The global competition for talent: Life science and biotech careers, international mobility, and competitiveness

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"The issue of 'regional competitiveness' is thus ripe with theoretical, empirical and policy debate. In an era of 'performance indicators and rankings', it is perhaps inevitable that regions and cities should be compared against each other in terms of their economic performance. Such comparisons can serve a useful purpose in that they point up the fact that, and call for explanations of why, regions and cities differ in economic prosperity. But, to adapt Krugman's criticism of the idea of a national competitiveness, it is at best potentially misleading and at worst positively dangerous to view regions and cities as competing over market shares as if they are in some sort of global race in which there are only 'winners' and 'losers' […] Crucially, it is important to distinguish between 'competition' and 'competitiveness'." (Kitson, Martin, & Tyler, 2004, p. 997)

'Winners,' 'losers,' 'some sort of global race' – These phrases used for discussing global economic context or competitiveness, as well as more recently for immigration in the global 'race' or 'competition' for talent. National competitiveness, framed within a changing and advancing global context, seems to have become *the* keyword for a wide range of policy decisions. Economic competitiveness, in global context, is also often the driving force for new adoption of skilled migration policies, where they were not there previously. It also applies to policies for internationalization of the sciences and universities. And, it is also the keyword used for supporting the knowledge economy and scientific research as a whole. Yet, competitiveness is often intangible, prone to lots of different definitions, assessments, and changing across time. Furthermore, while migration research has long assumed individuals seek out moves to the most competitive places, which are historically often seen in terms of higher wages, personal motivations may defy this assumption. Even for highly skilled individuals, international mobility is not motivated only by wages, and studying life scientists, illuminates this further.

As discussed in Chapter 1, there has been much debate within the academic literature and no consensus on whether or not countries can 'compete,' although there is recognition that there can be a competition for resources, including skilled individuals. Following from the analysis in the previous chapters, there are two critiques of the "obsession with competitiveness" that are applicable to also understanding whether the concept of competitiveness can also apply to immigration destinations:

1. Many commonly cited tools create a competitiveness index, which gives the impression that a strict rank order of countries is possible. While these indexes are useful, and in some cases there may be a clear 'leader' in a given measure, more attention needs to be placed on the contextual features that are *not* captured by the index. There are clearly shortcomings in having comparable, international data, for every measure that matters. Even if the data was perfect, determining the 'winners' and 'losers' in this context ignores the constant dynamism of competitiveness. The exit of a single, large company can have a dramatic impact on a city's economic standing – just one company, one decision. In the same way, changing policies also can change industry or workforce dynamics.
2. Often, discussion intermingles and hence confuses the distinction between competition and competitiveness. A competition seems to imply that a concrete

event where there are identifiable 'winners' and 'losers'. Competitiveness, on the other hand, is more of a way to measure of the most important aspects that drive performance relative to others.

Both of these critiques are highly relevant to advancing understanding of the global competition for talent and will be expanded upon through the data shown in this chapter.

The brain drain versus brain gain paradigm is perhaps one of the best examples of how the concepts of competition leading to countries 'winning' or 'losing' has been applied in immigration discussions. For instance, Gaillard and Gaillard (1998) debate the idea that it can be determined which countries 'win' and 'lose' in their scientific workforce when individuals move abroad. These authors argue that former 'losers' can move to 'winners' if and when living standards rise and viable scientific work opportunities exist. International moves then may be a way to form international networks, rather than a move indicating loss (p.106). Cañibano and Woolley (2015, p. 115) argue that debate on brain drain is intertwined with discussion on human capital, as these theories both developed in the 1960s. These authors argue that the lack of conceptual distinction has led to brain drain being applied in cases a problematic way. They review the development of literature on brain drain and conclude with a focus on the role of knowledge networks.

The study up to this point has argued for the importance of the concept of competitiveness to skilled migration, both which need to be considered in light of changing global context. Chapter 4 showed that competitiveness is often a key concern and argument used by governments when implementing new skilled migration or mobility policies. The last chapter highlighted one way in which competitiveness is useful to migration studies in particular. Competitiveness can frame the overall context for migration decisions when multiple countries, or cities, are being considered by a potential migrant. In other words, individuals may assess where the 'top' destinations either in one's field, for quality of life, for having opportunities in general, or any other factor and combinations thereof determined as most important to that individual. Scientists are driven more by being able to conduct high quality research, and wages are usually less important. Table 21 showed that the CiLS respondents consider a number of countries to be first choice destinations for life science work, with the US, Germany, UK and Switzerland as the top choices.

The goal of this chapter is to further expand the discussion on *competitiveness* and *immigration* through insights from scientists participating in the CiLS research. The chapters up to this point in Part II have shown some of the dynamics of life science careers and scientific mobility, this chapter aims to bring these two aspects together and briefly examine variations in situations in different countries.

First, it analyzes:

- **Which cities and countries are seen as the most competitive for biotechnology globally?**

The first section begins by highlighting the main reports and indexes on competitiveness in the life sciences and biotechnology in various countries. This allows a brief snapshot to be given of how biotechnology competitiveness in international or global context has

been assessed by others. The goal is not to give a full analysis of competitiveness in biotech, but to introduce a few ideas better frame discussions on how competitiveness.

Following the statistical overview of biotechnology competitiveness, is analysis of CiLS data. First, is analysis of an open-end question where respondents name cities and countries that are competitive in biotechnology. This data looks at the cities and countries that are recognized as leaders in biotechnology by the CiLS respondents, to add additional context about which countries are seen as leaders and whether or not clusters play a central role in this recognition.

Second, assessments of the availability of opportunities in the life sciences are provided. This section will give a comparison of opportunities in the life sciences across various countries based on ratings for CiLS statements regarding opportunities where the individual comes from and in where they live now. This can be considered an additional measure of competitiveness. An assumption is often made that individuals are moving away from a lack of opportunities to go to highly competitive destinations in their field. As the CiLS study was designed and analyzed to focus primarily on cities and countries, this will be the main level of competitiveness discussed. Although it is essential to understand that competitiveness is dynamic, this study only assesses it at one given point in time. This means that the results may not be projectable to the current day. This is not the goal in this analysis. Instead, it aims to point out common career concerns as well as structural differences that influence impressions of competitiveness, and later point to its influence on migration, as seen through the viewpoint of life scientists.

The next section then looks at how individuals in various countries view international mobility, keeping in mind the paradigms of brain drain, brain gain and brain circulation. It examines the research questions:

- **Which duration of stay is most desired for moves for life science jobs in the US and in Europe?**
- **What effect do life scientists expect international mobility to have, in terms of staying abroad versus returning to their home country of work?**

This section will compare results among various countries. A general trend is found that most respondents expect international mobility to improve job opportunities in their home country and this often applies to both developing and developed countries. It first provides quotes that add context to better understand similarities across countries and regions. It then turns to briefly addressing structural differences among specific regions or countries, namely Italy and Central and Eastern Europe, which are seen as outliers in the data in that they show risk of brain drain. This section argues that the competitiveness of countries alone is not enough to understand the retention of life scientists, but that the opportunity structure, which is in part due to cultural norms and practices, including work culture, has a large influence.

This chapter argues that generally the dynamics of scientific mobility within the global competition for talent are more complex than that which can be defined as a relative gain or loss the country being studied. While movements from or between certain countries may be more prone to brain drain or brain gain, it is reflective of the broader opportunity

structure, and improving the institutional context should be the goal, rather than blaming the individual who seeks work elsewhere.

LIFE SCIENCE AND BIOTECHNOLOGY COMPETITIVENESS

Benchmarks for biotechnology competitiveness

Similar to the discussions on difficulties in measuring national and regional competitiveness, measuring the competitiveness of a certain field or industry, such as biotechnology, is no easy task. There are a few main areas that drive biotechnology competitiveness. Yet, given the high interest in biotechnology, government initiatives for scorecards have been made, but notably many of these have been a one-time only publication. One initiative that is important to note is the European Commission (2003) Biotechnology Innovation Scoreboard. This study has not been updated since then, although the EU now issues a scoreboard on innovation across all sectors. There are questions as to the value of biotech scoreboards:

> It is 'almost impossible' to rank individual countries, according to Bénédicte Callan, administrator at the biotechnology unit of the Organization for Economic Cooperation and Development (Paris, France). 'The conclusions that can be drawn from [a biotechnology competitiveness report] can only paint a very broad brushstroke picture,' she says. Also, focusing on indicators from individual countries has limited value because innovation performance may depend on international factors, too. 'This industry draws on international expertise and serves international markets,' she adds. (Louët, 2003)

Canada also created a global biotech scoreboard (Santerre, 2006), but it also is no longer being updated. A private initiative to annually rank countries for biotechnology performance exists, the Scientific American's *WorldView*.

Despite the missing information, the 'brushstroke picture' presented by biotechnology competitiveness reports does suggest some sort of benchmark, at least to which countries are active in biotechnology. In this regard, the reports are useful for framing the analysis in the CiLS study. However, it should also be kept in mind that the life sciences and particularly biotechnology are highly dynamic fields, and the competitive landscape is hence ever-changing.

Despite the difficulties in measuring the nuances, almost every study finds that the US is the most competitive country globally in biotechnology, given its long research history in the field, including the high number of firms and the success of these companies, the level of R&D investments and revenues, and high-quality universities. When comparing total number of biotech firms in US versus the EU as a whole, the numbers of companies are similar but the structural aspects related to its financing differ greatly, as well as to the rates of success of turning research into marketable products. The companies in Europe also tend to newer, with most of the biotech companies recognized as 'elite' in the Critical I study in 2004, being founded in the late 1990s or early 2000s. One area where EU's numbers are better than in the US is in the number of science of doctoral graduates (European Commission, 2004, pp. 68-72; Reiss et al., 2005, p. 57). However,

the EU has questioned whether their training can be capitalized on in Europe, that is whether it leads to job growth in the field of study (Hollanders & Es-Sadki, 2014). In other words, the EU is strong in life science research, but it is pooled more towards academic research, rather than applied for commercialization and biotech products in companies.

Policies to support biotechnology vary by country, and it has been difficult to find a link between policy and biotech competitiveness. The BioPolis study (Enzing et al., 2007) aimed to look at the policy routes taken between 2002-2005 and how it impacts biotech innovation performance in all countries of the European Union, as well as Switzerland and Norway. Although their analysis was very thorough and this study highlights many important comparisons in biotechnology policy and performance, the European Commission (2007a, p. 23) reports:

> The BioPolis study has attempted to find a link between how Member States organise funding system and their performance, but there is no clear link, mainly because becoming successful in biotechnology depends on a combination of favourable measures. This includes creating a solid knowledge base, transferring knowledge between academia and business, encouraging innovation and product development, providing adequate access to finance, and coordinating activities at national and regional levels. One single measure is simply not enough to succeed.

What can be said about the performance of European regions, or clusters, for biotechnology? As noted in the first chapter, Porter (1990) has claimed that clusters are one of the competitive drivers of an innovative sector's competitiveness. A report from the European Commission found:

> In the USA, biotechnology is characterised by a high degree of concentration of firms in a restricted number of regions, where the beneficial effects of company clusters reinforce both cooperation and competition. A similar process of clustering has taken place across Europe, with examples such as the BioTech-Region München and the Medicon Valley between Sweden and Denmark. In comparison with the US company structure, Europe has a lack of critical mass, not only at the individual company level but also at the cluster level. The majority of European biotechnology clusters do not seem big enough to compete effectively with those in the US. (European Commission, 2007a, p. 25)

A few of the measures listed are shown below, which were felt to show some aspect linked to the workforce dimensions of competitiveness. The figures and tables are selected to show the status as a leader in biotechnology or the life sciences (depending on the data available) as defined on different scales and for different measures – national R&D, regional clusters, company performance, and institution's publications. The tables and figures shown only partially portray life science and biotechnology competitiveness across the world and fully assessing its competitiveness is made of a multitude of measures (see Appendix D).

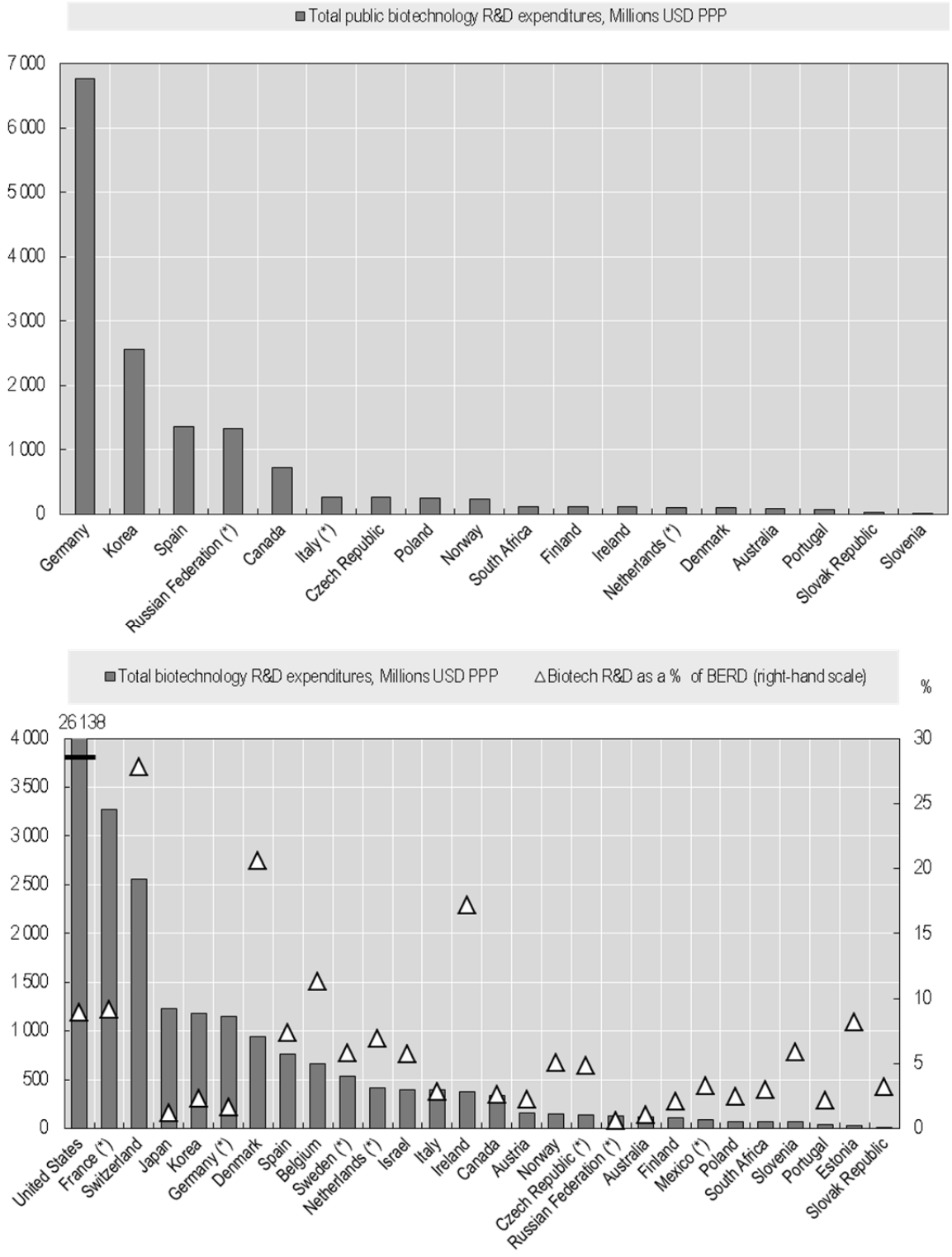
Figure 16 shows OECD data for R&D investments in the business sector compared to the public sector. In brief, this measure shows why it is difficult to determine rankings in biotechnology, other than that of the leading country. The US has a substantial lead in the

amount of business investment in R&D. Switzerland specializes in biotechnology as a top R&D sector, with it receiving more than 25% of total R&D, and specialization can also drive competitiveness. Germany has very high public R&D spends focused on biotechnology. While biotechnology R&D is present around the world, levels between many countries are often similar, although this cannot be equated with equal biotech competitiveness.

Table 23 first shows the *WorldView* innovation index score country rankings (top 10). What becomes clear is that most of the leading countries have a similar composite performance. Hence, understanding biotechnology competitiveness will involve better understanding the nuances of the industry, the differences in specialization, the variations in the opportunity structure, to name a few. The next columns show where regional strengths in biotech may be found. The competitiveness literature argues that clusters are crucial in driving innovation. Again, the majority of the top clusters are found in the US. Yet, it shows that regional specialty has emerged, with some small countries, such as Denmark and the Netherlands, having regions that are among the top globally for patents in biotechnology and nanotechnology. China also receives mention as having a top region, Beijing. The third column shows where biotechnology clusters are found in the US. It indicates that they are spread across the East and West coasts of the United States, and the list bears similarity to that reported by the OECD. The final column helps put the size of the European biotech industry in perspective. Critical I conducted a study of the strength of biotechnology in Europe. One of their measures was to look at the number of elite companies in various countries, which were defined as those which "outperform an appropriate benchmark by 100%. And the appropriate benchmark we have chosen is the Typical US company" (Critical I, 2006, p. 17). This method was adopted noting that while the European biotech sector is commonly said to be less competitive than that in the US, "the sector is not the competitive unit in biotechnology: the company is" (p.17). Their findings indicate that the number of European elite biotech companies is generally small and most of these companies had been founded in the past ten years or less, pointing to the dynamism of the biotech industry.

Table 24 looks at ScImago's life science rankings through a different metric, that of the number of publications by various institutions, including academic, governmental agencies, and companies. The numbers shown in this table are for the number of publications, not their impact scores (which is also part of their rating), as well as the percent of publications that involve international collaboration. Interestingly, by the amount of output alone, Russia, China and Brazil all appear in the top 30. These are all large countries, but it also is a reflection of their research activity and that this research happens globally. Within the European Union, Germany, France, and Spain have institutions listed as top life science publishers. The amount of papers that involve international collaboration among these top institutes range from around 20% the Veteran's Affair Medical Centers in the US to nearly 60% of that published by Max Planck in Germany between 2004-2008.What needs to be highlighted is that regardless of the country that the top institutions are in, at least 20% of the published life science work was found to involve international collaboration.

FIGURE 16 BIOTECHNOLOGY R&D EXPENDITURES IN THE BUSINESS SECTOR (TOP) COMPARED TO PUBLIC AND UNIVERSITY R&D EXPENDITURES (BOTTOM), 2012 OR LATEST AVAILABLE YEAR



Source: OECD, Key Biotech Indicators, 2014

TABLE 23 VARIOUS REGIONAL INDICATORS FOR BIOTECHNOLOGY INDUSTRY STRENGTH

Rankings of Countries –	**Global – Top Clusters**	**US- Top Clusters**	**European Elite Companies**
Biotech Innovation, 2009, top 10 countries, index scores	**OECD Sci and tech Scoreboard 2013: Top regions for patenting in biotechnology and nanotechnology*, share of country's patents**	**Top 10 Biotech Regions in US, 2004, Composite Scores**	**# of Elite biotech companies in Europe at end of 2004, # of companies/ range of yrs founded**
US 3.8	Maryland (USA) 3.5	San Diego, CA 100	UK – 9/ 1991-2003
Singapore 3.5	Massachusetts (USA) 2.0	Boston, MA 95.1	Germany – 6/ 1997-2002
Denmark 3.2	Beijing (CHN) 1.9	Raleigh-Durham-Chapel Hill, NC 92.5	Switzerland – 5/ 1995-2002
Israel 3.1	West-Nederland (NLD) 1.6	San Jose, CA 87.8	France – 4/ 1995-2002
Sweden 3.1	Hovedstaden (DNK) 1.6	Seattle-Bellevue-Everett, WA 83.8	Austria – 3/ 1997-2003
Australia 3.0	Northern-Kanto, Koshin (JPN) 1.5	Washington, DC 79.4	Belgium – 2/ 2000-2001
Finland 3.0	North Carolina (USA) 1.2	Philadelphia, PA 76.5	NL – 2/ 2000
Iceland 3.0	Pennsylvania (USA) 1.2	San Francisco, CA 75.8	Sweden 1/ 1997
New Zealand 3.0	New York (USA) 1.1	Oakland, CA 74.3	Denmark 1/ 2001
Switzerland 3.0	California (USA) 1.0	Los Angeles- Long Beach, CA 66.5	
Source: WorldView Scientific American Editors (2009, p. 39)	Source: OECD Science and Technology Scoreboard, (2013b) http://dx.doi.org/10.1787/888932890238	Source: Milken Institute, http://www.milkeninstitute.org/publications/view/231, Accessed 3 March 2015	Source: Authors calculation based on Critical I (2006, p. 18)

TABLE 24 GLOBAL RANKINGS, TOP 30 INSTITUTIONS PUBLISHING IN THE LIFE SCIENCES, BETWEEN 2004-2008*

Institution Name	Publica-tion Output	Internat'l Collabor-ation %	Country, Type of institution
1 Centre National de la Recherche Scientifique	30, 057	49.51	France, Govt. Agency
2 National Institutes of Health	27,845	37.20	USA, Health System
3 Chinese Academy of Sciences	22,769	26.29	China, Govt. Agency
4 Harvard University	21,500	36.69	USA, University
5 United States Department of Agriculture	20,668	22.90	USA, Govt. Agency
6 Russian Academy of Sciences	15,330	33.82	Russia, Govt. Agency
7 Consejo Superior de Investigaciones Cientificas	14,839	42.17	Spain, Govt. Agency
8 University of Tokyo	12,957	25.84	Japan, University
9 Institut National de la Sante et de la Recherche Medicale	12,341	42.96	France, Health System
10 Max Planck Gesellschaft	12,173	59.31	Germany, Govt. Agency
11 Johns Hopkins University	12,069	31.64	USA, University
12 University of Toronto	11,791	44.72	Canada, University
13 University of Washington	11,730	29.19	USA, University
14 Universidade de Sao Paulo	11,417	26.41	Brazil, University
15 University College London	11,210	47.64	UK, University
16 University of Pennsylvania	10,503	26.91	USA, University
17 University of California, Davis	10, 245	32.31	USA, University
18 Kyoto University	10,182	25.60	Japan, University
19 University of California, San Francisco	10,166	31.23	USA, University
20 University of California, Los Angeles	9,757	30.50	USA, University
21 University of California, San Diego	9,666	34.03	USA, University
22 University of Oxford	9,526	55.31	UK, University
23 University of Florida	9,507	27.18	USA, University
24 Veterans Affairs Medical Centers	9,385	19.57	USA, Health System
25 University of Minnesota, Twin Cities	9,157	25.89	USA, University
26 Cornell University	9,051	32.64	USA, University
27 Stanford University	8,860	31.49	USA, University
28 Yale University	8,844	31.84	USA, University
29 University of Wisconsin, Madison	8,844	25.25	USA, University
30 University of Michigan, Ann Arbor	8,690	25.16	USA, University

Source: ScImago SIR World Report – Life Sciences (2010) *Life Sciences includes: Agricultural and Biological Science; Biochemistry, Genetics, and Molecular Biology; Immunology and Microbiology; Neuroscience; Pharmacology, Toxicology, and Pharmaceutics

Competitive biotech countries and regions in the CiLS research

As also discussed in chapter 1, competitiveness in this project has been defined as "status as a leader," particularly in the life sciences and biotechnology. In order to see which markets are viewed as competitive by the life scientists answering the CiLS survey, two open-ended questions where the respondents name cities, regions and countries that they think have "an especially strong life science and biotechnology industry."

Table 25 shows the results of the places perceived as most competitive in the life sciences and biotechnology by the CiLS respondents. The country seen as the strongest in biotechnology is the US, named by 76%, or the majority, of respondents. Germany (mentioned by 55% of respondents) and the UK (41%) are also seen as top places for biotechnology. Switzerland was named as being strong in the life sciences and biotechnology by one-third of respondents. France, Sweden, Japan, the Netherlands and Canada are also recognized as competitive, but are named to a much lower extent than the top four, each being named by 10-15% of the respondents. These countries did not have high numbers of respondents in the CiLS data and hence may be even higher rated if that was controlled for.

Even though the first of these competitiveness questions asked individuals to name cities or regions that are competitive in the life sciences and biotechnology, many named countries instead. This may be an indicator that there is low awareness about many biotech clusters, or biotechnology on the regional level, but instead only understanding of which countries are active in biotechnology research.

Around 25 regions[37] or cities globally were recognized as strong biotech clusters by at least 10 (around 2%) of respondents. A few countries had multiple regions recognized – notably, the US, Germany and Switzerland are strong in this regard, and to a lesser degree, the UK and France. The highest recognized regions were in the US (California and the area around Boston, Massachusetts), UK (London), Switzerland (Basel), and Germany (Munich) as the only regions named by at least 10% of respondents.

Other countries that be said to have recognizable clusters are France (Paris was mentioned by 9%) and Singapore (mentioned by 7%), notable given it is outside of the region where most CiLS respondents live, and the mentions for Singapore were found in a large geographic range, including developing countries, India, Spain, and Switzerland.

A few methodological points should be pointed out. First of all, it should be noted that the numbers in the table are counts, not subtotals. For example, if someone listed Boston, but did not specifically mention the US, they are only counted in the line for Boston. Originally, there were plans to combine the results of questions on cities and countries to

[37] There is no consensus on how to define a biotech cluster, whether it is a larger region, several nearby cities, or just a single city. For example, should California be counted as a single cluster, even though it is larger than some countries in Europe? In some cases, biotech clusters are found across national borders as well, such as the BioValley, which is in Switzerland, France, and Germany. Also, some countries focus more on individual cities as clusters, whereas others group them. For instance, London-Cambridge-Oxford is often considered as a single cluster. Twenty-five is therefore an approximated number.

get a total count for each country. However, given that Cambridge is a strong biotech city both in the US, the location of top schools such as MIT, and in the UK (where area around Cambridge University is another top cluster), the corresponding country could not always be determined. A similar problem with language was found when "Washington," as both Washington DC and Washington state are top biotech regions in the US, but are located on opposite coasts, and hence these two regions are now counted together, given total mentions for either was low.

A second caution needs to be made based on uneven numbers of respondents from various countries. It was expected that proximity would have an influence on the recognition of various clusters, or cities, that are strong in the life sciences, meaning that life scientists would be most aware of scientific opportunities in their field which are nearby. Places that are further away and are still recognized as strong in biotech are likely to be top global biotech clusters or internationally-recognized 'hubs' for life science research, which was the case for the highest named clusters which received responses from diverse locations globally.

A key finding of the CiLS study is that generally the life scientists did not have high awareness of regions that were strong in biotechnology. This may draw questions as to how important clusters currently are for biotechnology, since most people name countries that are seen as competitive. Some individuals named specific companies, universities or research institutes. The survey did not ask respondents about the leaders on the institutional level, but it is conceivable that scientists may be more aware of this scale than the regions, as applications for study and jobs are done on the company or university level.

There is also a discrepancy in the biotech competitiveness indexes and in the countries named by CiLS respondents, in particular in that Germany is said to be more competitive in the CiLS study than in the usual indexes. Yet, when looking at the data by country of citizenship, it is clear that Germany is recognized globally, not just by individuals already living nearby. My own assessment is that this Germany has a higher reputation in the life sciences, as compared to many other fields. Furthermore, Germany has been active in international collaborations and has built a positive impression globally of German research and researchers. Germany also has had an active policy to support the development of biotech regions, industry, and research (see Box 3).

TABLE 25 COMPETITIVENESS IN CILS SURVEY: STRONG CITIES OR REGIONS (Q117)/ COUNTRIES (Q118) IN THE LIFE SCIENCES AND BIOTECHNOLOGY INDUSTRY

TOTAL	**574**		
United States	**439**	New Jersey	10
Boston	84	Washington or Washington DC	7
California	79	Chicago	7
San Francisco	50	Raleigh\Durham\Research Triangle\North Carolina	6
New York/ New York City	43	Texas	6
San Diego	37	Institutions in Boston area (MIT, Dana Farber, Harvard, Mass. General Hospital)	5
Massachusetts	11	Los Angeles	5
Germany	**315**	Hamburg	8
Munich	59	Bavaria	7
Heidelberg	49	Cologne-Dusseldorf	6
Berlin	43	Southern Germany	6
Frankfurt	9	Gottingen	5
Dresden	8	Leipzig	4
United Kingdom	**234**	Manchester, Liverpool and/or Leeds	13
London	82	Edinburgh	9
England	44	Glasgow	7
Oxford	22	Scotland	5
Switzerland	**198**	Geneva	26
Basel	84	Lausanne	13
Zurich	43	Bern	3
France	**92**	Grenoble	5
Paris	54	Lyon	5
Strasbourg	6	Bordeaux	3
Sweden	**67**	Stockholm	23
Japan	**62**	Tokyo	9
The Netherlands	**61**	Leiden	6
Amsterdam	10	Wageningen	6
Canada	**58**		
Montreal	7		
Singapore	**43**		
Cambridge (not clear if in Boston area/US or Oxford-London-Cambridge in UK)	39		
Spain	**36**	Madrid	15
Barcelona	36	Valencia	6
Australia	**34**	Melbourne	7
Denmark	**29**	Copenhagen	14
India	**28**	Trivandrum	10
Bangalore	15	Hyderabad	6

As was shown in the last chapter, the US had the most mentions as the first choice destination for life science work, but only marginally, named by 18% of the sample, compared with 16% for Germany. Looking at the total mentions for destinations considered is also another way to assess which countries are seen as leaders, as shown in Table 26. Three countries were named by over 50% of CiLS respondents – The US, UK, and Germany. Switzerland was mentioned by around 36%. The patterns of destinations for work reflect similar trends to what is seen in the chart on competitiveness. This is further evidence that the perceived competitiveness of countries does make a difference in migration location decisions of life scientists.

TABLE 26 COUNTRY OF CHOICE FOR FUTURE WORK BY CITIZENSHIP

	Citizenship													
	WB Developing, not in EU	India	China	EU-10	France	Germany	Italy	Poland	Spain	Swit-zerland	United Kingdom	United States	Others	Total
Country of choice: Total														
United States	59	67	10	8	6	39	25	14	41	28	3	8	27	335
United Kingdom	63	54	5	10	8	31	33	15	49	19	8	8	24	327
Germany	57	70	5	11	6	52	16	12	35	15	3	3	18	303
Switzerland	31	36	3	7	10	23	23	10	14	28	1	5	22	213
France	23	23	1	5	6	17	14	5	14	9	4	1	11	133
Australia	27	40	4	5	1	9	10	5	4	6	4	1	10	126
Canada	32	20	4	3	6	13	5	4	13	10	2	2	12	126
Spain	20	6	0	2	3	10	24	6	35	6	1	2	11	126
Sweden	16	13	0	1	3	25	7	5	9	10	0	2	18	109
The Netherlands	13	14	0	3	3	8	12	6	9	2	2	0	13	85
Italy	16	7	0	0	0	7	19	1	7	1	1	0	5	64
India	1	45	0	0	0	1	0	0	0	1	1	0	0	49
Belgium	8	7	0	4	3	3	5	2	7	2	0	0	6	47
Denmark	3	7	0	3	1	4	6	3	8	1	0	1	9	46
Singapore	4	19	3	0	0	2	0	2	1	11	0	2	0	44
Austria	10	3	0	4	0	9	0	0	4	2	1	0	6	39
Japan	2	11	1	2	0	4	3	0	10	4	1	0	1	39
Norway	8	7	0	2	0	6	3	1	1	2	0	1	4	35
Ireland	6	5	0	2	2	4	5	2	5	0	0	1	2	34
New Zealand	5	12	0	1	0	5	3	2	2	0	0	1	3	34
Finland	5	3	0	3	2	1	4	1	4	2	1	0	2	28
China	6	1	11	0	0	1	0	0	0	4	0	1	2	26
Poland	2	0	0	1	0	0	0	12	0	0	0	0	0	15
Brazil	4	1	0	0	0	5	0	2	0	1	0	0	1	14

BOX 3 COMPETITIONS TO BUILD COMPETITIVE BIOTECH REGIONS IN GERMANY

In 1996, an innovation competition sponsored by the German government, the BioRegio contest, allotted 25.5 million Euros (per region) for innovative regions that could present the best plan for attracting biotechnology companies and start-ups.

Germany has since had the fastest growth in the biotechnology sector within Europe and by some counts (ways of classifying and counting biotech companies can vary), has the highest number of biotech companies in Europe (Mergent, 2004, p. 7). However, the newness of the industry and its growth also means growth may not always be sustainable. An article in *Nature Biotechnology* (Hodgson, 2006, p. 272) named the BioRegio contest

as one of biotechnology's top ten 'gaffes,' as Germany experienced rapid biotech growth and then a rapid fall around 2001 in number of companies and funding available:

"The take-home message is that it is easy to dispense free money to scientific enterprises but creating sustainable businesses around a core technical idea requires investor persistence and careful management, preferably by people who have some relevant experience […] many other European nations are now making the same mistakes."

Yet, is this criticism fair, or was it a too quick judgment? In the CiLS research, it was found that Germany has built an image as being both strong in biotech and as an attractive location for biotech researchers, both in retaining its nationals and attracting researchers from around the globe.

Despite this criticism, Germany continued to adopt a similar approach in the next decades. In May 2007, the German Federal Ministry of Education and Research (BMBF) announced five new winning regions in the BioIndustry 2021 competition. The German government has reported that 60 million Euros has been allocated to the full BioIndustry 2021 program over the next 5 years to help build Germany's presences in the field of industrial (or 'white') biotechnology[38]. Five clusters were selected in Hamburg, Dusseldorf, Stuttgart, Frankfurt and Munich. As this list reflects, the German regions specializing in biotech are spread throughout the country.

It is important to note that German biotech policy has not focused on building companies alone. One strength of the German system has also been support of strong research institutions, for example the Fraunhofer institutes.

"Germany's Fraunhofer Gesellschaft is a network of institutes that offer some of the world's most successful applied-research programs. Fraunhofer employs 4,000 Ph.D. and master's students and has a $2.2 billion annual budget. It essentially is a contract research organization, but Germany's federal government supplies a third of its budget." (Wessner & Wolff, 2012, p. 72).

Several of the Fraunhofer institutes specialize in biotechnology. Furthermore, these institutes are found in multiple cities in Germany – for example, the Fraunhofer Institute for Interfacial Engineering and Biotechnology (IGB) is in Stuttgart (in the state of Baden-Württemberg), but other institutes with more specialized foci are found in Straubing (Bavaria), Würzburg (Bavaria) and Leuna (Saxony-Anhalt, former East Germany). A Fraunhofer Institute of molecular biotechnology was recently started in Delaware in the United States (Wessner & Wolff, 2012, p. 293), again showing the importance of international collaboration for advancing life science research.

Perceptions of availability of life science job opportunities in home countries and regions of residence: Results from CiLS study

The rest of this section takes up part of this topic in an exploratory manner, whereby the 'status as a leader' is assessed by looking at life scientists' perceptions of job

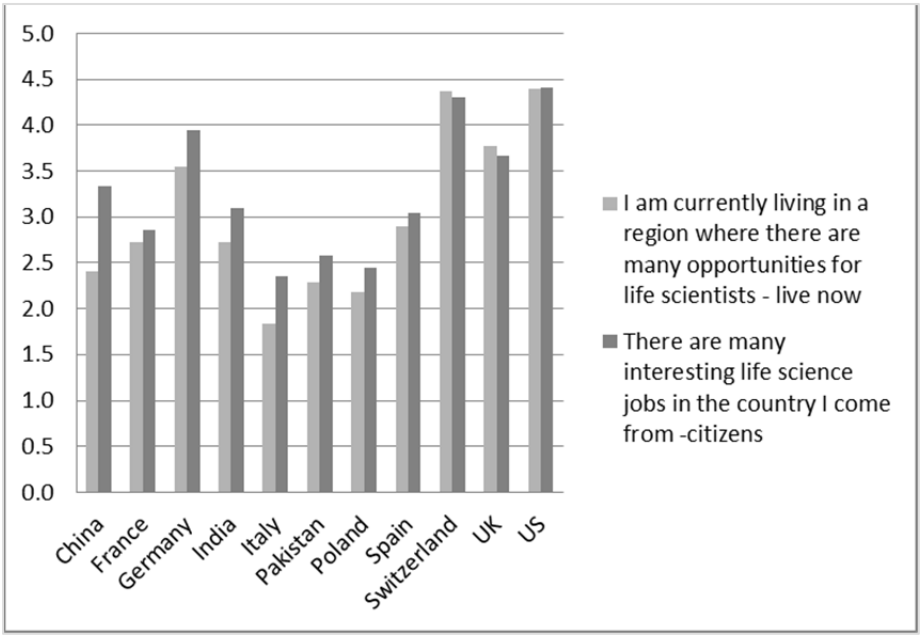
[38]https://www.biotechnologie.de/BIO/Navigation/EN/Funding/foerderbeispiele,did=71310.html?view=renderPrint

opportunities in one's home country and region of residence. This is assessed through agreement with two statements:

- There are **not** many interesting life science jobs in the country I come from, analyzed by country of citizenship (Scale: 5 = strongly agree; 4=agree; 3= neither agree nor disagree, 2=slightly disagree, 1 = completely disagree). The data for this statement is shown in its inverse, to so that the high numbers represent places that are seen as having good opportunities.
- I am currently living in a region where there are many great opportunities for life scientists" analyzed by country currently live in (regardless of citizenship) (same scale as above).

The data is shown in Figure 17. Germany, Switzerland, the UK and the US all are seen as offering good opportunities. Particularly the US and Switzerland are rated very highly both by the CiLS respondents currently living in regions in that country and by its citizens. Germany and the UK are rated similarly, with a mean score between 3.5 and 4 for the two statements. This information on the leaders is in line with the perceptions shown regarding life science competitiveness in the last section.

FIGURE 17 PERCEPTIONS OF LIFE SCIENCE OPPORTUNITIES IN VARIOUS COUNTRIES



Caution: Low base size for some countries. Data should be interpreted as providing a rough indication of the leaders in biotech only.

France, India, and Spain are seen to offer a medium number of opportunities. These are economies that do not have the advantage of being a leader, but are either emerging and improving their position in biotech (likely the case for Spain, which has improved its position in biotechnology considerably in the past years, and India) or are said to have moderate biotech competitiveness (France).

Chinese respondents give a mixed impression of the level of opportunities available in China. The ratings for having opportunities "in the country I come from" are high, while impressions of the amount of jobs around the respondents who live in China now, are low. This could be related to migrants having higher expectations of opportunities on return than what actually exist, or it could reflect regional disparities in biotech development in China. Further research, and larger sample sizes would be needed.

Italy, Pakistan, and Poland are all considered by their citizens and residents as having fewer opportunities for life science employment. Italy, in particular, will be examined in more detail in the rest of this chapter to add further context to understand better the careers and mobility decisions of Italian life scientists.

EFFECT OF MOVING ABROAD ON A CAREER IN LIFE SCIENCES -- ASSESSING THE BRAIN DRAIN, BRAIN GAIN, BRAIN CIRCULATION PARADIGMS

Beyond competitiveness – The influence of the opportunity structure in life science employment

The CiLS research has shown patterns and reasons for increases in scientific mobility as the internationalization of life science research deepens. This argument supports framing scientific moves from perspective of scientific mobility, in that it must be acknowledged that international mobility is often part of the career structure and are not necessarily permanent moves of 'brain gain' versus 'brain drain.' Furthermore, scientists who move abroad may still collaborate and conduct research internationally, including with their home country. However, there are exceptions and brain drain is still a risk particularly when there are other strong, structural problems that affect employment possibilities, whether cultural hiring issues or larger structural concerns, like an absence of research jobs in one's chosen specialization. While number of job opportunities is linked to the competitiveness of the life science sector, hiring practices and criteria are more reflective of the broader opportunity structure for the life sciences.

Sociological analysis has long pointed to differences in the opportunity structure as influencing outcomes. While the term, opportunity structure, is used in a wide range of contexts, it generally denotes "differential access to opportunities" (Merton, 1994, p. 7), which can be related to any number of goals, but initial ones typically used were economic success and/or social mobility (p.30). These differing outcomes must also be linked to the "structural context" "or structural constraint" (p.17). They also are influenced by social capital (p. 21). While Merton was looking primarily at the opportunity structure as a concept to understand deviant behavior, the same term has been applied widely to look at career outcomes (Roberts, 2009). The opportunity structure is a useful concept for study of career-related topics in an internationally comparative context, but it must be done with caution as to what aspects of the opportunity structure are most influential.

The opportunity structure also needs to be coupled with understanding of the individuals as actors, also defined as agency, as explained in the mixed embeddedness approach (Kloosterman, 2010; Kloosterman & Rath, 2001; Kloosterman, van der Leun, & Rath, 1999). Although the mixed embeddedness approach was designed to better examine immigrant entrepreneurship, it is applicable to assessing any other economic activity across varying national or local contexts. This means that meaningful, comparative

assessments must not see either individual characteristics or structure as deterministic, but rather take into account how structure and agency can interplay.

Desired length of stay in US vs EU

"Each year, more than 70% of Europeans who study in the US opt to stay on to pursue their careers. Many of the scientific elite prefer to pursue their careers in an environment that has more to offer their talent and ingenuity. Consequently, about 40% of scientists working in the US today are Europeans." (Mergent, 2004, p. 11)

As already pointed out in previous chapters, there is generally an assumption the US is the top choice for scientists globally to come for studies, work, and to stay long-term, while research in the US often claims the country is losing its lead in attracting 'talent.' The CiLS data shown so far indicates that it is viewed as the most competitive country for biotechnology and is also among the most desired locations for future work in the life sciences (see Chapter 7). Does this competitiveness then translate into a desire for scientist in other countries to work in the US permanently? Many studies make the assumption that this would be the case, but the CiLS research aimed to address it more directly.

Questions were asked in the CiLS survey to better understand how long life scientists would like to work abroad. The CiLS survey first asked a question to sort their interest into groups:

- Are you interested in moving (whether short-term or long-term) to another country in the future for (check all that apply): Working in another country; studying abroad/ in another country; None of these
- Now please think about where you are willing to move. Would you consider moving for work: In the United States; In Europe; Both in the United States and Europe; None

As shown in Table 27, the US is rarely the only destination considered[39]. In looking at the proportion of people who are still interested in working abroad, the highest percentage, regardless of the country of citizenship, is for both the US and Europe. Additionally, the number of people interested in just working in Europe (not in the US) is higher for every country/country group of citizenship except for the US itself. These results need to be interpreted in light of the data given in the past chapter regarding reasons for location choice. Proximity to the home country is likely influential for many people. Others may question whether the lifestyle or quality of life meets their personal preferences in the US. Box 4 briefly examines some of the institutional elements that may make the US a less attractive destination for scientific work, despite its highly rated competitiveness.

[39] As the survey was shown as being conducted by the Young European Biotechnology Network, there is a possibility that the interest in Europe is over-represented when compared to life scientists globally on the whole. Nonetheless, it provides important information to refute the assumption that life scientists with an interest to move abroad are aiming primarily at working in the United States.

TABLE 27 INTEREST IN MOVING TO US, IN EUROPE, OR BOTH AMONG THOSE WILLING TO MOVE FOR WORK IN LIFE SCIENCES, BY CITIZENSHIP

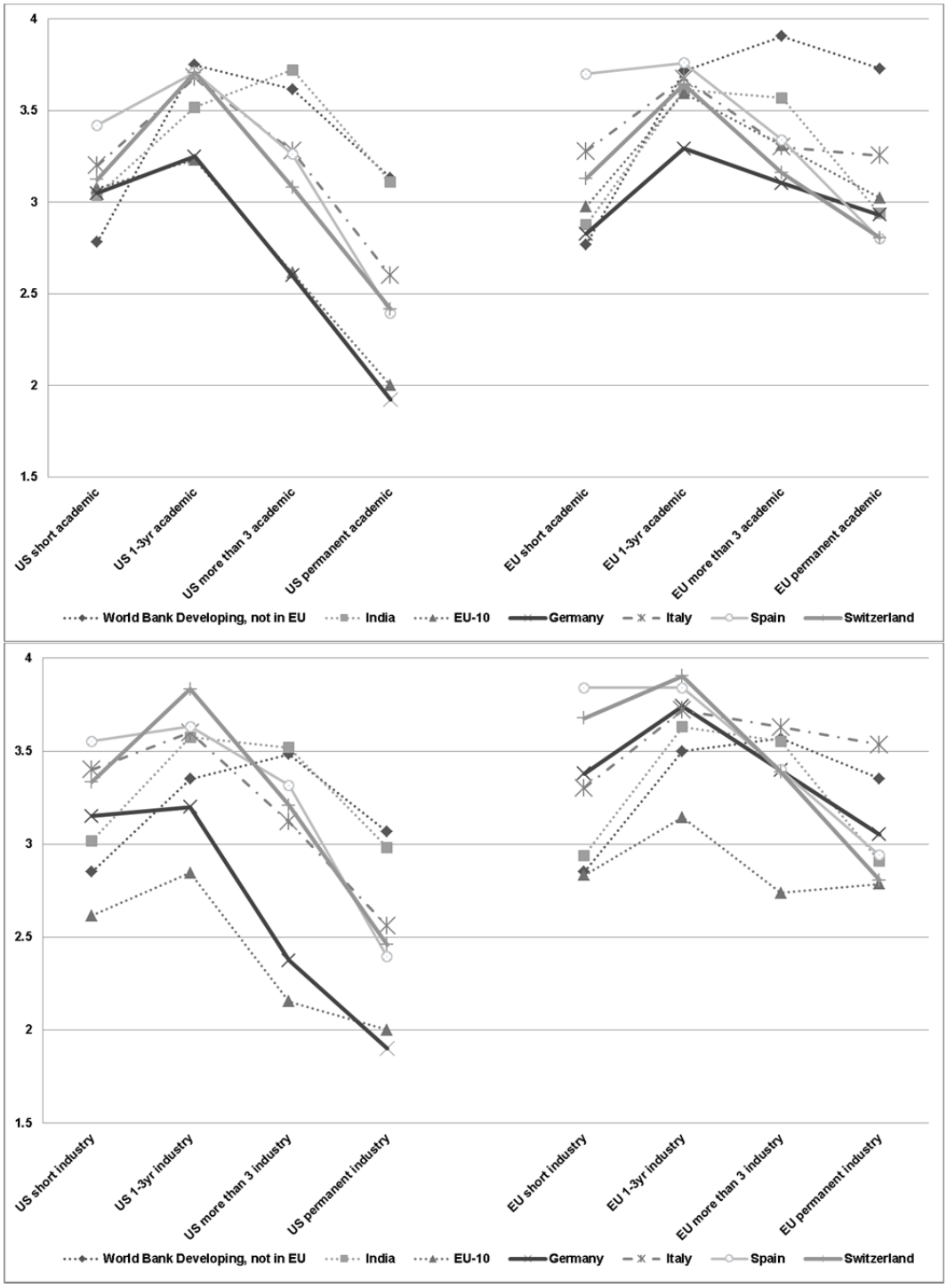
Count						
		Q99. Destination interested to moving to				Total
		In the United States	In Europe	Both in the US and Europe	None of these	
Country of citizenship	World Bank Developing, not in EU	6	20	48	1	75
	India	3	14	51	1	69
	China	0	0	6	2	8
	EU-10	0	10	9	0	19
	France	0	7	9	0	16
	Germany	2	20	38	0	60
	Italy	0	18	25	0	43
	Poland	0	6	17	0	23
	Spain	1	13	37	1	52
	Switzerland	2	9	22	0	33
	United Kingdom	0	5	3	0	8
	United States	2	1	6	0	9
	All others	2	15	26	1	44
Total		18	138	297	6	459

This question was then followed up by a rating scale of various lengths of stays for industry and academia for the locations, US and/or Europe (Q100-105), for those who were personally interested in moving to that location. These results are shown in Figure 18. In order to make the chart easier to read, countries that are considered developing or emerging are shown with the fine dotted line. These categories include countries classified by the World Bank as developing (excluding India and countries in the EU); India; and EU-10. Italy is shown with a large dotted line, as it is an important country of analysis in the next section discussing the brain drain phenomenon. The countries with highest competitiveness in the life sciences, Germany and Switzerland, are shown by the thicker solid lines. A few very interesting trends emerge.

First of all, the interest in length of stay varies more based on the location (US or EU) than on the type of career (academic or in industry). This is finding is interesting in light of the CiLS data in Chapter 7 and particularly considering that international mobility is seen as more important for academic careers than for industry. Among the country groups shown in Figure 18, Europe is seen as a more attractive destination among the CiLS sample for longer-term moves than the US.

Second, the interest is generally *highes*t for moves between 1-3 years among each country group. Indians and individuals from various developing countries are more likely to also express higher levels of interest in medium-length stays, of more than 3 years but

FIGURE 18 MEAN INTEREST IN VARIOUS LENGTHS OF STAY AMONG INDIVIDUALS INTERESTED IN WORKING IN EITHER US AND/OR EUROPE. SCALE 1 (NOT INTERESTED AT ALL) TO 5 (EXTREMELY INTERESTED), ACADEMIC VERSUS INDUSTRY, BY COUNTRY OF CITIZENSHIP*



*Caution: Low base size: World Bank Devel. (US=60/EU=74); India (54/65); EU-10 (26/42); Germany (40/58); Italy (25/43); Spain (38/50); Switzerland (24/31)

not permanently. However, this trend cannot be said to be linked directly to the development of the country, as those individuals from Central and Eastern European countries in the EU have the *lowest* interest in moving abroad for either industry or academia among any of the country groups.

Third, the lowest level of interest is for permanent moves to the United States, whether for academia or for industry, among most country groups except for Indians and those from developing countries outside of the EU, who still show a drop in interest compared to interest in shorter stays. This is interesting, as the United States is often expected to be the top migration choice for scientists and is considered the most competitive biotechnology location in the literature, but among the scientists participating in the CiLS survey, while there is interest in getting experience in the US for a few years, most are not hoping for permanent relocations. It is also interesting given that competitiveness reports show that the biotechnology industry (companies) are generally much stronger in the US than in Europe.

CiLS data on brain drain, return migration, and multiple moves

The CiLS study also tried to assess how individuals personally see the decision to move abroad, and their personal expectations as to whether it would help them find a job on return or lead to them having careers abroad (See Table 28).

- Q109: From your own impressions and personal experience, which statement **BEST** describes the effect of moving abroad on a career in life sciences[40].
    - o It provides experience that makes it easier to find work in the country I come from
    - o It is a stepping stone that leads to moving internationally again
    - o It makes it more unlikely that I'd return to the country I come from to work
    - o Other (please specify)
- This question was followed by the open-ended question, "Why do you think so?"

The answer choices were not phrased in terms of brain drain, or brain circulation specifically, but these ideas were instead implied. Individuals who say that they expect international mobility will help them to find a job in their home country, show potential for brain circulation and return migration. Whereas, countries where more individuals say that international mobility would make them less likely to return are at risk of brain drain. These countries likely show other structural problems, and this will be addressed by looking at the open-ended answers. Those who feel it is a stepping stone are expressing interest in a series of temporary moves, to multiple countries. While the question encouraged respondents to choose one statement that best applied, they were allowed to suggest multiples if they explained the reasons why. This change was made based on

[40] Multiple choices were allowed, but the question also included the request "If you select more than one, please explain why." This means that the data adds up to more than 100%. There was also an option for "other" and to type in the response, but due to space constraints, this data is not shown in the chart.

feedback from life scientists who completed the pilot study. In the survey results, some people felt that the result of moving just depended on circumstances, and can change across time, as life situation and impressions change. For instance:

- "*Own experience. Once you have left it's easier to go on moving to other countries. But it is not less likely to not move to my home country again since while being abroad, one learns to know what is great in one's home country."* 686628877 (Female, 21, Germany)
- *All 3 are true and I speak from personal experience. International working experience is always well recognized by employers, as they hope that such candidate would bring innovation and fresh ideas which he/she has seen abroad. Moreover his communication skills in foreign language are likely to be high. It is difficult to come back to the country I come from as there are far less jobs suitable for me, and my bonds with friends and family have weakened after such a long time abroad.* (Male, 23, from Poland living in Germany, Biotechnology)
- *"Moving abroad puts you in a situation where you no longer really belong to any place. So it´s leading you to move internationally again, it makes you understand that in some places other than your country things can work better, but it also makes you miss your country... IF you eventually decided to return, it would be easier for you to find a job because you had an experience abroad and thus have a much more open mind than before."* (Female, 27, Italian living in Germany, Cell Biology)

There are some noticeable differences as to the expected effect when divided by country groups. Table 28 provides the counts for each of these statements, divided by country of birth for every country in the CiLS sample. Although the sample size is low for some countries, this table should be interpreted qualitatively and as an exploratory way to find which countries may have similar patterns in terms of expectations toward scientific mobility. This is largely a new topic, particularly when analyzed in global context.

The majority of life scientists feel that international mobility will help them to find work in their home country (60 % of total sample, compared to 45% who say it is a stepping stone to move again and 16% who say it makes them less likely to return to their home country). Looking at the data by citizenship, or country groups (where sufficient base sizes are not available for individual countries), further indicates that international mobility is not equally valued everywhere. The main trends are outlined below and then the reasons supporting these differences are illuminated afterwards through quotes of scientists around the world with each perspective.

First of all, international mobility is typically seen as valuable in one's home country for many countries in continental Europe. In the CiLS data, France, Germany, Spain, and Switzerland all show this pattern. Similar levels of endorsements for the value of international experience were found for many, but not all, developing countries.

Second, very few life scientists express that moving abroad would make them less likely to return (16% of the total sample). While migration theory would typically lead to the assumption that individuals from developing countries would be likely to show this

pattern, and more likely to not want to return than those from OECD economies, the CiLS story suggests a different scenario.

- The data on the BRIC economies are also intriguing, again keeping in mind the very small sample sizes, which renders the results as qualitative suggestions. For both Brazil and China, none of the respondents said that international migration would make them less likely to return to their home country to work, and only one individual in Russia said international mobility may lead them not to return. For India, where the base size is higher, only 5% of individuals chose that moving abroad could lead them to not returning. These economies have emerged more recently as scientific research locations, and are seen as attractive work destinations by their citizens.
- Many other countries also had *none* of its life scientists in the CiLS survey saying that moving abroad. These countries are as diverse as Ireland, Iran, Pakistan, and Nigeria – to name a few examples of the countries where there are more than 5 respondents.
- The biggest risk of brain drain was found in Italy, where nearly half selected that working abroad would lead them not to return. Some of the Central and Eastern European countries (Slovenia and Latvia) also showed a tendency toward brain drain, but data is only available among a few individuals.
- 45% of all respondents select that they see intentional mobility as leading to additional international moves. Again, these individuals are divided between developed and developing countries. In many cases, it seems more linked to personal choice or career decisions, rather than the competitiveness of the destination where they are from or currently working.

Before looking in more detail at the CiLS quotes to illuminate what leads to the differences in data among countries seen above, it should be highlighted what types of expectations are shared across countries. In other words, why do so many individuals say that it will help them find work in their home country, a trend that can be seen in many developing as well as developed countries? These quotes are gathered from the full CiLS results, not focusing on specific countries. Five main lines of reasoning supporting the need for international mobility were identified and are critical to keep in mind for understanding any current or future trends in the global competition for talent among life scientists:

- International mobility is seen as necessary by some for successful life science research, as life scientists aim to tackle problems of global importance. This aspect is particularly called out by respondents from developing countries or those interested in working on issues particularly relevant for developing countries:
    - *Research (especially in life science) is not a regional one. This is a matter of improving the life quality of all mankind.* (Male, 24, India, Biotechnology)
    - *According to me, three things are very important in today's intense competitive environment - it is hard, it is necessary and more than anything we have significant reasons to address issues related to human health. To overcome gigantic competition, it is crucial for me to empower*

myself by laying my hands on vibrant research skills. The current exacting situation calls for corroboration of scientific data from every nook and corner of the world; often advocated by alternate solutions from investigating natively available resources that can help us in evading deadliest of the diseases. A world-wide scientific network is especially vital in understanding the current problems in daily life and healthcare sector, in turn, monitoring the regulatory boards of pharmaceutical and life science industry and helps in building amiable relationship across continents/nations. (Male, 26, India, Bioinformatics)

BOX 4 RESEARCH CAREER PARTICULARITIES IN THE UNITED STATES

The life sciences are forming the strongest core of university research in the US. The National Science Foundation reports: "In 2009, the life sciences represented the largest share (60%) of expenditures in academic S&E R&D. Over the last 20 years, the life sciences were the only broad field to experience a sizable increase in share—6 percentage points—of total academic R&D. Over the same period, the physical sciences share of total academic R&D dropped 3 percentage points[41]."

Stephan (2012)[42] states that the National Institutes of Health doubled their spends in the biomedical sciences between 1998-2003. This created a lot of new opportunities for research, as well as improved lab facilities.

In line with the increasing R&D for this field of study, it also now produces the highest number of scientists of *any* academic discipline. For example, in 2008, there were 234,000 doctorate graduates in the biological, agricultural, or environmental life sciences in the, US, compared to 67,000 in the computer/mathematical science, 169,00 in the physical sciences, 158,000 in engineering, and 226,000 across all the social and economic sciences[43]. Survey results from the National Institutes of Health show that in 1997, 70.5% of biological science doctorate holders said their job was closely related to their training. This had dropped to 59.3% in 2008[44].

As a result, there is often discussion in the US about why life scientists are quitting this career path, despite long years of study, and sometimes despite a continuing passion for research. This is often due to the competitive nature of science research in the US, but in a context where competition strongly decreases career satisfaction. Let's take two examples.

The first comes from an interview on National Public Radio in 2014, titled "When Scientists Give Up." This interview notes that after the NIH funding surge, these

[41] http://www.nsf.gov/statistics/seind12/c5/c5h.htm, Accessed 2 March 2015

[42] Stephan, P. (2012*). How Economics Shapes Science.* Cambridge, MA and London: Harvard University Press.

[43] http://www.nsf.gov/statistics/nsf13320/. P.14-15, Accessed 2 March 2015

[44] https://www.insidehighered.com/news/2013/02/19/research-aaas-meeting-notes-difficult-job-market-academic-science, Accessed 2 March 2015

budgets have more recently declined 20%. University scientists are expected to bring in research grants, but it is estimated only 1 in 8 are actually funded. Not only does this create a situation where scientists in US universities must spend much of their time pursuing research paths that are never built, it also can be discouraging for scientists who are funded. In the interview, a successful scientist, Ian Glomski, discusses why he is quitting his well-funded lab at age 41 to form a distillery. He says to get funded now: "*You have to actually be much more conservative these days than you used to. And being that conservative, I think, ultimately hurts the scientific enterprise because everybody's basically trying to be so conservative – to do things that ought to work or things that are expected to work, that you're losing out on the cutting-edge research that really is what pushes science forward."*

The second example comes from a blog ("A career in science will cost you your firstborn", www.johnskylar.com), from an early career scientist. In this blog, there is a discussion centered around why a successful postdoc candidate, who the author clearly looks up to, has decided not to further pursue her scientific career. He analyzes a range of reasons, but most importantly, pursuing science leads to an insecure life situation. First of all, pursuing a postdoc often means a lower salary than what many peers with the same education receive for different career paths, whether in industry, or outside fields like consulting. Many top universities in the biological sciences are also in areas with expensive cost of living. And in the US, "*Worse yet, a postdoc isn't a real job. You're considered a 'trainee' for the purposes of everything from social security to benefits. You're often locked out of retirement accounts, not that you'll have enough money to save any to begin with. And you often can't collect unemployment if you're fired.*[45]*"*

At the same time, it needs to be kept in mind that currently a *majority* of postdoc positions in the biological sciences are being filled by foreign nationals in the US. For example, in 2010 there were 10,283 US citizens and permanent residents doing postdocs in the biological sciences, compared to 11,443 temporary visa holders.

Should it be any surprise that so many foreign scientists return to their home country at some point after finishing their selected training in the US? It has all the elements shown in the CiLS study to matter – a chance to access top universities, prestige, excellent scientific equipment, in a culturally diverse environment…and a lack of attractive, long-term job opportunities.

Yes, the United States is one of the most important foci of the global competition for talent in the life sciences. It is still seen as the most competitive, the leader, both due to quality of the universities and research, and for the number of companies in the biotech industry. But it is occurring in an era where neither the domestic employment situation of life scientists in the US, nor the international mobility patterns of advanced research students point to predominantly permanent stays. This does not mean that the US is now 'losing out' in the global competition for talent. It means the game, the rules and players, have changed.

[45] http://ncsesdata.nsf.gov/gradpostdoc/2012/html/GSS2012_DST34.html, Accessed 4 March 2015

TABLE 28 WHICH STATEMENT BEST DESCRIBES THE EFFECT OF MOVING ABROAD ON A CAREER IN THE LIFE SCIENCES?

Counts for country of birth; highest number of responses in gray (countries with 3 or more respondents)

	It provides experience that makes it easier to find work in the country I come from		It is a stepping stone to moving internationally again		It makes it more unlikely that I'd return to the country I come from to work		
	Yes	Not Selected	Yes	Not Selected	Yes	Not Selected	Total
Country of birth							
Algeria	0	1	0	1	0	1	1
Argentina	3	3	2	4	1	5	6
Australia	1	0	0	1	0	1	1
Austria	2	1	2	1	0	3	3
Bangladesh	3	0	2	1	0	3	3
Barbados	1	0	0	1	0	1	1
Belgium	3	2	1	4	1	4	5
Belize	1	0	0	1	0	1	1
Bosnia and Herzegovina	0	2	2	0	0	2	2
Brazil	3	1	2	2	0	4	4
Bulgaria	0	4	3	1	1	3	4
Burkina Faso	1	0	0	1	0	1	1
Cameroon	1	0	1	0	0	1	1
Chile	3	0	2	1	2	1	3
China	9	3	4	8	0	12	12
Colombia	1	5	6	0	2	4	6
Croatia	1	3	1	3	1	3	4
Denmark	0	3	3	0	1	2	3
Egypt	3	3	4	2	1	5	6
El Salvador	0	1	1	0	0	1	1
Ethiopia	0	2	0	2	2	0	2
Finland	1	0	0	1	0	1	1
France	11	5	8	8	3	13	16
Germany	44	29	31	42	13	60	73
Greece	1	0	1	0	1	0	1
Hungary	0	2	0	2	2	0	2
Iceland	1	0	0	1	0	1	1
India	64	40	54	50	5	99	104
Indonesia	0	1	1	0	0	1	1
Iran	4	3	5	2	0	7	7
Ireland	2	3	4	1	0	5	5
Israel	1	0	0	1	1	0	1
Italy	17	31	25	23	23	25	48
Kazakhstan	1	1	1	1	0	2	2
Kenya	2	1	0	3	0	3	3
(South) Korea	0	1	1	0	0	1	1

TABLE 28 (Continued)

	It provides experience that makes it easier to find work in the country I come from		It is a stepping stone to moving internationally again		It makes it more unlikely that I'd return to the country I come from to work		
	Yes	Not Selected	Yes	Not Selected	Yes	Not Selected	
Country of birth							
Latvia	2	1	2	1	2	1	3
Lithuania	2	2	1	3	1	3	4
Luxembourg	1	1	1	1	0	2	2
Malaysia	3	1	3	1	2	2	4
Mexico	5	3	4	4	2	6	8
The Netherlands	2	3	3	2	1	4	5
New Zealand	1	0	0	1	0	1	1
Nigeria	6	0	3	3	0	6	6
Norway	1	0	1	0	0	1	1
Pakistan	10	2	4	8	0	12	12
Peru	1	1	1	1	0	2	2
Poland	16	11	13	14	4	23	27
Portugal	3	2	3	2	2	3	5
Romania	4	1	1	4	0	5	5
Russia	3	4	5	2	1	6	7
Serbia	2	0	1	1	0	2	2
Slovakia	0	2	1	1	1	1	2
Slovenia	1	2	1	2	3	0	3
South Africa	1	0	0	1	0	1	1
Spain	53	17	24	46	6	64	70
Sweden	3	0	1	2	0	3	3
Switzerland	31	11	15	27	5	37	42
Syria	1	0	1	0	0	1	1
Taiwan	1	0	0	1	0	1	1
Trinidad and Tobago	1	0	0	1	0	1	1
Tunisia	1	0	1	0	0	1	1
Turkey	5	4	3	6	1	8	9
Ukraine	1	0	0	1	0	1	1
United Arab Emirates	1	0	0	1	0	1	1
United Kingdom	3	8	5	6	1	10	11
United States	5	8	4	9	3	10	13
Venezuela	1	1	0	2	0	2	2
Yemen	0	1	0	1	0	1	1
Zimbabwe	1	0	0	1	0	1	1
Total	**357**	**237**	**269**	**325**	**95**	**499**	**594**

New research skills, including exposure to new ways of conducting research and access to equipment, can be gained by moving abroad. Other people move abroad to build their foreign language skills. The prospects of building new skills are important both to individuals from advanced countries and particularly for individuals from developing countries where there are fewer scientific resources.

- *Besides, lack of technology in different life sciences is the most important point and even if I got experience, what will be the benefit if I don't have facilities!? Yes, it may provide good position (maybe) but days on days without practicing what knowledge I got, I will lose everything unless I am in touch with development in my field with new technologies and facilities.* (Female, 37, Yemen, Microbiology)

International mobility is seen to build soft-skills that are important for individual development or for careers, particularly open-mindedness and adaptability, and in some cases to show help the ability to work in multicultural environments.

- *"Provides experience different cultures, which is important in a country such as Canada as it is so multi-cultural."* (Female, 23, Canada, dual citizen of Canada and Trinidad and Tobago)
- *Because it broadens your mind, it helps you get to know other cultures and ways of living that you wouldn't be able to experience without moving abroad. It challenges your ability of adaptation. It helps you improve languages if the language of the country is not your mother tongue. As far as careers are concerned, I don't know how good or bad it would be*. (Female, 21, Spain)
- *Working abroad opens your horizons. It makes you able to cross the cultural barriers. Science is basically the same everywhere but besides work someone must enjoy his life in the country where he/she works. A great workplace, gaining skills and knowing new people and cultures makes you a citizen of the world. Working in science makes you a part of the overall humankind advancement and what is more rewarding than the feeling that you really are a citizen of the world that actively tries to unveil the mysteries of life*? (Male, 37, Romanian citizen living in US, Immunology)

- Some respondents state that international mobility is highly regarded or even a prerequisite for employment in their home country or chosen field. Even though the answers from some of these respondents express lower enthusiasm to move abroad, it is seen as a necessary step in the career path.
  - *Working abroad is valorized in Brazil.* (Male, 45, Brazil, Bioprocessing Engineering)
  - *Because companies like Siemens always ask for that in job interviews and consider international experience more important than the number of years one needs to finish his study. Better one year abroad and your study takes one year longer, than otherwise.* (Female, 20, Germany)
  - *Most of the research and academic institutes demand a good post doctoral or a graduate study from abroad for building up a scientific career. In that*

case it will provide me the necessary research experience and world class exposure for building a scientific career. The same things apply to industries as well. (Male, 25, India, Genetics)
    - *In Singapore, overseas experience is more valued than experience from local institutes.* (Male, 35, Singapore, no field of study provided)

- International mobility can be a way to forge new scientific networks. However, in some countries respondents express that moving abroad could lead to a weakening of their existing scientific network in their home country. Due to both of these viewpoints, the assessment on the value of international mobility for advancing one's career in the home country varies.
    - "*It makes it easier to collaborate with the country I come from to develop life sciences careers. Because having a strong international network will help establishing cooperation"* (Female, 27, Algerian citizen living in France, Cell Biology)
    - *The most important is the feedback between researchers around the world, moving abroad on a career allows that encounter and feedbacks.* (Male, 34, Columbia, Medical Sciences)
    - *It is mainly a risk to quit my country not to keep the contacts that will allow going back later. But intelligently used the experience acquired abroad is a plus. I personally would take the challenge to follow my partner in a country but with preparation in advance to do the contacts there and to keep the contact here. On the other hand, any other country I will go (not for purpose of following partner) would be with keeping a foot in a Swiss company or with contact in my country to come back is I want to*. (Female, 29 Switzerland, Cancer Research)
    - *When you leave, you lose visibility in your own country, and people forget to let you know job opportunities simply because you are not around. Working internationally can become addictive and you may not want to go back to a single cultural work setting." There are more work opportunities in the USA as a whole than in Europe for life scientists* (Female, 31, Belgian living in US, Molecular Biology)

Those who see international mobility as a stepping stone to move abroad again report either:

- Lifestyle reasons
    - *Well, once you tried it you cannot get enough, at least for a while. If you manage to 'survive' in a new country once you get the impression you will survive everywhere. The downside is that sooner or later you feel like you do not belong anywhere anymore. You start your life over and over again! It is great fun, if you (at least I need it), find a network of people like you around, which can be your friends for the time you are in that country, but maybe even forever, who knows... Anyway moving abroad teaches more than you can ever imagine sitting your whole life in your own country...* (Female, 31, Polish citizen living in the Netherlands, Molecular Biology)
    - *My main reason for wanting to move abroad was as a lifestyle choice - to experience a new country, a new culture and be near to other countries as*

well, living in Europe. The second influence was to experience what it would be like to be challenged in a new job." (Female, 32 Dual citizen New Zealand –UK, living in Switzerland, Immunology)

- *"I grew up in Luxembourg, one parent from (one European country) and one from (another European country), hence I always thought of myself as European, never belonging to one country. I have always enjoyed traveling. I studied/study in the UK but my studies involve frequent travels to Africa and other developing countries. One of my motivations for choosing this field of studies was, and still is, to experience working in and with different cultures, different countries. I enjoy learning new languages and meeting new people. I hope very much that my work continues to bring me these opportunities since that way I will enjoy it even more."* (Female, 24, dual citizen Luxembourg-UK, living in UK, Infectious Diseases)

- Lack of opportunities in their home country
  - "*The opportunities in my country on a career in life sciences is quite low, and I always think a person should see abroad to widen his/her perspective on life itself, so I would like to live and study or maybe work abroad. Also because I do not like the life standards in my country, and I can do nothing to improve it right now, all I can do is to use my energy and knowledge on the fields that I believe I can improve on this world.*" (Female, 23, Turkish citizen)

This section has aimed to highlight individuals attitudes toward international mobility and the effect expected on the career. The quotes illuminate why concerns about brain drain in many countries may be overstated. International mobility has become integrated in the career structure of life scientists in many countries. It is valued by many individuals for their personal and scientific growth, and it is highly valued by many employers. Yet, international mobility is not equally valued everywhere, and the expected effect on the career varies as well.

Brain drain in Italy and Central and Eastern Europe

Italy is a country in the CiLS data, where concerns about the opportunity structure are expressed by life scientists. Italy cannot be considered as necessarily uncompetitive in the life sciences when international competitiveness indexes are assessed. For example, the Scientific American listing shows Italy as one of the world's top countries in science, with it being rated as in the top 10 for number of research papers, patents, R&D expenditure, and number of science and education graduates (Editors, 2012, p. 36). While this is for science on the whole, it is still evidence that scientific work does have some competitive presence. Yet, Italy was rated the absolute lowest among any country in the CiLS research by its citizens, in terms of having good life science opportunities available and was the country showing the highest risk of brain drain. Italians express:

- *"The scientific career in Italy is not worth trying. Once abroad generally Italians don't want to go back mainly for the salary difference and for the opportunity to find a stable job. Even if not stable, abroad there are more opportunities than in Italy."* (Male, 30, Italian Living in Switzerland, Developmental Biology)

- *Italy is a very strange country, where you always need to keep connections and contacts and once that you go out from the "system" it is difficult to go back, especially in Academia.* (Female, 30, working on PhD in Neuroscience in Italy)
- *In Italy the good positions in life sciences are few, usually not in the best Italian areas, and the salaries/social charges are not good.* (Female, 35, Italian citizen in Switzerland)
- *I think that it's extremely important to gain experience abroad, as it opens your mind and gives unique possibilities. Once you begin to evolve you don't want to stop progressing … Having already some links and no need for work permit in the country I intended to move helped my decision, but the main reason was the lack of possibility in my country and the opportunity I have abroad to work in the field I am proficient and to gain experience for my career progression"* (Female, 35, Italian citizen with post-doc, working in academia in UK, no field of study provided)

These findings are in line with the ERAWATCH report for Italy, which finds that its R&D spends are below the Lisbon Agenda targets, and that there are problems with attraction and retention of researchers due to: "overall low attractive working conditions for researchers, low salaries, difficulties to gain permanent positions, scarce relevance of merit." (Potì & Reale, 2011, p. 5)

Central and Eastern Europe also showed some risk of brain drain, which it is linked mainly to the position as a transition economy, within the European Union. There are still disparities not only in salary as compared to Western Europe, for example, but also in terms of the quality of the work environment, which was particularly noted for academia. There is also often a frustration about the quality of the systems in place, including as reflected in politics as well as in the social structure:

- *Because studying and working (and meaning it!) in Slovenia really sucks and is but degradation to the student, the adviser, the research, etc. Complaints are either not taken seriously or downplayed. Politics seems to mess in. Servility and execution of tasks is how many PhD theses are completed (the candidate is thus a faithful copy of the instructor). Ideas take too long to mature and turn into products. Hierarchy and status are strong. Personal disqualifications are common in arguments. Again, what exactly is meant by analytical and critical thinking, research, motivation, etc., anyway?* (Female, 25, Slovenia, Biochemistry)
- *When you know how things should be done abroad and you know that there are no chances for any improvement in your country (in this matter) then the answer is simple. Moreover apart from the professional point of view, there is also this social square people are better for each other outside of my country, and politics can not change a lot from day to day in your life - like in Poland when you are not sure what will happened tomorrow, because of some political decisions that quite often does not make sense.* (Female, 28, Polish citizen, living in Switzerland, Biotechnology)

As is seen in many countries of the world, many governments in these countries are aiming to improve their position in biotechnology (Enzing et al., 2007, pp. 129-151). As

is the case with rating biotechnology competitiveness in general among countries, it is difficult to determine how each compares to each other and different reports will give different answers. It is important to note that while there may be some commonalities in terms of work conditions and societal concerns (low confidence in the government and corruption are widespread concerns, for example) in the former Central and Eastern European countries, there also will be a large number of differences that have an impact on both career opportunities and quality of life. More research is needed on this topic. Box 5 describes some impressions from my time living in Lithuania and researching the biotechnology sector there.

BOX 5 BRAIN DRAIN, RETURN MIGRATION AND INNOVATION TRANSITIONS IN LITHUANIA

Brain drain is among the top social and political issues in Lithuania. Yet, the Lithuanians have a highly divided view of emigration, despite high out-migration rates. This is expressed commonly even in day-to-day conversations, as well as in the media. For instance, the online version of the daily newspaper, *Lietuvos Rytas*, had a section called "Emigrantai" or "Emigrants" when I lived in Lithuania in 2008. It was a newspaper section lined with articles, on the one hand, of successful Lithuanians abroad. On the other hand, the section contained stories of social ills from moving abroad, such as divorce and internationally divided families, with another favorite topic being Lithuanian criminals arrested overseas.

These examples are also reflected in general opinions on 'emigration' in Lithuania: on one hand, those who emigrate are looked upon skeptically, and on the other hand, most Lithuanians know someone who has gone abroad and in many cases these stories are lined with ideas that they had high personal achievements, and ones felt to be unattainable at home. Adding to this image, the former and very popular President of Lithuania from 1998 to 2003 and then from 2004 to 2009, President Valdas Adamkus, was elected shortly after returning from his own migration, having spent most of his adult life in the United States.

Return migration does not always come easily. As part of my research in 2008, I interviewed life scientists in Lithuania who had returned after working in the United States. The reasons for wanting to return were usually family-based reasons, wanting to be closer to relatives or hoping for their children to better know their home country and language. I was told that the process of finding a job upon return was more time consuming, in some cases taking several years, than expected. The employment situation in Lithuania needs to be seen in light of the country as a transition economy, still moving from the legacy of communist systems into more market-oriented approaches. Academia is currently split between those from the 'old' system, where seniority determines status, and the new standards in academia, whereby status is determined by the ability to get international funding for research and through publications. Those from the old mindset do not necessarily want the younger, competitive mind-set working with them. It is not valued and may even be seen as threatening.

The disparities between systems can also be seen in policy discussions. One of the reasons I was drawn to study in Lithuania was because of the policy documents stating their efforts and intentions to build the biotech sector. The Institute of Biotechnology in Vilnius is considered to have a competitive atmosphere and quality research labs. Almost

all the scientists here are Lithuanians; many are scientists who have returned after working abroad. It was pointed out to me that researchers also visit this lab from abroad, although most of these are short-term visits. The building I visited was formerly one of the top research institutes of the Soviet Union, and now instead is part of Vilnius University, a symbol of the changing alliances in a transition economy. Successful biotech companies are also present in the area, notably Fermentas, which is very active in international markets and was acquired by the US company, Thermo Fisher Scientific in 2010.

When I asked scientists at various locations about policies to support biotechnology, I generally was told there is a lot of talk, often due to pressure from the EU to increase R&D, but little moves forward. As I was told in an interview with a scientist who was actively involved in policy-making, many politicians argue that employment in manufacturing and agriculture are still important in Lithuania, and prefer to put their efforts more on supporting initiatives in these more traditional areas of employment. Again, this creates a division between the side aiming to increase competitiveness and those who are focused more on trying to meet needs within the existing economy, and among a larger percentage of constituents.

CONCLUSION

Perceptions of high US competitiveness, and the often negative perspective taken on the performance of biotechnology in Europe as a whole, seem to pervade discussions about biotechnology careers in Europe, among students and in some policy reports. As was mentioned in chapter 2, the idea of brain drain originally started from discussions of loss of European scientists to the US.

The multiple definitions of biotechnology, the diverse applications it applies to, as well as different configurations of policies and institutions that support biotechnology growth make rating 'competitiveness' of countries in biotechnology nearly impossible. While various independent reports with competitiveness reports exist, international organizations such as the OECD have been reluctant to adopt an index of biotech competitiveness. As discussed in detail in the methodology section, internationally comparative studies on biotechnology seldom focus on the workforce or employment aspect, but rather on legislation or innovation (R&D spends, patenting and publishing) differences, where comparable data is available. Usually the best data indicator for the workforce is the number of life science PhD graduates, but this tells nothing or their employment trajectories or how the aspects that create fundamental structural differences in biotechnology across regions relate to the employment of biotechnologists. Albeit being incomplete and prone to both interpretation and error, examining competitiveness helps us to better understand how countries and cities are perceived to fare in global context. Perceptions of competitiveness are assumed to be important, for drawing in talented individuals, firms and investments.

Biotechnology competitiveness is difficult to assess, not only at a single point in time, but also in that it is dynamic. Growth and international recognition of strengths will also influence perceptions of competitiveness, as will the effects of recession or other reasons for retrenchment in employment. Hence the list of places seen as competitive when the CilS study was conducted have likely changed, at least slightly.

In the most basic sense, it can be said that there is a common *outcome* (evidenced by the presence of the biotech industry). However, the presence of these various factors does not imply that they are achieved in a similar manner. For example, a cluster can be largely supported by government funding, as has been the case for Germany's biotech sector, or it can be business or market-led, evolving from existing businesses and independent spin-offs. Comparative research is therefore necessary in order to understand the *contexts, including the opportunity structures,* that then influence the availability of workers in that region or country.

The CiLS survey adds to the existing research by looking at life science and biotech competitiveness from the viewpoint of the workforce. Very few regions are identified by the CiLS respondents as being strong in the life sciences and biotechnology. It is rarely the case that regions and biotech clusters are in and of themselves are beacons in the night that attract the best and brightest from around the world, since very few biotech cities have this type of status. Rather, individuals are aware of cities either based on proximity, or seem to be choosing locations based on a key institution, such as university or top company at which they are interested in working or studying. As discussed in chapter five, independent research is seen as the "ideal" occupation by most life scientists, and hence the individual's focus is likely on identifying key institutions in their field, not necessarily regions.

Although there is not necessarily a strong focus on regions, individuals are aware of biotech competitiveness on the national level. Four countries emerged as leaders for the biotech workforce, that is that they are very attractive to scientists from outside the country, as well as for the nationals: The United States, UK, Germany and Switzerland. The US has the highest recognized competitive regions in biotechnology among the CiLS sample, which is consistent with its reputation as the global leader in biotechnology.

All the discussion in the chapters up to this point have focused on structural dynamics that effect the global competition for talent and the competitiveness of the biotechnology industry in various countries. These reflect the investments, size, and specializations of biotechnology, but cannot make any claims about the biotech workforce. What can be said about the role of the workforce and their career and lifestyle *preferences and motivations* in shaping the global competition for talent?

Figure 18 looked at the desired length of stay for moves for life science work in the US as compared to in Europe. What is unique about this perspective is that the data is specifically for those interested in moving for work in the life sciences (data on intended student mobility is not included) to that specific location. What is shown is that the intentions for moves often defy conceptions about migration. Permanent moves are typically *not* the most desirable, regardless of the country of origin. This is even in light of academic careers sometimes involving tenure, or permanent positions. Among citizens of European countries, there is higher interest in longer-term relocations for moves within Europe than to the US. The level of development of a country is not necessarily the most important reason for wanting longer-term stays in the US or Europe. Individuals from Central and Eastern European countries, which generally are said to have lower wage and development levels than countries in the US or Western Europe, express among the

lowest interest in moving abroad to work in the US (for either academia or industry), slightly lower levels for working in industry in Europe, and similar levels to other countries/country groups for working in academia in Europe.

The final part of the analysis looked at life scientists' expectations as to whether moving abroad would lead to brain drain, return migration, or additional international moves. Most respondents felt that international mobility would make them more attractive in their home country. Scientists from very few countries expressed attitudes that lead to concerns about potential brain drain. Even among many developing countries, few scientists say that international migration makes them unlikely to return to their home country. Italy was an exception, in that many Italians felt they would not return, and cited uncompetitive hiring practices and a need to be within the 'network' to get a job as core reasons. This shows that it is not just the presence of the research infrastructure that matters, other aspects of the opportunity structure also influence brain drain. The Central and Eastern European countries also show some risk of brain drain, but the data is inconclusive, and likely due in part to the changes unique to each of these transition economies. The respondents from Poland, for example, were less likely to say they would not return.

Competitiveness and immigration are linked. The most competitive economies in one's field of work do have an advantage of also attracting people from other countries. Although competitiveness matters, it must also align with one's personal goals and preferences, and here other factors come into play and mean that the most competitive locations do not have a 'monopoly' on the scientific workforce. Most scientists wish to have international mobility as a stage of their career. Theory has suggested that brain drain is linked with human capital development, and that individuals from developing countries will move, with intentions to stay outside their home country permanently. The CiLS data presents a very different picture. It is one that recognizes that the sciences are increasingly internationalized and that new scientific as well as soft-skills and contacts are built by being abroad. It shows that most scientists view international mobility as a way to then better increase the contribution to science they can make in their home country. Brain drain seems to be a risk in very few countries, and where it does exist it is likely reflective of a highly underdeveloped biotech sector or other problems limiting equal opportunities for individuals to reach the desired job positions. The brain circulation discussion leads in the right direction but it does not go far enough. This is because it also needs to be recognized that the internationalization of the sciences, individual aspirations, including a desire to live in multiple countries, as well as to build skill-sets associated with international mobility. International moves are increasingly part of the life scientists' study or work trajectory in many countries of the world. The discussion surrounding scientific mobility therefore sets a more appropriate framework, in most cases, than that of brain drain and brain gain. The analysis also shows the importance in looking at the global competition for talent from a lens of competitiveness, that is the underlying drivers, and not of a strict competition.