



evidence

a division of Thomson Reuters

Bibliometric study of India's research output and international collaboration

A report commissioned on behalf of
Research Councils UK

June 2010

Contact details

Evidence, Thomson Reuters 103 Clarendon Road, Leeds, LS2 9DF
t/ 0113 384 5680
f/ 0113 384 5874
e/ scientific.enquiries.evidence@thomson.com

Evidence (<http://www.evidence.co.uk>) is a division of Thomson Reuters, incorporated under the laws of England and Wales (Registered No. 00756619, VAT registration: GB 796 39 0967), having its registered office at Aldgate House, 33 Aldgate High Street, London, EC3N 1DL, UK.

Disclaimer: Please note that while every effort has been made to ensure the information provided is accurate, the views and statements expressed are those of the authors and do not necessarily reflect those of RCUK.

Executive summary

This report was commissioned on behalf of Research Councils UK. It explores India's research in terms of the amount of activity taking place and the impact on the global research community. It also looks at India's collaboration internationally and, more specifically, with the UK.

The report uses bibliometric indicators, which are measures based on research publications, to perform these analyses. One key output of research is the publication of papers that describe the research and any conclusions that can be drawn. These papers are then cited by other authors – particularly if they describe important discoveries or contribute to a wider debate. Therefore the volume of papers published by a country is generally accepted as an indicator of research activity, and the volume of papers produced by co-authors from different countries as an indicator of collaboration between those countries. The number of citations that a paper receives is used as an index of the impact of a research paper on the wider research community. The average number of citations per paper is called the *citation impact* and can be used to evaluate the impact of a body of research. The citation impact is often calibrated to the global average for the relevant subject field and year. This puts the figures in context and allows data to be compared more easily.

The data presented here show that India's output of research papers although relatively low compared with other countries, is growing. They also show that India's share of global research paper output is growing. The result of this is that India, and other expanding research economies, will become increasingly important within the global research community and the observed growth should offer increased opportunities for collaboration.

While most of India's research papers are cited less than the global average, a significant proportion are more highly cited. Examination of trends over time also show that the mean number of citations Indian research papers receive is

increasing relative to the world average. Another observation is that collaboration with a UK co-author corresponds to higher average citation counts, suggesting a benefit to Indian research.

The USA is India's largest collaborator producing three-times more research co-authored papers with India than the UK. However, the USA's total output of research papers is nearer four-times higher than the UK's suggesting that, for its size, the UK competes well with the USA for Indian collaborative opportunities. However, Germany, which publishes slightly more co-authored papers with Indian researchers than the UK, would appear to represent a more significant competitor. Indeed the German Forschungszentrum Jülich produced a report in 2007 which also indicates that Germany is India's second largest collaborator¹.

While India and the UK collaborate on research which produces highly-cited research papers (those which are cited at least four times the world average) across a range of subjects the physical sciences are a particular strength. The data presented here also show that, in the UK, a diverse range of institutions are amongst those collaborating most frequently with India. This diversity of subject matter and institutions would imply a broad collaborative interface between the UK and India. This should place the UK in a strong position to take advantage of any new collaborative opportunities arising from India's growth in research base.

Key findings

- India's share of world papers and the relative number of citations these papers received have both increased in recent years. However, while India is currently ranked seventh in terms of total output of papers

¹ Mattermaier, B., Tunger, D., Burkard, U., Ramowsky, S., Lexis, H. (2007) *Bibliometric Analysis on the Scientific Output of India*. Forschungszentrum Jülich, Germany. Available online at: <http://www.kooperation-international.de/en/indien/themes/info/detail/data/1642/backpid/12/?PHPSESSID=f46f3edc685c6181987dffae83f98a9f>

within the group of countries selected by Research Councils UK for comparison, it remains tenth in terms of citation impact.

- India's output of research papers (and share of the total world output) has increased across all subjects. Citation impact has also increased across most subjects although it often lags behind other countries in the comparator group.
- While most of India's research is cited less frequently than word average it continues to improve and collaboration with the UK corresponds with an increase in impact to approximately world standard.
- In terms of overall collaboration across all subjects, the USA is India's largest partner by a sizeable margin followed by Germany and the UK. This pattern of collaboration has been consistent in every year between 1999 and 2008.
- The volume of papers which are cited at least four times the world average in different fields indicates that physical science subjects are particularly strong areas for India-UK collaboration. It is noteworthy that other fields, particularly medical, health and biological sciences, also produce a substantial volume of highly-cited research.
- A diverse range of UK institutions collaborate with India and the analysis of most frequent collaborators identifies several non-traditionally research intensive universities. The most frequent Indian institutions for collaborating with the UK are mostly research intensive universities and specialist research organizations. The analysis indicates that the Indian Institutes of Technology and Indian Institute of Science are particularly active collaborators with the UK.

Introduction and background

This report describes a study that *Evidence*, a Thomson Reuters business, performed for Research Councils UK using bibliometric indicators to investigate India's research in an international context and its international collaboration, particularly with the UK.

The study investigates the following aspects of India's research and collaboration:

- A comparison of the overall quantity and quality of Indian research compared with selected international countries
- An analysis of India's research performance broken down by subject area
- An overview of India's international collaboration and the subjects in which India collaborates most frequently with the UK
- The effect of collaboration with the UK on the quality of India's research
- An analysis of the Indian and UK institutes which most frequently participate in India-UK collaborative research broken down by subject area.

Bibliometrics and citation analysis

Bibliometrics are about publications and their citations. The field has emerged from information science and refers to analyses and methods used to study and index texts and information.

Journal papers (publications, sources) report research work. In this report the volume of research papers published by a country is used as an indicator of the volume of research taking place and the volume of co-authored papers is used as an indicator of collaboration between authors. If co-authors are located in different countries this can be taken as evidence of international collaboration.

Papers refer to or 'cite' earlier work relevant to the material being reported. New papers are cited in their turn. More highly-cited work is recognised as having a greater impact (interpreted as significance or influence in their field) and high citation rates correlate with other measures of research excellence. Citation analysis and content analysis are therefore commonly used bibliometric methods. Historically, bibliometric methods had been used to trace relationships amongst academic journal citations. Now, bibliometrics are increasingly important in indexing research performance.

The origins of citation analysis as a widespread tool of research performance can be traced to the mid-1950s, when Eugene Garfield proposed the concept of citation indexing and introduced the *Science Citation Index*, the *Social Sciences Citation Index* and the *Arts & Humanities Citation Index*, which were produced by the Institute of Scientific Information (currently part of the Healthcare and Science business of Thomson Reuters).

The data used by *Evidence* come from Thomson Reuters databases, including the Web of Science®, a single source collated to the same standard and therefore providing a level of comparability not found in other data. The data are also valuable because they can readily be disaggregated by field, by year, by country and by institution.

Data Sources

Evidence uses a range of publication data primarily from the databases of Thomson Reuters® as they maintain the most complete international data on research journal publications and their citations. The core data used by *Evidence* are the expanded Citation Indexes from which Thomson Reuters Web of Science®, which currently covers publications from over 11,000 of the most prestigious high impact research journals in the world, is derived. These are augmented by additional information on publication usage in universities derived from research and consultancy work by the company and its predecessors.

The constraint in using these data is that they refer only to journal articles and not to conference proceedings (although these can be collated) or to books and chapters in books. They therefore cover research activity in science and engineering better than in social sciences and humanities.

Starting in 2007 Thomson Reuters extended the coverage of regional journals in the Web of Science® adding over 1,500 titles. The journals that were added typically target a regional rather than international audience by approaching subjects from a local perspective or focusing on particular topics of regional interest. In addition to considering citation impact of journals the specificity of content is used as indicator of the importance of a regional journal as part of the selection criteria.

Comparator countries

For this report Research Councils UK specified that data should be shown for a comparator group of eight countries in addition to India and the UK. Therefore the ten countries for which data are given in this report are²: India, UK, USA, Germany, China, Japan, South Korea, France, Brazil and Australia. Data for the USA is not shown in charts of research paper output (sections 1.01 and 1.03). This is because the volume of publications produced by the US is so much larger than for other countries that it would require that the vertical axis be scaled in such a way as to effectively mask trends in the data.

Subject areas

For the purposes of this report analyses are broken down into ten broad subject areas: clinical, health and medically-related, biological sciences, environment, mathematics, physical sciences, engineering, social sciences, business and

² Standard UN three letter country codes are used in figures: India (IND), UK (GBR), USA (USA), Germany (DEU), China (CHN), Japan (JPN), South Korea (KOR), France (FRA), Brazil (BRA) and Australia (AUS)

humanities. Additionally, in section 2.03 the 250 Web of Science® journal categories are used to give a more detailed understanding of the picture of the fields in which India-UK collaboration results in highly cited research.

It should be noted that international research and development (R&D) databases have historically focussed on science and technology and therefore have some deficits in social sciences and humanities data.

Time period

The period generally covered by this report is the ten years from 1999 to 2008. This period was chosen as it focuses on current and emerging trends. However, in the overall analyses of research paper output and citation (sections 1.01 and 1.02) the period 1981 to 2008 was used to provide an historical context.

Summary of results

India has a relatively low share of global research publications although it is growing rapidly across all subject areas. This growth suggests that India, along with other emerging economies, will become increasingly important to the global research base and that opportunities to collaborate with Indian researchers will increase (sections 1.01 and 1.03).

The data also show that India's research is cited less frequently relative to other countries, and its average citation impact remains significantly below world average. However, a significant amount of Indian research is cited more than world average and over time the number of citations Indian research receives, relative to the world average, has increased (sections 1.02, 1.04 and 1.05).

The UK is India's third largest collaborator, behind the USA and Germany, and although UK collaboration with India is growing the rate of growth is less than for some of the expanding research economies. These data also suggest that Germany is a significant competitor to the UK for collaborative opportunities with India (section 2.01).

Collaboration with the UK correlates with Indian research papers being less frequently uncited and more highly cited than Indian research generally. The most highly cited India-UK collaborative research occurs across a range of subject areas but is particularly strong in the physical sciences (sections 2.01 and 2.02).

The Indian and UK institutions which contributed the most research papers to the India-UK collaborative interface are mostly research-focused institutions. However, when the UK institution data are analyzed by subject area it is evident that a diverse range of institutions are involved in collaboration with India, not just those that are traditionally research intensive (sections 2.04, 2.05 and 2.06).

The UK research base appears to be in a position of strength, both in terms of the volume of research activity (indexed by the volume of research papers published) and the impact that UK research has (as indexed by average citation counts per paper) and this pattern is generally observed for most subject areas. This strength could be leveraged to take advantage of opportunities for collaboration.

1.0 A bibliometric survey of India's research

One outcome of academic research is the publication of research papers. The volume of papers authored by researchers based in a country can be used as an index of the level of research activity in that country. Research papers are in turn cited or referred to by other authors. The number of citations received per paper (a statistic known as "citation impact") correlates with other measures of research excellence and can be used to index the quality of research.

Using data from the Thomson Reuters® databases we have analysed both the volume of publications and the citation impact for India, the UK and the comparator countries (see Introduction). This has been done for 1981 to 2008 for the nations as a whole (sections 1.01 and 1.02) to give a broad understanding of Indian research in its historical and geographical context. These data have also been broken down by subject area for the period 1999 to 2008 to provide an in-depth understanding of where recent research activity is focused in these countries. As well as looking at the average citation impact we have also used Impact Profiles® (see the methodology section below for a full description) to look at the distribution of citations across India's output of research papers. This gives a more detailed understanding of the impact of research.

Methodology

As noted above, citation counts are recognised as a measure of academic impact which can be used to index the excellence of the research produced by a particular group, institution or country. Academic impact is different from economic and social impact. While citation rates have been shown to correlate with other measures of research quality they do not directly measure any of the economic and social benefits that are generated. In order to investigate these other forms of impact, it might be appropriate to perform analyses of wealth generation, intellectual property production, the number of researchers trained,

or the impact on social policy. The relevance and suitability of quantitative indicators for these purposes is disputed.

Discipline factors

Citation rates vary between disciplines and fields. For the UK science base as a whole, ten years produces a general plateau beyond which few additional citations would be expected. On the whole, citations accumulate more rapidly and plateau at a higher level in biological sciences than physical sciences, and natural sciences generally cite at a higher rate than Social Sciences.

Papers are assigned to disciplines (journal categories or research fields) by Thomson Reuters, which groups similar research areas together. The 250 Web of Science® journal categories are well established and are informed by extensive work by Thomson Reuters and the research community over the last forty years. Papers are allocated according to the journal in which the paper is published. Some journals may be considered to be part of the publication record for more than one research field. However, some papers are not assigned to any research field and will not be included in specific analyses. The multidisciplinary research field may include papers from prestigious journals such as *Nature* and *Science*. Most papers from these 'multidisciplinary' journals can now be assigned to more specific research fields, based on the research area(s) of the references cited by the article.

Time factors

Citations accumulate over time. Older papers therefore have, on average, more citations than more recent work. Chart 1.0.1 shows the pattern of citation accumulation for a set of journals in geology. Papers less than ten years old are, on average, still accumulating additional citation while for older sources the citation count has plateaued. The chart also shows that the percentage of papers that have never been cited drops over a period of approximately five years. Beyond five years, around ten per cent or more of papers remain uncited.

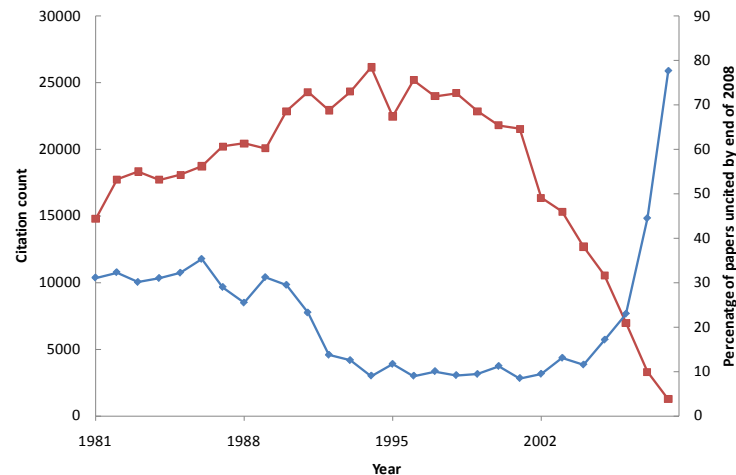


Chart 1.0.1 - Graph showing the number of citations accrued by geology papers and the proportion of geology papers that are uncited by publication year. This indicates that geology papers continue to accumulate citations for around ten years; after five years the number of uncited geology papers drops to a background level (approximately ten per cent).

Account must be taken of these time factors in comparing current research with historical patterns. For these reasons, it is sometimes more appropriate to use a fixed five-year window of papers and citations to compare two periods than to look at the longer term profile of citations and of uncitedness for a recent year and an historical year.

Rebased impact

Due to the time and discipline factors, all analyses must take both field and year into account. Because the absolute citation count for a specific article is influenced by its field and by the year it was published, comparisons of indexed data can only be made after normalising with reference to these two variables. This normalisation is also referred to as ‘rebasings’ the citation count. Citation

impact is therefore most commonly analysed in terms of ‘rebased impact’, or RBI.

The most common normalisation factors are the average citations per paper for the year and either the field or journal in which the paper was published. The level at which normalisation takes place may affect subsequent interpretation.

Average impact

Historically, research performance has been indexed using average impact (rebased as described to world average to standardise for time and discipline). This average may be misleading, however, when assumptions are made about the distribution of the data beneath it. Almost all research activity metrics are skewed: many have low performance values and a few have exceptionally high values. This is the case for research papers – many are uncited and very few accumulate extensive citation counts. In reality the average impact tends to be significantly different from either the median or mode in the underlying distribution.

Impact Profiles^o

Evidence has developed the Impact Profile^o to overcome the problems of skewed citation impact distributions among research articles. Instead of charting the citation count we categorise impact relative to a benchmark. Such Impact Profiles^o enable an examination and analysis of the balance of published outputs relative to world average. This provides much more information about the basis and structure of research performance than conventionally reported averages in citation indices.¹

¹ See discussion and examples in Adams J, Gurney K A and Marshall S (2007). Profiling citation impact: a new methodology. *Scientometrics*, 72 (2), 325-344.

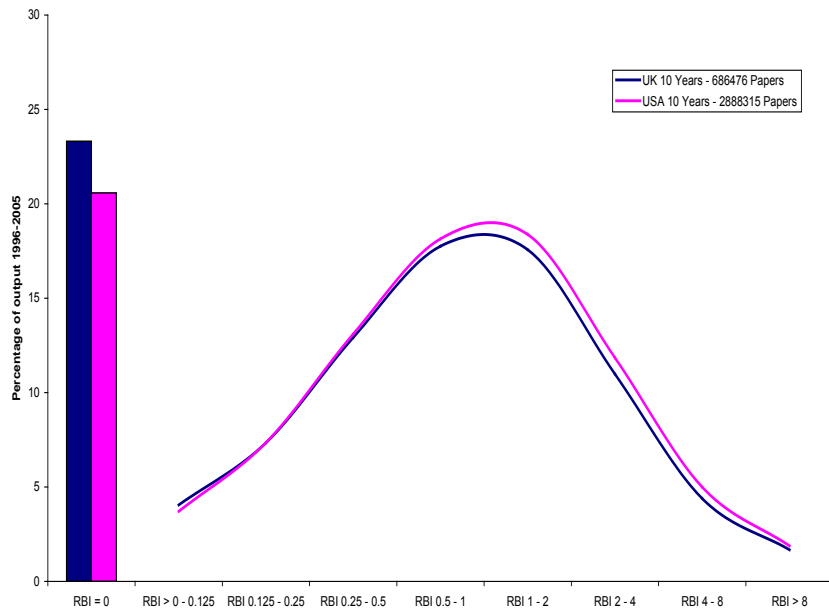


Chart 1.0.2 - Impact Profile™ comparing the citation impact and rate of uncited papers for the USA and UK over a ten year period. The impact profile shows that the USA publishes significantly more papers than the UK and that slightly more of the UK's papers remain uncited over the ten year period. The Impact Profile™ also shows that the modal group for both countries is around 1.0 (i.e. world average) with most papers being cited less frequently than world average. The Impact Profile™ suggests that papers published by the USA are slightly more highly cited than those with UK authors.

An Impact Profile[®] (see chart 1.0.2) shows what proportion of papers are uncited and what proportion are in each of eight categories of relative citation rates, normalised (rebased) to world average (which becomes 1.0). Rebased citation rates above 1.0 indicate papers which are cited more often than the world average for that subject area and year of publication.

When analysing an Impact Profile[®] attention should be paid to:

- The proportion of uncited papers on the left of the chart
- The proportion of cited papers either side of world average (1.0)
- The location of the most common (modal) group near the centre
- The proportion of papers in the most highly-cited categories to the right, (more than four-times world average, more than eight-times world average)

What is the threshold for 'highly cited'?

Thomson Reuters has traditionally used the term 'Highly Cited Paper' to refer to the world's one per cent of most frequently cited papers, taking into account year of publication and field. In rough terms, UK papers cited more than eight-times as often as relevant world average would fall into the Thomson Reuters Highly Cited category. About one to two per cent of papers (all papers, cited or uncited) typically pass this hurdle. Such a threshold certainly delimits exceptional papers for international comparisons but, in practice, is an onerous marker for more general management purposes. After reviewing the outcomes of a number of analyses, we have chosen a more relaxed definition for our descriptive and analytical work. We deem papers that are cited more often than four-times the world average to be relatively highly-cited for national comparisons. This covers the two most highly-cited categories in the graphical analyses: about five per cent of total UK papers typically pass this hurdle.

What are uncited papers?

Some journal articles are never cited after publication, even by their authors. These account for about half the total global output and about 20% of UK output (chart 1.0.2). It is not possible to tell why papers are not cited. It is likely that a significant proportion of papers remain uncited because they are reporting negative results which are an essential matter of record in their field but make

the content less likely to be referenced elsewhere. Inevitably, other papers are uncited because their content is trivial or marginal to the mainstream or plain wrong. It should not be assumed that this is the case for all such papers. There is variation in non-citation between countries and between fields. On the whole, relatively more engineering papers tend to remain uncited than papers in other sciences, indicative of a disciplinary factor as well as a quality/significance factor. There is also an obvious increase in the likelihood of citation over time but most papers that are going to be cited will be cited within a few years of publication.

We work on the assumption that relative non-citation rates within a field are an indicator of the extent to which work is regarded by others in the same field to be of greater or lesser significance.

Caveats

Most impact measures use average citation counts from groups of papers as some individual papers may have unusual or misleading citation profiles. The statistical effects of these unusual counts are diluted in larger sample sizes.

When examining trends in citation data it should be noted that the data from the most recent year often deviates from the trend exhibited in earlier years. It is notable in mature research economies producing stable volumes of research papers that citation rates are often higher than expected while in growing research economies the opposite is seen. Countries with growing research output have a relatively large number of papers in the most recent year citing relatively fewer papers from previous years resulting in an apparent increase in the citation impact for previous years. More mature research economies also have a tendency to cite more recent research.

Data for the USA is not shown in charts of research paper output (sections 1.01 and 1.03). This is because the volume of publications produced by the US is so much larger than for other countries that it would require that the vertical axis be scaled in such a way as to effectively mask trends in the data.

Summary of results

The number of research papers published at the national level by India, the UK and the comparator group countries were expressed as the share of the total number of research papers published globally by year. The data show that the UK is in a very strong position but its global share of research papers (and that of other mature research economies) has decreased as expanding economies increase their publication activity. India's output of papers remains relatively low, although it is roughly comparable to other emerging nations and has shown significant growth since 2000. China has now overtaken the UK in terms of the volume of research papers it publishes (table 1.01 and chart 1.01).

The citation impact data show that the UK is in a very strong position and has moved closer to the USA (the world leader) since 1981. The data also show that Germany's citation impact has increased even more rapidly. India's citation impact has increased two-fold over the period analysed and, although it remains ranked tenth in the comparator group, its citation count in 2008 is roughly similar to other emerging research nations (China, Brazil and Korea) (table 1.02 and chart 1.02).

Data on research output show that the UK is strong, particularly in health and medically related research, environment, the social sciences, business and the humanities. The UK is also ranked in the top three nations within the comparator group in terms of citation impact for all subjects except the social sciences. Both India's share of global research papers and its citation impact are low compared to other nations across all subject areas. They are growing and are roughly similar to the other emerging research economies. China's growth in publication output has been very strong across all subject areas and now exceeds that of most nations, although its citation impact still remains significantly below world average (tables 1.03.01-1.04.10 and charts 1.03.01-1.04.10).

The Impact Profiles® for India's research publications show that while most of India's research is cited less frequently than the world average, India produces a significant volume of more frequently cited research. Indian research is becoming

more frequently cited relative to the world average and that a significant increase in the modal citation impact is evident between 1999-2003 and 2004-2008 (charts 1.05.1-3).

1.01 Number and share of world papers

Table 1.01 Number of papers

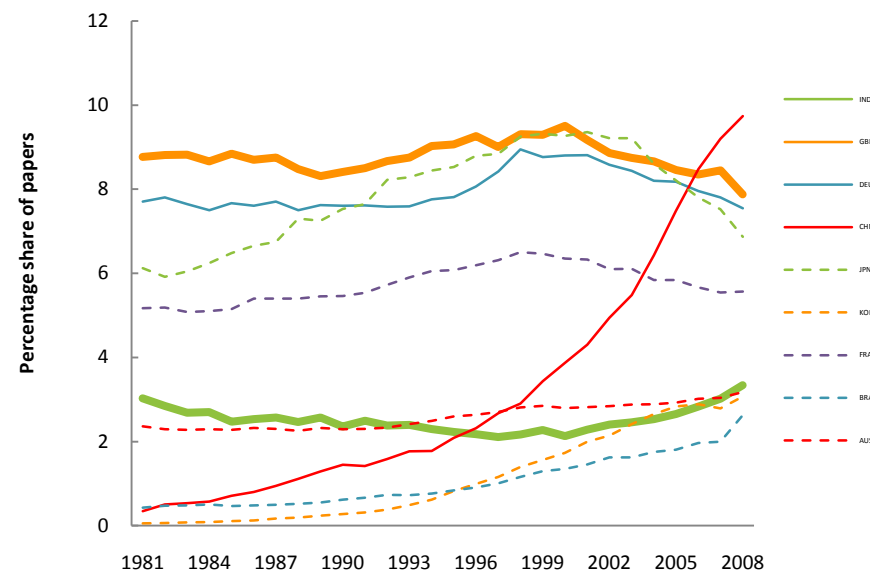
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK papers	79,630	91,273	+15%
India papers	25,301	38,700	+53%
Group average papers	75,185	91,764	+22%
UK rank in group	2	3	↓
India rank in group	9	7	↑
UK share of world	8.53%	7.88%	-8%
India share of world	2.70%	3.34%	+24%

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- Over the period 1981-2008 there has been a marked increase in the total global output of papers (more than trebling).
- Growth has been fairly constant for the G8 nations; however, in Brazil, China, South Korea and India growth has been very strong in recent years.
- While the UK has grown in output over the period it has shown a decrease relative to the comparator group and the rest of the world.
- India has shown marked growth in output, both in absolute terms (180 per cent) and relative to the comparator group and the world.
- Most of the growth in Indian output has occurred since 2000, more than doubling by 2008.
- in 2008 the volume of Chinese research papers published was over 70 times higher than in 1981, although this is accentuated by database changes.

Chart 1.01 Share of world papers



Data & Analysis: *Evidence*, Thomson Reuters

- Over the period 1981-2008 the UK, Japan, Germany and France all showed an increase in share of world papers until the late 1990s and early 2000s with a subsequent drop after this point.
- The United States (not shown) showed a marked drop in share of world papers from 40 to 29 percent between 1981 and 2008 (a relative decrease of 27 per cent).
- India experienced a decrease in world share from 3.0 per cent in 1981 to 2.1 percent in 2000 and then grew to 3.3 per cent in 2008.
- The UK has shown an relative decrease of ten per cent in share of world papers compared to 1981 levels.
- China has shown exceptional growth in global share over the 1981-2008 period (Australia, Brazil and South Korea also grew but to a lesser degree).

1.02 Citation impact relative to world baselines

Table 1.02 Citation impact

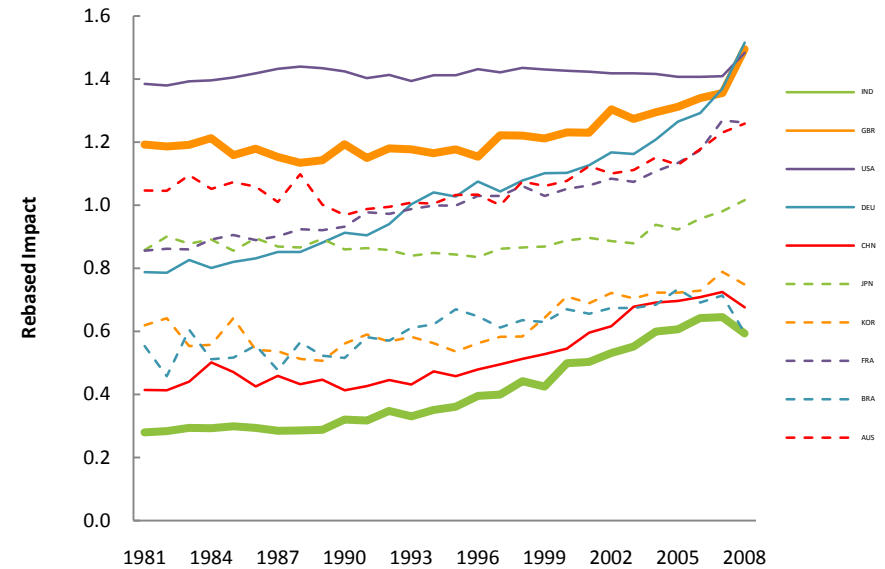
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK rebased impact	1.32	1.50	+14%
India rebased impact	0.61	0.59	-3%
Group average rebased impact	1.00	1.06	+7%
UK / group average	1.32	1.40	+7%
India / group average	0.61	0.56	-9%
UK rank in group	2	2	↔
India rank in group	10	10	↔

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- The most frequently used index of research performance is impact, measured as citations per paper. Because citations accumulate the index is normalized to the world average for that year (i.e. world average is 1.0).
- The citation impact for the most recent year often deviates from the prevailing trend. Mature research economies generally have a higher citation impact in the most recent year, while a lower citation impact is observed for growing economies.
- The citation impact relative to world baselines increased across the comparator group of countries analysed. However, this trend is notably less pronounced for the USA.

Chart 1.02 Citation impact



Data & Analysis: *Evidence*, Thomson Reuters

- The UK's citation impact increased from 1.19 in 1981 to 1.5 in 2008 - although most of this has been since the early 1990s.
- India's citation impact increased by a factor of two between 1981 and 2008 (from 0.28 to 0.59), although it is still significantly below world average. India also remains ranked tenth in the comparator group although the gap with other emerging nations has narrowed.
- Germany's citation impact increased from 0.79 to 1.52 between 1999 and 2008, overtaking the USA.
- The USA's citation impact compared to world average has been relatively stable – 1.39 in 1981 and 1.41 in 2007 (increasing to 1.48 in 2008).

1.03 Number and share of world papers by subject area

Table 1.03.01 Number of clinical papers

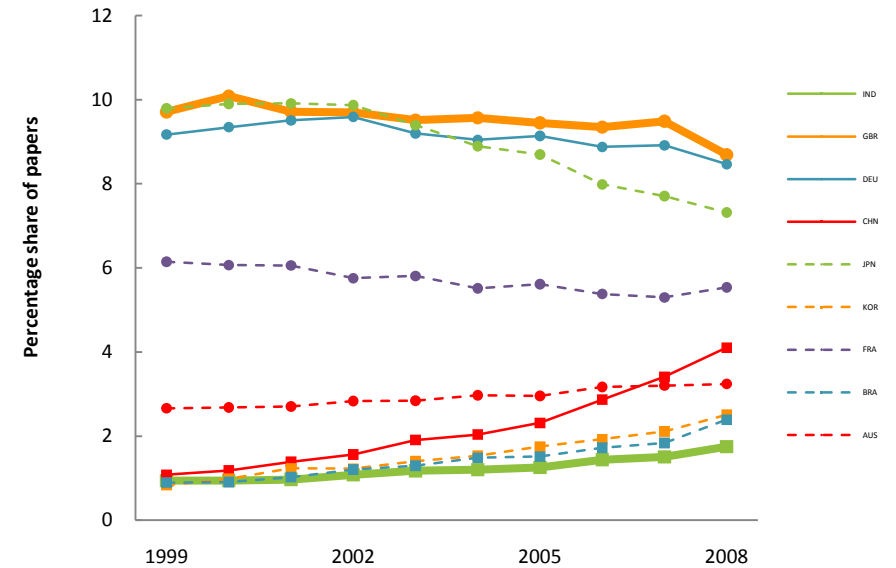
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK papers	28,979	32,805	+13%
India papers	4,043	6,603	+63%
Group average papers	24,449	29,966	+23%
UK rank in group	2	2	↔
India rank in group	10	10	↔
UK share of world	9.47%	8.69%	-8%
India share of world	1.32%	1.75%	+33%

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- As observed for overall output, the number of clinical papers published increased significantly between 1999 and 2008.
- The UK's output of clinical papers grew by a quarter over the period 1999-2008 although its rank within the comparator group remained static in recent years.
- India showed strong growth in terms of its output of clinical papers over the period 1999-2008 (over 150 per cent) although its rank within the comparator group remained tenth because of similarly strong performances by other nations.
- China's volume of clinical papers grew fourfold between 1999 and 2008 and South Korea and Brazil also showed strong increases of around threefold.

Chart 1.03.01 Share of world clinical papers



Data & Analysis: *Evidence*, Thomson Reuters

- The UK's share of world output decreased between 1999 and 2008 from 9.8 per cent to 8.7 per cent.
- India increased its share of clinical papers relative to the rest of the world in recent years from 0.9 per cent in 1999 to 1.8 per cent in 2008.
- Between 1999 and 2008 the UK, USA (data not shown), Germany, Japan and to a lesser extent France showed a decrease in the share of world clinical papers. This is in contrast to Australia, China, South Korea, Brazil and India who showed growth during this period.
- Over the period 1999 to 2008 Japan showed the greatest decrease in share of world output from 9.8 to 7.3 per cent, while China showed very strong growth from 1.1 to 4.1 per cent in the same period.

1.03 Number and share of world papers by subject area

Table 1.03.02 Number of health and medically-related papers

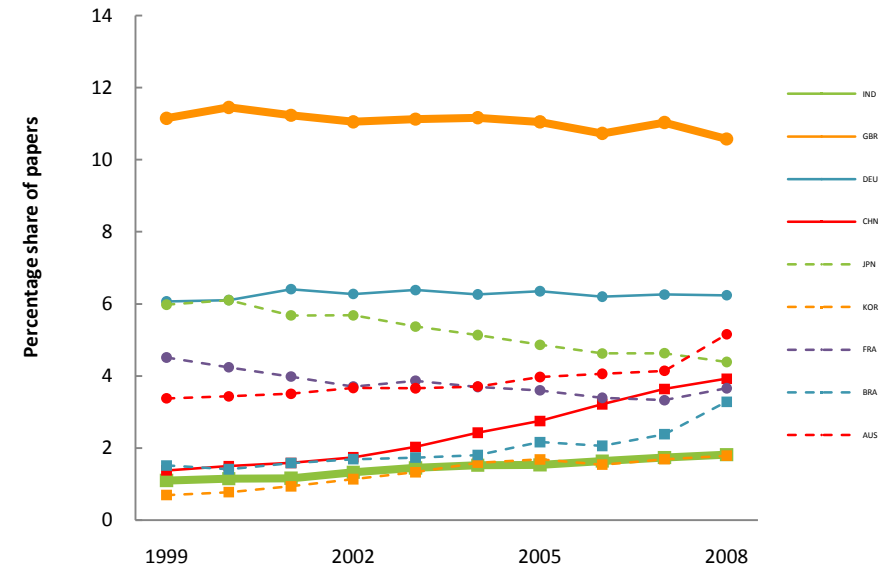
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK papers	11,202	14,375	+28%
India papers	1,613	2,472	+53%
Group average papers	8,297	11,085	+34%
UK rank in group	2	2	↔
India rank in group	9	9	↔
UK share of world	11.02%	10.58%	-4%
India share of world	1.58%	1.82%	+15%

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- The UK has shown growth in output of health and medically-related from 9,177 in 1999 to 14,375 in 2008 (57 per cent). However, this has again not changed its rank within the comparator group which has remained 2nd to the USA during this time period. Also, the UK's recent performance has declined relative to the group and world output.
- India has shown growth of 170 per cent between 1999 and 2008 and its performance relative to the comparator group and the world have also been strong in recent years, however, its rank has remained ninth in the comparator group because of even stronger performances by other nations.
- China showed nearly fivefold growth in output of health and medically-related papers over the period 1999-2008. South Korea (fourfold), Brazil (threefold), and Australia (twofold) also showed increases over this period.

Chart 1.03.02 Share of world health and medically-related papers



Data & Analysis: *Evidence*, Thomson Reuters

- The UK's share of world health and medically-related output decreased very slightly from 11.2 per cent in 1999 to 10.6 per cent in 2008. However, this is still a very strong field for the UK and its nearest rival in the comparator group is Germany which had a 6.2 per cent share of world output in 2008.
- India's share of world health and medically-related output has grown from 1.1 per cent in 1999 to 1.8 per cent in 2008.
- Over the period 1999 to 2008 the UK, USA (data not shown), Japan and France all decreased in world share of health and medically-related output while China, South Korea, Brazil, India and Australia have all shown growth. Germany has been relatively stable in terms of share of world output.
- China has shown the strongest growth in global share from 1.5 per cent in 1999 to 3.9 per cent in 2008.

1.03 Number and share of world papers by subject area

Table 1.03.03 Number of biological sciences papers

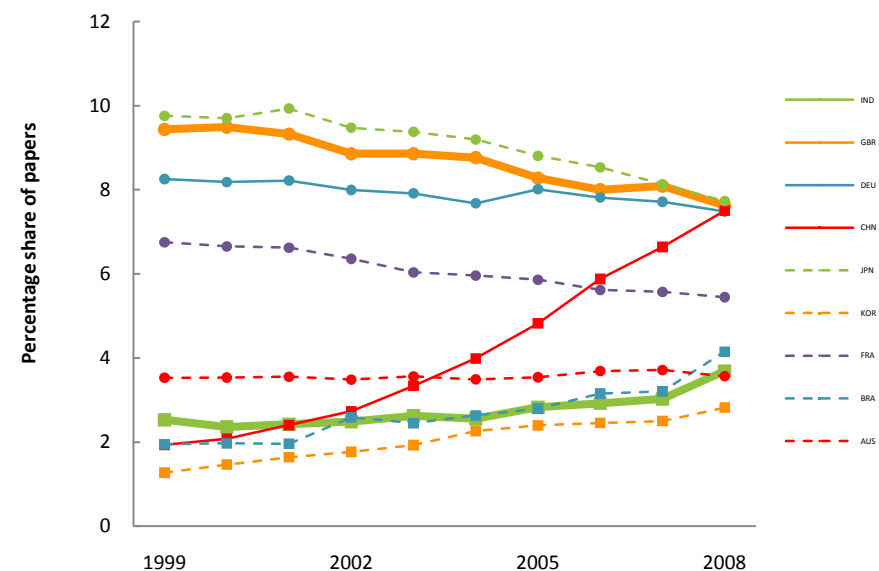
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK papers	21,376	23,406	+9%
India papers	7,144	11,326	+59%
Group average papers	20,924	24,951	+19%
UK rank in group	3	3	↔
India rank in group	9	8	↑
UK share of world	8.40%	7.63%	-9%
India share of world	2.79%	3.69%	+32%

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- The UK has shown some growth (13 per cent) in output of biological sciences papers between 1999 and 2008, but this has lagged behind that of the comparator group average and its share of world output has correspondingly declined (although its rank has remained third within the comparator group).
- India has shown growth of 105 per cent between 1999 and 2008 which is significantly above the comparator group, and it has correspondingly improved its share of world biological sciences output; it's recent rank rising from ninth in recent years to eighth in 2008.
- China (fivefold), South Korea (threefold), and Brazil (threefold) have also shown very strong growth in output of biological sciences papers.

Chart 1.03.03 Share of world biological sciences papers



Data & Analysis: *Evidence*, Thomson Reuters

- The UK's share of world biological sciences output has decreased from 9.4 per cent in 1999 to 7.6 per cent in 2008 and its lead over Germany and particularly China has narrowed significantly.
- India increased its share of world biological sciences output from 2.5 to 3.7 per cent between 1999 and 2008, however, its rate of growth is behind some other nations – notably Brazil and China.
- The UK, USA (data not shown), Japan, France and Germany all decreased their share of world biological sciences between 1999 and 2008, while India, Brazil, South Korea and China all showed strong growth. Australia's share of world output has been stable over this period.
- China demonstrated the strongest growth in terms of share of world output; rising from 1.9 per cent in 1999 to 7.5 per cent in 2008.

1.03 Number and share of world papers by subject area

Table 1.03.04 Number of environment papers

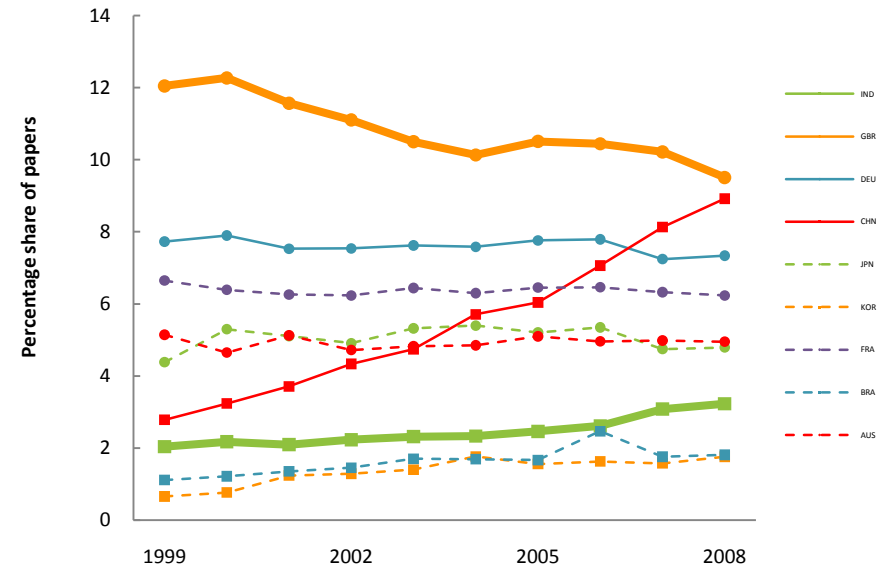
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK papers	8,879	10,763	+21%
India papers	2,213	3,659	+65%
Group average papers	6,899	8,989	+30%
UK rank in group	2	2	↔
India rank in group	8	8	↔
UK share of world	10.36%	9.51%	-8%
India share of world	2.56%	3.23%	+26%

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- The UK's output of environment papers has increased between 1999 and 2008 by 34 per cent, which although significant was the lowest growth rate within the comparator group and resulted in a corresponding fall in share of world share. The UK's rank within the comparator group has remained second due to its large starting lead over the other countries.
- India's output increased nearly twofold over the same period, which while higher than the average for the comparator group did not result in any change in ranking (eighth) because of strong performances by other countries and the starting gap between India and other nations.
- China demonstrated the strongest growth in output for environment papers with a fivefold increase over this period, which raised its rank to third.

Chart 1.03.04 Share of world environment papers



Data & Analysis: *Evidence*, Thomson Reuters

- The UK's share of world papers decreased significantly between 1999 and 2008 – from 12 to 9.5 per cent – and its strong lead over other nations has waned significantly.
- India has increased its share of world environment output from 2.0 per cent in 1999 to 3.2 per cent in 2008, however, its rate of growth remains lower than China, South Korea and (to a lesser degree) Brazil.
- China's growth in share of world output mirrored its increase in absolute paper output and it is close to the same level as the UK – it was only 23 per cent of the UK's share in 1999.

1.03 Number and share of world papers by subject area

Table 1.03.05 Number of mathematics papers

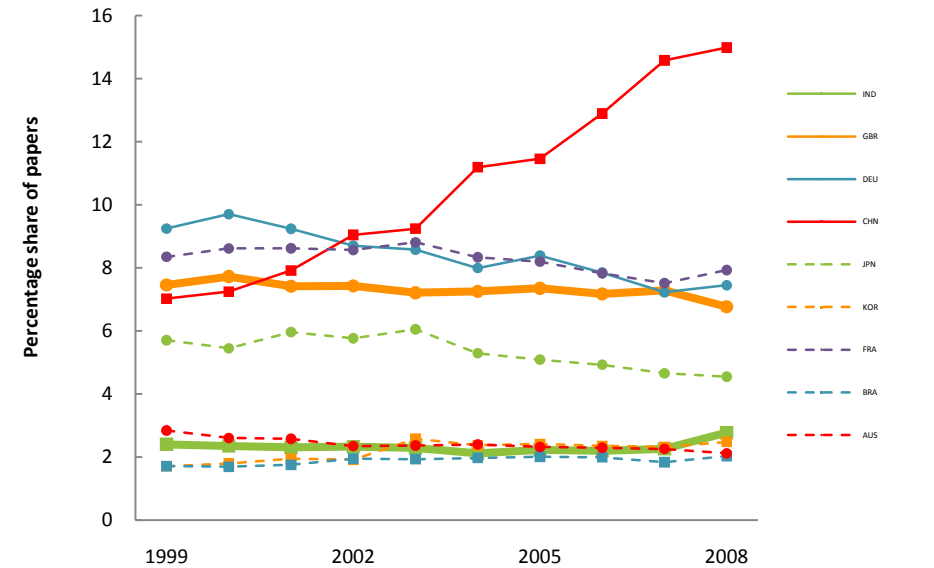
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK papers	4,488	5,930	+32%
India papers	1,375	2,430	+77%
Group average papers	4,867	6,792	+40%
UK rank in group	5	5	↔
India rank in group	9	7	↑
UK share of world	7.25%	6.77%	-7%
India share of world	2.22%	2.77%	+25%

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- The UK's output of mathematics papers has increased between 1999 and 2008 (69 per cent), however, this is behind the average for the comparator group with the result that its rank has remained fifth. The strong performance of other nations has also meant that the UK's share of world mathematics output has decreased to 6.8 per cent.
- India, as in other subject areas has shown strong growth in both its output of mathematics papers (doubling between 1999 and 2008) and its share of world mathematics papers has increased to 2.8 per cent in recent years. This has seen India's ranking within the comparator group raised to seventh in 2008.
- China quadrupled its output between 1999 and 2008 and South Korea trebled theirs in the same period.

Chart 1.03.05 Share of world mathematics papers



Data & Analysis: *Evidence*, Thomson Reuters

- Like the UK, the share of world mathematics output from the USA (data not shown), Germany, France, Japan and Australia has also fallen.
- China and South Korea have again seen the largest increases in world output share with figures rising from 7 to 15 per cent for China and 1.7 to 2.5 per cent for South Korea during the 1999-2008 period. China's rank within the comparator group has increased from fifth in 1999 to second in 2008.

1.03 Number and share of world papers by subject area

Table 1.03.06 Number of physical sciences papers

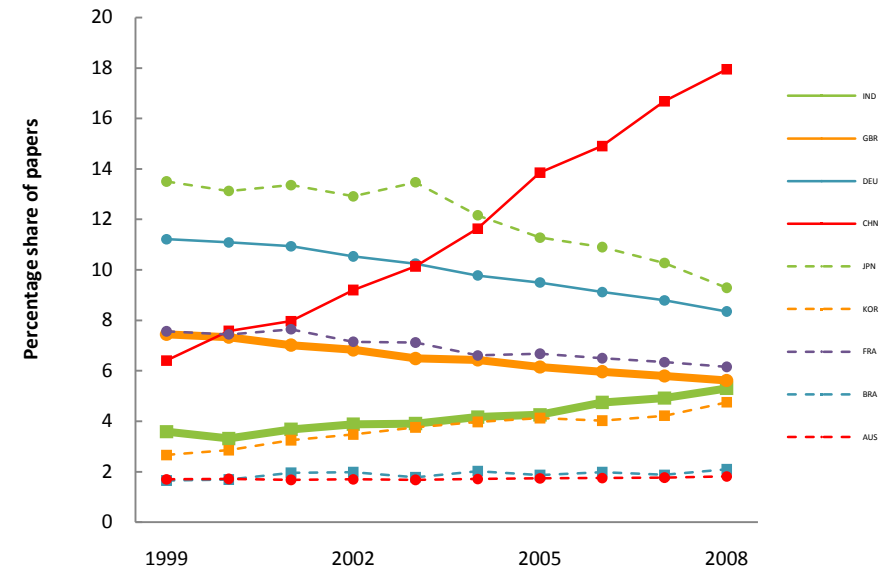
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK papers	23,241	26,025	+12%
India papers	16,708	24,577	+47%
Group average papers	30,656	37,624	+23%
UK rank in group	6	6	↔
India rank in group	7	7	↔
UK share of world	6.17%	5.62%	-9%
India share of world	4.40%	5.30%	+21%

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- The UK's output of physical sciences papers has increased by 15 per cent over the period 1999-2008; however, this has not translated into an increase in the share of world output, which has fallen to 5.6 per cent, because of substantial growth seen in other nations. While the UK's rank has not improved in recent years India has narrowed the difference in output between the two countries from 11,695 papers in 1999 to 1,448 in 2008 to become the UK's closest rival.
- India has shown strong growth in output of physical sciences papers (more than doubling between 1999 and 2008) and this has also been reflected in its increase in share of global output.

Chart 1.03.06 Share of world physical sciences papers



Data & Analysis: *Evidence*, Thomson Reuters

- China's three-fold growth in physical sciences output between 1999 and 2008 has again been far higher than other nation, and its rank has improved from sixth in 1999 to second in 2008.
- China, India, South Korea, Brazil, and (to a far lesser degree) Australia have all shown growth in terms of share of world physical sciences out between 1999 and 2008. At the same time the UK, USA (data not shown), Germany, France and Japan have all experienced decreases in their share of physical sciences output.
- While the USA (not shown) still has the largest share of world physical sciences output, it has experienced a decrease from 23.1 per cent in 1999 to 19.9 per cent in 2008.
- China with 18 per cent of world physical sciences output in 2008 has become a serious competitor to the United States, at least in terms of output.

1.03 Number and share of world papers by subject area

Table 1.03.07 Number of engineering papers

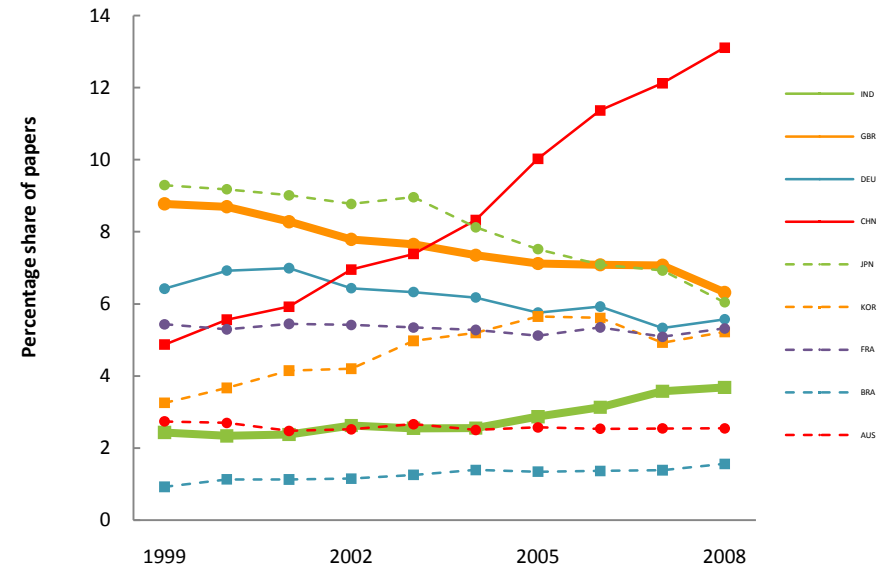
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK papers	14,820	15,784	+7%
India papers	6,058	9,201	+52%
Group average papers	15,474	18,457	+19%
UK rank in group	4	3	↑
India rank in group	8	8	↔
UK share of world	7.26%	6.32%	-13%
India share of world	2.94%	3.68%	+25%

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- The UK's growth in output of engineering papers between 1999 and 2008 was 27 per cent, however, this was less than the average for the comparator group because of the strong performance of other nations. This weakening relative performance was also reflected in the UK's loss of world share of engineering output which fell to 6.3 per cent in 2008. The table shows that the UK's rank has risen to third in the comparator group in recent years; however, this is because of greater falls in Japanese output rather than an increase in UK performance.

Chart 1.03.07 Share of world engineering papers



Data & Analysis: *Evidence*, Thomson Reuters

- India has demonstrated strong growth in engineering paper output between 1999 and 2008 (approaching threefold) which is higher than the average for the comparator group over this period. India has also increased its share of world output from 2.4 per cent in 1999 to 3.7 per cent in 2008.
- China increased its output of engineering papers fourfold between 1999 and 2008 and Brazil and South Korea trebled theirs in the same period.
- The UK, USA (data not shown), Germany, Japan and (to a lesser extent) France and Australia have experienced a decline in their share of world engineering output. Over the same period India, China, South Korea and Brazil have experienced strong growth. China in particular has increased its share of world engineering output from 4.9 per cent in 1999 to 13.1 per cent in 2008.

1.03 Number and share of world papers by subject area

Table 1.03.08 Number of social sciences papers

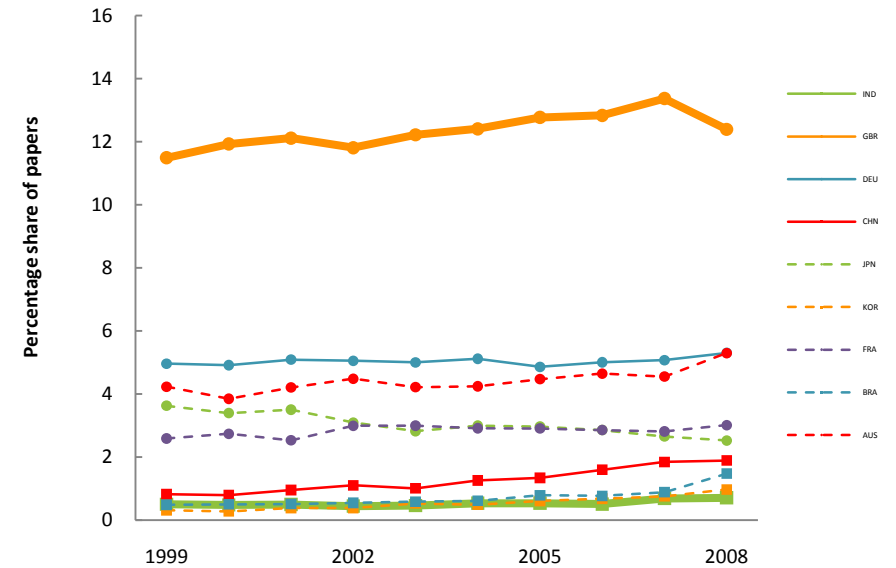
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK papers	6,289	7,822	+24%
India papers	272	449	+65%
Group average papers	4,067	5,013	+23%
UK rank in group	2	2	↔
India rank in group	10	10	↔
UK share of world	12.72%	12.39%	-3%
India share of world	0.55%	0.71%	+30%

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- The UK demonstrated growth in output of social sciences papers over the period 1999-2008 of 58 per cent. The UK remains ranked second within the comparator group and its output of social sciences papers is over double that of Germany (ranked third).
- India doubled its social sciences output over the same period; however, the very strong performance of other countries means that its rank within the comparator group has not changed in recent years.
- South Korea experienced the strongest growth in social sciences output during the period shown (over fourfold) although its very low starting volume (136 papers) means that it remains ranked ninth in the comparator group. Brazil has also shown strong growth but, again because of low volumes, remains ranked eighth.

Chart 1.03.08 Share of world social sciences papers



Data & Analysis: *Evidence*, Thomson Reuters

- Apart from the USA (data not shown) and Japan, who's share of social science papers have fallen, all other countries in the comparator group have shown growth in their share of world output – albeit very slight for Germany and the UK.
- The UK's share of social sciences output increased 8 per cent (relative to 1999 levels) between 1999 and 2008 although this figure doubles if only the period 1999-2007 is considered because of a strong decrease in 2008.
- India's share of social sciences output grew from 0.5 per cent in 1999 to 0.7 per cent in 2008 – with South Korea, Brazil and China showing even stronger growth over the same period.

1.03 Number and share of world papers by subject area

Table 1.03.09 Number of business papers

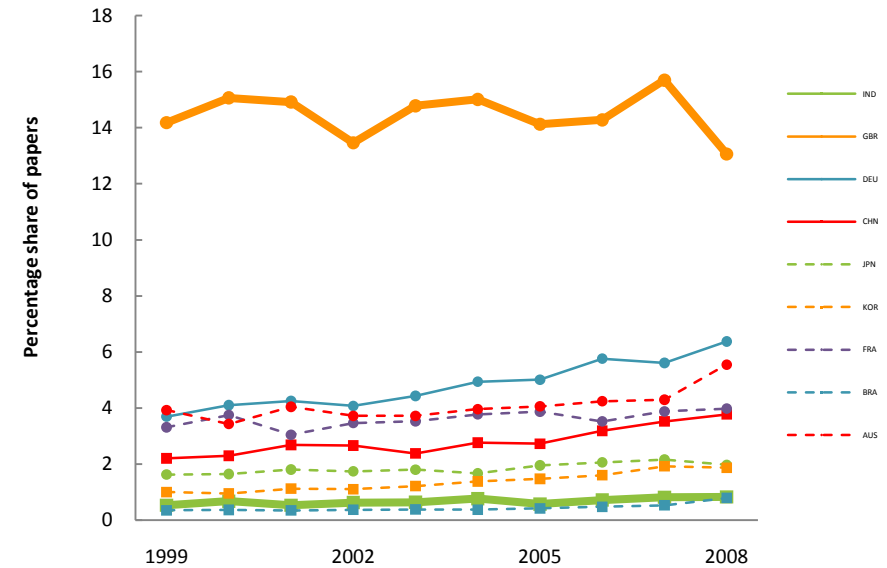
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK papers	2,620	3,390	+29%
India papers	125	216	+72%
Group average papers	1,504	2,099	+40%
UK rank in group	2	2	↔
India rank in group	9	9	↔
UK share of world	14.78%	13.06%	-12%
India share of world	0.71%	0.83%	+18%

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- The UK showed growth of 73 per cent in output of business papers during the period 1999-2008, however, because of strong performance by other countries (most notably Brazil) the UK's share of the world has decreased and its rate of growth has been lower than the average for the comparator group in recent years.
- India's output increased over the same period by 192 per cent with its performance in recent years stronger than the group average, increasing its share of the total world output.
- Brazil's fourfold growth between 1999 and 2008 was the highest within the comparator group although its 2008 output in absolute terms (206 papers) is still ranked tenth Germany, South Korea and China all more than trebled their output of business papers between 1999 and 2008.

Chart 1.03.09 Share of world business papers



Data & Analysis: *Evidence*, Thomson Reuters

- All countries except the UK and the USA (data not shown) increased in world share out the global output of business papers. The UK's share decreased from 14.2 per cent in 1999 to 13.1 per cent in 2008. However, because of the UK's high relative strength in terms of output of business papers it remains ranked second in the group behind the USA.
- India's share of world business paper output rose from 0.5 per cent in 1999 to 0.8 per cent in 2008, however, it is still ranked 9th in the comparator group ahead of Brazil.

1.03 Number and share of world papers by subject area

Table 1.03.10 Number of humanities papers

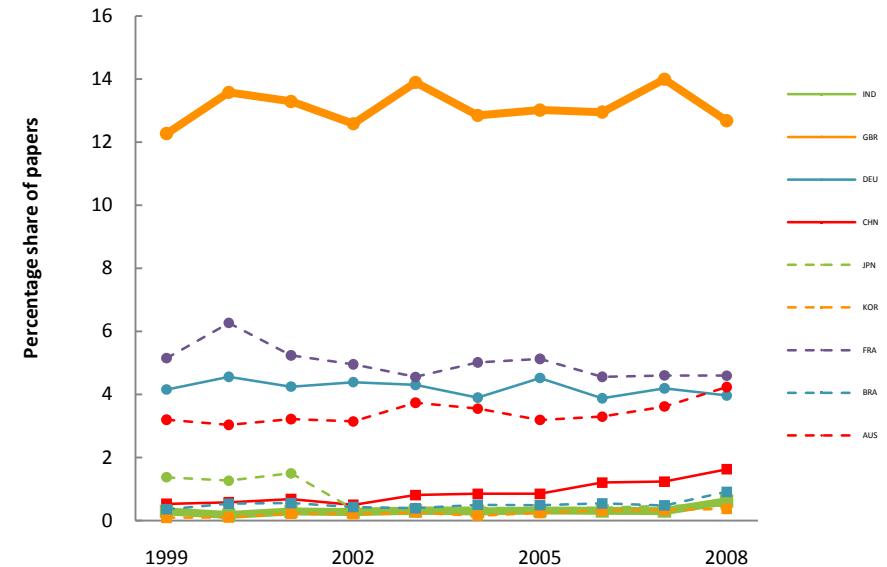
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK papers	2,999	3,641	+21%
India papers	69	178	+158%
Group average papers	1,760	2,056	+17%
UK rank in group	2	2	↔
India rank in group	9	8	↑
UK share of world	13.34%	12.68%	-5%
India share of world	0.31%	0.62%	+103%

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- The UK's output of humanities papers has grown by 39 per cent between 1999 and 2008 which is slightly above the comparator group average. The UK's share of world output has increased during this period although only nominally, and was lower in 2008 than during the five preceding years. However, the UK's humanities papers output has historically been much higher than the other nations of the comparator group (except for the USA) and this remains the case.
- India has seen very strong growth in humanities output nearly trebling between 1999 and 2008 and within the comparator group its rank has raised one place, to eighth.

Chart 1.03.10 Share of world humanities papers



- Of the comparator group, only Japan has shown a decrease in humanities output – falling by half between 1999 and 2008. All other nations have shown growth, with South Korea, China and Brazil experiencing fourfold, threefold and twofold increases respectively.
- The UK's share of world humanities output has been relatively stable over the ten years shown and remains 2.8 times higher than France which is ranked one place lower within the comparator group.
- While India has shown strong growth in terms of output in the humanities its share of the world still remains very low – 0.6 per cent in 2008.

1.04 Citation impact relative to world baselines by subject area

Table 1.04.01 Citation impact of clinical papers

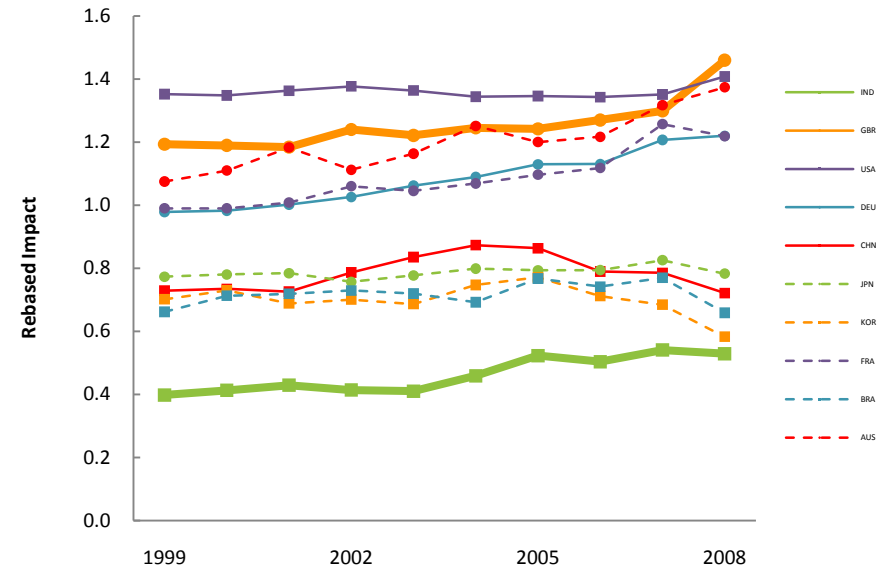
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK rebased impact	1.26	1.46	+16%
India rebased impact	0.49	0.53	+9%
Group average rebased impact	1.00	1.06	+7%
UK / group average	1.26	1.37	+9%
India / group average	0.49	0.50	+2%
UK rank in group	2	1	↑
India rank in group	10	10	↔

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- When analysing citation impact trends the most recent year often deviates from the prevailing trend. Mature research economies generally have a higher citation impact in the most recent year, while a lower citation impact is observed for growing economies.
- The citation impact of the UK's clinical papers relative to world baselines has grown over the period 1999 to 2008, and in 2008 its rank within the collaborator group increased to first.
- India's clinical impact also increased over the period 1999-2008 and although it is still ranked tenth in the comparator group the gap with South Korea has narrowed substantially.

Chart 1.04.01 Citation impact of clinical papers



Data & Analysis: *Evidence*, Thomson Reuters

- Australia, France and Germany have all shown an increase in clinical impact over the period shown while the impact of the USA, China, Japan and Brazil has remained stable. Only South Korea showed a significant dip in impact from 0.7 to 0.58.
- The graph shows two groupings of countries: The UK, USA, Australia, France and Germany – all above the world average (1.0), and Japan, China, Brazil, South Korea and India which are all below the world average.

1.04 Citation impact relative to world baselines by subject area

Table 1.04.02 Citation impact of health and medically-related papers

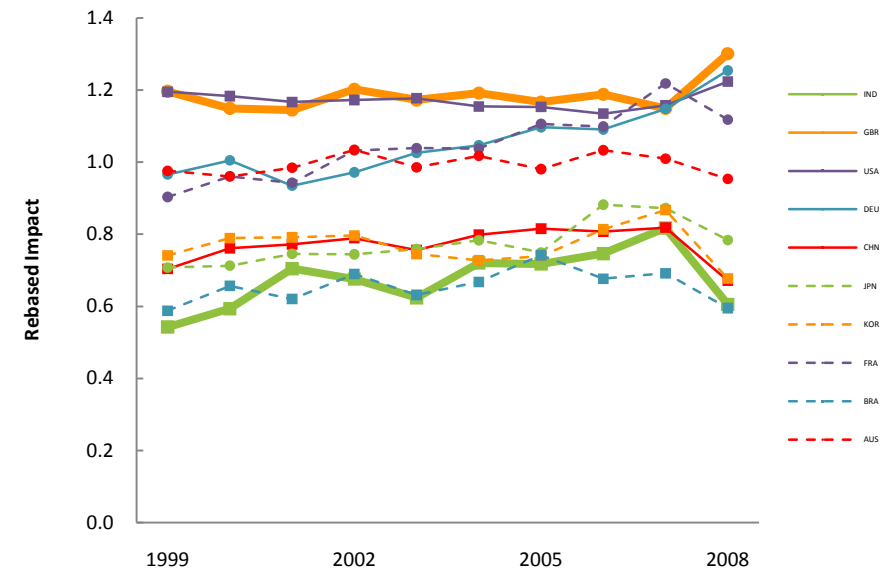
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK rebased impact	1.17	1.30	+11%
India rebased impact	0.73	0.61	-17%
Group average rebased impact	1.00	1.06	+7%
UK / group average	1.18	1.22	+4%
India / group average	0.73	0.57	-22%
UK rank in group	1	1	↔
India rank in group	9	9	↔

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- When analysing citation impact trends the most recent year often deviates from the prevailing trend. Mature research economies generally have a higher citation impact in the most recent year, while a lower citation impact is observed for growing economies.
- The impact of the UK's health and medically-related papers relative to world baselines has been stable for most of 1999-2008, although there has been a large increase (1.15 to 1.30) between 2007 and 2008. The UK has also ranked first or second in the comparator group for most of this period (although this dropped to joint third in 2007).

Chart 1.04.02 Citation impact of health and medically-related papers



Data & Analysis: *Evidence*, Thomson Reuters

- The impact of India's health and medically-related papers has increased over the period 1999-2008 (with a significant fall between 2007 and 2008) and it has been consistently ranked ninth or tenth within the comparator group.
- As with rebased impact of clinical papers a similar pattern of grouping can be observed for health and medically-related publications; UK, USA, France, and Germany near or above world average, and Japan, China, Brazil, South Korea and India below the world average. Australia seems to fall between the two groupings and its impact has remained stable over the period.

1.04 Citation impact relative to world baselines by subject area

Table 1.04.03 Citation impact of biological sciences papers

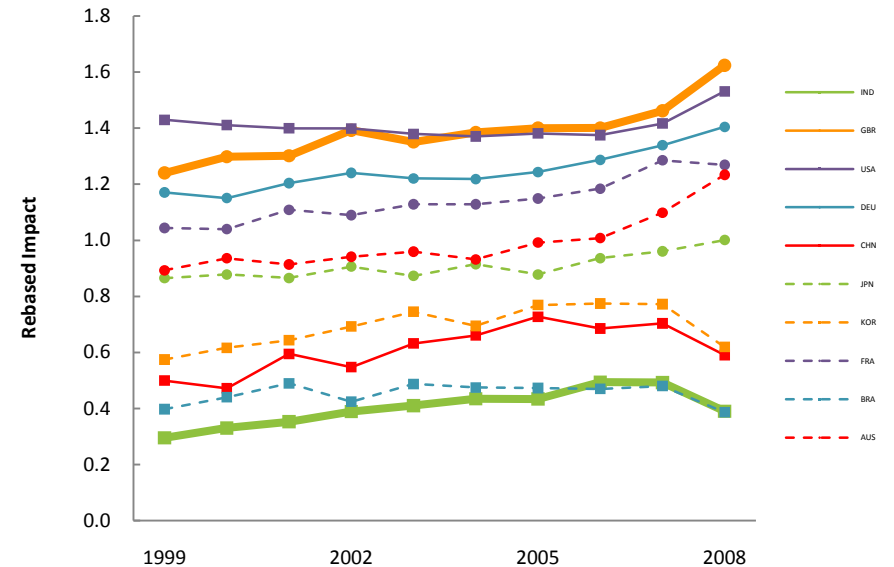
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK rebased impact	1.40	1.62	+16%
India rebased impact	0.45	0.39	-14%
Group average rebased impact	1.00	1.06	+7%
UK / group average	1.40	1.53	+9%
India / group average	0.45	0.37	-19%
UK rank in group	1	1	↔
India rank in group	10	9	↑

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- When analysing citation impact trends the most recent year often deviates from the prevailing trend. Mature research economies generally have a higher citation impact in the most recent year, while a lower citation impact is observed for growing economies.
- The UK has shown a strong increase in the relative citation impact of its biological sciences papers to a value of 1.62 in 2008, the UK has also moved ahead of the USA to be ranked first in the comparator group.

Chart 1.04.03 Citation impact of biological sciences papers



Data & Analysis: *Evidence*, Thomson Reuters

- India has also shown increased its average citation impact relative to world baselines for biological sciences. However, its impact is still significantly below world average and its rank within the comparator group has only recently improved from tenth to ninth.
- While the grouping of countries observed for clinical and pre-clinical papers is less obvious for biological sciences the UK, USA, Germany, France and Australia still have citation rates above world average, while Japan, South Korea, China, Brazil and India are still cited less frequently.

1.04 Citation impact relative to world baselines by subject area

Table 1.04.04 Citation impact of environment papers

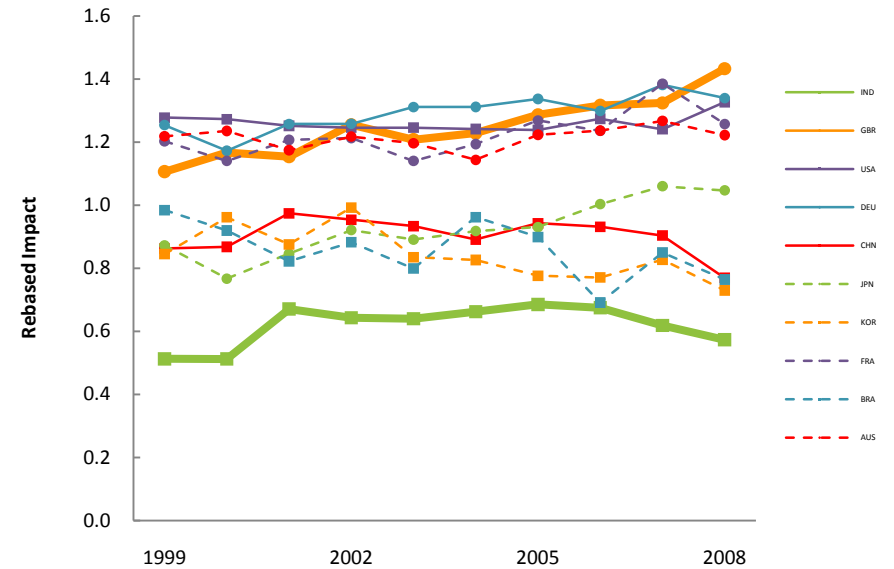
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK rebased impact	1.27	1.43	+13%
India rebased impact	0.66	0.57	-13%
Group average rebased impact	1.00	1.06	+7%
UK / group average	1.28	1.35	+6%
India / group average	0.66	0.54	-18%
UK rank in group	2	1	↑
India rank in group	10	10	↔

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- When analysing citation impact trends the most recent year often deviates from the prevailing trend. Mature research economies generally have a higher citation impact in the most recent year, while a lower citation impact is observed for growing economies.
- The UK's citation impact relative to world baselines has increased over the period 1999-2008 for environment papers and during this period its rank in the comparator group has increased from fifth to first.
- India has again shown growth in relative citation impact of its environment papers, however, this has fallen in recent years from a peak in 2005. Despite this India remains ranked last in the comparator group.

Chart 1.04.04 Citation impact of environment papers



Data & Analysis: *Evidence*, Thomson Reuters

- The grouping of countries observed for other subject areas is also seen for environment papers. Countries with more well established economies and research bases generally have higher citation impact than the emerging economies.

1.04 Citation impact relative to world baselines by subject area

Table 1.04.05 Citation impact of mathematics papers

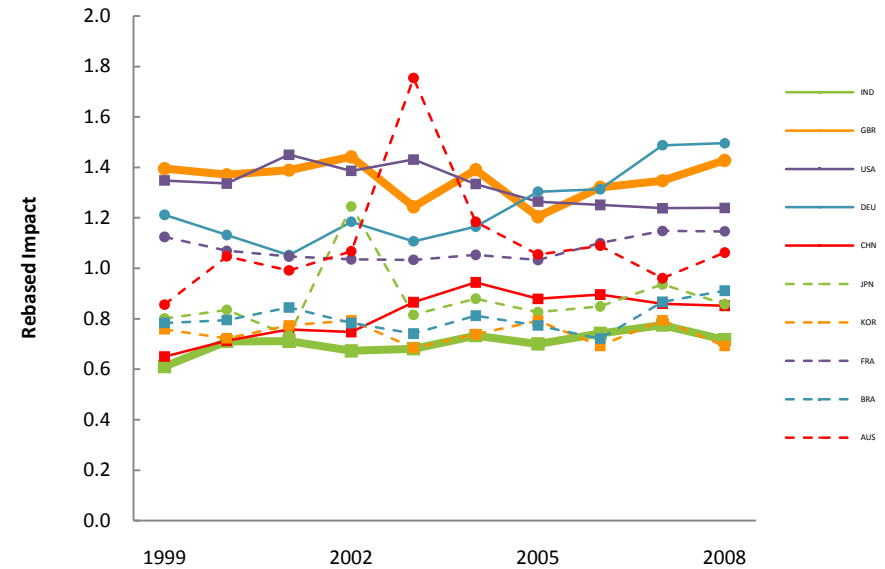
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK rebased impact	1.30	1.43	+10%
India rebased impact	0.73	0.72	-1%
Group average rebased impact	1.00	1.06	+7%
UK / group average	1.30	1.34	+3%
India / group average	0.73	0.67	-8%
UK rank in group	2	2	↔
India rank in group	10	9	↑

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- When analysing citation impact trends the most recent year often deviates from the prevailing trend. Mature research economies generally have a higher citation impact in the most recent year, while a lower citation impact is observed for growing economies.
- The UK's citation impact for mathematics papers has remained relatively stable although it has been overtaken by Germany. Its growth in recent years has however, been higher than the average for the comparator group.
- India's citation impact for mathematics papers relative to world baselines increased from 0.6 to 0.7 between 1999 and 2008 but remains relatively low compared to other countries in the group.

Chart 1.04.05 Citation impact of mathematics papers



Data & Analysis: *Evidence*, Thomson Reuters

- Grouping of countries by citation impact is not as pronounced as for other subject areas, however, the more established economies appear to have generally higher citation rates than the emerging economies.
- China's growth in relative citation impact for mathematics papers has been the most significant (from 0.65 in 1999 to 0.85 in 2008) although it still remains below world average and it has been relatively stable since 2005.
- Erratic peaks are seen for Japan and Australia in 2002 and 2003 respectively. This is because the countries have relatively small output volumes in mathematics and therefore a few exceptional highly cited papers can influence the average citation impact to a greater degree than for other countries.

1.04 Citation impact relative to world baselines by subject area

Table 1.04.06 Citation impact of physical sciences papers

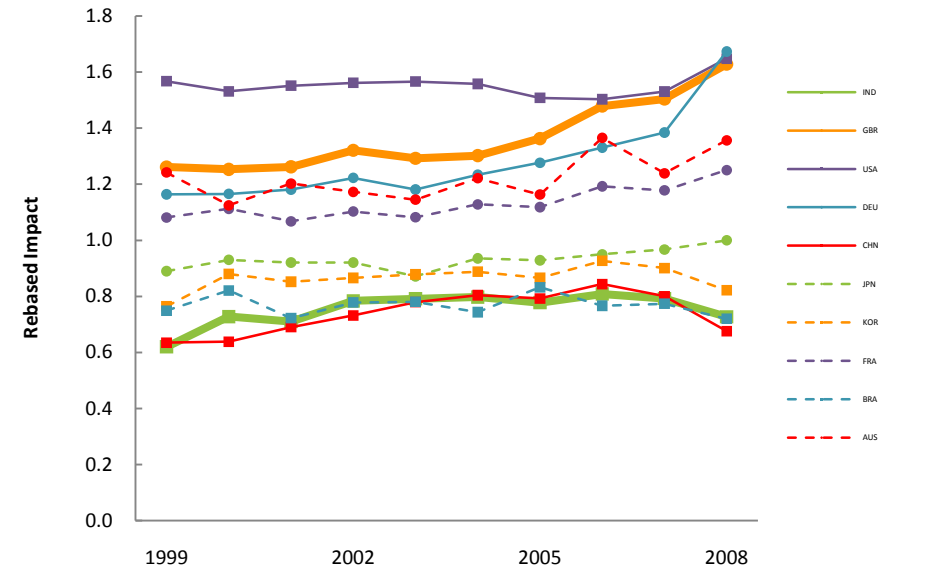
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK rebased impact	1.39	1.63	+17%
India rebased impact	0.79	0.73	-8%
Group average rebased impact	1.00	1.06	+7%
UK / group average	1.39	1.53	+10%
India / group average	0.80	0.68	-14%
UK rank in group	2	3	↓
India rank in group	9	8	↑

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- When analysing citation impact trends the most recent year often deviates from the prevailing trend. Mature research economies generally have a higher citation impact in the most recent year, while a lower citation impact is observed for growing economies.
- The UK's rebased impact figure for physical sciences has increased from 1.26 in 1999 to 1.63 in 2008. However, its rank has dropped from second in the comparator group to third in 2008 because of Germany's strong performance. The UK remains ranked below the USA although the gap between the two countries has decreased from 0.28 impact points to almost zero.

Chart 1.04.06 Citation impact of physical sciences papers



Data & Analysis: *Evidence*, Thomson Reuters

- India's physical sciences rebased impact has increased from 0.62 in 1999 to 0.73 in 2008 and its rank within the comparator group has increased. However, India's impact has fallen since 2006 and its overall performance during the time period shown lags behind the comparator group average.
- There is some grouping of countries evident on the graph. The UK, USA, Germany, Australia and France have higher than world average citation impact and a higher rate of growth than Japan, South Korea, India, China and Brazil.
- Over the time period 1999-2008 Germany has shown the greatest improvement in terms of physical sciences relative impact and in 2008 was ranked first in the comparator group.

1.04 Citation impact relative to world baselines by subject area

Table 1.04.07 Citation impact of engineering papers

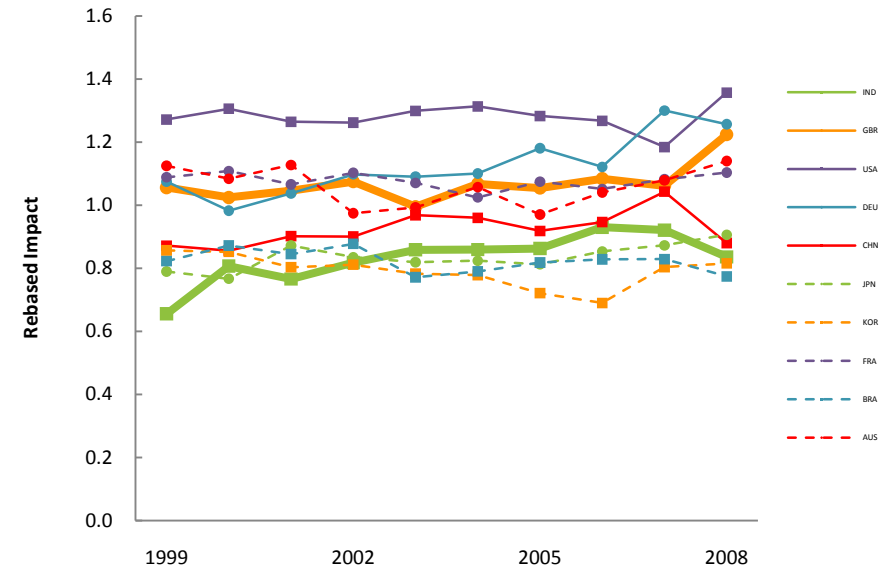
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK rebased impact	1.05	1.22	+16%
India rebased impact	0.89	0.84	-6%
Group average rebased impact	1.00	1.06	+7%
UK / group average	1.06	1.15	+9%
India / group average	0.89	0.79	-12%
UK rank in group	4	3	↑
India rank in group	7	8	↓

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- When analysing citation impact trends the most recent year often deviates from the prevailing trend. Mature research economies generally have a higher citation impact in the most recent year, while a lower citation impact is observed for growing economies.
- The UK's citation impact for engineering papers has been relatively stable between 1999 and 2007. There was, however, a significant increase between 2007 and 2008 (1.06 to 1.22) which was accompanied by an increase in rank within the comparator group to third.

Chart 1.04.07 Citation impact of engineering papers



Data & Analysis: *Evidence*, Thomson Reuters

- India showed the largest growth in percentile terms relative to other countries in the comparator group over the period 1999-2008 (from 0.62 to 0.73) although it has shown a fall in impact since 2006 and its rank within the comparator group decreased in 2008 relative to recent years.
- Some grouping of countries is evident. Those nations with mature research economies have higher citation rates than those with emerging economies; China's relative impact for engineering papers appears to be between the two groups.

1.04 Citation impact relative to world baselines by subject area

Table 1.04.08 Citation impact of social sciences papers

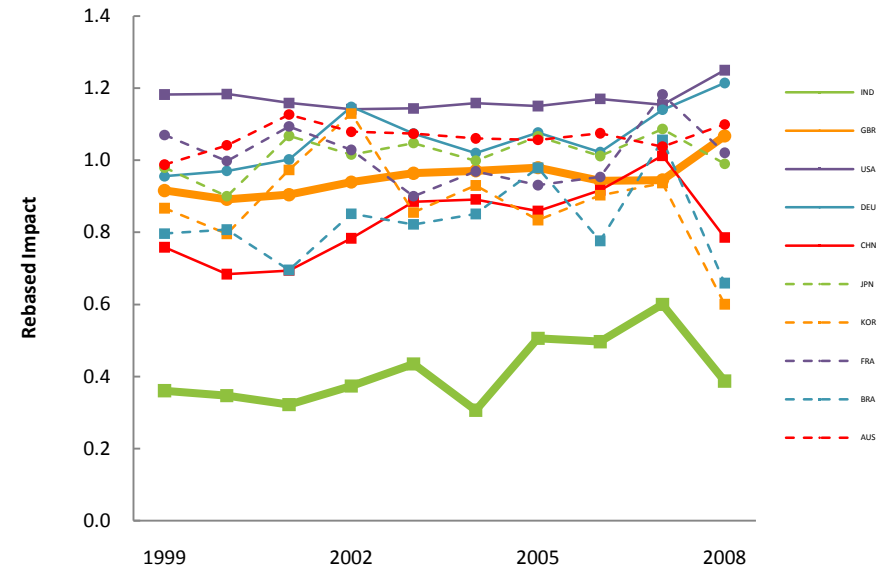
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK rebased impact	0.96	1.07	+11%
India rebased impact	0.47	0.39	-17%
Group average rebased impact	1.00	1.06	+7%
UK / group average	0.96	1.00	+4%
India / group average	0.47	0.36	-23%
UK rank in group	6	4	↑
India rank in group	10	10	↔

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- When analysing citation impact trends the most recent year often deviates from the prevailing trend. Mature research economies generally have a higher citation impact in the most recent year, while a lower citation impact is observed for growing economies.
- The UK's citation impact for social sciences papers has been relatively stable for most of the period between 1999 and 2008. There has, however, been a large increase in the UK's citation impact for 2008 and a corresponding jump in rank to fourth within the comparator group.

Chart 1.04.08 Citation impact of social sciences papers



Data & Analysis: *Evidence*, Thomson Reuters

- India's relative citation impact increased from 0.36 in 1999 to 0.6 in 2007; however, in 2008 this fell significantly to 0.39. India's citation impact for social sciences papers remains significantly lower than the other countries in the comparator group and it has been consistently ranked tenth over the ten years shown.
- The grouping of countries seen in other subject areas is not as evident for social sciences papers although the USA, Germany, Australia, Japan, France and the UK still generally have higher citation impact than the other nations in the comparator group.

1.04 Citation impact relative to world baselines by subject area

Table 1.04.09 Citation impact of business papers

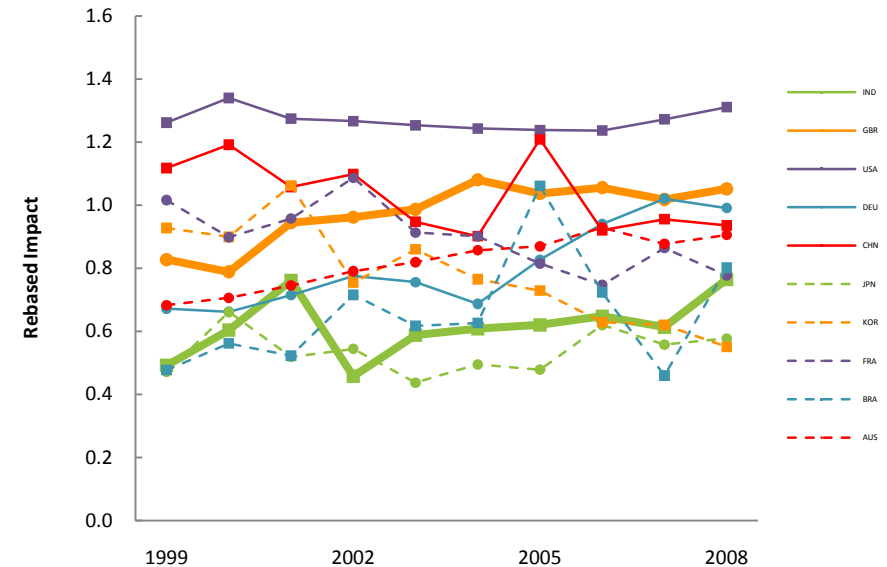
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK rebased impact	1.04	1.05	+2%
India rebased impact	0.62	0.76	+24%
Group average rebased impact	1.00	1.06	+7%
UK / group average	1.04	0.99	-5%
India / group average	0.62	0.72	+16%
UK rank in group	2	2	↔
India rank in group	9	8	↑

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- When analysing citation impact trends the most recent year often deviates from the prevailing trend. Mature research economies generally have a higher citation impact in the most recent year, while a lower citation impact is observed for growing economies.
- The UK's relative citation impact for business papers has risen from 0.83 in 1999 to 1.05 in 2008 – although this figure has been relatively stable since 2004. Business remains a strong area for the UK and it is second only to the USA which has shown a fairly consistent relative citation impact for the entire period shown.

Chart 1.04.09 Citation impact of business papers



Data & Analysis: *Evidence*, Thomson Reuters

- India's increase in business citation impact has been amongst the highest, rising from 0.49 in 1999 to 0.76 in 2008. Its rank within the comparator group has increased in recent years although its citation impact remains below world average.
- German business citation impact has increased significantly (0.83 in 1999 to 0.99 in 2008) and its rank has improved from seventh to third within the comparator group.
- The grouping of countries seen in other subjects is not evident for business papers although developed economies often have a higher citation impact than growing ones (China's relatively high impact is an exception).

1.04 Citation impact relative to world baselines by subject area

Table 1.04.10 Citation impact of humanities papers

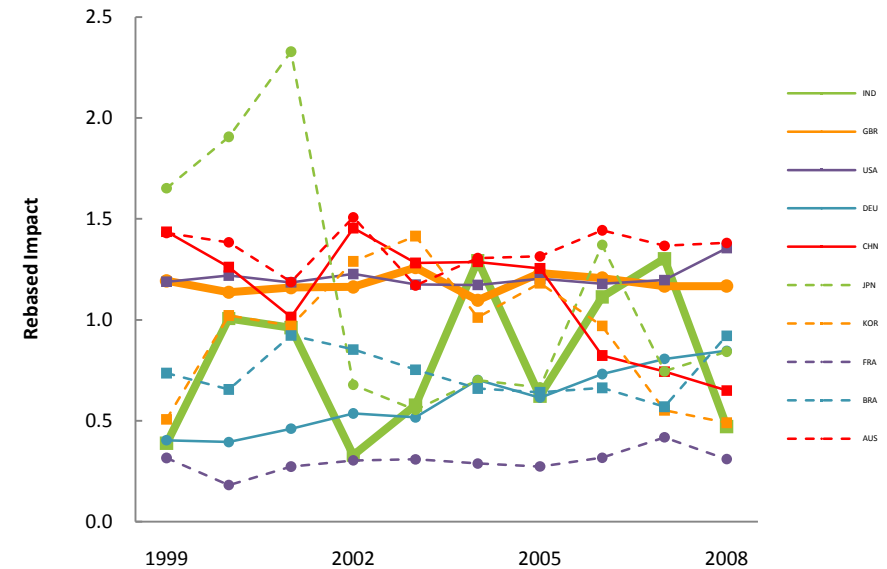
	Recent average (2003-2007)	Current value (2008)	Current relative to recent
UK rebased impact	1.19	1.17	-2%
India rebased impact	0.98	0.47	-52%
Group average rebased impact	1.00	1.06	+7%
UK / group average	1.20	1.10	-8%
India / group average	0.98	0.44	-55%
UK rank in group	2	3	↓
India rank in group	6	9	↓

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- When analysing citation impact trends the most recent year often deviates from the prevailing trend. Mature research economies generally have a higher citation impact in the most recent year, while a lower citation impact is observed for growing economies.
- The UK's citation impact for humanities papers has been stable over the period 1999 to 2008.
- India's relative citation impact for humanities papers has been erratic over the period 1999-2008 with no apparent trend evident. This is due to statistical noise arising from the relatively small volumes of Indian publications in this field (an annual average of 74 papers between 1999 and 2008).

Chart 1.04.10 Citation impact of humanities papers

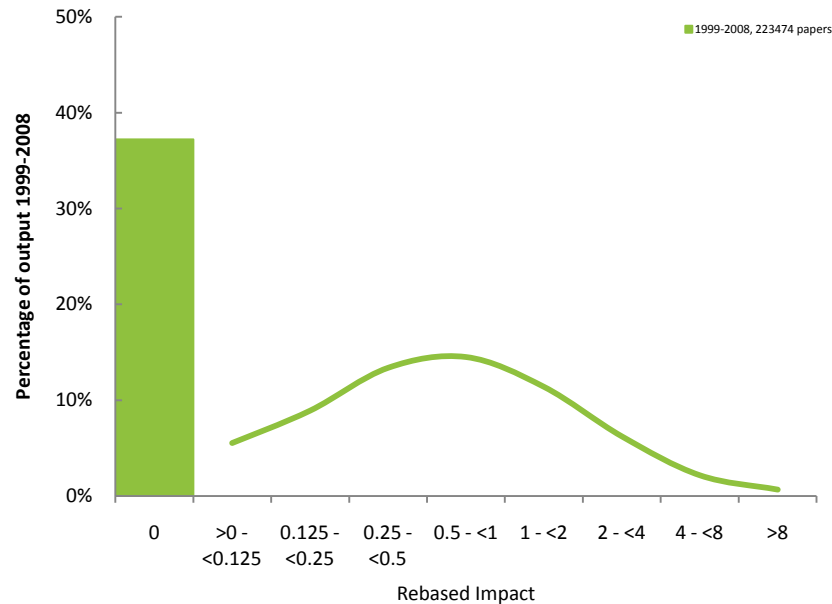


Data & Analysis: *Evidence*, Thomson Reuters

- French and German humanities papers are cited significantly less frequently than the world average, however, Germany's citation rates increased over the period shown.
- There is a general trend for the impact figures for countries with smaller output volumes to be significantly more erratic than those with larger outputs making any underlying trends in relative citation impact less obvious. This is because of statistical noise arising from small samples sizes.
- The country groupings observed for other subject areas are not apparent for humanities papers.

1.05 Impact Profiles® - India

Chart 1.05.1 - India Impact Profile® 1999-2008



Data & Analysis: *Evidence*, Thomson Reuters

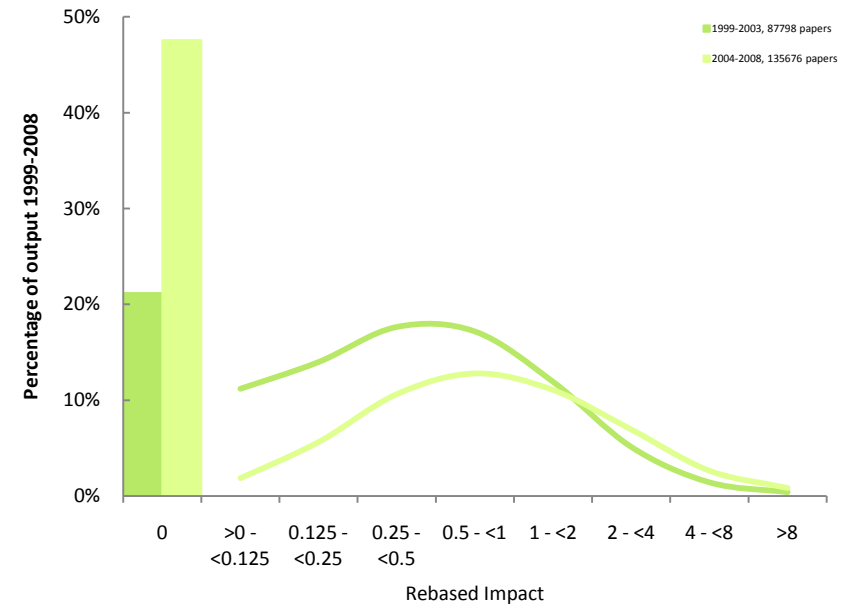
Commentary

The overall Impact Profile® for India's published research papers shows that:

- 37 per cent of India's journal output between 1999 and 2008 is uncited.
- Most of India's papers remain below world average.
- 20.5 per cent of India papers have a rebased impact of world average or better and 2.8 per cent of papers at least four times the world average.

The Impact Profile® indicates that India's research papers are on average cited less than world average but with a significant body of research above this level.

Chart 1.05.2 - India Impact Profile® 1999-2003 and 2004-2008



Data & Analysis: *Evidence*, Thomson Reuters

Commentary

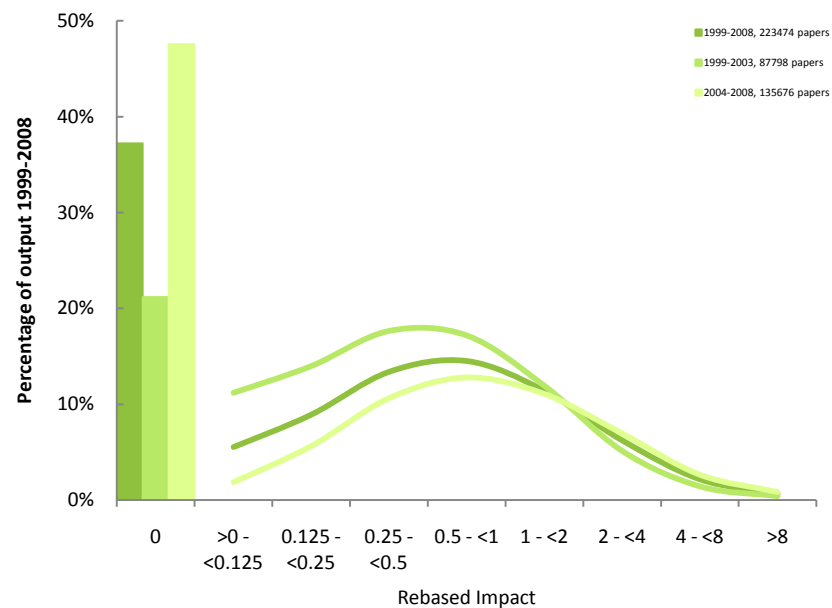
The Impact Profile® comparing India's citation impact from 2004-2008 to that from 1999-2003 shows that:

- 47.6 per cent of papers published between 2004 and 2008 are uncited while 21.1 per cent are uncited between 1999 and 2003 because these papers have had less time to accumulate citations.
- The modal citation impact of India's research papers has increased between 1999-2003 and 2004-2008.
- 1.8 per cent of articles published between 1999 and 2003 have a citation impact at least four times the world average, increasing to 3.5 per cent in the later period.

The Impact Profile® indicates India's published output has improved in terms of rebased citation impact between the two time periods.

1.05 Impact Profiles® - India

Chart 1.05.3 - India overall Impact Profile®



Data & Analysis: *Evidence*, Thomson Reuters

Commentary

The Impact Profile combining India's citation impact data for 2004 to 2008, 1999 to 2003, and the entire ten year period (1999-2008) shows that:

- The number of articles remaining uncited is greater in the most recent period as would be expected given that these papers have had less time to accumulate citations.
- There has been a noticeable shift in the Impact Profile® to the right over the time period analysed suggesting the citation impact of India's published output has increased over the time period analysed.

The Impact Profile® indicates that India's published output has improved in terms of rebased citation impact over the past ten years.

2.0 A bibliometric survey of India's international research collaboration

Co-authored research papers are a generally accepted indicator of collaboration between researchers and the number of collaborative publications can be used to index the activity of the collaboration.

Using data from the Thomson Reuters® databases we have analyzed the volume of Indian research papers with co-authors based in other countries. This provides a picture of India's international collaboration. We also produced Impact Profiles® (see Section 1.0) to investigate the number of citations collaborative research papers receive relative to the background levels for both the UK and India. In order to determine where India-UK collaboration is strongest we analysed which subject areas produce the most highly cited co-authored research papers (i.e. those cited at least four-time the world average). Finally, we determined which UK and Indian institutions collaborate most frequently both overall and by subject area.

Methodology

As in the previous section, volumes of research papers have been used to index the levels of research activity occurring and the number of citations a research paper receives as an index of academic impact.

Collaboration

Co-authorship is generally accepted as a good indicator of collaboration, although there are collaborations that do not result in co-authored papers and co-authored papers which involve limited collaboration. Conceivably other indicators of collaboration such as co-funding and international exchanges could be used but comprehensive and consistent data are not available.

Impact Profiles®

As described more fully in section 1.0, we have used Impact Profiles® to investigate and compare the distribution of citations received by Indian research papers and those arising from India-UK collaboration. Citation impact, calculated as the average number of citations received by a paper, is a useful indicator of the quality of research. However, average citation counts give an incomplete picture of the relative importance of research. This is because citation data are highly skewed – many papers are uncited and very few accumulate extensive citation counts – and the mean citation count is often very different from the median or mode. Impact Profiles® were developed by *Evidence* to overcome this. They show the proportion of papers that are uncited and the proportion falling into each of eight categories of relative citation rates, normalised (rebased) to world average (which becomes 1.0). Rebased citation rates above 1.0 indicate papers cited more often than world average for the field in which that journal is categorised and in their year of publication.

Subject areas

As in the rest of this report ten broad subject areas have been used for most of the analyses: clinical, health and medically-related, biological sciences, environment, mathematics, physical sciences, engineering, social sciences, business and humanities. However, in section 2.03 the more specific 250 journal categories used in the Thomson Reuters Web of Science® were used to provide a more in-depth picture of the strengths of India-UK collaboration.

Research institutions

The institution addresses provided by the authors of research papers are often not reported consistently. For example, authors may variously refer to their institution as “MRC Laboratory of Molecular Biology”, “MRC, Cambridge”, “LMB, Cambridge”, “MRC Cambridge University” etc. This makes it difficult to correctly assign research papers to institutions. Therefore, *Evidence* has fully unified all of

the UK address variants for Thomson Reuters citation databases enabling accurate association of articles with institutions. For the purposes of this report, this process has been extended to cover Indian institutions collaborating with the UK. In this report we have used the unified address data to determine which UK and Indian research institutions collaborate most frequently.

Summary of results

The UK is India's largest collaborator behind the USA and Germany. That Germany has collaborated more frequently with India than the UK, both recently and in the past despite a difference in language and equal geographical challenges, indicates that it is a strong competitor. These data also show that the number of Indian research papers with a UK-based co-author has increased threefold, although many other countries have grown faster in their collaboration with India (charts 2.01.1 and 2.01.2).

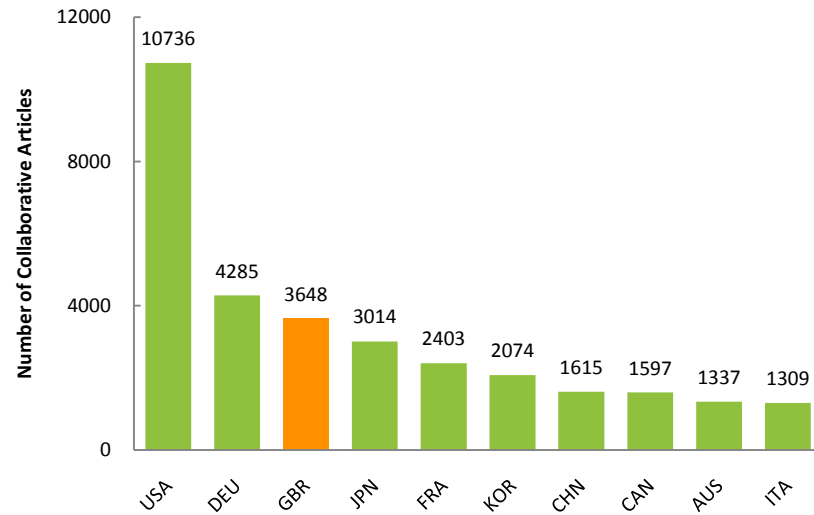
Around half of cited India-UK co-authored papers are cited at least as many times as the global average and that a significant proportion (8.5 per cent) are highly cited (i.e. cited at least four-times the world average). Impact Profiles® show that the modal citation impact of India-UK collaborative papers was higher between 2004 and 2008 than between 1999 and 2003. They also show that India-UK collaborative research papers are less likely to be uncited than Indian papers generally and that India-UK collaborative papers have a higher citation impact (charts 2.02.1 to 2.02.4).

The most highly cited India-UK collaborations are in physical sciences subjects (for example particle and field physics, crystallography, and inorganic and nuclear chemistry). In addition to the physical sciences the data also show that India-UK collaboration is strong across a range of subject areas. These include public, environmental and occupational health, biochemistry and molecular biology, and psychiatry (table 2.03).

The UK and Indian institutions which contributed the most research papers to the India-UK collaborative interface are mostly research intensive universities or specialist research institutions. A similar pattern is seen when the Indian institution data are broken down by subject area. However, when the UK institution data are analyzed by subject area it is evident that a diverse range of institutions are involved in collaboration with India, not just those that are traditionally research intensive (table 2.04.1 to 2.06.10).

2.01 India international collaboration

Chart 2.01.1 - India's international collaborators 2004-2008

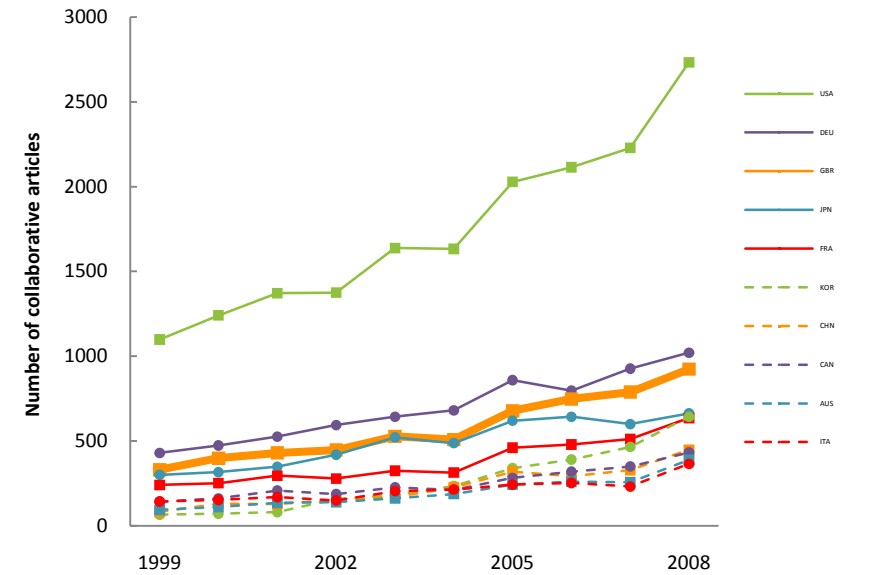


Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- India collaborated with an internationally based co-author on a total of 30,722 papers between 2004 and 2008.
- The chart shows the ten partner countries that published the most collaborative articles with India between 2004 and 2008.
- Between 2004 and 2008 India's largest collaborator by a very sizable margin (a factor of 2.5) is the USA with 10,736 collaborative papers (35% of India's total international collaboration).
- The UK is India's third largest collaborator, having co-published 3,648 papers (around 12 per cent of India's total international collaboration).

Chart 2.01.2 - India's international collaboration 1999-2008



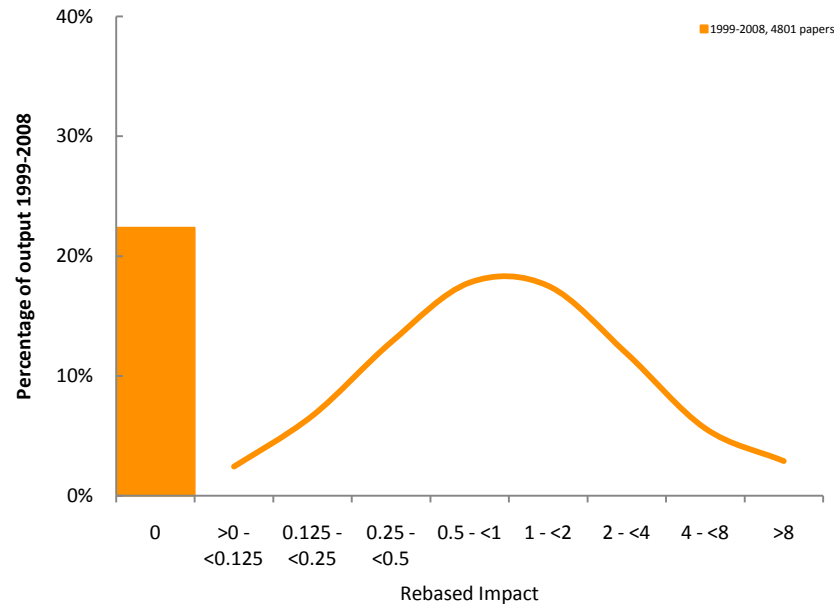
Data & Analysis: *Evidence*, Thomson Reuters

Commentary

- The graph shows that all of the countries have experienced growth in their collaborative output with India.
- Within the comparator group South Korea showed the largest growth in terms of collaborative publications with India - approaching a tenfold increase between 1999 and 2008. South Korea's ranking in terms of output has also risen from tenth within the comparator group to sixth.
- The UK's co-authorship with India over the period from 1999 to 2008 has increased nearly threefold, and it ranks fifth within the comparator group in terms of growth.

2.02 Impact Profiles® - India-UK collaboration

Chart 2.02.1 - India-UK collaborative Impact Profile® 1999-2008



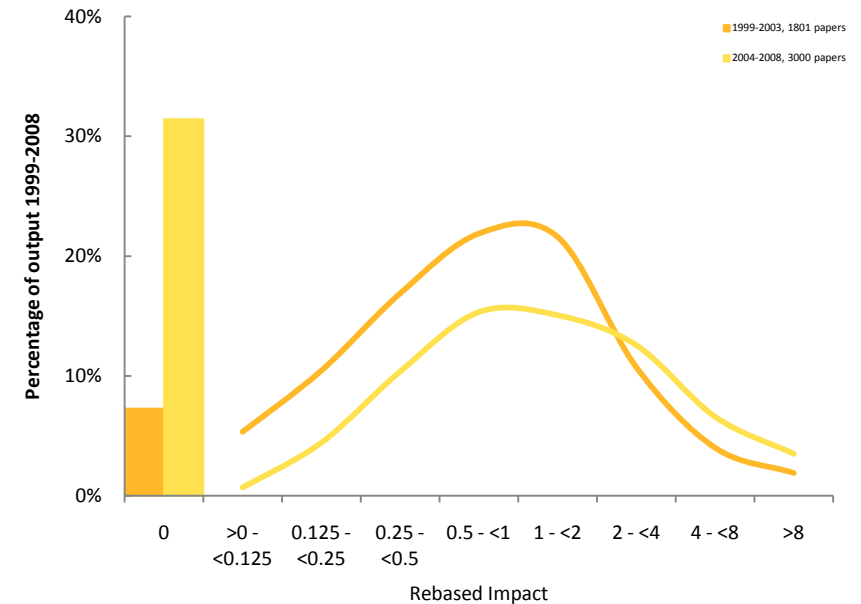
Data & Analysis: *Evidence*, Thomson Reuters

Commentary

The Impact Profile® for India's collaborative publications with the UK for the past ten year period (1999-2008) shows:

- 22 per cent of India's collaborative output with the UK between 1999 and 2008 is uncited.
- Approximately half of the cited India-UK collaborative publications are around world average or better.
- 37.9 per cent of India's papers have a rebased impact of at least the world average and 8.5 per cent of papers of at least four times the world average. The Impact Profile® indicates that India's collaborative publications are of approximately the same standard as world average.

Chart 2.02.2 - India-UK collaborative Impact Profile® 1999-2003 and 2004-2008



Data & Analysis: *Evidence*, Thomson Reuters

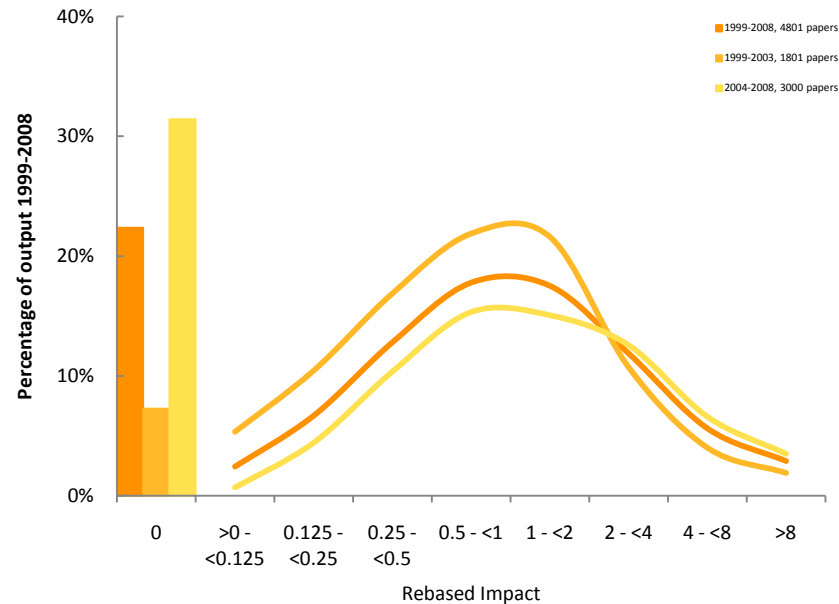
Commentary

The Impact Profile® comparing India-UK collaborative articles from 2004-2008 with those from 1999-2003 shows:

- 7.3 per cent of papers published in 1999-2003 and 31.4 per cent of papers published in 2004-2008 are uncited. This is because newer papers have had less time to accumulate citations.
- The modal citation impact is greater for more recently published UK-India papers.
- 5.8 per cent of papers published in 1999-2003 had a citation of at least four times the world average increasing to 10.1 per cent in the later period. The Impact Profile® indicates that both the volume and citation impact of UK-China collaborative papers has increase over time.

2.02 Impact Profiles® - India-UK collaboration

Chart 2.02.3 - India-UK collaborative overall Impact Profile®



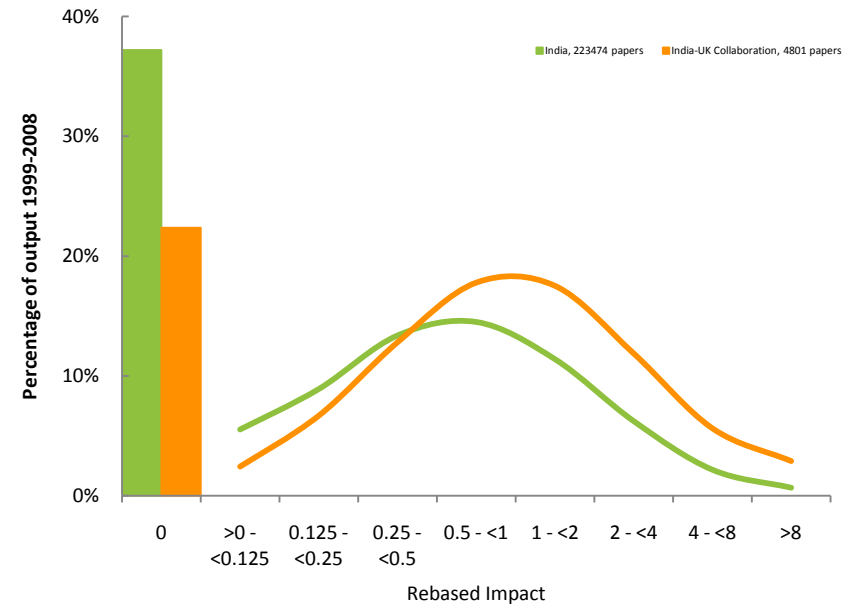
Data & Analysis: *Evidence*, Thomson Reuters

Commentary

The Impact Profile® combining India-UK collaborative citation impact data for the past five years (2004-2008), the previous five years (1999-2003), and the entire ten year period shows:

- The number of articles remaining uncited is greater in the more recent years because these papers have had less time to accumulate citations.
 - There has been an increase in the modal citation impact of India's collaborative research papers with the UK over the time period analysed.
- The Impact Profile® indicates India's collaborative publications with the UK have improved in terms of rebased citation impact over the past ten years.

Chart 2.02.4 - India and India-UK collaboration Comparative Impact Profile®



Data & Analysis: *Evidence*, Thomson Reuters

Commentary

The Impact Profile® comparing India's citation impact with that for UK-India collaborative publications over the period 1999-2008 shows:

- 37.2 per cent of India's articles published between 1999 and 2008 remain uncited dropping to 22.4 per cent for India-UK collaborative publications.
 - There is a shift to the right in the Impact Profile® for India's collaborative output with the UK showing collaborative articles have a higher citation impact.
 - While 2.8 per cent of articles published by India between 1999 and 2003 had a citation of at least four times the world average, this figure increased to 8.5 per cent for collaborative publications with the UK.
- The Impact Profile® indicates collaboration with the UK is linked to improved rebased citation impact of India's published articles.

2.03 Top subject areas for UK-India highly-cited co-authorship (1999-2008)

Table 2.03 - Top subject areas for UK-India co-authorship

	Number of papers
Physics, Multidisciplinary	66
Physics, Particles & Fields	47
Astronomy & Astrophysics	42
Physics, Nuclear	24
Crystallography	22
Chemistry, Inorganic & Nuclear	20
Public, Environmental & Occupational Health	16
Materials Science, Multidisciplinary	15
Physics, Condensed Matter	15
Biochemistry & Molecular Biology	13
Biotechnology & Applied Microbiology	13
Chemistry, Multidisciplinary	12
Environmental Sciences	12
Psychiatry	12
Ecology	9
Genetics & Heredity	8
Geosciences, Multidisciplinary	8
Instruments & Instrumentation	8
Nutrition & Dietetics	8
Agronomy	7
Endocrinology & Metabolism	7
Microbiology	7
Pharmacology & Pharmacy	7
Plant Sciences	7
Physics, Applied	6

Commentary

Highly-cited articles are those with a citation impact greater than or equal to four times the world average for that subject area and year. The list of the top 25 subject areas (out of the 250 Web of Science journal categories) in which Indian authors have published highly-cited papers with UK-based coauthors shows that the physical sciences (particularly physics) are significantly the largest area of highly-cited collaboration between the UK and India. However, UK-India collaborative research spans a wide range of subject areas - public, environmental and occupational health, biochemistry and molecular biology, and psychiatry, for example, are all prominent areas of collaboration with exceptionally high quality output. The 2009 Global Research Report for India published by Thomson Reuters¹ shows that in terms of national output some of these subject areas are ones where India has a significant share of world output (e.g. crystallography and agronomy). These data also suggest that UK-India collaborations which produce highly-cited papers do not just occur in those fields which are India's traditional strengths - for example, tropical medicine, textiles and agricultural engineering.

¹ Adams, J., King, C., Singh, V. (Oct. 2009) Global Research Report: India, Thomson Reuters http://science.thomsonreuters.com/m/pdfs/grr-India-oct09_ag0908174.pdf

2.04 Most frequent UK and Indian institutions for co-authorship (1999-2008)

Table 2.04.1 - Most frequent UK institutions

	Number of papers	Percentage of UK-India co-authored articles
Imperial Coll London	327	6.8%
Univ Manchester	314	6.5%
Univ Cambridge	306	6.4%
Univ Oxford	247	5.1%
Univ Reading	217	4.5%
Univ Southampton	201	4.2%
Lancaster Univ	197	4.1%
Univ Birmingham	186	3.9%
London Sch Hyg & Trop Med	184	3.8%
Univ Coll London	144	3.0%

Data & Analysis: *Evidence*, Thomson Reuters

Table 2.04.2 - Most frequent Indian institutions

	Number of papers	Percentage of UK-India co-authored articles
Tata Inst Fundamental Res	336	7.0%
Univ Delhi	290	6.0%
Panjab Univ	287	6.0%
Indian Inst Sci	199	4.1%
Indian Assoc Culivat Sci	161	3.4%
Jadavpur Univ	141	2.9%
Indian Inst Technol Mumbai	117	2.4%
Bhabha Atom Res Ctr	116	2.4%
All India Inst Med Sci	107	2.2%
Christian Med Coll & Hosp	99	2.1%

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

These data show that the most frequently collaborating UK and Indian institutions are generally traditionally research intensive universities and specialist research institutes. Seven of the ten UK institutions most frequently collaborating with India are Russell group institutions, and most of them appear several times in the lists of most frequently occurring institutions broken-down by subject area (section 2.05). Eight out of these ten UK institutions appear in the list of most frequently collaborating institutions in the physical sciences (chart 2.05.6), which is the most productive area for UK-India collaboration. Similarly the most frequently collaborating Indian institutions appear several times in the lists of most frequently occurring institutions by subject area (section 2.06) and collaborate particularly strongly in the physical sciences (chart 2.06.6).

2.05 Most frequent UK institutions for co-authorship with India (1999-2008)

Table 2.05.1 - Most frequent UK institutions - clinical

	Number of papers	Percentage of UK-India co-authored articles
London Sch Hyg & Trop Med	74	9.2%
Univ Coll London	62	7.7%
Univ Oxford	43	5.3%
Kings Coll London	30	3.7%
Imperial Coll London	30	3.7%
Univ Cambridge	28	3.5%
Univ Southampton	27	3.3%
Hlth Protect Agcy	25	3.1%
Univ Manchester	20	2.5%
Univ Aberdeen	18	2.2%

Data & Analysis: *Evidence*, Thomson Reuters

Table 2.05.3 - Most frequent UK institutions - biological sciences

	Number of papers	Percentage of UK-India co-authored articles
Univ Cambridge	47	5.3%
Univ Oxford	45	5.1%
Univ Reading	36	4.1%
Nat Hist Museum	34	3.8%
Imperial Coll London	34	3.8%
Univ Greenwich	32	3.6%
Univ Ulster	31	3.5%
London Sch Hyg & Trop Med	28	3.2%
Scottish Crop Res Inst	27	3.1%
Univ Aberdeen	26	2.9%

Data & Analysis: *Evidence*, Thomson Reuters

Table 2.05.2 - Most frequent UK institutions - health and medically-related

	Number of papers	Percentage of UK-India co-authored articles
London Sch Hyg & Trop Med	97	20.1%
Kings Coll London	60	12.4%
Univ Oxford	29	6.0%
Univ Coll London	23	4.8%
Univ Aberdeen	13	2.7%
Univ Edinburgh	12	2.5%
Univ Liverpool	12	2.5%
Univ Southampton	11	2.3%
Univ Cambridge	10	2.1%
Uk Govt	7	1.4%

Data & Analysis: *Evidence*, Thomson Reuters

Table 2.05.4 - Most frequent UK institutions - environment

	Number of papers	Percentage of UK-India co-authored articles
Univ Cambridge	36	10.9%
Open Univ	22	6.7%
Univ Southampton	13	3.9%
Univ Edinburgh	12	3.6%
Imperial Coll London	11	3.3%
Univ Leicester	11	3.3%
Univ Reading	11	3.3%
Univ Leeds	10	3.0%
Fisheries Res Serv	10	3.0%
Nat Hist Museum	10	3.0%

Data & Analysis: *Evidence*, Thomson Reuters

2.05 Most frequent UK institutions for co-authorship with India (1999-2008)

Table 2.05.5 - Most frequent UK institutions - mathematics

	Number of papers	Percentage of UK-India co-authored articles
Nottingham Trent Univ	26	12.7%
Univ Cambridge	18	8.8%
Univ Manchester	17	8.3%
Univ Oxford	12	5.9%
Univ Glasgow	8	3.9%
Univ Southampton	7	3.4%
Univ Warwick	7	3.4%
Loughborough Univ	7	3.4%
Univ Edinburgh	6	2.9%
Univ Nottingham	6	2.9%

Data & Analysis: *Evidence*, Thomson Reuters

Table 2.05.7 - Most frequent UK institutions - engineering

	Number of papers	Percentage of UK-India co-authored articles
Univ Manchester	36	7.5%
Manchester Metropolitan Univ	34	7.0%
Univ Cambridge	32	6.6%
Loughborough Univ	22	4.6%
Univ Southampton	21	4.3%
Univ Sheffield	19	3.9%
Univ Birmingham	16	3.3%
Imperial Coll London	16	3.3%
Newcastle Univ	16	3.3%
Swansea Univ	14	2.9%

Data & Analysis: *Evidence*, Thomson Reuters

Table 2.05.6 - Most frequent UK institutions - physical sciences

	Number of papers	Percentage of UK-India co-authored articles
Imperial Coll London	241	10.9%
Univ Manchester	237	10.7%
Lancaster Univ	194	8.8%
Univ Reading	175	7.9%
Univ Cambridge	164	7.4%
Univ Birmingham	152	6.9%
Univ Southampton	130	5.9%
Univ Oxford	119	5.4%
Durham Univ	98	4.4%
Cardiff Univ	88	4.0%

Data & Analysis: *Evidence*, Thomson Reuters

Table 2.05.8 - Most frequent UK institutions - social sciences

	Number of papers	Percentage of UK-India co-authored articles
London Sch Hyg & Trop Med	10	11.1%
Univ Southampton	7	7.8%
Univ Cambridge	6	6.7%
Univ Oxford	5	5.6%
Univ Warwick	4	4.4%
Kings Coll London	4	4.4%
Univ Bath	4	4.4%
Durham Univ	3	3.3%
Univ E Anglia	3	3.3%
Keele Univ	3	3.3%

Data & Analysis: *Evidence*, Thomson Reuters

2.05 Most frequent UK institutions for co-authorship with India (1999-2008)

Table 2.05.9 - Most frequent UK institutions - business

	Number of papers	Percentage of UK-India co-authored articles
Univ E Anglia	4	8.0%
Univ Warwick	4	8.0%
London Sch Econ & Polit Sci	3	6.0%
Cardiff Univ	3	6.0%
Univ Nottingham	3	6.0%
Brunel Univ	2	4.0%
London Business Sch	2	4.0%
Univ Bath	2	4.0%
Univ Leeds	2	4.0%
Aston Univ	2	4.0%

Data & Analysis: *Evidence*, Thomson Reuters

Table 2.05.10 - Most frequent UK institutions - humanities*

	Number of papers	Percentage of UK-India co-authored articles
Univ Cambridge	2	11.1%
Newcastle Univ	2	11.1%
Keele Univ	2	11.1%
Univ Manchester	2	11.1%

Data & Analysis: *Evidence*, Thomson Reuters

Commentary

The lists of most frequent UK institutions for co-authorship of papers with India are relatively diverse and contain traditionally research intensive institutions (e.g. Russell group universities), specialist institutions and newer universities. The lists of most frequent UK institutions for collaborative authorship of clinical and pre-clinical papers are very similar (seven institutions appearing in both lists) and the London School of Hygiene and Tropical Medicine appear at the top of both lists. It is more difficult to draw statistically meaningful conclusions about the most frequent UK institutions for co-authoring papers in business and the humanities because of the low volumes involved although the lists are still diverse in nature. Where institutions not particularly known as specialist or research-intensive appear in the top ten collaborators with India this could be due to a variety of factors - for example, strong personal ties between individual collaborators or historical links between the collaborating institutions would play a part, as could the contributions of a particularly active collaborative researcher.

*Only four institutions have been shown for the humanities because the numbers of publications involved are very low and therefore less statistically meaningful.

2.06 Most frequent Indian institutions for co-authorship with the UK (1999-2008)

Table 2.06.1 - Most frequent Indian institutions - clinical

	Number of papers	Percentage of UK-India co-authored articles
All India Inst Med Sci	76	9.4%
Christian Med Coll & Hosp	68	8.4%
Post Grad Inst Med Educ & Res	24	3.0%
Natl Inst Mental Hlth & Neurol Sci	19	2.4%
St Johns Med Coll	13	1.6%
Sanjay Gandhi Postgrad Inst Med Sci	11	1.4%
Tata Mem Hosp	10	1.2%
Ccs Haryana Agr Univ	9	1.1%
Univ Delhi	8	1.0%
Tata Inst Fundamental Res	8	1.0%

Data & Analysis: *Evidence*, Thomson Reuters

Table 2.06.3 - Most frequent Indian institutions - biological sciences

	Number of papers	Percentage of UK-India co-authored articles
Int Crops Res Inst Semi Arid Trop	54	6.1%
Univ Agr Sci Bangalore	38	4.3%
Ccs Haryana Agr Univ	37	4.2%
Indian Inst Sci	28	3.2%
Ctr Cellular & Mol Biol	19	2.1%
Bombay Nat Hist Soc	19	2.1%
Punjab Agr Univ	19	2.1%
Univ Delhi	19	2.1%
Univ Hyderabad	15	1.7%
Banaras Hindu Univ	15	1.7%

Data & Analysis: *Evidence*, Thomson Reuters

Table 2.06.2 - Most frequent Indian institutions - health and medically-related

	Number of papers	Percentage of UK-India co-authored articles
Natl Inst Mental Hlth & Neurol Sci	33	6.8%
Christian Med Coll & Hosp	28	5.8%
All India Inst Med Sci	27	5.6%
Banaras Hindu Univ	12	2.5%
Jadavpur Univ	12	2.5%
Post Grad Inst Med Educ & Res	9	1.9%
St Johns Med Coll	9	1.9%
Natl Inst Pharmaceut Educ & Res	6	1.2%
Punjabi Univ	5	1.0%
Univ Pune	5	1.0%

Data & Analysis: *Evidence*, Thomson Reuters

Table 2.06.4 - Most frequent Indian institutions - environment

	Number of papers	Percentage of UK-India co-authored articles
Natl Geophys Res Inst	20	6.1%
Natl Inst Oceanog	19	5.8%
Phys Res Lab	18	5.5%
Indian Inst Technol Roorkee	15	4.5%
Univ Delhi	14	4.2%
Indian Inst Technol Mumbai	12	3.6%
Indian Inst Astrophys	10	3.0%
Anna Univ	8	2.4%
Banaras Hindu Univ	8	2.4%
Wadia Inst Himalayan Geol	8	2.4%

Data & Analysis: *Evidence*, Thomson Reuters

2.06 Most frequent Indian institutions for co-authorship with the UK (1999-2008)

Table 2.06.5 - Most frequent Indian institutions - mathematics

	Number of papers	Percentage of UK-India co-authored articles
Tata Inst Fundamental Res	24	11.7%
Univ Delhi	22	10.7%
Indian Stat Inst Kolkata	16	7.8%
Indian Inst Sci	12	5.9%
Inst Math Sci	9	4.4%
Indian Inst Technol Kharagpur	8	3.9%
Indian Inst Technol Chennai	7	3.4%
Indian Inst Technol Mumbai	6	2.9%
Sn Bose Natl Ctr Basic Sci	6	2.9%
Indian Inst Technol Kanpur	5	2.4%

Data & Analysis: *Evidence*, Thomson Reuters

Table 2.06.7 - Most frequent Indian institutions - engineering

	Number of papers	Percentage of UK-India co-authored articles
Indian Inst Sci	58	12.0%
Indian Inst Technol Kharagpur	48	9.9%
Indian Inst Technol Mumbai	24	5.0%
Indian Inst Technol Chennai	24	5.0%
Aligarh Muslim Univ	22	4.6%
Indian Inst Technol Roorkee	22	4.6%
Indian Inst Technol Delhi	16	3.3%
Anna Univ	14	2.9%
Indian Inst Technol Kanpur	13	2.7%
Bhabha Atom Res Ctr	11	2.3%

Data & Analysis: *Evidence*, Thomson Reuters

Table 2.06.6 - Most frequent Indian institutions - physical sciences

	Number of papers	Percentage of UK-India co-authored articles
Tata Inst Fundamental Res	299	13.5%
Panjab Univ	279	12.6%
Univ Delhi	225	10.2%
Indian Assoc Culivat Sci	158	7.1%
Jadavpur Univ	121	5.5%
Indian Inst Sci	110	5.0%
Bhabha Atom Res Ctr	105	4.7%
Inter Univ Ctr Astron & Astrophys	96	4.3%
Inst Phys	86	3.9%
Indian Inst Technol Mumbai	85	3.8%

Data & Analysis: *Evidence*, Thomson Reuters

Table 2.06.8 - Most frequent Indian institutions - social sciences

	Number of papers	Percentage of UK-India co-authored articles
Univ Delhi	7	7.8%
Natl Inst Mental Hlth & Neurol Sci	4	4.4%
All India Inst Med Sci	4	4.4%
Karnatak Univ	3	3.3%
Tata Inst Social Sci	3	3.3%
Jawaharlal Nehru Univ	2	2.2%
Univ Hyderabad	2	2.2%
Panjab Univ	2	2.2%
Bengal Engn & Sci Univ	2	2.2%
Christian Med Coll & Hosp	2	2.2%

Data & Analysis: *Evidence*, Thomson Reuters

2.06 Most frequent Indian institutions for co-authorship with the UK (1999-2008)

Commentary

The lists of most frequent Indian institutions collaborating with the UK consist, for the most part, of specialist research units and research-intensive universities. Specialist institutions dominate the lists for co-authorship on clinical, pre-clinical and environment papers. The Indian Institutes of Technology are well represented in the fields of mathematics and engineering. Also notable is the presence of the Indian Institute of Science which appears in the lists of top collaborators for biological sciences, mathematics, physical sciences, engineering and business papers. Note: data have not been shown for co-authorship of business and humanities papers because the numbers of publication involved are too low to provide statistically meaningful data.

Conclusions

This report describes a bibliometric study of Indian research and international research collaboration. Several conclusions can be drawn from this work which indicate the future role of India in international research and suggest how this will impact on the UK.

- India's research activity (measured here by the number of research papers produced by Indian authors), although relatively low in international terms, is growing and along with other emerging research economies is likely to become increasingly important to the global research community. This growth is likely to provide increased opportunities for international collaboration which the UK could leverage.
- The impact of Indian research (indexed in this report by the number of citations that Indian research receives) is still low compared with other nations, although a substantial proportion is influential and this is increasing over time. This implies that there are opportunities for collaboration of a high standard.
- UK collaboration with India (as measured by the number of co-authored research papers that are produced) is strong compared to other nations and has an average academic impact of around world standard. Collaboration with India takes place in a diverse range of UK institutions across a diverse range of subject areas. The data suggest physical sciences are a particular strength of India-UK collaboration although this is to be expected given that they are India's largest area of research activity. This strength and diversity puts the UK in a good position to take advantage of future collaborative opportunities with India.
- The USA is India's largest collaborative partner (the US research economy is the largest globally). Germany is India's second largest partner and represents a significant competitor to the UK.

These conclusions indicate that the UK is well placed to take advantage of the emergence of the Indian research base globally and that opportunities to do so are likely in future. However, other nations are also active in their collaboration with India and the UK will need to remain competitive in order to remain a partner of choice.

Potential future work

While this report provides a detailed picture of Indian research and collaboration there is potential for further work to provide a deeper understanding of the issues that it raises.

- A deeper analysis of why the trends which are outside the norms highlighted in this report exist. This would give a fuller understanding of the international research environment.
- An evaluation of the strengths, weakness, opportunities and threats that the emergence of India as a research economy provides for collaboration at a detailed subject level. This would indicate specific areas that the UK and India could target for collaborative opportunities and would consider research capacity and strength (in both countries) and potential competitors.
- An analysis of the individual researchers who contribute most to the India-UK research interface. This could help identify potential models for successful future collaboration and provide targets for stimulus measures.
- A survey of the bodies that fund India-UK collaborative research. This would indicate potential sources of income for future collaborative research, and provide some attribution to key sponsors.
- A survey of competitor nations' research collaboration with India to determine where the UK is relatively weaker and also where un-exploited opportunities exist.