

# EXECUTIVE SUMMARY: INTERNATIONAL COMPARATIVE PERFORMANCE OF THE UK RESEARCH BASE - 2011

## **UK research is high-quality and efficient**

The UK is a leading research nation in the world in terms of the number of articles that it publishes annually. It is also a leading research nation in the world in terms of the usage and citation of those articles, both of which indicate that its articles are high quality. While the UK has far fewer researchers than larger countries such as the US and China, as a country, it is far more efficient in terms of output per researcher: of the top five research nations (based on article output in 2010: US, China, UK, Japan, Germany), UK researchers generate more articles per researcher, more citations per researcher, and more usage per article authored as measured by global downloads of UK articles.

Similarly, while the UK spends far less in absolute terms on research than the US, China, Japan and Germany, recent trends indicate that it is becoming more efficient than all four in terms of output per unit spent. The UK is also becoming even more efficient over time in terms of output per researcher and per unit of research spend. The UK is the clear leader among all eight comparator countries (Canada, China, France, Germany, Italy, Japan, UK, US) on citations per unit spend on Gross Expenditure on Research & Development (GERD).

The UK's volume of articles published has grown by 2.9% per year since 2006, which is lower than the world average growth of 4% per year. As a result the UK's share of articles published declined slightly from 6.7% in 2006 to 6.4% in 2010. Conversely, in the same period citations to UK articles increased at 7.2% per year, faster than the world average of 6.3% per year. As a result the UK's share of global citations increased from 10.5% to 10.9%. The UK's share of the world's top 1% of most highly cited papers, which indicates its share of the highest quality published research, was 13.8% in 2010, 2nd only to the US.

The UK's field-weighted citation impact, an indicator of quality that adjusts for differing citation practices in different subject fields and therefore of the different subject emphases of comparator countries, is 2nd only to and

closing in on the US among the comparator group. Within the UK, its constituent countries reflect the UK's overall positive trend in field-weighted citation, while Scotland shows a modest increase in article share relative to England, Wales and Northern Ireland.

## **UK research is mobile and international**

The UK researcher population is highly mobile internationally: almost 63% of researchers that are or have been affiliated with UK institutions have also published articles while working at institutions outside the UK. Researchers who have returned to the UK after an extended time abroad are significantly more productive in terms of articles published than those who have never left the UK. The UK's leading position in terms of research efficiency is therefore in part due to its effectiveness in attracting productive and internationally mobile researchers to work in the UK, both those that began their research careers in the UK and those that began them elsewhere.

While the UK's researcher population is growing more slowly than the global average, it is fluid, dynamic and internationally collaborative: nearly 31% of all researchers that published work while affiliated with UK institutions during the period from 1996-2010 stayed in the UK for less than two years before moving abroad. These researchers, who were also more productive than average, were primarily senior and most often came from the US.

The proportion of UK researchers that publish articles with non-UK researchers is high and rising, reaching 46% in 2010. This proportion is far higher than in most other research-intensive nations and also accounts for the UK's high number of citations per researcher, because articles that have co-authors residing in more than one country are more highly cited. UK-based researchers' ability to move internationally and to collaborate with non UK researchers are therefore key drivers of the UK's leading global position in terms of research efficiency. Countries that the UK collaborates with also publish high-quality research which benefits those countries and the UK.

### **UK research is well-rounded**

The UK's Activity Index (i.e. outputs of research papers) reveals the disciplinary emphasis of its research efforts versus the global average. Relative to the world average, the UK has generally a well rounded portfolio, with a strong and increasing emphasis in clinical sciences, health & medical sciences, social sciences, business and humanities. In the biological sciences and environmental science the UK's publishing activity, although relatively strong, fell back closer to the world average from 2000 to 2010. In mathematics, physical sciences and engineering the UK has a lesser focus, although its articles in these fields are cited considerably more than the global average. The UK's field-weighted citation impact shows the UK to perform better than the world average in all subject fields. Moreover, the UK's strong citation performance relative to the world average grew in all disciplines over the period 2000 to 2010.

### **UK research has mixed performance in knowledge transfer**

In contrast to the UK's leading position in terms of articles published, and the usage and citations of those articles, UK researchers have a low and declining share of patents compared with other research-intensive nations. This probably reflects the relatively lower research spend in business enterprise as a proportion of UK research spend (GERD) compared to countries where patenting activity is high. While UK researchers move freely between the academic and corporate sectors, the UK's proportion of articles that are co-authored by researchers in both academic and corporate sectors is relatively low (1.3%) compared to other major countries. However, high usage by R&D-intensive corporations of articles authored by academic researchers suggests a productive knowledge flow between academic and corporate sectors.

### **UK research has some potential areas of vulnerability**

While the UK is a world leader in terms of article and citation output per researcher and per unit of spend, its leadership position may be threatened by its declining

share of researchers globally, and by its declining share of global spending on research. For while the number of UK researchers and the UK's spending on research are both growing in absolute terms, the growth rates of both are being outstripped by the growth rate of the global averages.

There are over four hundred niche areas of research in which the UK is distinctively strong. However, interviews with leading researchers in selected areas of strength (cognitive neuroscience, ecology, computer science, languages and education) revealed concerns about the difficulty of recruiting high quality post-graduate students. While thus far the UK has been highly effective in developing domestic and attracting non-domestic researchers, it is potentially at risk of falling behind relative to other research-intensive nations, especially when the relatively low underlying growth in the population and labour force are considered. Inability to develop, attract and retain enough researchers may have negative consequences for national R&D capacity.

In terms of spending on research, UK GERD is increasing but also remains below that of several key comparator countries both proportionally and in absolute terms. The UK's world share of GERD fell from 3.7% in 2006 to 3.0% in 2010. By contrast, China's share increased from 8.9% to 13.3% over the same period. Inability to sustain R&D spending at levels comparable to the global average may also have consequences for the UK's future research performance relative to other countries.

### **Summary**

The UK is a world leader in research, and is a world leader in terms of article and citation output, both per researcher and per unit of research spending. However, the global landscape of research is fluid, dynamic and intensely competitive. Other countries are outpacing the UK in terms of growth in number of researchers and spending on research. The UK is well positioned, but its ability to sustain its leadership position is far from inevitable.