



## Research and Development: Going Global

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### Introduction

The unprecedented pace and scale of today's globalisation process has attracted much attention in recent years. Globalisation is having a particularly large impact on innovation. The scope for global collaboration is increasing as more of the world's regions possess important research and innovation capabilities. So while the United States, the European Union and Japan have so far been the leaders in this respect, countries such as China and India have a growing research and innovation capacity.

This has become a major reason for companies to locate research and development (R&D) outside the home country. While corporate R&D activities are still carried out predominately in the home country, companies are changing how they innovate and building globally distributed R&D (and innovation) networks. Innovation strategies of companies increasingly depend on global sourcing to sense new market and technology trends worldwide, as global competition has forced companies to innovate and to develop commercially viable products and services faster. The knowledge needed to do so has become more multidisciplinary and more broadly located, making innovation more expensive and riskier.

The internationalisation of R&D is not entirely new: in the 1980s, R&D investments mainly took place between developed countries, often through mergers and acquisitions (M&As). The current internationalisation of R&D has three distinguishing characteristics: it is gathering pace because of the often greenfield investments of multinational enterprises (MNEs), it is spreading to more countries, including developing countries, and it goes beyond adapting technology to local conditions. The internationalisation of R&D and the redistribution of R&D capabilities are in many cases part of firms' broader strategic decisions on production, marketing and M&As. This *Policy Brief* looks at the changing R&D landscape and its implications for business and government policy. ■

### How is globalisation affecting R&D?

R&D has long been one of the least mobile activities of MNEs, largely because of the complex and “tacit” nature of much technological knowledge – a person’s knowledge and experience are personal to them, and are therefore not easy to transfer to someone else. So some knowledge is not easily transferable; it remains linked to a specific location. Because of economies of scale and scope in R&D, the dispersion of R&D across various locations also prevented R&D laboratories from reaching critical mass and reduced synergies among a company’s various R&D projects. Finally, a company’s competitive advantage is often directly related to that of its home country and as such is strongly shaped by that country’s industrial specialisations and national innovation systems, including its accumulated research and labour force skills.

These centripetal forces seem to be increasingly counterbalanced by centrifugal forces favouring the geographical decentralisation of R&D. The rising cost and risk of R&D (because of its increasingly multidisciplinary character and growing complexity) and the growing global competition in innovation have led firms to aim at reducing R&D costs while speeding up the development process. This has led companies to source technology and knowledge from abroad and rely more on external sources of innovation. The increasing globalisation of science and technology capabilities and the larger number of locations with attractive science and technology bases have widened the opportunities for R&D-investment abroad.

New technological opportunities, notably ICT, are among the main drivers of the internationalisation process as these have enabled new ways of collaboration and have led to greater specialisation in the global innovation system. Advances in ICT have also facilitated the management of dispersed innovative activities and enabled the outsourcing of R&D. For instance, developments in the codification and standardization of R&D processes have increased the possibilities to segment R&D activities and disperse R&D stages over different locations. ■

### What is the role of multinationals?

Foreign Direct Investment (FDI) plays a major role in the internationalisation of R&D, and MNEs are the main actors. More than 95% of the 700 firms worldwide with the largest R&D expenditure are MNEs; they account for close to half of the world’s total R&D expenditure and more than two-thirds of the world’s business R&D. The top R&D-performing MNEs often spend more on R&D than many nation states and their presence is felt not only through activities in their home countries but also increasingly abroad.

Recent evidence shows that the top spenders on R&D have increasingly invested in R&D outside their home country. Following the fragmentation of the value chain and the resulting internationalisation of manufacturing, MNEs now increasingly establish R&D facilities at many locations worldwide. A survey by the UN Conference on Trade and Development (UNCTAD) of the largest investors in R&D suggests that the pace of internationalisation in R&D is accelerating. As many as 69% of the responding firms stated that their share of foreign R&D is set to increase (only 2% indicated a decline and the remaining 29% expected the level of internationalisation to remain unchanged).

These survey results are confirmed by more systematically gathered data on outward R&D investment of MNEs. For countries for which data are available, R&D performed abroad has increased since 1995 relative to R&D performed at home (Figure 1). The only exception is Switzerland which has

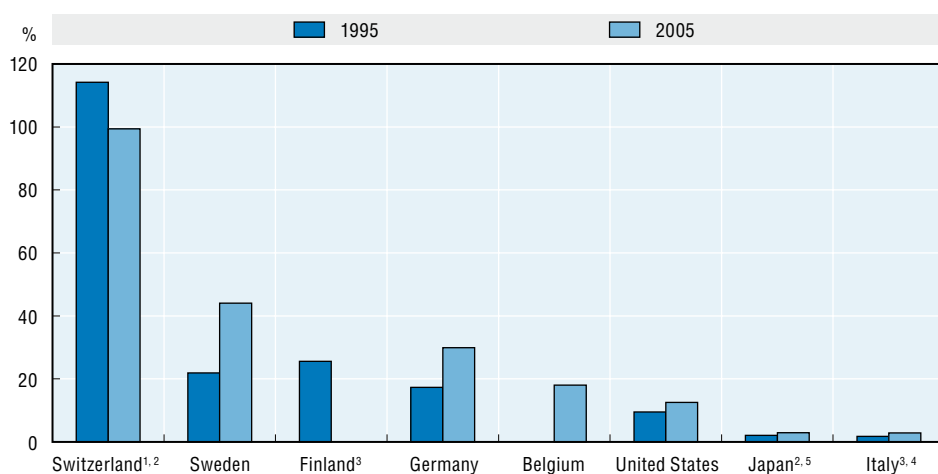
seen a slight decrease, but Swiss affiliates abroad still do as much research as all companies inside Switzerland. The share of R&D investments abroad is smaller in other countries but still over 20% in Germany, Finland and Sweden. However, some authors have pointed out that R&D establishments abroad may be acquired “incidentally” through mergers and acquisitions whose main objective was not access to R&D. Assessing the importance of such “incidental” internationalisation of R&D is difficult as data on R&D facilities abroad that distinguish between M&As and greenfield investment are not readily available. ■

**Which countries are attracting R&D investment?**

Most R&D investment still goes to OECD countries, and the United States is the most important receiving country. In the OECD area, the largest cross-border flows of R&D take place between the three main regions: the United States, the European Union and Japan. US multinationals placed over USD 17 billion of their foreign investment in R&D in the European Union and USD 1.7 billion in Japan in 2005. The European Union invested USD 19.1 billion in the United States and USD 3.9 billion in Japan. The United States was a net exporter of R&D to the EU in the late 1990s, but in the early 2000s European firms established more foreign R&D affiliates in the United States. Japan invested only USD 1.1 billion in the United States and USD 0.7 billion in the EU.

While most internationalisation of R&D by MNEs still takes place within the main OECD regions, emerging countries increasingly attract R&D investments although these remain relatively small in a global perspective. A 2007 study by the Economist Intelligence Unit of more than 300 senior executives identified India (26% of respondents), the United States (22%) and China (14%) as the most attractive overseas locations for R&D. The Asia-Pacific region, in particular, is expected to attract more offshore R&D over the next three years: 30% of respondents planned a substantial increase in their investment there.

**Figure 1.**  
BUSINESS R&D EXPENDITURE BY AFFILIATES ABROAD AS % OF DOMESTIC R&D



1. 1996.  
2. 2004.  
3. 1998.  
4. 2003.  
5. 1997.

Source: OECD, AFA database, January 2008.

The large increases in foreign R&D investment in developing Asia and particularly in China and India have attracted much attention in recent years. According to official Chinese statistics, 1160 foreign R&D centres had been established in China by the end of 2007, most of them after 2001. Other surveys and studies, including by the OECD, present lower figures. Japanese-based manufacturing companies increasingly base their foreign R&D centres in China, with an increase of over 400% from 2000 to 2004, compared to a 36% increase in EU15 and 23% in North America. In absolute terms, China had 67 Japanese R&D centres in 2004 and the EU15 had 60.

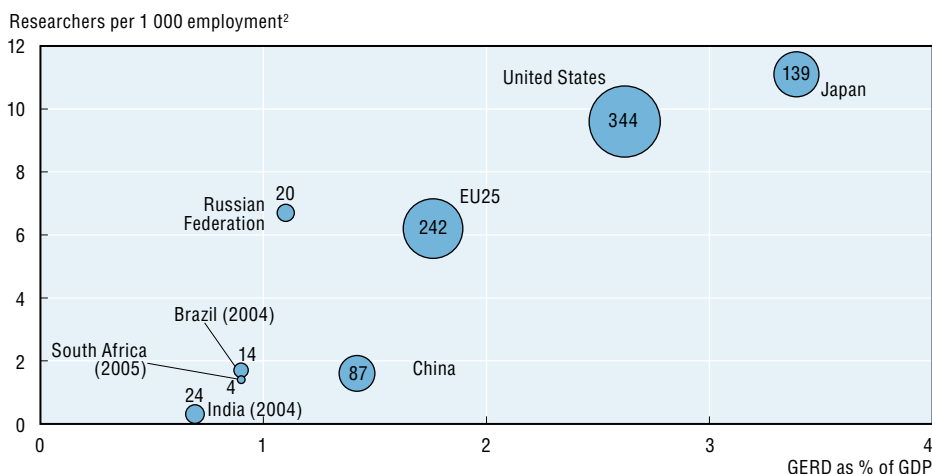
This shift towards emerging countries is expected to continue, as demonstrated by the findings on future R&D investments in a survey by the UN Conference on Trade and Development (UNCTAD). China was the location mentioned most often, followed by the United States. India was in third place, and Russia was also among the top ten target locations. Other emerging economies named were Singapore, Chinese Taipei and Thailand.

But the investment trend is not only from the developed to the developing world. MNEs with headquarters in the developing world have recently started to set up foreign R&D affiliates. For Chinese firms alone, 37 R&D units were located abroad in 2006, of which 26 were in developed countries (11 in the United States and 11 in Europe). Companies from developing countries have recently also purchased western companies, often to gain access to intellectual property or markets. ■

**Are there new reasons for taking R&D abroad?**

The traditional motive of FDI in R&D is to serve as a conduit for exploiting intellectual assets developed in the MNE's home country. Accordingly, R&D in affiliates abroad is adaptive, designed to customise technologies developed in the home country to fit local conditions. Motives for decentralising this type of R&D are primarily demand-oriented and related to market proximity. Technological knowledge tends to flow from the parent firm's laboratory to the foreign-based facility so that the affiliate's technological advantages primarily reflect those of the home country (where core innovation activities continue to be concentrated) while foreign R&D units tend to exploit the parent company's technologies.

**Figure 2.**  
GLOBAL SUPPLY OF S&T CAPABILITIES  
Global investments in R&D, 2006<sup>1</sup>



1. The size of the bubble represents R&D expenditure in billions of current USD in PPP;  
2. For researchers per 1 000 persons employed: India 2000, Brazil, United States and South Africa: 2005

In recent years, owing to changes in the competitive, international and technological environment, MNEs have complemented this decentralised, adaptive R&D with more innovative R&D abroad. Innovation strategies increasingly use global sourcing to tap into new market and technology trends worldwide and to develop new ideas which they then implement worldwide. Knowledge is more likely to flow from foreign units to the parent company if the foreign affiliates undertake asset-augmenting R&D activities that generate knowledge that is valuable for the rest of the organisation. To absorb local sources of knowledge, foreign subsidiaries need to be embedded in the host country's innovation system but also in the firm's organisational network.

The shift towards subsidiaries that are actively engaged not simply in incremental, adaptive R&D but also in radical innovation reflects the increasing importance of supply-related location factors and the presence of scientific and technological skills. Location decisions for these kinds of R&D facilities are related to the host country's technological infrastructure, the presence of other firms and institutions that may create benefits which investing firms can absorb, access to trained personnel, established links with universities or government institutions, the existence of an appropriate infrastructure for specific kinds of research, etc.

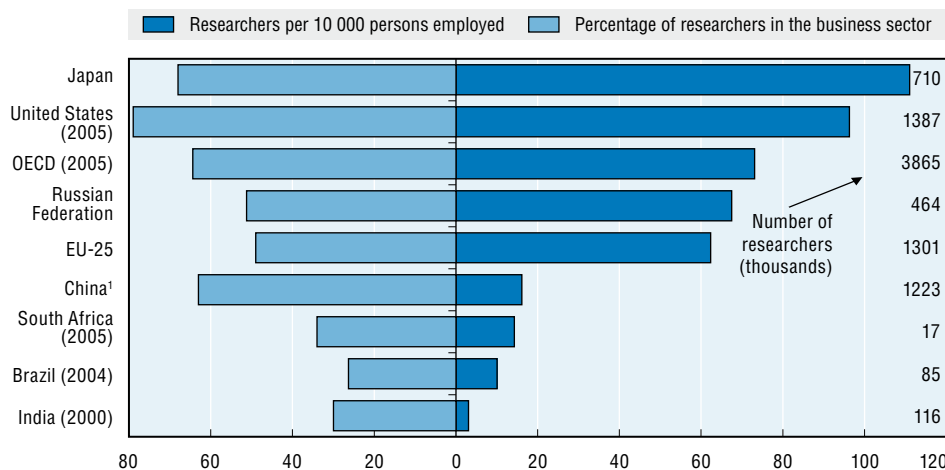
The distinction between adaptive and innovative R&D centres seems clear in theory, but may be less so in the real world. A wide range of empirical studies indicate that both demand and supply motivations are behind the location of R&D activities in host countries, but that technology-sourcing motivations are on the rise. ■

**Why locate R&D in emerging countries?**

Surveys indicate that China and India, among others, are now considered very attractive locations for future investment because of their large and rapidly growing markets and their large pools of qualified workers with relatively low labour costs (although they are rising). They combine low wages and a good education system with a large mass of well-trained researchers. Typically, while the number of R&D personnel as well as R&D investments in emerging countries may look small in relative terms, the absolute numbers give a different picture (Figure 2). In China, for example,

Figure 2. (cont.)

**GLOBAL SUPPLY OF S&T CAPABILITIES**  
**Researchers, 2006**



1. Data for scientists and engineers rather than researchers; overestimation possible.

only a small proportion of the population has a tertiary degree, but in absolute numbers enrolments and graduates from tertiary education in China match those in the United States and the EU. Nevertheless, enrolments in and graduations from advanced research programmes such as the PhD are still low in China compared to other countries. Recent evidence on the suitability of new graduates from China and India for work in internationally active MNEs, based on interviews with human resource managers, indicates that on average only 13% of the potential talent supply in low-wage countries is suitable for employment by MNEs.

The attractive cost and availability of researchers in emerging countries are clearly important new drivers for the internationalisation of R&D. Just as the internationalisation of manufacturing had important cost advantages, the internationalisation of R&D is also motivated to some extent by cost-cutting and the outsourcing of activities and location of R&D in countries with low costs. However, the reason seems less to be lower wages per se than an available pool of skilled scientists and engineers. A survey on the reasons for locating MNEs' R&D in developed and emerging countries (Thursby and Thursby, 2006) confirms the complexity of R&D location decisions in both. The results generally indicate that growth potential, quality of R&D talent and collaboration with universities were crucial factors for locating R&D in developed countries. The same three factors, not low costs, were also important for locating R&D in emerging countries.

Emerging countries also display some important drawbacks, such as inadequate enforcement of intellectual property rights (IPR). Although China has strengthened its IPR regime through stricter laws and regulations, enforcement remains a problem (OECD *Reviews of Innovation Policy: China*, forthcoming 2008). While India has improved its IPR regime, the protection of intellectual property remains weak in some areas owing to inadequate laws and ineffective enforcement. Previous OECD work has shown that stronger IPR helps attract foreign multinationals, which can strengthen domestic capabilities. In trying to explain why MNEs set up foreign R&D affiliates in emerging countries with weak IPR regimes, UNCTAD and OECD studies have found that these R&D activities often focus on technologies that are typically used in combination with complementary technologies. In the absence of the latter, local technology leakage does not pose a major threat. ■

### Where do we go from here?

Changes in the investment behaviour of MNEs reflect the changing landscape of innovation and the increasingly global supply of science and technology resources and capabilities. The internationalisation of business R&D is part of the broader process of internationalisation of innovation and science, human resources and technology co-operation. Complex policy issues therefore arise, since innovation policy instruments such as R&D support, education and training policies, and infrastructure policies are predominantly national in scope. The challenge for governments is to adjust national policies in light of increasingly international innovation networks.

Overall, the internationalisation of innovative activities can bring substantial benefits, e.g. greater cost efficiency in the innovation process, greater ability to learn about innovation conducted by other companies/institutions, a reduced time length before commercialisation and a positive impact on the innovation capacity of the own firm. At the same time, concerns are raised in many countries, notably the possible erosion of home based innovative activities by off-shoring and outsourcing abroad that could result in a reduced

capacity to absorb knowledge and technologies developed abroad. This concern is particularly strong for smaller countries that may not have the critical mass for research and too small a market. Some OECD countries, as well as many developing countries fear being marginalised in this process.

The policy responses are typically aimed at transforming the national innovation system so as to embrace the global division of labour in R&D and to specialise in local strengths. This can be achieved by strengthening the local innovation system and by supporting capabilities to acquire and assimilate knowledge and technologies developed elsewhere in the world.

The policy response to these challenges needs to take account of the current nature of the globalisation process and to build on individual countries' strengths. The key elements for action include:

- **Excellent framework conditions.** Political stability, public infra-structure, market size and development, tax rates and labour market conditions are key factors in locating R&D.
- **An excellent innovation system based on local strengths.** A strong and vibrant research base, effective protection of IPR and a well-trained workforce are major determinants of MNEs' investment in R&D and promoting the growth of domestic enterprises.
- **Stronger international linkages.** This involves supporting the inter-nationalisation of public research organisations, fostering the inter-national mobility of researchers, and linking domestic firms to foreign sources of innovation. It may also require opening R&D funding and programmes in OECD countries to foreign firms and research institutes.
- **Policy coherence.** This involves co-ordination across various policy areas (education, science and innovation, but also macroeconomic, trade, fiscal, competition, development and employment policies) as well as vertical co-ordination at regional, national and inter-national levels of governance.

Effective policies should respond not only to national concerns in terms of attractiveness and competitiveness, but also to global challenges. Turning the internationalisation of R&D into a global win-win situation will require a stronger policy focus on:

- Encouraging "brain circulation" and "brain connection" to make researchers more mobile and working together more.
- Embedding inward and outward foreign direct investment in R&D in the local environment and thus fostering inward and outward spillovers.
- Enhancing the exploitation of home-based knowledge in developing countries in response to global challenges and development objectives.
- Strengthening the relevance of international collaboration by focusing on thematic priorities in fields of worldwide importance. ■

**For further  
information**

For more information on the OECD's work on the internationalisation of R&D, please contact

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### For further reading

OECD (2006), **Science, Technology and Industry Outlook**, Chapter 4  
"The internationalisation of R&D", ISBN 978-92-64-02848-7, € 80, 250 pages.

OECD (2007), **Science, Technology and Industry Scoreboard 2007**, available at  
[www.oecd.org/sti/scoreboard](http://www.oecd.org/sti/scoreboard).

OECD (2007), **Staying Competitive in the Global Economy: Moving up the Value Chain**, ISBN 978-92-64-03365-8, € 35, 126 pages.

OECD (2008), **The Internationalisation of Business R&D: Evidence, Impacts and Implications**, ISBN 978-92-64-04404-3, € 35, 108 pages.

Or visit: [www.oecd.org/sti/stpolicy](http://www.oecd.org/sti/stpolicy).

Thursby, J. and M. Thursby (2006). **"Here or There? A Survey of Factors in Multinational R&D Location and IP Protection"**, Marion Ewing Kauffman Foundation, Washington, DC.

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