.9	4.2	3.7	-
UK	85.1	1.0	2.3	2.2	9.4

S: ELFS, Basis: employed aged 15 and older excluding Bulgaria, Ireland, Sweden and employed with unknown education and/or occupation,

Table A1.1 (cont'd): Employed in HRST, research occupations and in the overall economy by labour market status in the year preceding the interview and country (average 2006 and 2007)

	All				
AT	88.1	2.3	3.7	5.9	0.0
BE	93.5	2.3	2.5	1.7	0.0
CY	92.6	2.5	2.3	2.5	0.0
CZ	91.6	2.3	1.9	4.2	0.0
DE	86.9	3.3	3.1	2.3	4.5
DK	88.6	1.8	7.5	1.4	0.8
EE	93.1	2.6	2.3	1.9	0.0
ES	90.1	4.3	2.8	2.1	0.7
FI	86.3	2.6	7.4	3.7	0.0
FR	91.4	3.7	3.5	1.3	0.0
GR	96.0	2.3	0.9	0.8	0.0
HU	92.7	3.6	1.5	2.2	0.0
IT	91.8	4.8	1.6	1.8	0.0
LT	93.8	2.4	2.0	1.8	0.0
LU	95.0	2.0	1.8	1.1	0.0
LV	89.9	4.3	2.9	2.9	0.0
MT	94.3	1.4	2.9	1.1	0.0
NL	81.1	0.0	11.2	1.6	6.1
PL	89.5	5.0	3.0	2.6	0.0
PT	93.9	3.9	1.2	0.8	0.0
RO	90.9	2.2	1.0	6.0	0.0
SI	94.4	2.5	2.9	0.1	0.0
SK	90.6	4.9	1.9	2.6	0.0
UK	82.0	1.7	3.0	2.6	10.8

S: ELFS, Basis: employed aged 15 and older excluding Bulgaria, Ireland, Sweden and employed with unknown education and/or occupation,

ANNEX 2 ADDITIONAL TABLES FOR CHAPTER 3

Table A2.1: Country of Work and Sector of current Employer – Subsample drawn by FP6 contacts

	A	B	C	D	E	F	G	H	I	J	K	M	N	O	P	Q	S	T	Total
Austria	0	0	6	0	1	0	0	1	0	2	0	2	0	0	0	0	0	0	12
Belgium	2	0	9	0	1	0	0	0	0	5	0	8	1	0	0	1	0	0	27
Bulgaria	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	3
Cyprus	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Czech Republic	1	1	3	0	2	0	0	0	0	2	0	1	0	0	0	1	0	0	11
Denmark	4	0	11	3	0	0	0	1	0	0	0	6	0	0	0	2	0	0	27
Estonia	0	0	0	0	0	1	0	0	0	3	0	1	1	0	0	0	0	0	6
Finland	0	0	9	2	0	1	0	0	0	10	0	4	0	0	0	0	0	0	26
France	1	0	28	3	0	1	1	5	1	15	0	26	1	0	0	2	1	0	85
Germany	6	1	78	6	1	5	0	8	0	25	2	55	0	0	1	6	2	0	196
Greece	0	0	3	0	0	1	0	1	0	3	0	1	0	0	0	0	1	0	10
Hungary	0	0	3	0	0	0	0	1	0	2	0	1	0	0	0	0	0	0	7
Ireland	5	0	5	0	0	0	0	0	0	4	0	2	0	0	0	0	0	0	16
Italy	1	0	30	2	0	1	0	1	0	11	0	19	0	0	0	1	0	2	68
Latvia																			
Lithuania	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
Luxembourg	0	0	4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	5
Malta																			
Netherlands	1	2	26	0	1	1	2	1	0	11	1	25	0	0	1	2	0	0	74
Poland	0	0	2	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	4
Portugal	1	0	3	0	0	0	0	0	0	4	0	1	0	0	0	1	0	0	10
Romania	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3
Slovakia	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	3
Slovenia	0	0	4	0	0	1	0	0	0	1	0	2	0	0	0	0	0	0	8
Spain	3	1	19	0	2	1	0	2	2	12	0	14	0	0	0	1	0	0	57
Sweden	1	0	19	2	0	0	0	2	0	3	0	11	0	0	0	3	2	0	43
United Kingdom	1	3	38	2	0	0	2	1	0	12	1	43	0	1	0	1	2	0	107
Total	28	8	305	20	8	13	5	24	3	130	4	227	3	1	3	21	8	2	813

S: MORE-Questionnaire on industry researchers

Table A2.2: Country of Work and Sector of current Employer – Subsample drawn by FP7 contacts

	A	B	C	D	E	F	G	H	I	J	K	M	N	O	P	Q	R	S	U	Total
Austria	1	0	14	1	0	1	0	5	0	7	0	18	0	1	0	3	0	0	0	51
Belgium	2	0	27	0	2	0	0	6	0	9	0	27	0	0	0	5	0	2	0	80
Bulgaria	0	0	2	1	0	0	0	1	0	4	0	2	0	0	0	0	0	0	0	10
Cyprus	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Czech Republic	0	1	8	0	2	2	0	0	0	4	0	4	0	0	2	1	0	0	0	24
Denmark	1	0	17	4	1	2	0	0	1	4	0	17	0	0	0	2	0	0	0	49
Estonia	0	0	0	0	0	0	0	1	0	3	0	1	1	0	0	0	0	0	0	6
Finland	0	0	15	4	0	1	0	0	0	6	0	6	0	0	0	0	0	0	0	32
France	2	0	49	4	3	1	0	11	0	27	0	48	1	2	0	2	1	5	1	157
Germany	9	0	94	12	2	6	1	11	0	46	0	84	0	0	0	5	3	7	0	280
Greece	3	0	6	1	1	2	0	0	0	12	0	4	0	0	0	0	0	1	1	31
Hungary	0	0	1	0	0	0	0	0	0	3	0	6	1	0	0	0	0	0	0	11
Ireland	0	0	3	2	1	1	0	0	0	5	0	7	0	0	1	0	0	1	0	21
Italy	3	1	68	1	1	2	0	8	1	38	0	43	0	2	0	5	2	4	0	179
Latvia	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	4
Lithuania	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2
Luxembourg	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	4
Malta	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2
Netherlands	6	1	37	6	1	2	0	4	1	8	0	31	1	0	0	4	0	3	0	105
Poland	0	0	5	1	0	1	0	0	0	5	0	2	0	0	0	0	0	0	0	14
Portugal	0	1	7	1	1	1	0	0	0	8	0	7	0	0	0	0	1	2	0	29
Romania	0	1	3	1	0	0	0	2	0	2	0	8	0	0	0	0	0	1	0	18
Slovakia	0	0	3	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	5
Slovenia	0	0	8	0	0	0	0	2	0	2	0	1	0	0	1	0	0	1	0	15
Spain	1	2	27	8	4	3	0	5	1	33	1	37	0	0	0	3	0	1	0	126
Sweden	0	0	35	1	0	0	2	7	0	13	1	30	1	0	0	3	0	1	0	94
United Kingdom	5	2	72	4	2	4	1	5	0	11	1	60	0	2	0	3	2	1	0	175
Total	33	9	503	52	24	30	4	68	4	257	3	445	5	7	4	36	9	30	2	1525

S: MORE-Questionnaire on industry researchers

Table A2.3: Country of Residence and Sector of current Employer – Subsample drawn by FP6 contacts

	A	B	C	D	E	F	G	H	I	J	K	M	N	O	P	Q	S	T	Total
Austria	0	0	6	0	1	0	0	1	0	2	0	2	0	0	0	0	0	0	12
Belgium	2	0	13	0	1	0	0	0	0	6	0	9	1	0	0	1	0	0	33
Bulgaria	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	3
Cyprus	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Czech Republic	1	1	3	0	2	0	0	0	0	1	0	1	0	0	0	1	0	0	10
Denmark	4	0	10	3	0	0	0	1	0	0	0	6	0	0	0	2	0	0	26
Estonia	0	0	0	0	0	1	0	0	0	3	0	1	1	0	0	0	0	0	6
Finland	0	0	9	2	0	1	0	0	0	10	0	4	0	0	0	0	0	0	26
France	1	0	27	3	0	1	1	5	1	15	0	27	1	0	0	2	1	0	85
Germany	6	1	77	6	1	5	0	8	0	25	2	57	0	0	1	6	2	0	197
Greece	0	0	3	0	0	1	0	1	0	3	0	1	0	0	0	0	1	0	10
Hungary	0	0	3	0	0	0	0	1	0	2	0	1	0	0	0	0	0	0	7
Ireland	5	0	4	0	0	0	0	0	0	4	0	2	0	0	0	0	0	0	15
Italy	1	0	31	2	0	1	0	1	0	11	0	18	0	0	0	1	0	2	68
Latvia																			
Lithuania	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
Luxembourg	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Malta																			
Netherlands	1	2	25	0	1	1	2	1	0	11	1	22	0	0	1	2	0	0	70
Poland	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3
Portugal	1	0	3	0	0	0	0	0	0	4	0	2	0	0	0	1	0	0	11
Romania	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3
Slovakia	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	3
Slovenia	0	0	4	0	0	1	0	0	0	1	0	2	0	0	0	0	0	0	8
Spain	3	1	19	0	2	1	0	2	2	12	0	14	0	0	0	1	0	0	57
Sweden	1	0	20	2	0	0	0	2	0	3	0	11	0	0	0	3	2	0	44
United Kingdom	1	3	39	2	0	0	2	1	0	12	1	44	0	1	0	1	2	0	109
Total	28	8	305	20	8	13	5	24	3	130	4	227	3	1	3	21	8	2	813

S: MORE-Questionnaire on industry researchers

Table A2.4: Country of Residence and Sector of current Employer – Subsample drawn by FP7 contacts

	A	B	C	D	E	F	G	H	I	J	K	M	N	O	P	Q	R	S	U	Total
Austria	1	0	12	1	0	1	0	5	0	7	0	17	0	1	0	3	0	0	0	48
Belgium	3	0	29	0	2	0	0	6	0	10	0	27	0	0	0	4	0	3	0	84
Bulgaria	0	0	2	1	0	0	0	1	0	4	0	2	0	0	0	0	0	0	0	10
Cyprus	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Czech Republic	0	1	7	0	2	2	0	0	0	4	0	4	0	0	1	1	0	0	0	22
Denmark	1	0	17	4	1	2	0	0	1	4	0	17	0	0	0	2	0	0	0	49
Estonia	0	0	0	0	0	0	0	1	0	3	0	1	1	0	0	0	0	0	0	6
Finland	0	0	16	4	0	1	0	0	0	6	0	6	0	0	0	0	0	0	0	33
France	2	0	49	4	3	1	0	11	0	27	0	50	1	2	0	2	1	5	1	159
Germany	9	0	95	12	2	6	1	11	0	46	0	82	0	0	0	5	3	7	0	279
Greece	3	0	8	1	1	2	0	0	0	12	0	5	0	0	0	0	0	1	1	34
Hungary	0	0	1	0	0	0	0	0	0	3	0	6	1	0	0	0	0	0	0	11
Ireland	0	0	3	2	1	1	0	0	0	5	0	7	0	0	2	0	0	1	0	22
Italy	3	1	67	1	1	2	0	7	1	38	0	44	0	2	0	5	2	3	0	177
Latvia	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	4
Lithuania	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2
Luxembourg	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
Malta	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2
Netherlands	5	1	35	6	1	2	0	4	1	7	0	30	1	0	0	5	0	3	0	101
Poland	0	0	5	1	0	1	0	0	0	5	0	2	0	0	0	0	0	0	0	14
Portugal	0	1	6	1	1	1	0	0	0	8	0	7	0	0	0	0	1	2	0	28
Romania	0	1	3	1	0	0	0	2	0	2	0	8	0	0	0	0	0	1	0	18
Slovakia	0	0	4	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	6
Slovenia	0	0	8	0	0	0	0	2	0	2	0	2	0	0	1	0	0	1	0	16
Spain	1	2	29	8	4	3	0	5	1	33	1	37	0	0	0	3	0	1	0	128
Sweden	0	0	35	1	0	0	2	7	0	13	1	30	1	0	0	3	0	1	0	94
United Kingdom	5	2	71	4	2	4	1	6	0	11	1	60	0	2	0	3	2	1	0	175
Total	33	9	503	52	24	30	4	68	4	257	3	445	5	7	4	36	9	30	2	1525

S: MORE-Questionnaire on industry researchers

Table A2.5: Country of Residence by Source of Contact

country of residence	FP6	FP7	Eng. Assoc.	Other	SnB	Total	t-Test (p-Value) Ha: diff(FP6-FP7) ≠ 0	
Austria	19	56	0	0	0	75	0.0808	*
	1.88	*2.96*	*0*	*0*	*0*	*2.45*		
Belgium	38	95	0	0	6	139	0.1218	
	3.76	*5.02*	*0*	*0*	*5.13*	*4.54*		
Bulgaria	4	12	0	0	0	16	0.4087	
	0.4	*0.63*	*0*	*0*	*0*	*0.52*		
Cyprus	3	1	0	0	0	4	0.0914	*
	0.3	*0.05*	*0*	*0*	*0*	*0.13*		
Czech Republic	14	28	0	1	5	48	0.8391	
	1.39	*1.48*	*0*	*7.14*	*4.27*	*1.57*		
Denmark	31	56	0	0	10	97	0.8711	
	3.07	*2.96*	*0*	*0*	*8.55*	*3.17*		
Estonia	7	7	0	0	0	14	0.232	
	0.69	*0.37*	*0*	*0*	*0*	*0.46*		
Finland	31	42	28	3	5	109	0.1647	
	3.07	*2.22*	*96.55*	*21.43*	*4.27*	*3.56*		
France	107	185	0	0	13	305	0.4894	
	10.59	*9.78*	*0*	*0*	*11.11*	*9.96*		
Germany	226	329	0	0	17	572	0.0012	***
	22.38	*17.4*	*0*	*0*	*14.53*	*18.69*		
Greece	14	42	0	0	1	57	0.1196	
	1.39	*2.22*	*0*	*0*	*0.85*	*1.86*		
Hungary	12	15	0	0	2	29	0.2915	
	1.19	*0.79*	*0*	*0*	*1.71*	*0.95*		
Ireland	20	27	0	0	2	49	0.2617	
	1.98	*1.43*	*0*	*0*	*1.71*	*1.6*		
Italy	92	234	0	1	11	338	0.008	***
	9.11	*12.37*	*0*	*7.14*	*9.4*	*11.04*		
Latvia	0	6	0	0	0	6	0.0732	*
	0	*0.32*	*0*	*0*	*0*	*0.2*		
Lithuania	3	4	0	0	0	7	0.6549	
	0.3	*0.21*	*0*	*0*	*0*	*0.23*		
Luxembourg	4	2	1	0	0	7	0.1012	
	0.4	*0.11*	*3.45*	*0*	*0*	*0.23*		
Malta	0	2	0	0	0	2	0.3013	
	0	*0.11*	*0*	*0*	*0*	*0.07*		
Netherlands	86	128	0	0	11	225	0.0866	*
	8.51	*6.77*	*0*	*0*	*9.4*	*7.35*		
Poland	4	25	0	0	0	29	0.0169	**
	0.4	*1.32*	*0*	*0*	*0*	*0.95*		
Portugal	11	31	0	0	0	42	0.2374	
	1.09	*1.64*	*0*	*0*	*0*	*1.37*		
Romania	5	30	0	0	2	37	0.0103	**
	0.5	*1.59*	*0*	*0*	*1.71*	*1.21*		
Slovakia	5	8	0	0	0	13	0.7822	
	0.5	*0.42*	*0*	*0*	*0*	*0.42*		
Slovenia	10	23	0	2	0	35	0.5843	
	0.99	*1.22*	*0*	*14.29*	*0*	*1.14*		
Spain	68	166	0	4	9	247	0.0539	*
	6.73	*8.78*	*0*	*28.57*	*7.69*	*8.07*		
Sweden	58	117	0	0	9	184	0.632	
	5.74	*6.19*	*0*	*0*	*7.69*	*6.01*		
United Kingdom	138	220	0	3	14	375	0.1135	
	13.66	*11.63*	*0*	*21.43*	*11.97*	*12.25*		
Total	1010	1891	29	14	117	3061		

Note: Table contains the number of observations for the countries of residence reported in the questionnaire. The t-Tests evaluate differences in the distribution of observations between the subsamples drawn from FP6 and FP7 contacts.

ANNEX 3 ADDITIONAL TABLES FOR CHAPTER 4

Table A3.1 Share of mobile researchers by the country of residence

Country	Share of mobile researchers	Number of observations > 30	Differences
AUT	37%	Yes	
BEL	58%	Yes	DEU, FIN, GBR, ITA,
BGR	44%	No	
CYP	50%	No	
CZE	42%	Yes	
DEU	38%	Yes	BEL
DNK	46%	Yes	
ESP	41%	Yes	
EST	29%	No	
FIN	38%	Yes	BEL
FRA	49%	Yes	ITA
GBR	38%	Yes	BEL
GRC	44%	Yes	
HUN	45%	No	
IRL	63%	Yes	ITA
ITA	33%	Yes	BEL, FRA, IRL
LTU	0%	No	
LUX	100%	No	
LVA	17%	No	
MLT	0%	No	
NLD	45%	Yes	
POL	38%	No	
PRT	29%	Yes	
ROU	43%	Yes	
SVK	38%	No	
SVN	26%	Yes	
SWE	43%	Yes	
EU27	41%	-	
EU25	41%	-	
EU15	42%	-	
Total	41%		

Note: Table contains of mobile researchers in the sample by residence reported in the questionnaire. Three letter codes designate countries based on ISO 3166-1 alpha-3.The last column identifies significant differences at the 10% level. Only countries with more than 30 observations included. Bonferroni correction for multiple testing applied.

Table A3.2 Share of mobile researchers, number of stays and duration of longest stay abroad by industry

	Mobile[1)]		Number of stays abroad[2)]			Duration of longest stay[2)]		
	Internationally immobile	Internationally mobile	no stays abroad	1 stay abroad	2 or more stays abroad	3 months to 1 year	1-3 years	3 or more years
A	2.2	3.1	2.2	2.6	4.8	1.8	3.1	3.8
B	0.3	1.4	0.3	0.9	2.8	0.9	1.2	1.9
C	37.2	30.7	37.2	32.5	25.3	27.8	30.0	32.2
D	3.8	1.8	3.8	1.7	2.0	4.0	0.8	0.7
E	1.4	1.3	1.4	1.7	0.0	0.4	1.9	1.4
F	2.4	0.9	2.4	0.8	1.2	0.9	1.2	0.9
G	0.5	0.2	0.5	0.3	0.0	0.4	0.0	0.2
H	3.8	3.7	3.8	3.4	4.8	4.4	2.3	4.5
I	0.2	0.4	0.2	0.4	0.4	0.0	0.4	0.7
J	16.8	16.3	16.8	16.2	16.5	18.5	16.7	15.3
K	0.3	0.3	0.3	0.3	0.4	0.0	0.0	0.5
M	25.1	34.9	25.1	34.5	36.1	35.7	37.4	33.8
N	0.5	0.2	0.5	0.1	0.4	0.4	0.0	0.2
O	0.5	0.1	0.5	0.1	0.0	0.0	0.0	0.2
P	0.3	0.2	0.3	0.1	0.4	0.4	0.4	0.0
Q	1.9	3.2	1.9	3.1	3.6	2.6	3.5	3.1
R	0.5	0.2	0.5	0.1	0.4	0.4	0.4	0.0
S	2.0	1.0	2.0	1.1	0.8	1.3	0.8	0.7
T	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
U	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0

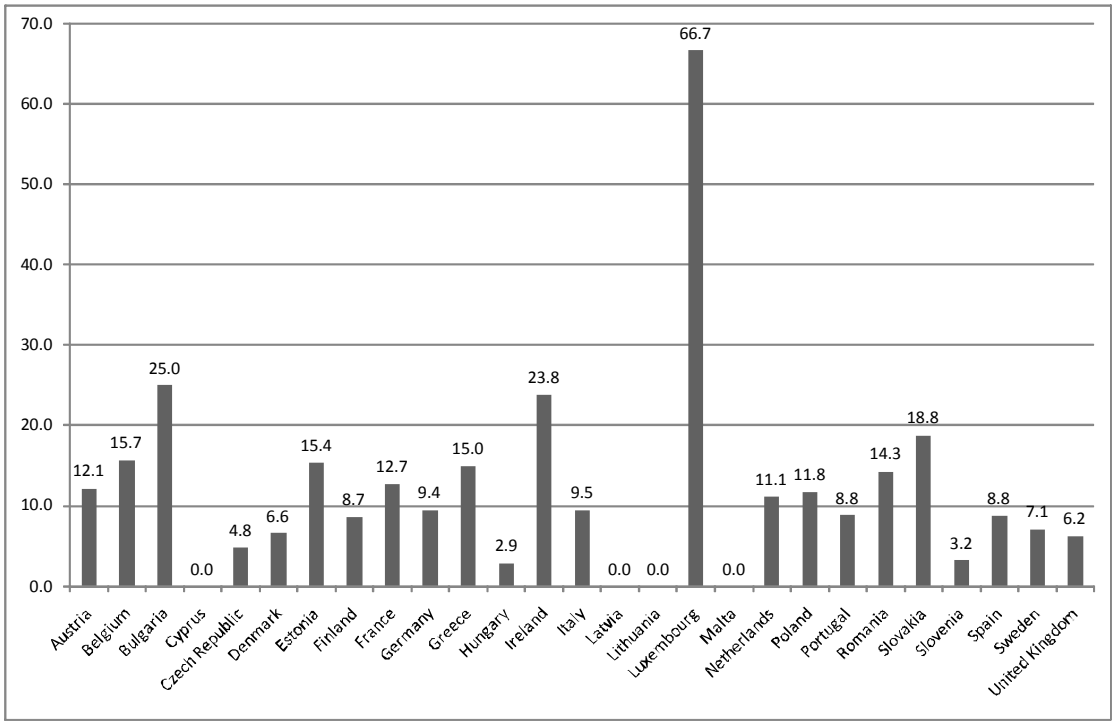
S: MORE-Questionnaire on industry researchers, internationally mobile=industry researchers that have worked in another country than their country of graduation, internationally 1) immobile=industry researchers that have always worked in the same country as their country of graduation 2) Based on question: Please provide the name of the countries you worked in as a researcher, scientist or development engineer for a minimum of 3 months in the last 3 years and indicate the duration of your stays beginning with your longest stay (max. No. of entries equals 5 stays). Sector classification bases on NACE rev.2 sections. A: Agriculture, Forestry and Fishing; B: Mining and quarrying; C: Manufacturing; D: Electricity, gas, steam and air conditioning supply; E: Water supply, sewerage, waste management and remediation activities; F: Construction; G: Wholesale and retail trade; repair of motor vehicles and motorcycles; I: Accommodation and food service activities; H: Transportation and storage; J: Information and communication; K: Financial and insurance activities; L: Real estate activities; M: Professional, scientific and technical activities; N: Administrative and support service activities; O: Public administration and defence; compulsory social security; P: Education; Q: Human health and social work activities; R: Arts, entertainment and recreation; S:Other service activities; T: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; U: Activities of extraterritorial organizations and bodies.

Table A3.3 Share of researchers intending to move abroad and by number of jobs held in last 3 years by the industry

	Intention to work abroad[1)]		Number of jobs in last 3 years[2)]	
	Not intending to work abroad	Intending to work abroad	One Job	2 or more jobs
A	2.8	2.1	2.6	2.7
B	0.7	0.8	0.6	1.3
C	35.9	32.1	35.7	29.6
D	2.9	3.3	2.9	3.3
E	1.3	1.4	1.4	1.3
F	1.8	1.9	1.8	2.0
G	0.5	0.1	0.4	0.2
H	3.1	5.2	3.9	3.1
I	0.1	0.6	0.3	0.2
J	15.9	18.0	16.3	18.1
K	0.3	0.2	0.3	0.2
M	28.8	29.4	28.8	29.9
N	0.4	0.4	0.2	0.9
O	0.4	0.2	0.3	0.4
P	0.2	0.4	0.2	0.4
Q	2.4	2.4	2.1	3.8
R	0.4	0.4	0.3	0.4
S	2.0	0.8	1.5	2.0
T	0.1	0.1	0.1	0.0
U	0.1	0.0	0.1	0.0

S: MORE-Questionnaire on industry researchers, internationally mobile=industry researchers that have worked in another country than their country of graduation, internationally, Sector classification bases on NACE rev.2 sections. A: Agriculture, Forestry and Fishing; B: Mining and quarrying; C: Manufacturing; D: Electricity, gas, steam and air conditioning supply; E: Water supply, sewerage, waste management and remediation activities; F: Construction; G: Wholesale and retail trade; repair of motor vehicles and motorcycles; I: Accommodation and food service activities; H: Transportation and storage; J: Information and communication; K: Financial and insurance activities; L: Real estate activities; M: Professional, scientific and technical activities; N: Administrative and support service activities; O: Public administration and defence; compulsory social security; P: Education; Q: Human health and social work activities; R: Arts, entertainment and recreation; S:Other service activities; T: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; U: Activities of extraterritorial organizations and bodies. 1) Based on the question: "Do you intend to look for work (lasting for more than three months) in another country in the next three years" 2) Based on question: How many jobs did you hold in the last three years?

Figure A3.1 Share of mobile researchers in last three years by nationality



S: MORE-Questionnaire on industry researchers, internationally mobile=industry researchers that have worked in another country than their country of graduation, internationally, Sector classification bases on NACE rev.2 sections. Based on first named nationality, only nationals of the EU27 residing in the EU 27 (see table below for absolute values)

Table A3.4 Share of mobile researchers in last three years by nationality

Nationality	Not mobile	Mobile	Nationality	Not mobile	Mobile
Algeria	1		Israel	2	1
Angola		1	Italy	287	30
Argentina	2		Latvia	5	
Australia	4	2	Liberia	1	
Austria	58	8	Lithuania	7	
Belgium	86	16	Luxembourg	2	4
Bosnia and Herzegovina		1	Malta	3	
Brazil	1	2	Mexico	1	
Bulgaria	12	4	Moldova, Republic of		1
Canada	4	1	Netherlands	176	22
Central African Republic	1		New Zealand	1	1
Colombia	1		Norway		2
Croatia	1	1	Peru	1	
Cyprus	3		Poland	30	4
Czech Republic	40	2	Portugal	31	3
Denmark	71	5	Romania	30	5
Egypt	1		Russia	1	2
Estonia	11	2	Serbia	8	
Finland	95	9	Slovakia	13	3
France	227	33	Slovenia	30	1
Germany	489	51	Spain	187	18
Ghana	1		Sudan	1	
Greece	51	9	Sweden	144	11
Hungary	34	1	Switzerland	3	
Iceland	1		Turkey	1	1
Indonesia	2		United Kingdom	302	20
Iran	1		United States of America	6	3
Ireland	32	10			

S: MORE-Questionnaire on industry researchers, internationally mobile=industry researchers that have worked in another country than their country of graduation, internationally, Sector classification bases on NACE rev.2 sections. Based on first named nationality, only nationals of the EU27 residing in the EU 27 (see table below for absolute values)

ANNEX 4 ADDITIONAL TABLES FOR CHAPTER 5

Table A4.1 Flows between the sectors conditioned on source sector

	from sector																		
to sector	A	B	C	D	E	F	G	H	I	J	K	M	N	O	P	Q	R	S	T
No. of obs.	29	14	440	34	21	42	7	41	1	252	17	284	7	8	9	31	9	36	2
A	83%					2%					18%		14%					3%	
B		36%										1%							
C	3%	14%	77%	24%	14%	7%	14%	10%	100%	11%	18%	15%	43%	13%	33%	10%	11%	28%	
D		7%	2%	50%	5%	5%		2%		2%		1%						6%	
E			0%		71%	2%				0%		0%							
F	3%	7%	0%	6%		50%		2%				1%	14%						
G			0%							1%	6%	1%			11%				
H			2%	6%			14%	68%		2%		2%		13%	11%			8%	
I	3%		0%			2%						1%							
J			4%	3%	5%	12%		7%		69%	29%	3%		25%	11%	3%		6%	
K			0%							1%	18%				11%				
M	7%	36%	13%	12%	5%	19%	29%	10%		12%	6%	73%		13%	22%	29%		31%	
N			0%				14%					0%	14%						
O											6%			25%					
P										0%								3%	
Q			1%									0%		13%		58%		3%	
R																	89%		
S			0%				29%			2%		2%	14%					14%	
T																			100%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Note: Flow of researchers between sectors. Percentage gives the distribution of target sectors for each of the source sectors. Sectoral classification bases on NACE rev.2 sections. A: Agriculture, Forestry and Fishing; B: Mining and quarrying; C: Manufacturing; D: Electricity, gas, steam and air conditioning supply; E: Water supply, sewerage, waste management and remediation activities; F: Construction; G: Wholesale and retail trade; repair of motor vehicles and motorcycles; I: Accommodation and food service activities; H: Transportation and storage; J: Information and communication; K: Financial and insurance activities; L: Real estate activities; M: Professional, scientific and technical activities; N: Administrative and support service activities; O: Public administration and defence; compulsory social security; P: Education; Q: Human health and social work activities; R: Arts, entertainment and recreation; S:Other service activities; T: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; U: Activities of extraterritorial organizations and bodies.

Table A4.2 Flows between the sectors conditioned on target sector

	No. of	from sector																		
to sector	Obs	A	B	C	D	E	F	G	H	I	J	K	M	N	O	P	Q	R	S	T	
A	30	80%					3%					10%		3%					3%		100%
B	8		63%										38%								100%
C	453	0%	0%	74%	2%	1%	1%	0%	1%	0%	6%	1%	9%	1%	0%	1%	1%	0%	2%		100%
D	38		3%	18%	45%	3%	5%		3%		11%		8%						5%		100%
E	20			10%		75%	5%				5%		5%								100%
F	31	3%	3%	6%	6%		68%		3%				6%	3%							100%
G	7			14%							29%	14%	29%			14%					100%
H	54			15%	4%			2%	52%		7%		11%		2%	2%			6%		100%
I	5	20%		20%			20%						40%								100%
J	221			7%	0%	0%	2%		1%		79%	2%	4%		1%	0%	0%		1%		100%
K	7			14%							29%	43%				14%					100%
M	346	1%	1%	17%	1%	0%	2%	1%	1%		9%	0%	60%		0%	1%	3%		3%		100%
N	4			25%				25%					25%	25%							100%
O	3											33%			67%						100%
P	2										50%								50%		100%
Q	24			13%									4%		4%		75%		4%		100%
R	8																	100%			100%
S	21			10%				10%			24%		29%	5%					24%		100%
T	2																			100%	100%

Note: Flow of researchers between sectors. Percentage gives the distribution of source sectors for each of the target sectors. Sectoral classification bases on NACE rev.2 sections. A: Agriculture, Forestry and Fishing; B: Mining and quarrying; C: Manufacturing; D: Electricity, gas, steam and air conditioning supply; E: Water supply, sewerage, waste management and remediation activities; F: Construction; G: Wholesale and retail trade; repair of motor vehicles and motorcycles; I: Accommodation and food service activities; H: Transportation and storage; J: Information and communication; K: Financial and insurance activities; L: Real estate activities; M: Professional, scientific and technical activities; N: Administrative and support service activities; O: Public administration and defence; compulsory social security; P: Education; Q: Human health and social work activities; R: Arts, entertainment and recreation; S:Other service activities; T: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; U: Activities of extraterritorial organizations and bodies.

Table A4.3 Intersectoral flows

	Inflows		Outflows	
Sector	N	Percent	N	Percent
A	6	20%	5	17%
B	3	38%	9	64%
C	116	26%	103	23%
D	21	55%	17	50%
E	5	25%	6	29%
F	10	32%	21	50%
G	7	100%	7	100%
H	26	48%	13	32%
I	5	100%	1	100%
J	46	21%	77	31%
K	4	57%	14	82%
M	140	40%	78	27%
N	3	75%	6	86%
O	1	33%	6	75%
P	2	100%	9	100%
Q	6	25%	13	42%
R	0	0%	1	11%
S	16	76%	31	86%
T	0	0%	0	0%

Note: Number and share of intersectoral flows among the sectors. Sectoral classification bases on NACE rev.2 sections. A: Agriculture, Forestry and Fishing; B: Mining and quarrying; C: Manufacturing; D: Electricity, gas, steam and air conditioning supply; E: Water supply, sewerage, waste management and remediation activities; F: Construction; G: Wholesale and retail trade; repair of motor vehicles and motorcycles; I: Accommodation and food service activities; H: Transportation and storage; J: Information and communication; K: Financial and insurance activities; L: Real estate activities; M: Professional, scientific and technical activities; N: Administrative and support service activities; O: Public administration and defence; compulsory social security; P: Education; Q: Human health and social work activities; R: Arts, entertainment and recreation; S:Other service activities; T: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; U: Activities of extraterritorial organizations and bodies.

Table A4.4 National and international flows (EU27)

to \ from	AUT	BEL	BGR	CZE	DEU	DNK	ESP	EST	FIN	FRA	GBR	GRC	HUN	IRL	ITA	LTU	LUX	LVA	MLT	NLD	POL	PRT	ROU	SVK	SVN	SWE	
AUT	43	1			4	1	1				2									2							54
BEL		75			3	1	1				6		1		3					4		1	1			1	97
BGR			8		1	1																					10
CYP																						1					1
CZE		1		32	1					1	1									2				1			39
DEU	3	4			356	3	2		1	5	9			1	4				1	6	2		2	1	1	2	403
DNK					1	74	1				5				1					2						3	87
ESP					4		160			7	9			2	4					2						1	189
EST								8			2																10
FIN					1				67											1							69
FRA	1	4			4		2			157	14				3					2	1		1				189
GBR	2		1		5	2	3		1	4	255	1	1	1	2		2			1						5	286
GRC					2						1	42															45
HUN					2								18							1							21
IRL		1			1						4			21	1					1							29
ITA		1			5				1	7	3	1			221												239
LTU																7											7
LUX	1	2			2					1	1				1		2										10
LVA																		4									4
MLT																			1								1
NLD		8			9	1			1	2	6				1					148						1	177
POL					2		1														18						21
PRT		1			1		1			1	2											27					33
ROU																							32				32
SVK																								7			7
SVN																									22		22
SWE					3	2					3				1											128	137
Total	50	98	9	32	407	85	172	8	71	185	323	44	20	25	242	7	4	4	2	172	21	29	36	9	23	141	2219

Table A4.5 International flows into EU27

Country	Percent
ARE	1%
ARG	1%
AUS	5%
BGD	1%
CAN	1%
CHE	9%
CHL	3%
CHN	4%
CMR	1%
GEO	1%
IDN	1%
IND	1%
ISL	1%
ISR	3%
JPN	9%
MEX	4%
MYS	1%
NOR	4%
NZL	3%
PAN	1%
PHL	1%
RUS	7%
SAU	3%
SGP	3%
SRB	1%
TUN	1%
TUR	3%
TZA	1%
USA	17%
ZAF	1%
AUS	1%
HRV	1%

ANNEX 5 LIST OF VARIABLES (QUESTIONNAIRE)

Part A	SOCIODEMOGRAPHICS AND R&D ACTIVITIES
A1_1	current job encompasses…: carrying out research
A1_2	current job encompasses…: supervising research
A1_3	current job encompasses…: improving products / processes
A1_4	current job encompasses…: developing new products / processes
A1_5	current job encompasses…: supervising the improvement or development of products / processes
A2	current job encompasses…: development/application of new tech-niques/knowledge
A3	gender
A4	year of birth
A5	country of birth
A6	country of residence
A7	number of citizenships: count
A7_0	dummy citizenship: 1 := more than one citizenship
A7_i	country of citizenship i
A8	current marital status
A9	children: yes / no
A9_1	number of children
A9_2	age of the eldest child
A10	highest educational attainment
A11_11	postgraduate degree: dummy indicating single or multiple degree
A11_12	postgraduate degree: country of graduation
A11_13	postgraduate degree: year of graduation
A11_21	graduate degree: dummy indicating single or multiple degree
A11_22	graduate degree: country of graduation
A11_23	graduate degree: year of graduation
A11_31	undergraduate degree: dummy indicating single or multiple degree
A11_32	undergraduate degree: country of graduation
A11_33	undergraduate degree: year of graduation
A11_41	secondary degree: dummy indicating single or multiple degree
A11_42	secondary degree: country of graduation
A11_43	secondary degree: year of graduation
A11_52	vocational education or other: country of graduation
A11_53	vocational education or other: year of graduation
A12	highest education - field of science
A12_sub	highest education - field of science (subcategory)
A13_1	during tertiary education: studying in another country
A13_2	during tertiary education: working in industry
Part B	CAREER PATH – PREVIOUS JOBS AND SECTORAL MOBILITY
B1	number of jobs since graduation
B1_1	number of jobs as a researcher since graduation
B2	number of jobs in last 3 years
B2_1	number of jobs as a researcher in last 3 years
B3	summary of career path
B3_other	summary of career path: other - text field
B4_1	motivation for career path: prospects in scientific career

B4_2	motivation for career path: promotion prospects
B4_3	motivation for career path: job satisfaction
B4_4	motivation for career path: challenging position
B4_5	motivation for career path: job security
B4_6	motivation for career path: high salary
B4_7	motivation for career path: other financial incentives
B4_8	motivation for career path: working conditions / climate
B4_9	motivation for career path: contribution to society
B4_10	motivation for career path: work-life balance
B4_11	motivation for career path: job changes / life satisfaction of partner
B4_12	motivation for career path: education / life satisfaction of children
B4_13	motivation for career path: keeping in touch with friends or family
B4_14	motivation for career path: other private reasons
Part C	GEOGRAPHICAL MOBILITY
C1	worked in another country than country of graduation
C2	intend to work in another country in next three years
C3_11	longest stay abroad in last three years: country
C3_12	longest stay abroad in last three years: duration
C3_1_add	technical variable: add another country?
C3_21	2nd longest stay abroad in last three years: country
C3_22	2nd longest stay abroad in last three years: duration
C3_2_add	technical variable: add another country?
C3_31	3rd longest stay abroad in last three years: country
C3_32	3rd longest stay abroad in last three years: duration
C3_3_add	technical variable: add another country?
C3_41	4th longest stay abroad in last three years: country
C3_42	4th longest stay abroad in last three years: duration
C3_4_add	technical variable: add another country?
C3_51	5th longest stay abroad in last three years: country
C3_52	5th longest stay abroad in last three years: duration
C4	dummy: question text differs in C4_i if respondent was mobile or not
C4_1	reasons to work abroad: language
C4_2	reasons to work abroad: culture
C4_3	reasons to work abroad: quality of life
C4_4	reasons to work abroad: attitude towards foreigners in host country
C4_5	reasons to work abroad: quality of social security system
C4_6	reasons to work abroad: work permission for partner
C4_7	reasons to work abroad: availability of adequate schools for children
C4_8	reasons to work abroad: finding adequate housing at reasonable prices
C4_9	reasons to work abroad: financial support for family members by state agencies
C4_10	reasons to work abroad: private support structures by government agencies
C4_11	reasons to work abroad: recognition of educational degrees
C4_12	reasons to work abroad: external R&D infrastructure of enterprise's location
C4_13	reasons to work abroad: existence of leading experts in the region
C4_14	reasons to work abroad: existence of alternative jobs
C4_15	reasons to work abroad: high country specific wage level
C4_16	reasons to work abroad: administrative barriers
C4_17	reasons to work abroad: tax burden
PART D	CURRENT EMPLOYMENT
D1	current employer: country of work

D2	current employer: type of organization
D2_1	current employer: sector (NACE code) of company
D2_1_sub	current employer: sector (NACE code) of company - subcategory
D2_2	current employer: technological field of work
D2_2_sub	current employer: technological field of work - subcategory
D3	current employer: type of contract
D3_other	current employer: type of contract - other (text field)
D4	current employer: full time yes/no
D4_sub	current employer: percentage of full time contract
D5_1	current employer: starting month
D5_2	current employer: starting year
D6	current employer: when starting, where coming from
D7_1	current employer: starting resulted in relocation
D7_2	current employer: starting resulted in commuting
D7_3	current employer: starting resulted in using new working language
D7_4	current employer: starting resulted in change from public to private sector
PART E	MOTIVATIONS / REASONS FOR STARTING WORK AT CURRENT EMPLOYER
E1_1	reasons to work for current employer: increase in salary
E1_2	reasons to work for current employer: other financial incentives
E1_3	reasons to work for current employer: possibility to get ahead
E1_4	reasons to work for current employer: increased responsibility
E1_5	reasons to work for current employer: higher autonomy
E1_6	reasons to work for current employer: ability to apply previous knowledge
E1_7	reasons to work for current employer: organisation is leading
E1_8	reasons to work for current employer: presence of other experts
E1_9	reasons to work for current employer: curiosity-driven research
E1_10	reasons to work for current employer: employer offers further education
E1_11	reasons to work for current employer: other considerations career development
E1_12	reasons to work for current employer: higher job security
E1_13	reasons to work for current employer: dissatisfaction with prior position
E1_14	reasons to work for current employer: employer offered assistance in moving
E1_15	reasons to work for current employer: corporate culture
E1_16	reasons to work for current employer: attractiveness of location of work
E1_17	reasons to work for current employer: health reasons
E1_18	reasons to work for current employer: job prospects
E1_19	reasons to work for current employer: other private reasons
E1_20	reasons to work for current employer: changes of firm ownership
E1_21	reasons to work for current employer: previous business contacts
E1_22	reasons to work for current employer: temporary contract in old organisation
E1_23	reasons to work for current employer: end unemployment
E1_24	reasons to work for current employer: other
PART F	OUTPUT-EFFECTS OF WORKING AT CURRENT EMPLOYER
F1_1	effects starting at current employer: publication output
F1_2	effects starting at current employer: invention output"
F1_3	effects starting at current employer: patent output
F1_4	effects starting at current employer: chances on the job market
PART G	NETWORK-EFFECTS OF WORKING AT CURRENT EMPLOYER
G1_1	effects starting at current employer: contacts to previous colleagues

G1_2	effects starting at current employer: contacts to external partners
G1_3	effects starting at current employer: diversity of network
G1_4	effects starting at current employer: contacts to scientific community
G1_5	effects starting at current employer: contacts to other research partners
G1_6	effects starting at current employer: ability to work interdisciplinary
PART H	PREVIOUS EMPLOYMENT
H1	previous employer: country of work
H2	previous employer: type of organisation
H2_1	previous employer: field of department - university
H2_1_sub	previous employer: field of department - university - subcategory
H2_2	previous employer: sector - company
H2_2_sub	previous employer: sector - company - subcategory
H2_3	previous employer: technology field worked in - company
H2_3_sub	previous employer: technology field worked in - company - subcategory
H3	previous employer: type of contract
H3_other	previous employer: type of contract - other (text field)
H4	previous employer: full time - yes/no
H4_sub	previous employer: percentage of full time contract
H5_1	previous employer: starting month
H5_2	previous employer: starting year
H6_1	current position...: is continuation of prior career
H6_2	current position...: involves higher share of managerial activities
H6_3	current position...: involves higher share of applied research
H6_4	current position...: involves higher share of basic research
H6_5	current position...: offers more autonomy
H6_6	current position...: offers more flexibility
H6_7	current position...: involves lower workload
TECHNICAL VARIABLES	
SnB	technical variable: willing to forward questionnaire (Snowballing)
comments	text field: (technical) comments about survey
tech_Response_ID	technical variable: ID

ANNEX 6 QUESTIONNAIRE

	INTRODUCTION					
EXPL	This questionnaire is part of a study launched by the European Commission to • investigate patterns of the mobility (geographical as well as between employers) of researchers, scientists and development engineers in Europe. • better understand the factors inhibiting or supporting the mobility of researchers, scientists and development engineers in terms of job changes across borders. In this survey we would like to ask you about problems, needs and attitudes towards mobility. Have you been mobile and why / why not? This is very important in order to help the Commission set up better targeted policies. **Thank you very much for your time and support!** For further information about the project, the project team etc., please visit www.researchersmobility.eu or contact us directly at sur-					
	RESEARCH AND DEVELOPMENT ACTIVITIES					
A1	Are you currently working as a researcher, scientist or development engineer, i.e. does your current job encompass…					
A1_1	• carrying out research		☐1	yes	☐0	no
A1_2	• supervising research		☐1	yes	☐0	no
A1_3	• improving products / processes		☐1	yes	☐0	no
A1_4	• developing new products / processes		☐1	yes	☐0	no
A1_5	• supervising the improvement or development of new products / processes		☐1	yes	☐0	no
A2	Do your job-related activities include the development and application of new techniques or knowledge?		☐1	yes	☐0	no
	PART A: SOCIODEMOGRAPHICS					
A3	Gender		☐0	female	☐1	male
A4	Year of birth		< Drop down using List YEAR >			
A5	Country of Birth		< Drop down using List COUNTRY >			
A6	Country of residence		☐ < Country of Birth (A5) >		< Drop down using List COUNTRY>	

A7	Please list the country or countries of your citizenship?	☐ < Country of Birth (A5) >	< Drop down using List COUNTRY > (Multiple answers allowed)
	Marital Status and Family		
A8	Current Marital Status	☐ Married or co-habiting ☐ Single ☐ Widowed ☐ Divorced ☐ Other	
A9	Do you have children	$☐_1$ yes	$☐_0$ no
A9_1	If yes: Number of children	< integer >	
A9_2	If yes: Age of the eldest child?	< integer >	
	Educational Attainment		
EXPL	In the following questions we would like to ask you about your steps in higher education. Where and when did you complete your degree(s)? If you attained multiple degrees, please refer your answers (country and year) to the degree closest to your field of work.		
A10	Highest Educational Attainment	☐ Postgraduate degree (PhD or equivalent) ☐ Graduate degree (master degree or equivalent) ☐ Undergraduate degree (bachelor degree or equivalent) ☐ Secondary education (i.e. high school, gymnasium, grammar school, lycee or equivalent) ☐ Vocational education ☐ Other	
A11_11	Postgraduate degree (PhD or equivalent)	☐ Single degree	☐ Multiple degree
A11_12	Country of Graduation	☐ < Country of Birth (A5) >	< Drop down using List COUNTRY >
A11_13	Year of Graduation	< Drop down using List YEAR >	
A11_21	Graduate degree (master degree or equivalent)	☐ Single degree	☐ Multiple degree ☐ NA

A11_22	Country of Graduation	☐ < Country of Birth (A5) >	< Drop down using List COUNTRY >
A11_23	Year of Graduation	< Drop down using List YEAR >	
A11_31	Undergraduate degree (bachelor degree or equivalent)	☐ Single degree ☐ Multiple degree ☐ NA	
A11_32	Country of Graduation	☐ < Country of Birth (A5) >	< Drop down using List COUNTRY >
A11_33	Year of Graduation	< Drop down using List YEAR >	
A11_41	Secondary education (i.e. high school, gymnasium, grammar school, lycee or equivalent)	☐ Single degree ☐ Multiple degree ☐ NA	
A11_42	Country of Graduation	☐ < Country of Birth (A5) >	< Drop down using List COUNTRY >
A11_43	Year of Graduation	< Drop down using List YEAR >	
A11_51	Vocational education or other: highest educational attainment		
A11_52	Country of Graduation	☐ < Country of Birth (A5) >	< Drop down using List COUNTRY >
A11_53	Year of Graduation	< Drop down using List YEAR >	
	Education		
A12	Please choose the field of science which describes best the field of your highest education.	< Drop down using List SCI > < Drop down using List SCI – SUB-CATEGORIES >	
A13	If Highest educational attainment (A10) = Postgraduate, graduate or undergraduate degree: During your graduate and / or undergraduate education, did you …		
A13_1	study in another country (e.g. ERASMUS etc.) for more than 3 months?	$\square_1$ yes	$\square_0$ no
A13_2	work in industry (e.g. internship, apprenticeship)? (please exclude vacation or side jobs unrelated to your programme of study)	$\square_1$ yes	$\square_0$ no
	PART B: PREVIOUS JOBS AND SECTORAL MOBILITY		

EXPL	In this section, we would like to ask you some questions related to your previous career. Please refer your answers to your previous jobs including internships, apprenticeships etc. if they lasted more than 3 months. Please do NOT include promotions within the company unless this promotion made you move to another country.	
B1	How many jobs did you hold since your graduation (please also include periods of self-employment)?	< Drop down using List NUMBER OF JOBS >
B1_1	Of these as a researcher, scientist or development engineer?	< Drop down using List NUMBER OF JOBS >
B2	How many of these jobs did you hold in the last 3 Years?	< Drop down using List NUMBER OF JOBS >
B2_1	Of these as a researcher, scientist or development engineer?	< Drop down using List NUMBER OF JOBS >
	Career Path	
B3	As a summary of your career path, which one of the following career paths describes your situation best? (please consider only changes of employer, not research visits)	☐ I have **always** worked as a researcher, scientist or development engineer in the **public sector** (university, other higher education institutes, public or governmental research institute) ☐ I have **always** worked as a researcher, scientist or development engineer in the **private sector** (firm or private research institute) ☐ I **started** as a researcher, scientist or development engineer in the **public sector**, after which I **moved to the private sector** and I am still working there ☐ I **started** as a researcher, scientist or development engineer in the **public sector**, after which I **moved to the private sector** and I **moved back to the public sector** ☐ I **started** as a researcher, scientist or development engineer in the **private sector**, after which I **moved to the public sector** and I am still working there ☐ I **started** as a researcher, scientist or development engineer in the **private sector**, after which I **moved to the public sector** and I **moved back to the private sector** ☐ Other, please specify: … < string >

		Not important at all				Extremely important	NA
B4	How important have the following criteria / motivations been for your job decisions / your career path?						
B4_1	Prospects in scientific career	☐1	☐2	☐3	☐4	☐5	☐9

B4_2	Promotion prospects within companies / organizations	☐1	☐2	☐3	☐4	☐5	☐9
B4_3	Job satisfaction	☐1	☐2	☐3	☐4	☐5	☐9
B4_4	Challenging position	☐1	☐2	☐3	☐4	☐5	☐9
B4_5	High job security	☐1	☐2	☐3	☐4	☐5	☐9
B4_6	High salary	☐1	☐2	☐3	☐4	☐5	☐9
B4_7	Other financial incentives (e.g. stock options)	☐1	☐2	☐3	☐4	☐5	☐9
B4_8	Good working conditions / climate	☐1	☐2	☐3	☐4	☐5	☐9
B4_9	Contribution to society	☐1	☐2	☐3	☐4	☐5	☐9
B4_10	Good work-life balance	☐1	☐2	☐3	☐4	☐5	☐9
B4_11	Job changes of partner / life satisfaction of partner	☐1	☐2	☐3	☐4	☐5	☐9
B4_12	Education/life satisfaction of children	☐1	☐2	☐3	☐4	☐5	☐9
B4_13	Keeping in touch with friends or family	☐1	☐2	☐3	☐4	☐5	☐9
B4_14	Other private reasons	☐1	☐2	☐3	☐4	☐5	☐9
	PART C: GEOGRAPHICAL MOBILITY						
C1	Since your graduation have you ever worked as a researcher, scientist or development engineer in a country other than the country you graduated in for more than three months	☐1	yes		☐0	no	
C2	Do you intend to look for work (lasting for more than 3 months) in another country in the next 3 years?	☐1	yes		☐0	no	
EXPL	Please provide the name of the country (countries) you worked in as a researcher, scientist or development engineer for minimum 3 months in the last 3 years and indicate the duration of your stays beginning with your longest stay.						
	Longest stay						
C3_11	Country	< Drop down using List COUNTRY >					
C3_12	Duration	< Drop down using List Duration >					

	2nd longest stay						
C3_21	Country	< Drop down using List COUNTRY >					
C3_22	Duration	< Drop down using List Duration >					
	3rd longest stay						
C3_31	Country	< Drop down using List COUNTRY >					
C3_32	Duration	< Drop down using List Duration >					
	4th longest stay						
C3_41	Country	< Drop down using List COUNTRY >					
C3_42	Duration	< Drop down using List Duration >					
	5th longest stay						
C3_51	Country	< Drop down using List COUNTRY >					
C3_52	Duration	< Drop down using List Duration >					
	Motivations / Reasons to work abroad						
C4	If C1 = YES: How important have the following aspects been for your latest decision to work abroad? If C1 = No: Please indicate how important the following aspects are for your willingness to work abroad.	Not important at all				Extremely important	NA
C4_1	Language	☐1	☐2	☐3	☐4	☐5	☐9
C4_2	Culture	☐1	☐2	☐3	☐4	☐5	☐9
C4_3	Quality of life at the new place of residence (e.g. geographical appeal of the region / city)	☐1	☐2	☐3	☐4	☐5	☐9
C4_4	The general attitude towards foreigners in a country	☐1	☐2	☐3	☐4	☐5	☐9
C4_5	Quality of social security system (health care, unemployment, compatibility with old country of residence.)	☐1	☐2	☐3	☐4	☐5	☐9
C4_6	Work permission for partner (and other family members)	☐1	☐2	☐3	☐4	☐5	☐9
C4_7	(if A9 = YES (children) Availability of adequate schools for children	☐1	☐2	☐3	☐4	☐5	☐9
C4_8	Finding adequate housing at a reasonable price	☐1	☐2	☐3	☐4	☐5	☐9

C4_9	Financial support for family members by state agencies	☐1	☐2	☐3	☐4	☐5	☐9
C4_10	Private support structures (e.g. relocation support, welcome services etc.) by government agencies	☐1	☐2	☐3	☐4	☐5	☐9
C4_11	Recognition of educational degrees	☐1	☐2	☐3	☐4	☐5	☐9
C4_12	External R&D infrastructure of the enterprise's location (e.g. existence of universities, advanced companies in the same field, etc.)	☐1	☐2	☐3	☐4	☐5	☐9
C4_13	The existence of leading experts in your field in the region of your new work place	☐1	☐2	☐3	☐4	☐5	☐9
C4_14	Existence of alternative jobs requiring your skills at the location of the new job.	☐1	☐2	☐3	☐4	☐5	☐9
C4_15	The high country-specific wage level	☐1	☐2	☐3	☐4	☐5	☐9
C4_16	Administrative barriers for immigration (e.g. migration law, labour permission law, law of residence permission)	☐1	☐2	☐3	☐4	☐5	☐9
C4_17	Tax burden	☐1	☐2	☐3	☐4	☐5	☐9
	PART D: CURRENT EMPLOYMENT						
EXPL	Please tell us about your current employer and your current position:						
D1	Country of Work	< Drop down using List Country >					
D2	Type of Organization	< Drop down using List ORG>					
	Field of Activity of Current Employer						
EXPL	Please indicate the field of activity / technological field you are working in.						
D2_1	If organization = Company (D1) => Please indicate the sector, in which your current employer operates	< Drop down using List NACE > < Drop down using List NACE – SUB-CATEGORIES >					
D2_2	If organization = Company (D1) => Please indicate the technological field you work in	< Drop down using List TECH FIELDS > < Drop down using List TECH FIELDS – SUBCATEGORIES >					
	Contract at Current Employer						
D3	Which type of contract do you have?	< Drop down using List Contract Type>					

D4	Do you work full time?	☐1	yes	☐0	no
D4_1	If No: What percentage of a full time contract do you work?	< Drop down using List PERCENTAGE >			
D5	When did you start working for your current employer?	< integer > [MONTH] < integer > [YEAR]			
D6	When starting to work for your current employer, where did you come from?	☐1 right out of school / university ☐2 from unemployment/inactivity ☐3 from employment with another organization / company ☐4 self employment ☐5 other			
D7	When starting to work for your current employer did the position require / result in:				
D7_1	Relocation	☐1	yes	☐0	no
D7_2	Commuting	☐1	yes	☐0	no
D7_3	Using a different working language than in previous job	☐1	yes	☐0	no
D7_4	A change from public to private sector	☐1	yes	☐0	no
	PART E: MOTIVATION / REASONS FOR STARTING WORK AT CURRENT EMPLOYER				
E1	Please tick if the following reasons / motivations have been important for starting to work for your current employer.				
	Remuneration				
E1_1	Increase in / High salary	☐1			
E1_2	Other financial incentives (e.g. stock options, patent earnings) or non-wage related benefits (e.g. social security contributions etc.)	☐1			
	Career				
E1_3	Possibility to get ahead in the new enterprise (enterprise-internal career)	☐1			
E1_4	Increased responsibilities in the new position	☐1			
E1_5	Higher autonomy in the new position	☐1			
E1_6	Ability to apply your previous knowledge & expertise	☐1			

E1_7	The organization is leading in your field of science, research or development	☐1
E1_8	Presence of other experts I wanted to work with	☐1
E1_9	Possibility to do curiosity-driven research or academic publications using the enterprise's infrastructure and / or during work time	☐1
E1_10	The new employer offers further education (incl. attendance at scientific conferences or congresses)	☐1
E1_11	Other Considerations about career development	☐1
	Job Satisfaction	
E1_12	Higher job security than in prior position	☐1
E1_13	Dissatisfaction with prior position	☐1
E1_14	The employer offered assistance in moving and other job-change related aspects (including job search for partner, international schools, helping with administration, other everyday life questions)	☐1
E1_15	The good corporate culture / working climate in the company / organisation	☐1
	Private Reasons	
E1_16	Improvement in attractiveness of place / location of work (e.g. better schools, more exciting city)	☐1
E1_17	Health reasons	☐1
E1_18	Job prospects/ life satisfaction of partner	☐1
E1_19	Other family / private reasons	☐1
	Other Reasons	
E1_20	The job change was a direct result of changes in the firm ownership	☐1
E1_21	I previously had business contacts (or employment relationships) with this organization	☐1
E1_22	Temporary contract in the old organization expired	☐1
E1_23	Position taken to end unemployment	☐1
E1_24	Other	☐1
	PART F: OUTPUT-EFFECTS OF WORKING AT YOUR CURRENT EMPLOYER	
EXPL	Please indicate in hindsight how working for your current employer affected certain outcomes of your work.	

F1	Due to starting work for your current employer, your …	de-creased strongly		un-changed remained		in-creased strongly	NA
F1_1	publication output …	☐1	☐2	☐3	☐4	☐5	☐9
F1_2	invention output and problem solving capacity …	☐1	☐2	☐3	☐4	☐5	☐9
F1_3	patent output …	☐1	☐2	☐3	☐4	☐5	☐9
F1_4	chances on the job market …	☐1	☐2	☐3	☐4	☐5	☐9
	PART G: NETWORK-EFFECTS OF WORKING AT YOUR CURRENT EMPLOYER						
EXPL	Please indicate in hindsight how working for your current employer affected certain networking and social effects of your work.						
G1	Due to starting work for your current employer …	dete-riorated strongly		un-changed remained		im-proved strongly	NA
G1_1	your contacts to colleagues at your prior employer …	☐1	☐2	☐3	☐4	☐5	☐9
G1_2	your contacts to external partners at your prior employer …	☐1	☐2	☐3	☐4	☐5	☐9
G1_3	the diversity of your network …	☐1	☐2	☐3	☐4	☐5	☐9
G1_4	your contacts to the scientific community …	☐1	☐2	☐3	☐4	☐5	☐9
G1_5	your contacts to other research partners …	☐1	☐2	☐3	☐4	☐5	☐9
G1_6	your ability to work in interdisciplinary contexts …	☐1	☐2	☐3	☐4	☐5	☐9
	PART H: (If previously employed) PREVIOUS EMPLOYMENT						
EXPL	Please tell us about your previous employer and position:						
H1	Country of work at previous employer	< Drop down using List Country >					
H2	Type of Organization	< Drop down using List ORG>					
	Field of Activity at Previous Employer						

H2_1	If organization = University or Research Organization (H1) => Please indicate the field of the department you worked in	< Drop down using List SCI > < Drop down using List SCI – SUB-CATEGORIES >
H2_2	If organization = Company (H1) => Please indicate the sector, in which your previous employer operated	< Drop down using List NACE > < Drop down using List NACE – SUB-CATEGORIES >
H2_3	If organization = Company (H1) => Please indicate the technological field you worked in for your previous employer	< Drop down using List TECH FIELDS > < Drop down using List TECH FIELDS – SUBCATEGORIES >
	Contract at Previous Employer	
H3	Which type of contract did you have?	< Drop down using List Contract Type>
H4	Did you work full time?	☐$_1$ yes ☐$_0$ no
H4_1	If No: What percentage of a full time contract did you work?	< Drop down using List PERCENTAGE >
H5	When did you start working for your previous employer?	< integer > [MONTH] < integer > [YEAR]
	Continuity of Career	
EXPL	If D6=3 (previously employed) => Please indicate how much you agree or disagree with the following statements concerning your current job/position relative to that at your previous employer.	

		strongly agree		indifferent		strongly disagree	NA
H6	Your current position …						
H6_1	is a continuation of your prior career.	☐$_1$	☐$_2$	☐$_3$	☐$_4$	☐$_5$	☐$_9$
H6_2	involves a higher share of managerial activities than your previous work.	☐$_1$	☐$_2$	☐$_3$	☐$_4$	☐$_5$	☐$_9$
H6_3	involves a higher share of applied research activities than your previous work.	☐$_1$	☐$_2$	☐$_3$	☐$_4$	☐$_5$	☐$_9$
H6_4	involves a higher share of basic research activities than your previous work.	☐$_1$	☐$_2$	☐$_3$	☐$_4$	☐$_5$	☐$_9$
H6_5	offers more autonomy than your previous job.	☐$_1$	☐$_2$	☐$_3$	☐$_4$	☐$_5$	☐$_9$

H6_6	offers more flexibility than your previous job.	☐1	☐2	☐3	☐4	☐5	☐9
H6_7	involves a lower workload (stress) than your previous job.	☐1	☐2	☐3	☐4	☐5	☐9

THANK YOU FOR YOUR COOPERATION.

ANNEX 7 SURVEY SUMMARY

RESEARCH AND DEVELOPMENT ACTIVITIES									
A1 & A2	No			Yes			Non response		Total
A1_1	30.06			51.13			18.82		100.00
A1_2	19.47			65.63			14.90		100.00
A1_3	18.43			63.31			18.26		100.00
A1_4	20.16			64.19			15.65		100.00
A1_5	15.91			69.10			15.00		100.00
A2	5.13			93.50			1.37		100.00
PART A: SOCIODEMOGRAPHICS									
A3	Male			Female			Non response		Total
A3	84.65			15.06			0.29		100.00
A4	Mean		Median		Min		Max		Non response
A4	1964		1964		1931		1985		-
A5 & A6	See below (A11)								
A7	1	2	3	4	5	6	8	Non response	Total
A7	88.37	2.68	0.13	0.03	0.03	0.03	0	8.72	100.00
A8	Married or co-habiting	Single	Widowed	Divorced	Other	Non response			Total
A8	84.16	10.13	0.46	4.12	0.72	0.42			100.00
A9	No			Yes			Non response		Total
A9	25.61			73.86			0.52		100.00
A9_1	1	2	3	4	5	6	8	Non response	Total
A9_1	17.22	38.22	14.41	2.74	0.59	0.10	0.03	26.69	100.00
A9_2	Mean		Median		Min		Max		Non response
A9_2	15.7		15		0		49		28.78%
A10	Postgraduate	Graduate	Undergraduate	Secondary education	Vocational education	Other			Total
A10	50.96	39.63	7.09	1.83	0.20	0.29			100.00
A11_i1	Single		Multiple		NA		Non response		Total
A11_11	46.06		4.44		-		49.49		100.00

A11_21	68.05	11.27	7.12	13.56	100.00
A11_31	44.50	3.66	28.32	23.52	100.00
A11_41	65.50	4.57	9.25	20.68	100.00

A5 & A6 & A11_i2	A5	A6	A11_12	A11_22	A11_32	A11_42	A11_52
Austria	2.22	2.45	1.37	1.99	0.72	1.73	0.16
Belgium	3.53	4.54	1.76	3.04	2.58	2.97	0.03
Bulgaria	0.62	0.52	0.13	0.59	0.29	0.62	
Cyprus	0.10	0.13				0.10	
Czech Republic	1.57	1.57	0.98	1.47	0.29	1.18	
Denmark	2.84	3.17	1.63	2.61	1.08	2.35	0.03
Estonia	0.42	0.46		0.29	0.33	0.39	
Finland	3.56	3.56	0.91	3.27	0.72	2.71	0.07
France	8.79	9.96	5.78	8.20	6.17	5.68	0.03
Germany	17.97	18.69	11.24	15.84	7.35	14.15	0.13
Greece	2.19	1.86	0.56	0.62	1.37	1.93	
Hungary	1.05	0.95	0.52	1.01	0.29	0.69	0.03
Ireland	1.34	1.60	0.36	0.72	1.24	1.08	0.13
Italy	11.07	11.04	2.87	8.85	3.79	8.89	0.56
Luxembourg	0.13	0.23			0.03	0.20	
Malta	0.10	0.07			0.07	0.07	
Nether-lands	6.60	7.35	4.15	5.75	4.08	5.88	0.20
Norway	0.07		0.03	0.07	0.07	0.07	
Poland	1.40	0.95	0.49	1.18	0.26	1.08	0.03
Portugal	1.21	1.37	0.20	1.18	0.91	1.01	
Romania	1.80	1.21	0.78	1.24	0.98	1.18	
Slovakia	0.52	0.42	0.23	0.33	0.23	0.59	
Slovenia	1.08	1.14	0.42	0.82	0.95	0.95	0.03
Spain	7.61	8.07	2.65	6.08	3.66	4.18	0.10
Sweden	5.29		3.33	4.15	1.63	3.76	0.46
Switzerland	0.13	6.01	0.49	0.13	0.03	0.07	
United Kingdom	10.75	12.25	7.15	7.58	11.04	7.12	0.29
United States of America	0.59		1.24	1.80	0.78	0.69	
others	5.07	0.43	1.46	2.6	2.07	2.93	
Non response	0.38		49.27	18.59	46.99	25.75	97.72
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

A11_i3	Mean	Median	Min	Max	Non response
A11_13	1994	1995	1958	2009	49.53%
A11_23	1990	1991	1955	2009	19.76%

A11_33	1986	1987	1951	2009	49.16%
A11_43	1983	1984	1948	2007	26.43%
A11_53	1981	1979	1964	2002	97.84%

A12	Natural Sciences	Engineering and Techno-logy	Medical and Health Sciences	Agricult. Sciences	Social Sciences	Humanities	Non res-ponse	Total
A12	28.78	58.77	3.50	1.70	4.97	1.05	1.24	100.00

A13	No	Yes	Non response	Total
A13_1	75.17	19.83	5.00	100.00
A13_2	46.32	49.26	4.41	100.00

PART B: PREVIOUS JOBS AND SECTORAL MOBILITY

B1 & B2	B1	B1_1	B2	B2_1
0	0.10	4.41		14.73
1	15.19	27.28	80.04	72.49
2	21.99	28.39	16.24	9.80
3	24.08	19.99	2.22	1.40
4	15.98	10.52	0.39	0.23
5	10.29	5.06	0.07	0.03
6	5.42	2.61	0.03	
7	2.78	0.72		
8	2.09	0.46		
9	0.59	0.13		
10	0.39	0.20		
>10	1.08	0.20	0.03	0.03
Non response	0.03	0.03	0.98	1.27
Total	100.00	100.00	100.00	100.00

B3	Always public sector	Always private sector	Public => private	Public => private => public	Private => public	Priv. => public => priv.	Other	Non res-ponse	Total
B3	2.22	31.39	35.51	1.27	1.18	3.59	8.76	16.07	100.00

B4	Not impor-tant at all	Less important	Moderately important	Highly important	Extremely important	NA	Non res-ponse	Total
B4_1	8.13	15.13	25.02	31.00	15.03	2.74	2.94	100.00
B4_2	4.93	10.88	25.81	39.40	14.18	1.86	2.94	100.00
B4_3	0.56	0.42	2.61	21.86	72.56	0.65	1.34	100.00
B4_4	1.24	3.40	11.73	41.26	39.17	0.78	2.42	100.00
B4_5	3.46	14.41	29.70	36.07	13.23	0.59	2.55	100.00

B4_6	2.58	10.55	33.16	40.64	10.09	0.56	2.42	100.00
B4_7	21.23	24.99	25.48	15.39	4.25	5.49	3.17	100.00
B4_8	1.63	4.31	15.78	42.76	32.60	0.82	2.09	100.00
B4_9	2.78	10.81	29.01	40.28	13.88	0.88	2.35	100.00
B4_10	2.29	8.36	23.03	38.09	25.25	0.49	2.48	100.00
B4_11	6.11	11.30	24.67	33.62	14.93	6.47	2.91	100.00
B4_12	8.17	7.61	16.24	30.45	21.72	12.90	2.91	100.00
B4_13	7.12	19.70	28.65	27.18	12.41	2.48	2.45	100.00
B4_14	10.13	10.75	20.81	12.25	5.78	28.75	11.53	100.00

PART C: GEOGRAPHICAL MOBILITY

C1 & C2	No	Yes	Non response	Total
C1	58.64	41.29	0.07	100.00
C2	65.50	34.43	0.07	100.00

C3_i1	C3_11	C3_21	C3_31	C3_41	C3_51
Austria	0.52	0.07			
Belgium	1.96	0.52	0.07		0.03
Bulgaria	0.13	0.07			
Cyprus	0.03	0.03			
Czech Republic	0.20	0.10	0.03		
Denmark	0.88	0.23	0.03		
Estonia	0.03				
Finland	0.46	0.10	0.03		
France	3.14	0.75	0.39		
Germany	4.87	1.08	0.26	0.07	0.07
Greece	0.42	0.16	0.03	0.03	
Hungary	0.20	0.03	0.03		
Ireland	0.65	0.07			
Italy	1.80	0.46	0.13		
Luxembourg	0.26	0.10	0.03		
Malta		0.03			
Netherlands	2.35	0.59	0.03	0.03	0.03
Norway	0.26	0.07	0.03	0.03	
Poland	0.10	0.10	0.03		
Portugal	0.20	0.07	0.03		
Romania	0.07	0.03	0.03		
Slovakia	0.13				
Slovenia	0.03				
Spain	1.67	0.29	0.03	0.07	

Sweden	1.08	0.20	0.07	0.07	
Switzerland	1.34	0.26	0.10		
United Kingdom	4.44	1.44	0.20		
United States of America	6.53	1.50	0.16	0.13	
others	3.7	1.94	0.66	0.24	0.09
Non response	62.55	89.71	97.60	99.33	99.78
Total	100.00	100.00	100.00	100.00	100.00

C3_i2	>=3 and < 6 months	>=6 and <12 months	>=1 year and < 2 years	>=2 years and < 3 years	>=3 years	Non response	Total
C3_12	5.42	3.69	6.08	4.41	18.00	62.40	100.00
C3_22	2.71	1.73	1.67	1.31	2.91	89.68	100.00
C3_32	0.78	0.52	0.52	0.20	0.42	97.55	100.00
C3_42	0.16	0.16	0.10	0.13	0.13	99.31	100.00
C3_52	0.16	0.00	0.00	0.07	0.00	99.77	100.00

C4	Not important at all	Less important	Moderately important	Highly important	Extremely important	NA	Non response	Total
C4_1	12.02	11.47	19.90	28.94	19.05	3.59	5.03	100.00
C4_2	5.65	9.18	24.01	37.99	14.47	3.30	5.39	100.00
C4_3	3.17	6.04	17.31	40.22	24.57	3.27	5.42	100.00
C4_4	5.68	11.92	25.87	34.50	12.51	4.05	5.46	100.00
C4_5	6.47	13.17	22.35	32.21	15.65	4.28	5.88	100.00
C4_6	11.96	9.41	14.60	22.90	22.64	12.77	5.72	100.00
C4_7	13.13	5.39	7.64	18.59	28.94	20.45	5.85	100.00
C4_8	6.53	8.95	20.32	36.79	16.40	5.29	5.72	100.00
C4_9	18.20	16.82	21.07	17.77	5.16	14.34	6.63	100.00
C4_10	14.73	18.72	24.44	20.71	6.57	8.46	6.37	100.00
C4_11	8.46	9.80	18.65	29.66	21.17	5.95	6.31	100.00
C4_12	6.57	10.52	21.46	31.69	17.41	5.88	6.47	100.00
C4_13	6.21	12.64	21.20	28.98	20.52	4.80	5.65	100.00
C4_14	9.67	16.07	22.77	27.41	11.89	5.85	6.34	100.00
C4_15	1.80	5.72	19.41	18.75	5.82	3.14	45.38	100.00
C4_16	10.39	14.60	24.08	24.47	12.02	8.07	6.37	100.00
C4_17	11.50	17.09	28.42	21.43	7.91	7.02	6.63	100.00

	PART D: CURRENT EMPLOYMENT	**PART H: PREVIOUS EMPLOYMENT**
D1 / H1	D1	H1
Austria	2.38	1.67

Belgium	4.05	3.23
Bulgaria	0.46	0.29
Cyprus	0.13	
Czech Republic	1.57	1.08
Denmark	3.30	2.78
Estonia	0.46	0.26
Finland	3.43	2.32
France	9.25	6.11
Germany	18.16	13.46
Greece	1.73	1.44
Hungary	0.98	0.65
Ireland	1.50	0.82
Italy	10.52	7.94
Luxembourg	0.42	0.13
Malta	0.07	0.07
Netherlands	7.42	5.62
Norway	0.10	0.13
Poland	0.85	0.69
Portugal	1.34	0.95
Romania	1.11	1.18
Slovakia	0.29	0.29
Slovenia	1.05	0.78
Spain	7.71	5.62
Sweden	5.65	4.74
Switzerland	0.33	0.46
United Kingdom	11.76	10.72
United States of America	0.13	2.03
others	0.63	24.55
Non response	3.22	2.33
Total	100.00	100.00
D2 / H2	D2	H2
University / Higher Education Organization	NA	16.20
Company / Self employment	82.65	47.34
Research Laboratory / Research Organization	10.23	10.62

Other	4.28	4.90
Non response	2.84	20.94
Total	100.00	100.00
H2_1	-	H2_1
Natural Sciences	-	10.36
Engineering and Technology	-	15.78
Medical and Health Sciences	-	2.29
Agricultural Sciences	-	0.91
Social Sciences	-	1.31
Humanities	-	0.39
Non response	-	68.96
Total	-	100.00
D2_1 / H2_2	D2_1	H2_2
A	2.09	1.05
B	0.59	0.56
C	28.00	15.68
D	2.45	1.21
E	1.11	0.88
F	1.47	1.54
G	0.29	0.26
H	3.07	1.50
I	0.23	0.07
J	13.43	9.05
K	0.23	0.62
M	23.52	10.29
N	0.29	0.23
O	0.26	0.29
P	0.23	0.29
Q	1.96	1.05
R	0.29	0.33
S	1.31	1.34
T	0.07	0.07
U	0.07	0.00
Non response	19.05	53.71
Total	100.00	100.00
D2_2 / H2_3	D2_2	H2_3
A	4.08	2.33

B	3.76	2.32
C	8.46	4.64
D	1.00	0.83
E	0.99	0.75
F	10.06	6.53
G	5.74	2.75
H	5.02	3.36
NA	25.16	15.14
Non response	35.71	61.26
Total	100.00	100.00
D3 / H3	D3	H3
Fixed term. <1 years	0.95	4.48
Fixed term. 1-2 years	1.27	8.43
Fixed term. > 2 years	6.60	11.83
Open ended contract	75.01	46.65
Non-employment contract	0.39	1.86
Self-employed	9.18	3.56
Other	0.00	1.24
Non response	6.30	21.95
Total	100.00	100.00
D4 / H4	D4	H4
No	6.11	4.61
Yes	88.99	72.33
Non response	4.90	23.06
Total	100.00	100.00
D4_1 / H4_1	D4_1	H4_1
0 < 20%	0.26	0.23
20 < 40%	0.23	0.10
40 < 60%	1.67	1.96
60 < 80%	1.34	1.34
80 < 100%	2.19	0.59
100%	73.86	57.43
Non response	20.45	38.35
Total	100.00	100.00
D5_1 / H5_1	D5_1	H5_1

Mean	6	6
Median	6	6
Min	1	1
Max	12	12
Non response	11.79%	30.12%
D5_2 / H5_2	D5_2	H5_2
Mean	1999	1994
Median	2001	1996
Min	1964	1958
Max	2009	2008
Non response	8.49%	25.48%

D6	Right out of school	Unemployment or inactivity	Employment with another organisation	Self employ-ment	Other	Non response	Total
D6	19.63	3.43	63.28	5.91	2.42	5.33	100.00

D7	No	Yes	Non response	Total
D7_1	52.73	38.75	8.53	100.00
D7_2	57.95	29.92	12.12	100.00
D7_3	69.72	18.92	11.37	100.00
D7_4	61.39	28.13	10.49	100.00

H6	Strongly disagree	Disagree	Indifferent	Agree	Strongly agree	NA	Non respon-se	Total
H6_1	8.40	10.36	9.54	23.65	22.90	1.37	23.78	100.00
H6_2	2.29	3.72	7.61	19.99	42.01	1.01	23.36	100.00
H6_3	2.48	6.89	16.20	23.82	24.73	2.29	23.59	100.00
H6_4	10.65	15.32	19.67	14.37	11.79	4.44	23.75	100.00
H6_5	2.38	6.27	14.44	20.91	31.49	1.21	23.29	100.00
H6_6	2.65	7.12	16.43	21.10	28.16	1.01	23.52	100.00
H6_7	29.30	18.49	16.40	6.50	4.80	0.98	23.52	100.00

PART E: MOTIVATION / REASONS FOR STARTING WORK AT CURRENT EMPLOYER

E1	No	Yes	Total
E1_1	52.92	47.08	100.00
E1_2	81.28	18.72	100.00
E1_3	54.03	45.97	100.00
E1_4	49.46	50.54	100.00
E1_5	54.72	45.28	100.00
E1_6	35.09	64.91	100.00
E1_7	58.84	41.16	100.00

E1_8	76.77	23.23	100.00
E1_9	79.19	20.81	100.00
E1_10	81.71	18.29	100.00
E1_11	78.83	21.17	100.00
E1_12	66.84	33.16	100.00
E1_13	77.95	22.05	100.00
E1_14	92.29	7.71	100.00
E1_15	54.23	45.77	100.00
E1_16	77.56	22.44	100.00
E1_17	98.43	1.57	100.00
E1_18	84.22	15.78	100.00
E1_19	77.95	22.05	100.00
E1_20	90.46	9.54	100.00
E1_21	77.23	22.77	100.00
E1_22	91.47	8.53	100.00
E1_23	95.59	4.41	100.00
E1_24	85.40	14.60	100.00

PART F: OUTPUT-EFFECTS OF WORKING AT YOUR CURRENT EMPLOYER

F1	Strongly decreased	Decreased	Remained unchanged	Increased	Strongly increased	NA	Non response	Total
F1_1	11.96	12.05	26.46	17.74	10.72	12.68	8.40	100.00
F1_2	1.24	3.63	17.61	35.12	29.08	5.19	8.13	100.00
F1_3	3.01	4.44	28.62	16.66	16.17	21.79	9.31	100.00
F1_4	0.95	4.90	22.18	31.46	22.35	9.25	8.92	100.00

PART G: NETWORK-EFFECTS OF WORKING AT YOUR CURRENT EMPLOYER

G1	Strongly deteriorated	Deteriorated	Remained unchanged	Improved	Strongly improved	NA	Non response	Total
G1_1	10.75	27.05	36.88	5.52	2.48	8.62	8.69	100.00
G1_2	12.64	20.25	29.30	11.83	6.83	10.26	8.89	100.00
G1_3	0.88	3.63	12.05	36.98	34.92	2.61	8.92	100.00
G1_4	2.19	9.25	19.73	30.71	26.23	3.17	8.72	100.00
G1_5	1.05	6.21	16.60	35.38	28.68	3.46	8.62	100.00
G1_6	0.59	2.84	13.43	33.26	39.01	2.48	8.40	100.00

ANNEX 8 INTERVIEWEES – EXPLORATIVE INTERVIEWS

Name	Function - department	Organisation	Type	Country
Andre Grube	Chief Financial Officer	Pepsico Germany	MNE, beverages	DE
Andrea Kindl	HR Manager	Verbund – HPB (Österreichische Elektrizitätswirtschafts-AG)	large company, electricity production	AT
Edeltraud Stiftinger, Paul Pavetich and Bernd Wohlkinger	Corporate Innovation Center	Siemens Austria AG	MNE, many scientific fields, mainly IT solutions and services	AT
Frank Ahlrichs	R&D Manager	KHS ag	MNE, manufacturer of filling and packaging systems for the beverage, food, and non-food industries	DE
Guido Unterberger	Head of Human Resources	Intercell AG	SME, Biotechnology	AT
Joachim von Heimburg	Director Corporate R&D Innovation and Knowledge	Procter & Gamble	MNE, many scientific fields	DE
Maria Popova	R&D Manager	Sanochemia Pharmazeutika AG	SME, Chemicals	AT
Marjo Hirvonen	Adviser, Career Services	The Finnish Association of Graduate Engineers TEK	Engineering Association	FI
Markus Posch	Head of Human Resources, Management & Innovation, Head of HR-Development global	Phillips Austria	MNE, many scientific fields, mainly electrical equipment, medical en health equipment, etc.	AT
Peter Reichel	Secretary General	Austrian Society of Engineers and Architects & Austrian Electrotechnical Association	Engineering Association	AT
Richard Piock	Managing Director	Durst Phototechnik AG	SME, system solutions for image reproduction	IT
Robert Lackner	Managing Director	Tyrolit Schleifmittelwerke	MNE, solutions in grinding, cutting, drilling, honing, dressing and polishing	AT
Rudolf Lichtmanneger	Economic policy department	Austrian Federal Economic Chamber	Policy maker	AT
Wolfgang Haidinger	Education, Innovation and Research	Federation of Austrian Industries	Policy maker	AT