

## Executive Summary

### **International mobility of human resources in science and technology is of growing importance...**

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*The scale and complexity of the migration of human resources in science and technology (HRST) are increasing*

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Alongside sustained growth in foreign direct investment (FDI), in trade and in the internationalisation of research and development (R&D), mobility of human resources in science and technology (HRST) has become a central aspect of globalisation. Migration of talent now plays an important role in shaping skilled labour forces throughout the OECD area.

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*Mobile talent contribute to the creation and diffusion of knowledge*

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The importance of mobility stems from its contribution to the creation and diffusion of knowledge. Not only does it aid in the production and dissemination of codified knowledge, it is also an important means of transmitting tacit knowledge. In the broadest sense, tacit knowledge is any knowledge that cannot be codified and transmitted as information through documentation, academic papers, lectures, conferences or other communication channels. Such knowledge is more effectively transferred among individuals with a common social context and physical proximity.

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*Economic incentives but also access to quality research infrastructure and to leading researchers drive mobility*

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Various factors contribute to the flows of the highly skilled. In addition to economic incentives, such as opportunities for better pay and career advancement and access to better research funding, mobile talent also seek higher quality research infrastructure, the opportunity to work with “star”

scientists and more freedom to debate. Less amenable to potential government policy, but still important, are family or personal ties that draw talent to certain locations.

### **... and can have important impacts on knowledge creation and diffusion...**

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*Mobile people diffuse knowledge directly and indirectly in their new location*

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Once in another country, people diffuse their knowledge. In the workplace, knowledge spreads to colleagues, especially those in close contact. Knowledge also spills over to geographically proximate individuals and organisations and can contribute to the emergence of local concentrations of activity. Mobile HRST also act as a vital complement to the transfer of knowledge through flows of goods and capital across borders.

### **... in both receiving and sending countries...**

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*Countries receiving inflows benefit from a variety of positive effects related to knowledge flows and R&D*

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For receiving countries, the inflow of talent has positive effects relating to knowledge flows, including the possibility of increased R&D and economic activity owing to the availability of additional skilled workers, improved knowledge flows and collaboration with sending countries, increased enrolments in graduate programmes, and potential firm and job creation by immigrant entrepreneurs. Mobility can help to link domestic firms to foreign knowledge and to stimulate spillovers from foreign R&D to local R&D units and the economy at large. At the same time, receiving countries must ensure that inflows of scientists and researchers do not delay reforms to policies that may be limiting the domestic supply of HRST.

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*Much of the literature on highly skilled emigration focuses on remittances and brain drain*

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For sending countries, work on the effects of emigration has often focused on migrant remittances and brain drain, with particular emphasis on the impact on developing countries. Remittances are an important source of income for many low- and middle-income households in developing countries. The main concerns about brain drain centre on the loss of productive labour and its

associated output, the fiscal cost of educating workers who then move abroad, and the potential impact on much-needed institutional development and structural change. However, these concerns must be balanced against the question of whether these researchers and scientists could have found productive employment at home.

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*But emigration of skilled workers can also spur human capital accumulation in the sending country*

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Emigration of skilled workers, such as researchers and scientists, can also be beneficial for creation and diffusion of knowledge in their country of origin. In particular, emigration possibilities may encourage the development of skills. In addition, when skilled individuals move to larger and “denser” economies they can benefit the sending country by producing “better” knowledge than they could at home, accumulating human capital faster and improving their productivity, thereby increasing the potential return flows of knowledge. This can increase the global stock of knowledge.

**... indicating that it is not necessarily a zero-sum game**

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*Brain circulation stimulates knowledge flows and builds links between locations*

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“Brain circulation” can stimulate knowledge transfer to sending countries. This may mean the return of skilled migrants to their home country after a period abroad, or a pattern of temporary and circular migration between home and abroad. Professionals diffuse the knowledge they acquire to their home country and maintain networks, thereby facilitating continuing knowledge exchange. To make the most of brain circulation, the home country needs to have sufficient absorptive capacity, and returning talents need to be able to re-enter local labour markets at a level that is appropriate for their skills and knowledge.

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*A country’s diaspora can also act as a conduit...*

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The existence of a diaspora further enhances the transfer of knowledge. A stock of skilled HRST abroad can act as a conduit for flows of knowledge and information back to the home country, and social and other links increase the probability that knowledge will continue to flow back even after individuals move back or move away. In some emerging economies, diaspora networks play a vital role in developing science and technology capacity.

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*... so that all countries can benefit*

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Taken together, these effects suggest that knowledge flows associated with the emigration of researchers and scientists can provide benefits to sending countries. The mobility of researchers therefore is not necessarily a zero-sum game in which receiving countries gain and sending countries lose.

## **International mobility patterns differ substantially across countries**

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*Most OECD countries are net beneficiaries of highly skilled migration...*

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Data on international mobility of HRST show that most OECD countries are net beneficiaries, with inflows exceeding outflows. The United States, Canada, Australia and France, in particular, have experienced strongly positive net inflows of tertiary-educated migrants.

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*... but there are significant variations*

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However, a more detailed picture reveals that, in relative terms, New Zealand and Ireland have experienced large outflows. In absolute terms, the United Kingdom and Germany have the highest number of skilled expatriates, while Luxembourg, Norway and the Slovak Republic have the fewest. For some countries, intra-OECD flows add substantially to the stock of highly skilled individuals. For other OECD countries, non-OECD migrants play a more important role, and the main sources are Asian, led by China, India and the Philippines.

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*Students are increasingly mobile as well*

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The international mobility of students is a further aspect of the internationalisation of HRST. OECD countries benefit from the inflow of talented students and scholars, and many now actively seek to attract foreign students. Benefits also occur when domestic students study abroad and gain knowledge and experience in another country. Data show that the number of students enrolled outside their country of citizenship has risen sharply since 1995.

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### *Return and circular migration is largely driven by family ties and employment opportunities*

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Return and circular flows of migrants add to the mobility picture. Data show a tendency for many “permanent” or long-term migrants to return to their country of origin. Return rates appear to be higher for skilled workers and for those from countries at a greater cultural, economic and geographic distance from the host country. This trend is consistent with the notion of a globalising labour market in which the mobility of skilled workers is affected by changes in relative labour market conditions. The decision to return is driven strongly by lifestyle and family considerations and the availability of attractive employment opportunities at home. For students, the considerations are similar.

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### *There is room for improving the collection of data*

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While recent years have seen major efforts to improve data on international stocks and flows of the highly skilled, difficulties relating to international comparability, to differing and/or insufficient disaggregation and to timeliness remain. Further work is needed if countries are to better understand patterns and changes in stocks and flows of scientists, engineers and researchers and the broader category of the highly skilled.

## **The evidence on the impact of international mobility is limited...**

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### *Direct evidence of the impact of mobility on innovation outcomes is hard to find*

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Quantitative evidence on the impact of mobility patterns is not readily available. Many variables and factors influence science and technology outcomes and are hard to disentangle. Nevertheless, data and information can be used to build a picture and to see some links between mobility and broader science and innovation outcomes.

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### *Mobility is clearly leading to greater internationalisation of the labour market*

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A clear effect of the mobility of highly skilled workers is the increasing internationalisation of the labour market for the highly skilled. Both in private industry and academia, foreign staff are sought for their specific knowledge or abilities, their language skills and their knowledge of foreign markets.

## **... but points to a range of positive impacts on knowledge creation and diffusion**

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*Some evidence suggests that immigrant HRST contribute strongly to innovation*

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The links between mobility and innovation are less clear, although some evidence suggests that immigrants contribute strongly to patent applications and creation of technology firms. Studies from several countries highlight a trend towards more international co-authorship of academic articles. Some work suggests that the impact of collaborative work, as measured by citations, is higher than the average impact of national work.

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*Mobility opportunities are growing*

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In the broader context of R&D and innovation activity, many countries have greatly improved their ability to exploit and perform research and innovation over the past decade. This is changing the geographical spread and intensity of research and scientific activity. The growing sums spent on R&D in non-OECD countries and their human capital resources, coupled with the increasingly internationalised activities of technology firms, all suggest that the opportunities for talent mobility will continue to grow.

## **A wide range of policies aim at attracting and retaining HRST...**

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*Most countries offer a range of policies*

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OECD policies reveal a wide range of “intensity” in countries’ approach to the mobility of HRST. Most countries see it as important in a context of retaining and attracting talent and have policies to encourage and assist mobility. These range from economic incentives to encourage inflows, immigration-oriented assistance, procedures for recognising foreign qualifications, social and cultural support, and support for research abroad. Some countries focus on just a few policy mechanisms, while others offer “something for everyone”.

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*However, few have a specific mobility strategy*

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Only a few countries’ policy approaches are part of an explicit mobility strategy. For those in which policies are not part of such a strategy, there is a greater risk of incoherence among policies on inflows, outflows and the diaspora. Ideally,

mobility policies should be part of a wider mobility strategy that contributes to the country's economic and social objectives and sets out the rationale for intervention. There is generally more support for inflows of researchers and other HRST than for outflows, perhaps because countries judge outward mobility to be adequate or because they are reluctant to encourage outward mobility, despite arguments about the benefits of brain circulation.

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### *National policies generally target the same HRST...*

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National policies appear generally to target the same population, with little orientation towards national scientific and technological interests. Since many countries offer support for mobility, as opposed to permanent migration, researchers may use these policies to work in a number of countries. It is difficult to know if the similarity of mobility policies represents a move towards best practice, as few policies have been evaluated.

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### *... and most do not impose geographical restrictions*

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In most cases, national policies do not place restrictions on the country of origin (inward mobility) or of destination (outward mobility). In theory, then, mobility policies often have a global focus.

## **Policy for the future**

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### *What should future mobility policy look like?*

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OECD countries already have a wide selection of policy tools at their disposal, which they use more or less intensively to promote HRST mobility. The question then is, what is the role for international mobility policy in the future, given what is known about mobility and knowledge flows and about current mobility, R&D and innovation patterns?

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### *Identifying a clear rationale for intervention is the first step*

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In designing future mobility policies, a key first step is to identify a rationale for intervention and clear objectives. For mobility, the main rationale may be the potential positive externalities from knowledge spillovers and information asymmetry issues. The obstacles to mobility commonly cited include legal and administrative barriers, lack of funding, personal issues and language.

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*As many mobility policies have not been evaluated, best practice has yet to emerge*

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Few policies have been evaluated, so it is difficult to point to best practices. However, some lessons can be drawn from evaluation material provided by countries in response to the OECD questionnaire, including the importance of setting appropriate funding levels and programme durations for the target population. More work on evaluation would be valuable.

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*Removing barriers to circular mobility and fostering the diaspora may prove fruitful*

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Given differences among countries, it is not possible to identify a “recipe” for what governments should do more of, what they should do less of, and what should stay the same. One promising avenue, however, is removal of barriers to short-term and circular mobility. Shorter (and potentially repeated) periods abroad may avoid some of the obstacles that currently hinder mobility, and would support knowledge flows associated with brain circulation and the diaspora.

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*Countries must ensure that the broad environment for science and innovation is sound*

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Moreover, policy coherence is important not only for mobility policies but also to ensure that the broader environment for innovation and scientific endeavour is sound. In particular, to improve innovation outcomes, it is not sufficient simply to increase the number of HRST; these people must operate in a system that enables them to use, create and disseminate knowledge.

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*Countries should also remove obstacles to the domestic supply of HRST*

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Finally, an important message from this study is that the global competition for talent is growing. Many OECD countries and a growing range of non-member economies aim to attract the same pool of highly skilled researchers and scientists. Relying extensively on international flows and mobility policies to fill existing or future gaps in supply may therefore entail risks. Policy will also need to focus on addressing shortcomings in national policies that may limit the supply of HRST.



# Table of Contents

<b>Executive Summary</b> .....	9
<b>Chapter 1. Introduction</b> .....	17
References .....	20
<b>Chapter 2. Knowledge Diffusion and Impacts of International Mobility</b> .....	21
Why is mobility important? .....	22
What induces mobility? .....	23
How does mobility spread knowledge? .....	26
How much knowledge moves? .....	32
The effect on the receiving country .....	35
The effect on the sending country .....	39
Highly skilled immigration and world welfare .....	59
Summary .....	61
Notes .....	61
References .....	62
<b>Chapter 3. Mobility and Its Impact: Data and Evidence</b> .....	67
Patterns of mobility .....	69
Impact .....	100
Outlook – the internationalisation of R&D .....	111
Summary .....	115
Notes .....	116
References .....	116
<b>Chapter 4. Current Policy Approaches</b> .....	121
Mobility strategies .....	122
Overview of policies .....	126
Discussion of national-level policies .....	136
Policy at the institutional level .....	141
Summary .....	142
Notes .....	144
References .....	144

Chapter 5. <b>Looking Ahead: Mobility Policy</b> .....	145
Establishing the rationale for government intervention .....	146
What role for mobility policy? .....	151
Policy coherence .....	156
Summary .....	163
Note .....	164
References .....	164

### List of Boxes

2.1. Immigrants' labour market performance in OECD countries – recent trends .....	36
2.2. Labour market impact of migrants .....	37
2.3. Open innovation .....	39
2.4. Further impacts of emigration on developing countries .....	42
2.5. Brain circulation: Korea's ICT .....	48
2.6. Networks .....	49
2.7. Innovation capability – a measure of absorptive capacity .....	52
2.8. Diaspora at work .....	57
2.9. Supporting the diaspora in developing countries .....	58
3.1. Data availability and limitations .....	68
3.2. The migration of academics and scientists: recent evidence from Australia .....	70
3.3. Attitudes to mobility in Europe: the 2005 Eurobarometer survey ..	98
4.1. Other policy options to facilitate mobility .....	132
4.2. Further mobility policy examples (1) .....	133
4.3. Further mobility policy examples (2) .....	135
5.1. Market failure .....	147
5.2. Evaluation of current mobility policies .....	153
5.3. Encouraging innovation – policy levers .....	157
5.4. Migration and development – some policy proposals for Europe	160

### List of Tables

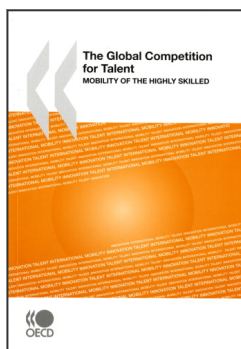
2.1. Reasons given by doctorate holders for coming to the United States over the last ten years, 2003 .....	25
2.2. Possible effects of highly skilled international migration on receiving countries .....	38
2.3. Possible effects of highly skilled international migration on sending countries .....	43
2.4. Level of diaspora engagement based on country conditions and diaspora characteristics .....	56

3.1. Expatriates in OECD countries, highly skilled, by OECD country of birth, 2001 .....	73
3.2. Share of science professionals in tertiary-educated workers, circa 2000 .....	80
3.3. International students in Korea, 2006 .....	85
3.4. Foreign students in Japan, 1985-2006 .....	86
3.5. Foreign students in China, 2005 .....	88
3.6. Percentage of the foreign-born population with a duration of stay of ten or more years .....	91
3.7. Percentage of recent doctorate holders having declared their intention to move out of the country in the next year ....	95
3.8. Percentage of temporary residents who received US S&E doctorates in 1998 and were in the United States, 1999-2003 ...	96
3.9. US inflows of highly skilled workers .....	101
3.10. Indicators of international collaboration for major S&E publishing centres .....	106
3.11. Change in international collaboration in the United Kingdom, 1996-2000 to 2001-05 .....	108
3.12. Average impact of national papers and co-authored papers, 2001-05 .....	110
4.1. Mobility strategies .....	124
4.2. Economic incentives for inflows of HRST .....	127
4.3. Immigration policy to facilitate inflows of HRST .....	128
4.4. Recognition of foreign qualifications to facilitate inflows of HRST .....	129
4.5. Social and cultural support to facilitate inflows of HRST .....	130
4.6. Policies to facilitate research abroad (outflows of HRST) .....	131

### List of Figures

3.1. Expatriates in OECD countries, as a percentage of all native-born, by OECD country of birth, 2001 .....	72
3.2. Distribution of expatriates by skill level and country of origin, 2001 .....	73
3.3. Main OECD destinations of OECD-born highly skilled expatriates, 2001 .....	74
3.4. Percentage of immigrants in OECD countries with tertiary education .....	75
3.5. Highly skilled migrants from OECD and non-OECD countries, by OECD country of residence, 2001 .....	76
3.6. Share of foreign-born in HRST aged 25-64, in EU27 and selected countries, 2006 .....	77
3.7. Foreign born highly skilled expatriates in OECD countries, by country of origin, 2001 .....	78

3.8. Immigrant and emigrant population 15 years and over with a tertiary education in OECD countries, 2001 .....	79
3.9. Foreign-born doctorate holders as a percentage of total doctorate holders, 2001 .....	80
3.10. Expatriation rates of the highly skilled to the OECD, 2001 .....	81
3.11. Number of students enrolled outside their country of citizenship, 1975-2005 .....	84
3.12. Students from non-OECD economies enrolled in tertiary education in OECD countries, 2004 .....	86
3.13. International students in advanced research programmes, 2005 .....	87
3.14. International students by field of education, 2005 .....	88
3.15. Immigrant-founded start-ups in US technology centres, 1995-2005 .....	91
3.16. Foreign science and engineering doctorates who intend to stay in the United States, 2000-03 .....	97
3.17. Post-graduation plans of Korean doctorate recipients from US universities in science and engineering fields .....	98
3.18. Percentage change in permanent academic staff in UK universities, by nationality, 1995/96 to 2003/04 .....	101
3.19. Share of highly cited researchers with research experience outside of their home country .....	103
3.20. Patents with foreign co-inventors .....	105
3.21. US S&E articles (whole counts) with at least one author at a top 200 research university and one author at a foreign institution .....	107
3.22. Relationship of foreign-born US S&E doctorate recipients to their country's scientific collaboration with the United States ..	107
3.23. Co-authorship network in "Superconductivity and quantum computing" .....	109
3.24. R&D intensity, 2006 and evolution of GDP expenditure on R&D, 1996-2006 .....	112
3.25. Gross expenditure on R&D (GERD), 2006 .....	114



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