



# **International Comparative Performance of India's Scientific Research**

A Report prepared for the

**Department of Science and Technology, India.**

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# INTRODUCTION

This report has been commissioned by The Department of Science and Technology, India (DST) to assess the performance of India's scientific research. We focus specifically identifying India's relative strengths in terms of the volume, growth and world normalized citation impact of India's scientific output, compared to 9 selected countries (Brazil, China, Iran, Israel, Russian Federation, Singapore, South Africa, United Kingdom, and the United States) and compared to world benchmarks. We also look at international collaboration and its relationship with world normalized citation impact. This report includes 16 subject areas<sup>1</sup> which have been selected by The Department of Science and Technology.

Our methodology is founded upon the theoretical principles and best practices developed in the field of quantitative science and technology studies, particularly in science and technology indicators research. The data source used for the bibliometric analyses is Scopus. The analyses focus on the 5 year period (2006–2010) and make use of whole counting rather than fractional counting. Publication and citation data prior to this 5 year period are provided in the appendix. Further details of the methodology used can be found in the appendix.

## EXECUTIVE SUMMARY

In 2010 India produced a total of 65,487 publications, which represents 3.4% of the world's output for that year – which is an increase from 2.5% in 2006.

India's publication output is growing rapidly. Between 2006 and 2010, the number of papers published by India yearly, has grown 12.3% (compound annual growth rate) per year, while the total stock of world publications has grown 4% in the same period. The only comparator countries' whose output is growing faster than India's are China (13.7%) and Iran (25%).

Energy was the fastest growing subject area in India between 2006 – 2010 (13.3% CAGR) but does not yet represent a large share of India's total research output (3.1%). Interestingly, of the 16 subject areas investigated in this report, Energy is the subject area showing the highest world normalized citation impact, indicating that the overall quality of India's energy research is above world average.

Materials Science, Physics and Astronomy, and Medicine are significant subject areas for India because they each represent over 13% of Indian total output and have also each grown more than 7% per year in the 2006 -

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<sup>1</sup> The All Science Journal Classification used in Scopus classifies publications into 27 main fields. This report focuses on 16 of those 27 fields.



2010 period. Of these, Materials Science has a citation impact just about equal to the world average (1.01), while the others show below world average citation impact.

The United States and United Kingdom share the top spot in terms of producing the highest impact publications. Both countries have an overall world normalized relative citation impact of 1.7 for the period (2006-2010) indicating their papers were on average, cited 1.7 times as often as the world average for the same period. In contrast, India has an overall relative citation impact of 0.68 for the same period (2006-2010) – which is below the world average (1.0). India has shown an increase in overall world normalized citation impact from 0.58 in the period 2002-2006 to 0.68 in the period 2006-2010.

We also see that South Africa and Singapore have gone from below world average citation impact to above world average levels by the 2006-2010 period indicating significant improvements in quality of research. The quality of Indian research, as represented by world normalized citation impact, is above that of the Russian Federation, China, and Iran, while marginally below that of Brazil; and significantly below the other comparator countries.

Of the 16 subject areas examined in this report, India shows 4 subject areas which demonstrate above world average citation impact, namely: Energy (1.26), Chemical Engineering (1.18), Engineering (1.04) and Materials science (1.01). Energy stands out as the subject area in which India has the highest world normalized citation impact (1.26), while also being the fastest growing subject area in India (13.3% CAGR).

Engineering and Materials Science stand out in that each represent a significant share of India's output (over 13% each) while Engineering demonstrates above world average citation impact (1.04) and Materials science just about equal to world average citation impact (1.01).

Looking at levels of international collaboration during the period 2006-2010 as a whole we see that 17.6% of all India's scientific publications have at least one author affiliated to an institution in another country, which is a similar level to Iran (17.7%) and higher than China (13.1%). The remaining comparator countries show higher levels of international collaboration than India. Most notably, we see that South Africa and Singapore show rapid increases in world normalized citation impact paired with high and rising levels of international collaboration (both countries show international collaboration levels of over 43% 2006-2010). In contrast, India, Iran, Brazil and the Russian Federation show relatively low levels of international collaboration (below 32% 2006-2010) and do not show significant increases (even some declines) as well as all demonstrating below world average citation impact.

Offsetting levels of international collaboration per country against world normalized citation impact for the period 2006-2010 reveals a correlation of .67 (indicating a positive relationship between citation impact and level of international collaboration). This supports findings reported in other studies, where international collaboration has been suggested to be a significant factor in achieving high citation impact.

Now that India has established itself as a significant player in terms of scientific output, future activities may focus on raising the overall quality of research. It may be of interest to understand how South Africa and Singapore have achieved the significant gains in overall quality of research, from below world average level, and how this may be related to their collaboration networks. In this context, India may need to identify which specific strategic partnerships and collaborations will help yield higher quality research and citation impact in the years to come.

Overview India 16 Subject Areas 2006-2010				
	Share of India's total output 2006-2010	World Normalized Citation Impact 2006-2010	Compound Annual Growth Rate 2006-2010	Percentage International Collaboration 2006-2010
*All subjects combined	100%	0.68	12.3%	17.6%
Agricultural and Biological Sciences	10.8%	0.58	5.8%	14.5%
Biochemistry, Genetics and Molecular Biology	13.2%	0.53	8.6%	20.2%
Chemical Engineering	6.6%	<b>1.18</b>	8.3%	15.7%
Chemistry	17.0%	0.71	5.3%	17.2%
Computer Science	9.9%	0.63	9.3%	17.3%
Earth and Planetary Sciences	4.1%	0.65	2.7%	26.1%
Energy	3.1%	<b>1.26</b>	13.3%	14.5%
Engineering	17.5%	<b>1.04</b>	5.9%	17.0%
Environmental Science	6.6%	0.63	5.4%	13.7%
Immunology and Microbiology	3.7%	0.52	6.7%	19.4%
Materials Science	13.9%	<b>1.01</b>	7.8%	22.0%
Mathematics	5.3%	0.87	10.5%	26.4%
Medicine	18.2%	0.52	8.0%	14.6%
Pharmacology, Toxicology and Pharmaceutics	8.7%	0.60	8.9%	8.9%
Physics and Astronomy	15.6%	0.83	9.0%	28.5%
veterinary	1.9%	0.33	8.9%	5.2%

**Figure 1.0** - Overview of India for 16 subjects 2006-2010: the percentage share of total Indian output for each subject area, the world normalized citation impact, compound annual growth rate and percentage international collaboration for the years 2006-2010. Publications are often classified with more than one subject area and as such, subject areas overlap in terms of the publications which represent them. For this reason, the cumulative percentage of the subject areas exceeds 100%.

# INDIA'S BIBLIOMETRIC FINGERPRINT

Here we present a bibliometric profile of India, which we have termed a bibliometric fingerprint. In doing so, we look at both quantity and quality of produced articles, and we benchmark India's scientific performance against world data and 9 selected comparators.

## 1.1 Publication output: article counts, share and growth

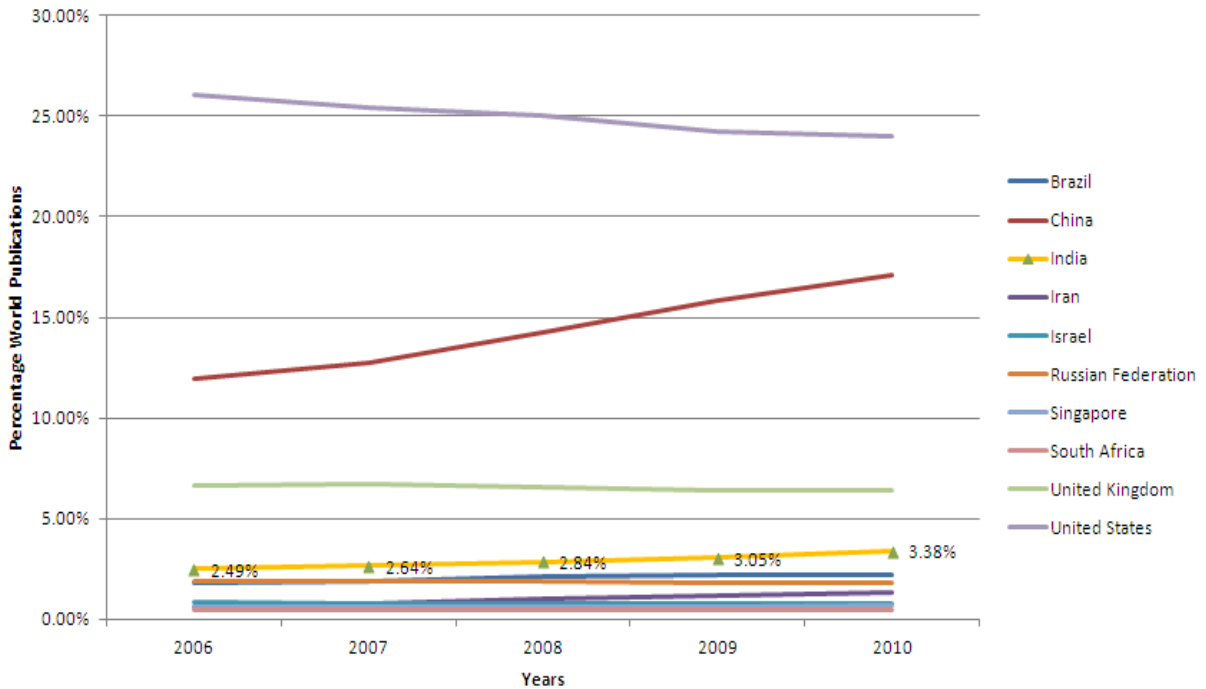
India's output in terms of articles published per year between 2006 and 2010 is shown in Figure 1.1 below.

In 2010, India published 65,487 articles and shows an overall high Compound Annual Growth Rate (CAGR) of 12.3% between 2006 and 2010. In contrast, the total number of articles produced in the entire world as a whole grew at 4% in the same period. Only China and Iran show more rapid growth for this 5 year period.

	2006	2007	2008	2009	2010	CAGR
<b>WORLD</b>	1656611	1741417	1801496	1864445	1935954	4.0%
<b>United States</b>	431612	442243	450621	452619	465262	1.9%
<b>China</b>	197802	221348	256546	295663	330818	13.7%
<b>United Kingdom</b>	110413	116558	117991	119778	123594	2.9%
<b>India</b>	<b>41200</b>	<b>45958</b>	<b>51128</b>	<b>56923</b>	<b>65487</b>	<b>12.3%</b>
<b>Brazil</b>	29682	33058	37569	40745	43188	9.8%
<b>Russian Federation</b>	31654	32754	33468	33609	34843	2.4%
<b>Iran</b>	10321	13844	17984	21638	25346	25.2%
<b>Israel</b>	13768	14027	14333	14060	14352	1.0%
<b>Singapore</b>	10232	10429	11497	11730	13155	6.5%
<b>South Africa</b>	7259	7658	8371	9194	9490	6.9%

**Figure 1.1** - Article counts per year for the world and selected countries, and the compound annual growth rate (CAGR) for the period 2006-2010

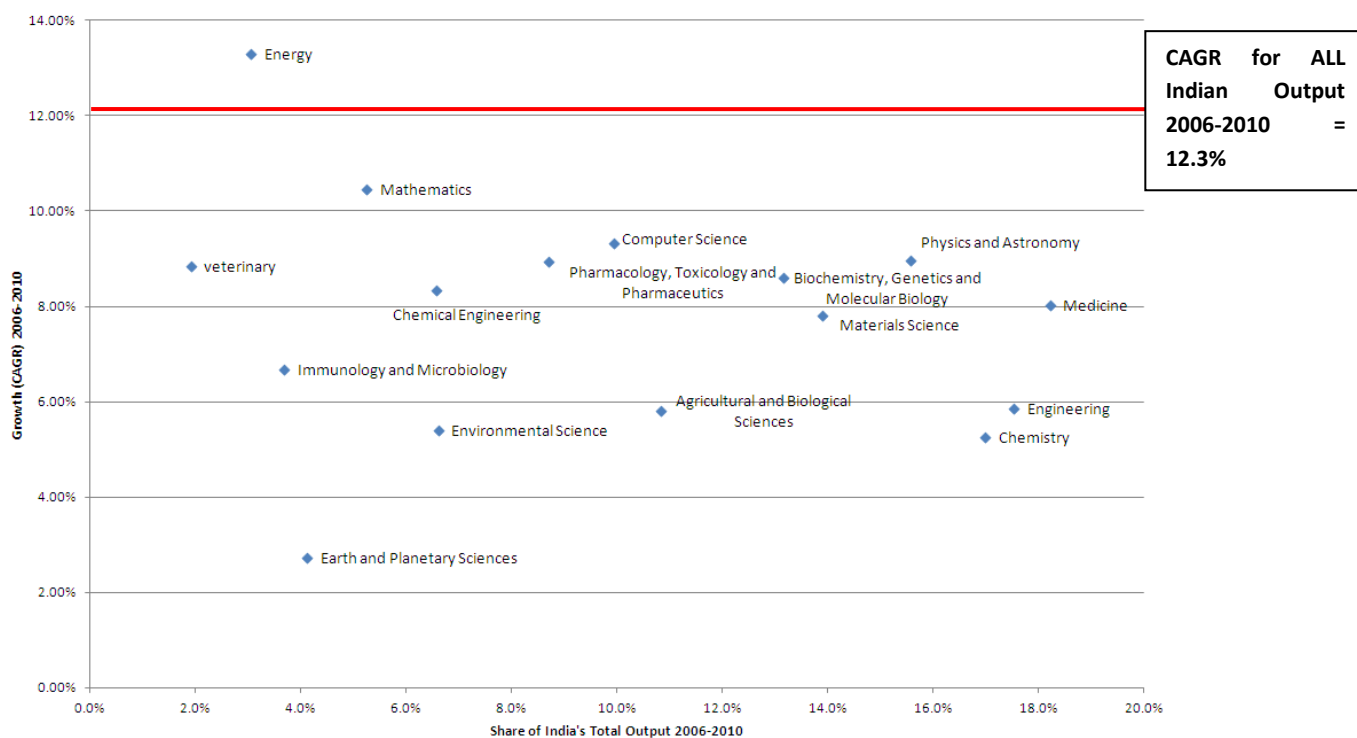




**Figure 1.2 – World Article Share: the percentage of total world articles, per year, per country**

Figure 1.2 shows each country's output as a share of total world output per year. Here we see that India's share has grown from 2.5% in 2006 to almost 3.4% in 2010, whereas countries such as the United States and the UK are observing a decline in share of world articles (even though absolute numbers are growing, but not as much as the overall world growth in article output). We see that Brazil's share of world output remains below that of India and the Russian Federation's share remained relatively stable, and has been overtaken by Brazil.

This confirms that India is not only growing in terms of number of publications produced per year, but is also steadily increasing its share of the world's scientific output to establish itself as a significant player.



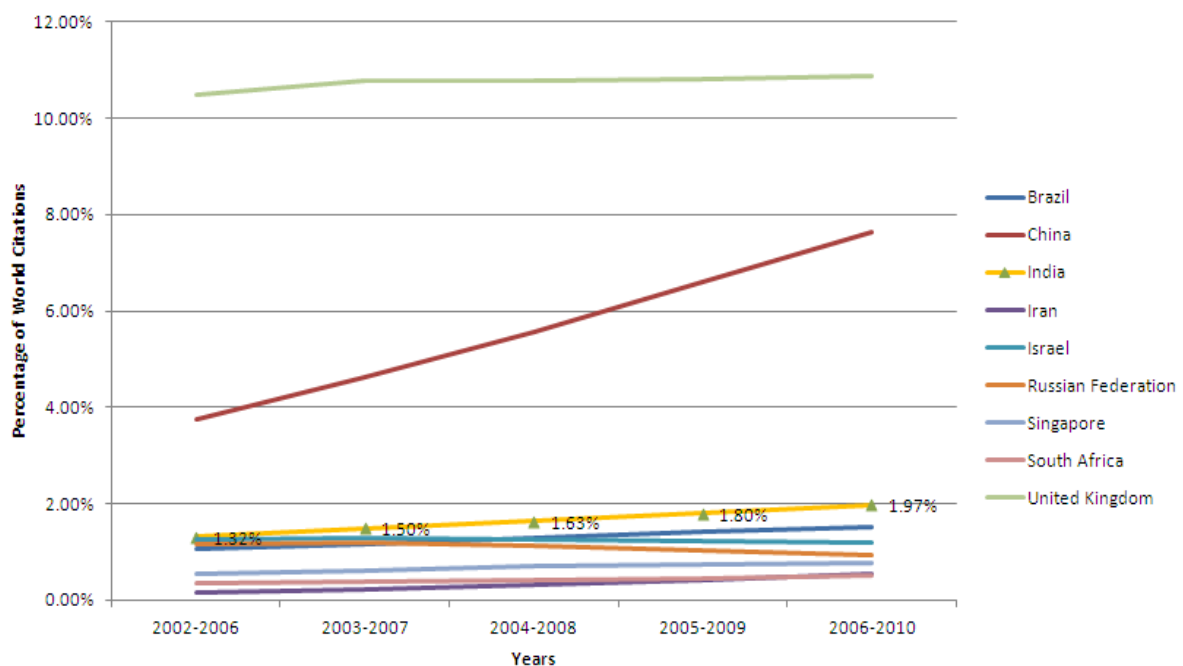
**Figure 1.3** - Share of total Indian articles (2006-2010) vs. Growth (CAGR) in article output per subject area (2006-2010)

In Figure 1.3 we see the relative share of total Indian output that each subject area represents, versus the rate at which that output has grown per year, expressed as compound annual growth rate (CAGR) for the period 2006-2010. Here we see that Energy is the fastest growing subject area in India (13.3%) but that it does not yet represent a large share of India's total research output (3.1%). We see that Materials Science grew 7.8% per year and represents 13.9% of total Indian output; Physics and Astronomy grew 9% per year and represents 15.6% of Indian output; Medicine grew 8% per year and represents 18.2% of Indian output.

We also see that 15 of the 16 subject areas investigated in the study show lower CAGR than the overall compound annual growth rate for all Indian output (12.3%). Here we should keep in mind that all output consists of 27 subject areas in Scopus, and this study examines 16 of those. This suggests that at least some of the subject areas not examined in the study, are likely growing faster than the average.

## 1.2 Citation share and growth

Another crucial dimension to investigate when looking at a country's scientific performance is citations. Citations are typically understood as a measure of quality or importance of scholarly work. Citations accumulate over time, which is why we are counting citations in overlapping five-year windows to allow for comparisons over time, so-called *roof-tiles*. For example, the 2006-2010 data point relates to articles published in the period 2006-2010 inclusive, and the citations to these same articles in the same period.



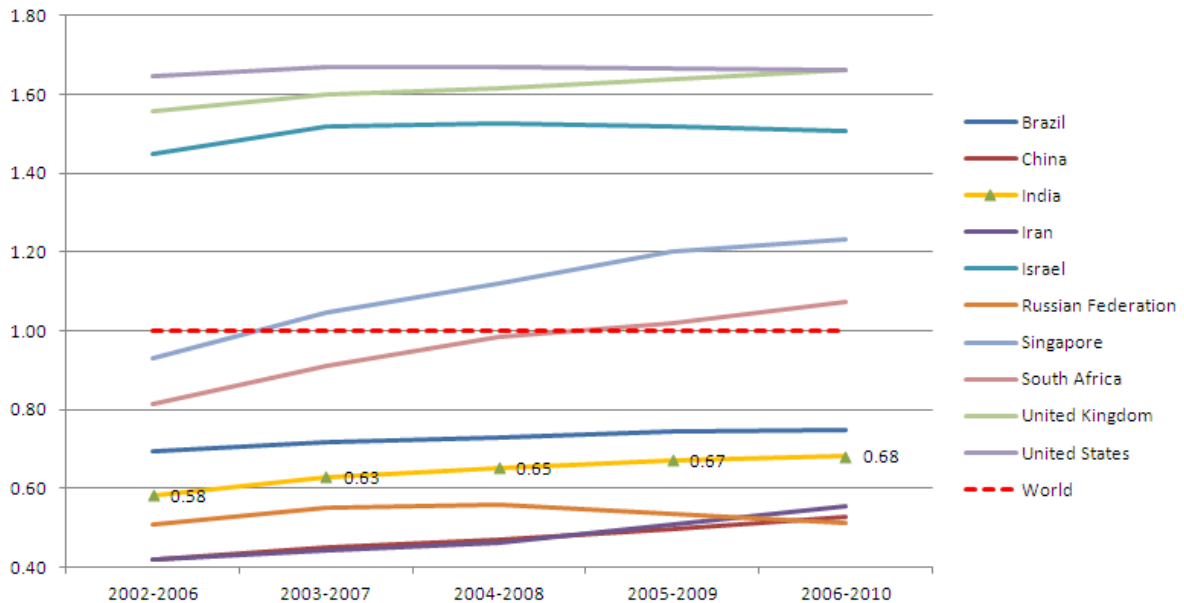
**Figure 1.4** – Share of citations in terms of percentage of total world citations, per year, per country (the United States is not displayed here for practical purposes)

In 2010, India's article share was just under 3.4%, whereas citation share was just under 2%. In Figure 1.4 we see that India's share of world citations is increasing and remains above that of Brazil while remaining significantly below China, the United Kingdom and the United States.



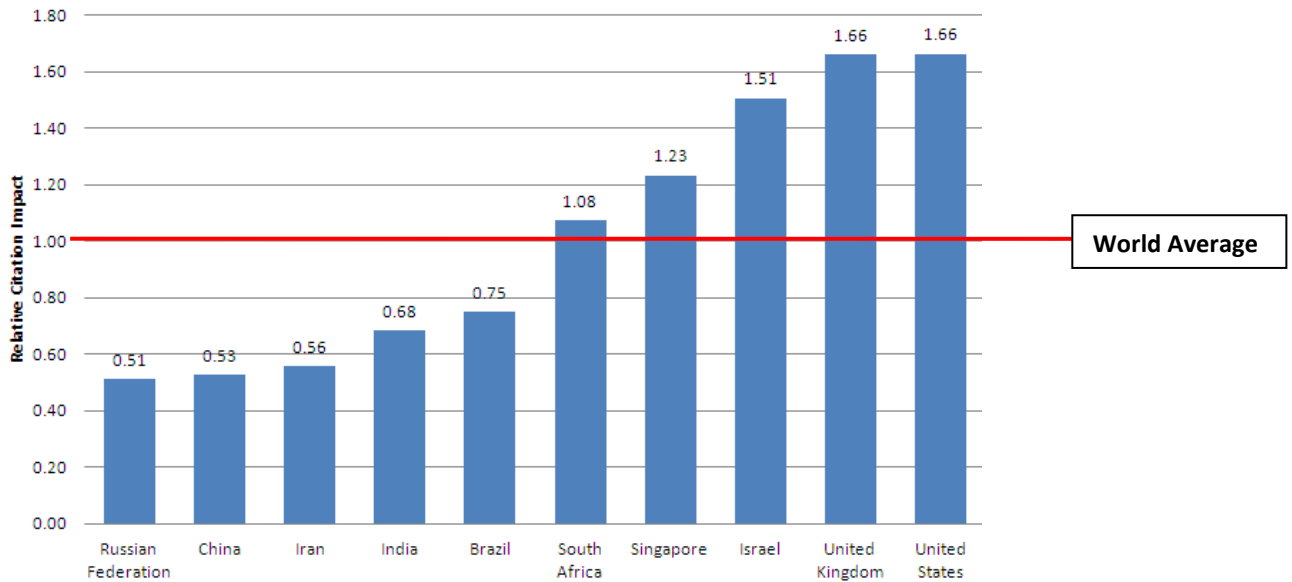
### 1.3 Research Impact: World Normalized Citation Impact

Here we focus on a measure of impact: World Normalized Citation Impact. We have calculated citations per article, and normalized against the world values of citations per article specific to each subject area. Rather than calculating citation impact per year, we use overlapping 5 year windows referred to as *roof-tiles*.



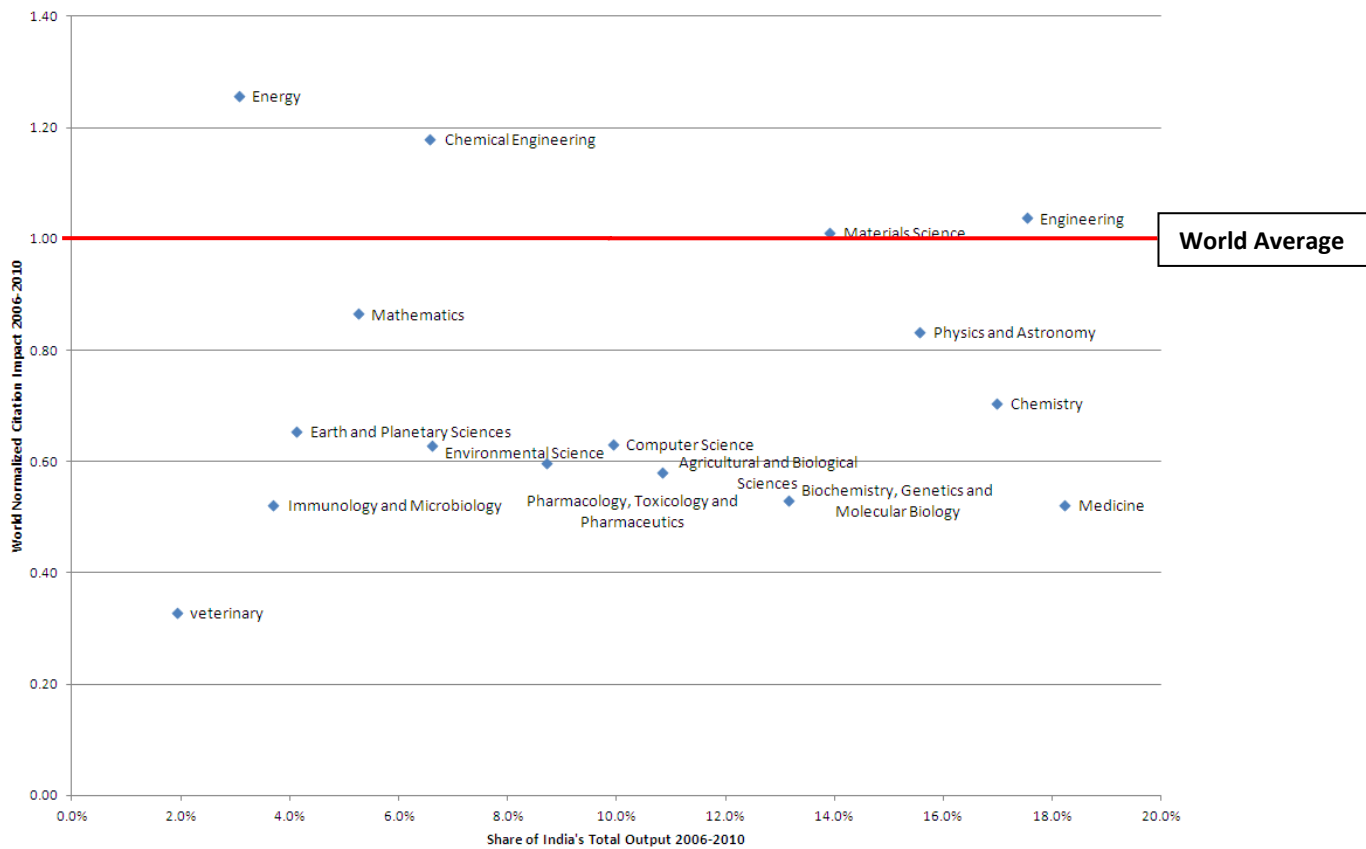
**Figure 1.5 – Overall World Normalized Citation Impact for ALL subject areas**

In Figure 1.5 above we clearly see that India's overall world normalized citation impact for all subject areas has steadily risen (from 0.58 to 0.68 ) suggesting increases in the overall quality of Indian research. We also see that South Africa and Singapore have main significant gains in terms of impact, having gone from below world average to above world average by 2010. It may be interesting for India to investigate what these nations have done to achieve such great gains in research quality. We also see that the United States, United Kingdom and Israel show the highest citation impact, consistently, and that the UK is catching up to the USA.



**Figure 1.6** – Overall World Normalized Citation Impact for the period 2006-2010.

Figure 1.6 again displays the world normalized citation impact, focussing on the most recent 5 year period 2006-2010, and ranking the countries. We again see that the United States and United Kingdom currently share the top spot as producing the publications which are cited most often, almost 1.7 times as often as the world average. In contrast, India has an overall world normalized citation impact of 0.68. While this is below world average level (which is by definition 1) we do see that the quality of Indian research is overall above that of the Russian Federation, China, and Iran, while marginally below that of Brazil.



**Figure 1.7 - Article share vs. relative citation impact India.**

In Figure 1.7 we see the relationship between quantity and quality of India's research in the 16 selected subject areas. On the x-axis we show the share of total Indian output which each subject area represents in the period 2006-2010, while on the y-axis we show the world normalized citation impact of each subject area based on the same period.

Here we clearly see that India has 4 subject areas which demonstrate above world average citation impact, namely, Energy, Chemical Engineering, Engineering and Materials science. Energy stands out as the subject area in which India is producing publications which on average are being cited often (1.26 times world average) while also being a subject area which represents a small share of India's total output (3.1%). Chemical Engineering similarly represents just 6.6% of India output but is cited 1.18 times as often as the world average for that subject area.

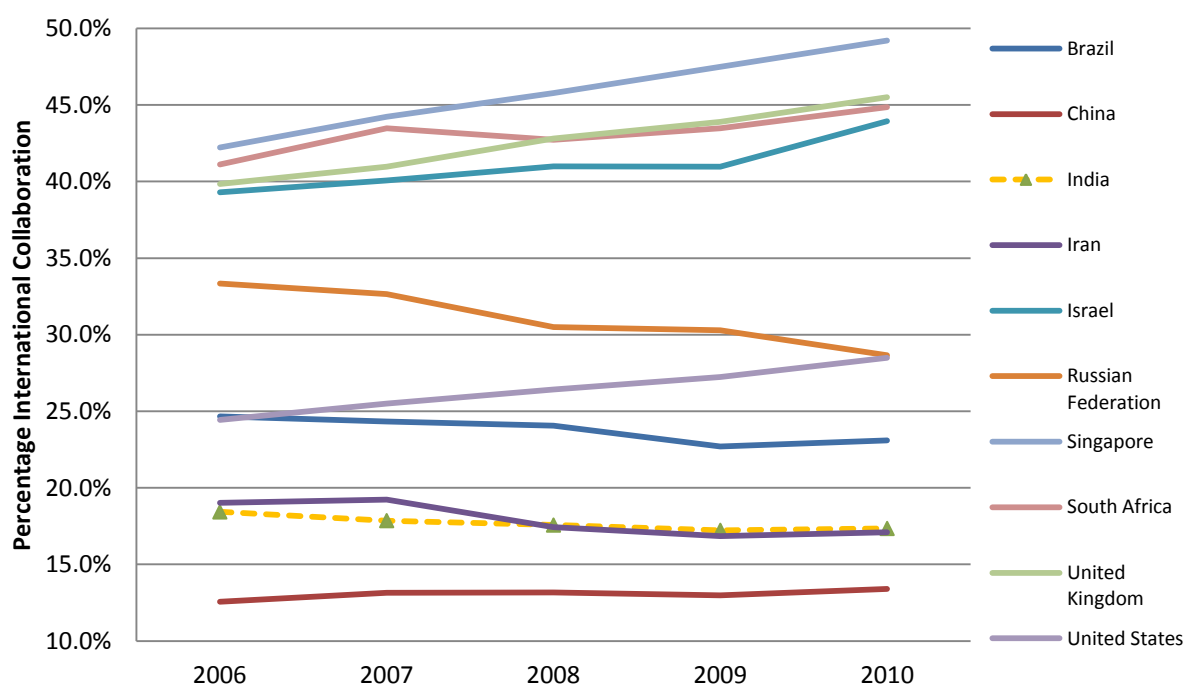
Engineering represents 17.5% of total Indian output in and has a world normalized citation impact of 1.04, while Materials Science represents 13.9% of total Indian output and has a world normalized citation impact of 1.01. Physics and Astronomy, Chemistry and Medicine each represent between 15-20% of India's output while

showing below average citation impact. Medicine stands out as representing over 18% of output while showing a relative citation impact of just 0.52 – indicating that Indian medical articles cited only half as often as the world average in this subject area.

#### 1.4 International Collaboration

Research collaboration may take many forms, some of them obvious (such as co-authorship of articles or acknowledgement within them) and some of them less obvious (such as informal discussions and information sharing). Most methodologies to address the question of the extent and patterns in international collaboration have employed co-authorship data from publication databases<sup>2</sup>.

In our methodology, a paper is considered to be an international publication if at least one of the authors is affiliated to an institution in another country. In examining international collaboration, it soon becomes clear that countries differ significantly in terms of what percentage of their total publication output is a co-authorship with someone from abroad.



**Figure 1.8** – Percentage Share International Collaboration of India and comparator countries (2006-2010)

<sup>2</sup> Melin, G. & Persson, O. (1996) Studying research collaborations using co-authorships. *Scientometrics* 36(3) pp 363-377



Figure 1.8 shows the percentage of each country's publication output which has at least one author affiliated to an institution in another country. 17.4% of India's articles in 2010 are international (down from 18.4% in 2006) which is the same as the level of international collaboration that Iran shows in 2010. While China shows lower levels of international collaboration than India (13.4% in 2010) the remaining comparator countries all demonstrate higher levels of international collaboration. While some countries have a downward trend representing decreases in international collaboration (such as the Russian Federation, Brazil, and Iran) others show increases, such as the United Kingdom, Israel; and most notably South Africa and South Africa and Singapore (which are the two countries which show the most significant gains in terms of citation impact - see Figure 1.5 page 10).

Figure 1.9 (below) displays the subject specific shares of international collaboration for the entire period 2006-2010, for India, Brazil, Singapore and South Africa. This radar chart nicely illustrates that India shows lower levels of international collaboration consistently across subject areas, than Brazil, Singapore and South Africa. It demonstrates that Singapore and South Africa are particularly active in co-publishing with authors from other countries.

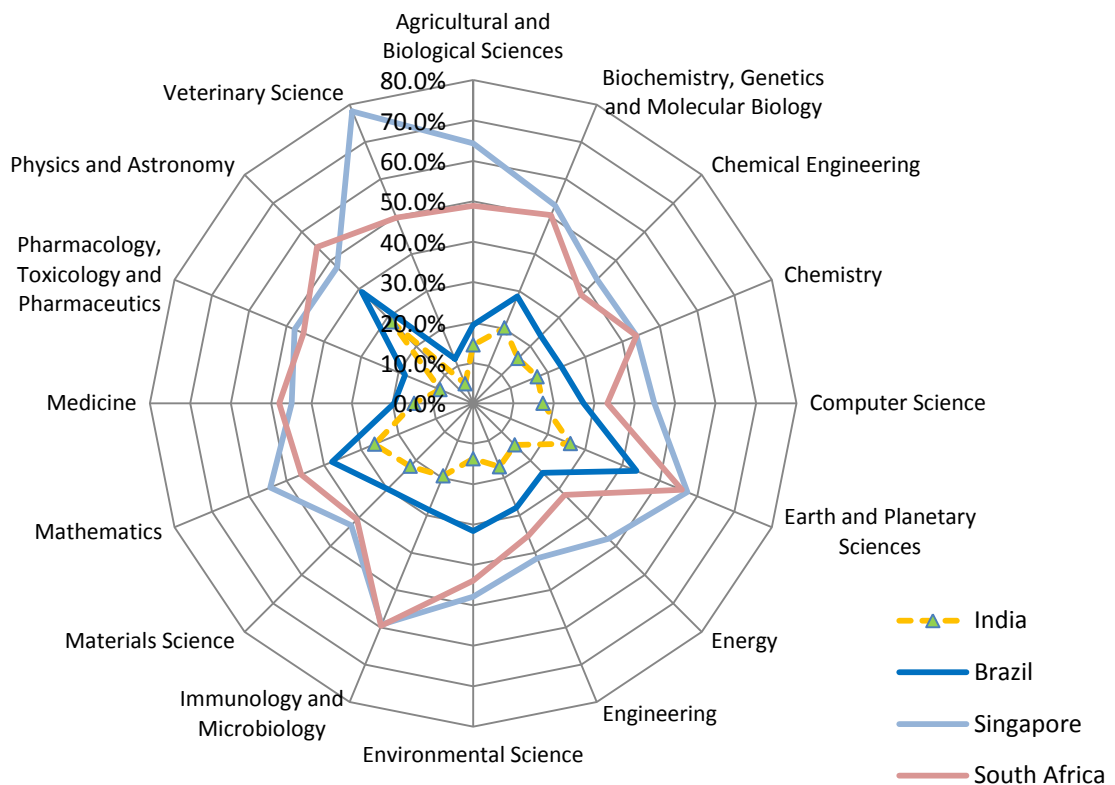


Figure 1.9 – Radar Chart Share International Collaboration India, Brazil, Singapore, South Africa, 2006-2010





This seeming pattern of relation between citation impact and international collaboration may raise us to wonder to what degree there is a statistically significant relationship. Various studies have found significant positive relationships between citation impact and international collaboration, indicating that international co-publications are *on average* cited more often than single authored papers and nationally collaborated papers (see: Glänzel, W., De Lange, C., 2002<sup>3</sup>; and Elsevier, 2011<sup>4</sup>).

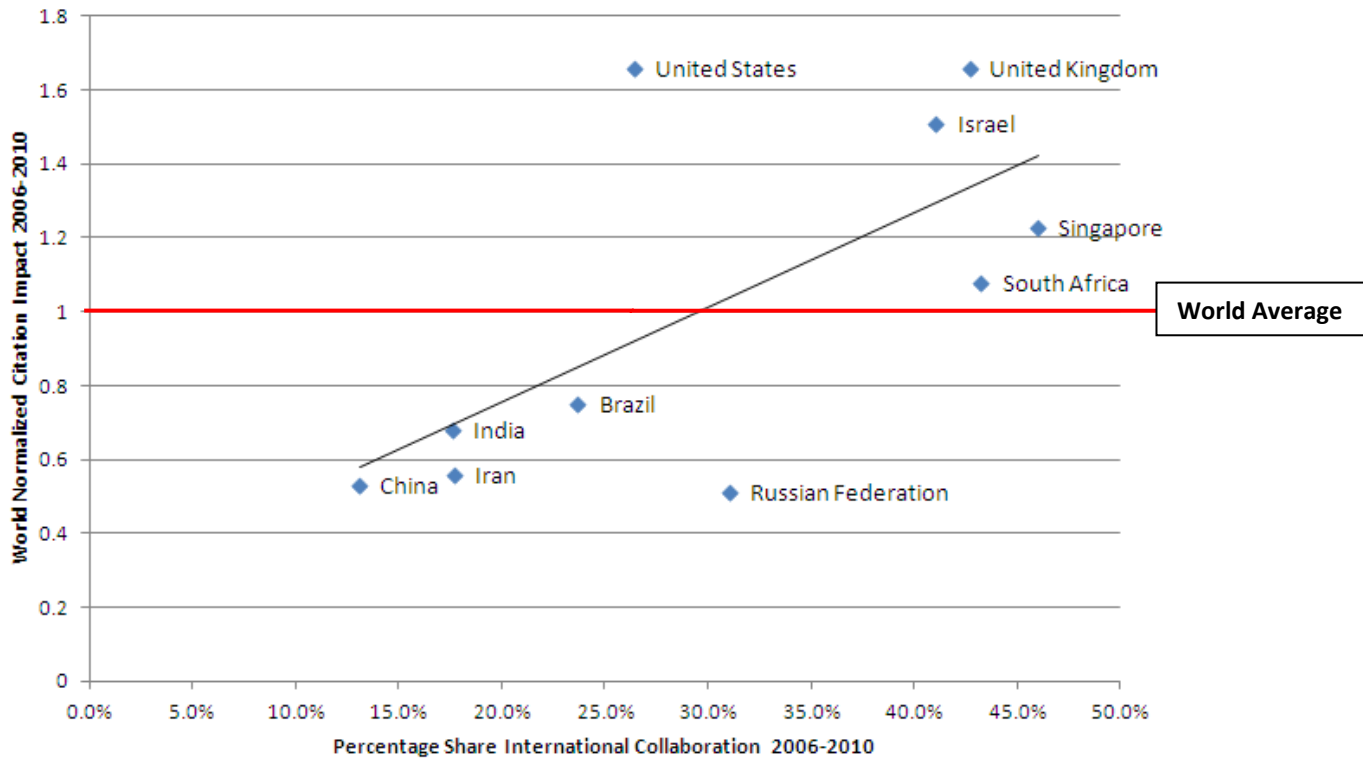
The data examined in this study certainly supports such findings. Figure 1.10 below shows the level of international collaboration as a percentage share of total output (for the entire period 2006-2010) for each country, offset against the world normalized citation impact for the same period. We see that more often than not, countries which collaborate more also show higher citation impact. The relationship from our data can be expressed as a correlation of .67.

The outlier is the United States which shows the highest citation impact, but not near the highest level of international collaboration. This is not surprising, as the United States may not need to collaborate internationally as much as some other countries, in order to publish papers which are cited often. Other countries may simply be smaller or may lack sufficient resources to consistently produce above average quality research without collaborating abroad.

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<sup>3</sup> Glänzel, W., De Lange, C. (2002), A distributional approach to multinationality measures of international scientific collaboration. *Scientometrics*, 54 (1) : 75–89.

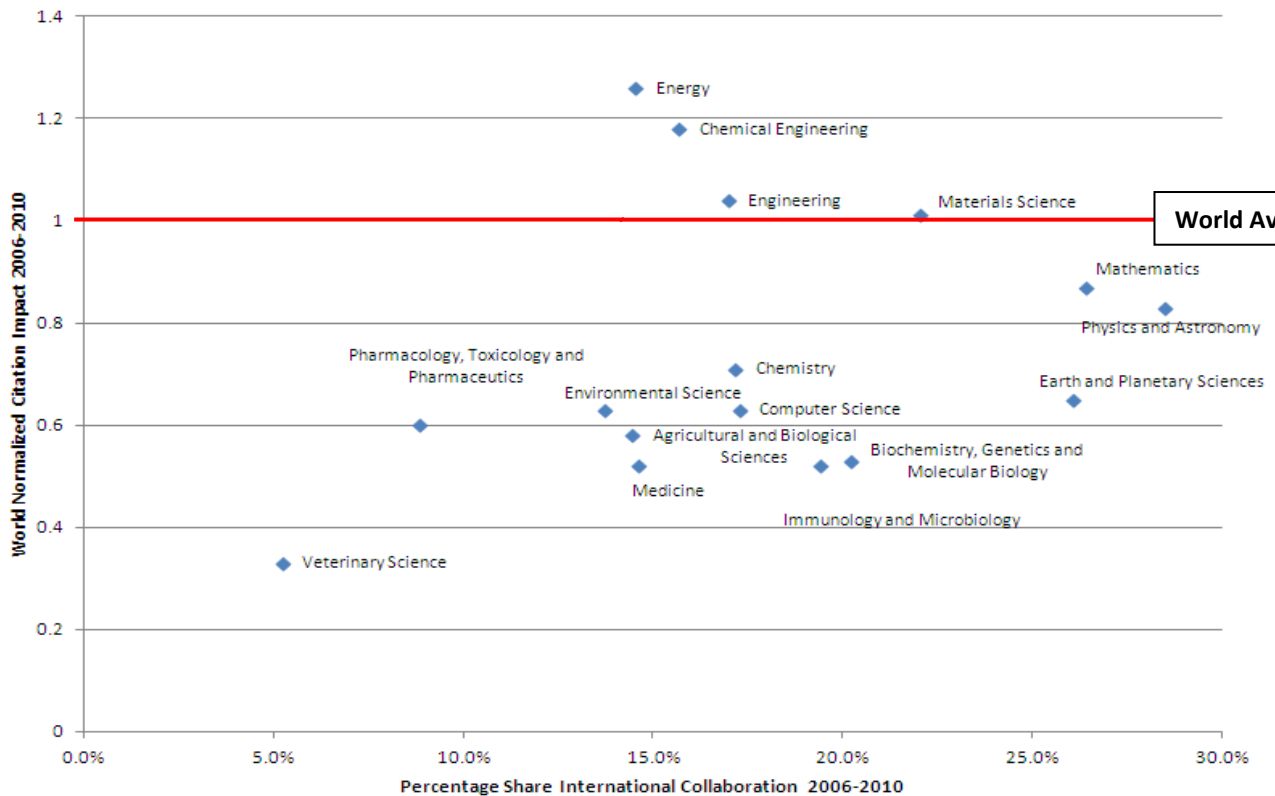
<sup>4</sup> Elsevier (2011) available at: <http://www.bis.gov.uk/assets/biscore/science/docs/i/11-p123-international-comparative-performance-uk-research-base-2011>



**Figure 1.10** – Percentage Share International Collaboration vs. World Normalized Citation Impact 2006-2010

It is again worth pointing out that the two countries which showed the most dramatic gains in world normalized citation impact, from under to above world average level, namely South Africa and Singapore (see Figure 1.5 on page 10) also show high levels of international collaboration (both over 43% compared to 17.6% for India during the same period (2006-2010).

Correlations are not proof of causality; not all international collaboration is guaranteed to raise the citation impact for a nation. Mutually enhancing collaborative partnerships can contribute to high quality research which may ultimately receive recognition of that by being cited often. Further research may wish to focus on gaining a more in depth and practical understanding of the relationship between international collaboration and citation impact for India. Specifically, efforts may wish to focus on identifying which specific strategic collaboration partners, per subject area, would likely positively influence the quality of Indian research and citation impact.



**Figure 1.11** – Per subject percentage Share International Collaboration vs. World Normalized Citation Impact 2006-2010

Figure 1.11 shows the percentage of Indian publications which have at least one author from another country, offset against the world normalized citation impact for each of the selected subject areas for the period 2006-2010. We see that in contrast to the analysis between *countries*, that in this particular case, there is no clear relationship between levels of international collaboration and relative citation impact between *subject areas* in India. In this case, the correlation between international collaboration and world normalized citation impact is only .28.

Just 14.5% of Indian Energy papers have at least one co-author from another country, while this subject demonstrates the highest relative citation impact. In contrast, 26.1% of Earth and Planetary Sciences papers are international collaborations, but show a below average relative citation impact of 0.65. This does not mean that there is not a relationship between international collaboration and citation impact *within* subject area; as previous research has demonstrated is often the case. The relationship between international collaboration and citation impact may differ from field to field, and ultimately the quality of specific collaboration partners will determine whether the collaboration produces high quality impactful research represented by highly cited publications.





## PER SUBJECT BREAKDOWN

The following section provides statistics for each of the 16 selected subject areas:

- A Table displaying the number of publications for each country, per year 1996-2010
- A Table displaying the percentage share of each country's total output, which the relevant subject area represents in each year 2006-2010; and the world normalized citation impact of each country, for the 2006-2010 period taken as a whole
- A Figure visualizing the percentage share of each country's total output, which the relevant subject area represents in each year 2006-2010; including the world as a comparator
- A Figure visualizing the world normalized citation impact of each country, for the 2006-2010 period taken as a whole

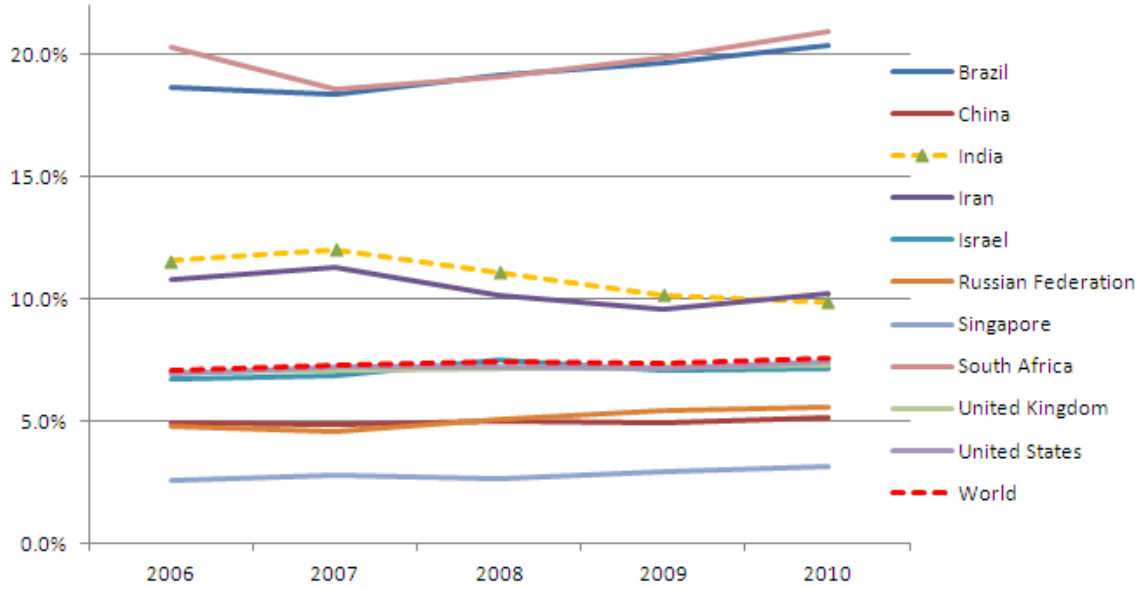
## Agricultural and Biological Sciences

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Singapore	112	141	141	154	150	135	153	181	204	240	264	295	305	344	417
Israel	783	855	782	782	814	756	770	829	892	929	929	968	1072	998	1029
Russian Federation	1454	1301	1237	1250	1478	1313	1403	1388	1507	1389	1512	1500	1694	1831	1947
South Africa	915	974	949	999	974	898	1137	1168	1254	1262	1473	1425	1597	1827	1991
Iran	68	82	77	119	121	135	219	266	348	486	1111	1566	1832	2070	2588
India	2799	2906	2965	3174	3317	3388	3269	3802	3932	4217	4762	5536	5685	5800	6471
Brazil	1357	1628	1908	1972	2023	2090	2609	2811	3048	3343	5533	6066	7208	8019	8796
United Kingdom	6642	6826	6979	6975	6842	6427	6569	6955	7051	7247	7780	8282	8438	8673	9039
China	1181	1404	1748	1928	1849	2684	2551	3284	4856	8407	9781	10797	12849	14510	17091
United States	28530	26649	27372	22049	22578	22305	23184	25634	27088	28420	29867	31806	32523	32273	34701
World	84185	84653	87432	80339	82634	83976	87213	90736	95390	103617	117607	126659	134366	138004	146698

**Figure 2.1** – Number of publications per year in Agricultural and Biological Sciences

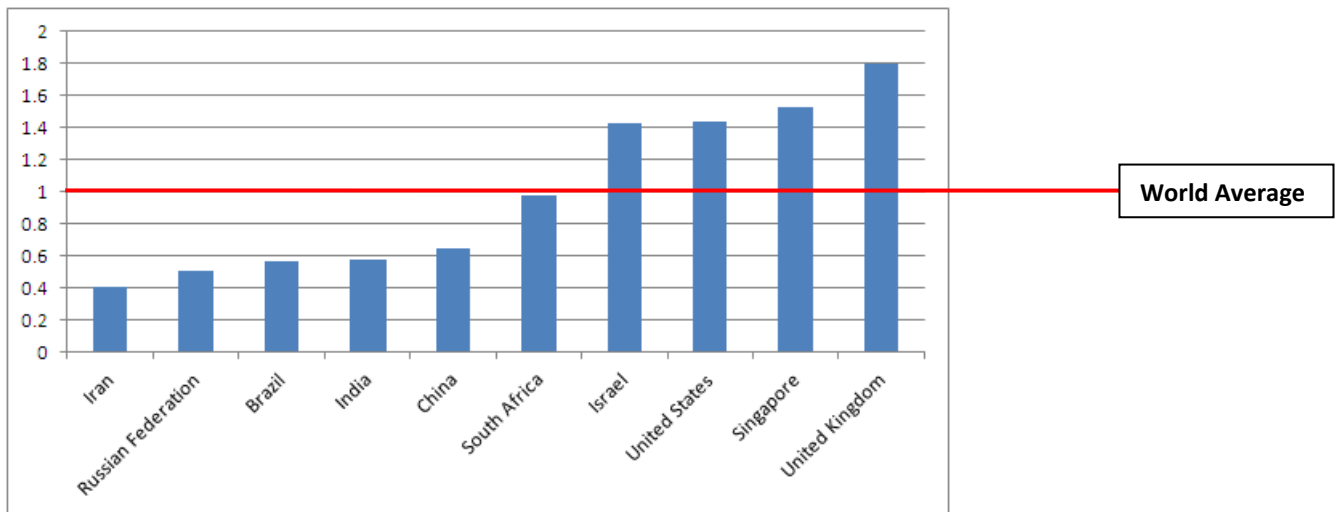
Country	Percentage of Country Total Output					World Normalized Citation Impact 2006-2010
	2006	2007	2008	2009	2010	
Brazil	18.6%	18.3%	19.2%	19.7%	20.4%	0.57
China	4.9%	4.9%	5.0%	4.9%	5.2%	0.65
India	11.6%	12.0%	11.1%	10.2%	9.9%	0.58
Iran	10.8%	11.3%	10.2%	9.6%	10.2%	0.41
Israel	6.7%	6.9%	7.5%	7.1%	7.2%	1.43
Russian Federation	4.8%	4.6%	5.1%	5.4%	5.6%	0.51
Singapore	2.6%	2.8%	2.7%	2.9%	3.2%	1.53
South Africa	20.3%	18.6%	19.1%	19.9%	21.0%	0.98
United Kingdom	7.0%	7.1%	7.2%	7.2%	7.3%	1.8
United States	6.9%	7.2%	7.2%	7.1%	7.5%	1.44
World	7.1%	7.3%	7.5%	7.4%	7.6%	1

**Figure 2.2** – Percentage of each country's total output and world normalized citation impact for Agricultural and Biological Sciences



**Figure 2.3 - Percentage of each country's total output for Agricultural and Biological Sciences**

In Figure 2.3 above we see that the India publication output in *Agricultural and Biological Sciences* is declining purely in terms of India's total output (from 11.6% in 2006 to 10% in 2010). This is still an overall higher percentage than we see for the world, where approximately 7.5% of the publications are *Agricultural and Biological Sciences*. In Figure 2.4 below we see that India's world normalized citation impact in this subject area is below average (0.58).



**Figure 2.4 - World normalized citation impact 2006-2010 (Agricultural and Biological Sciences)**

## Biochemistry, Genetics and Molecular Biology

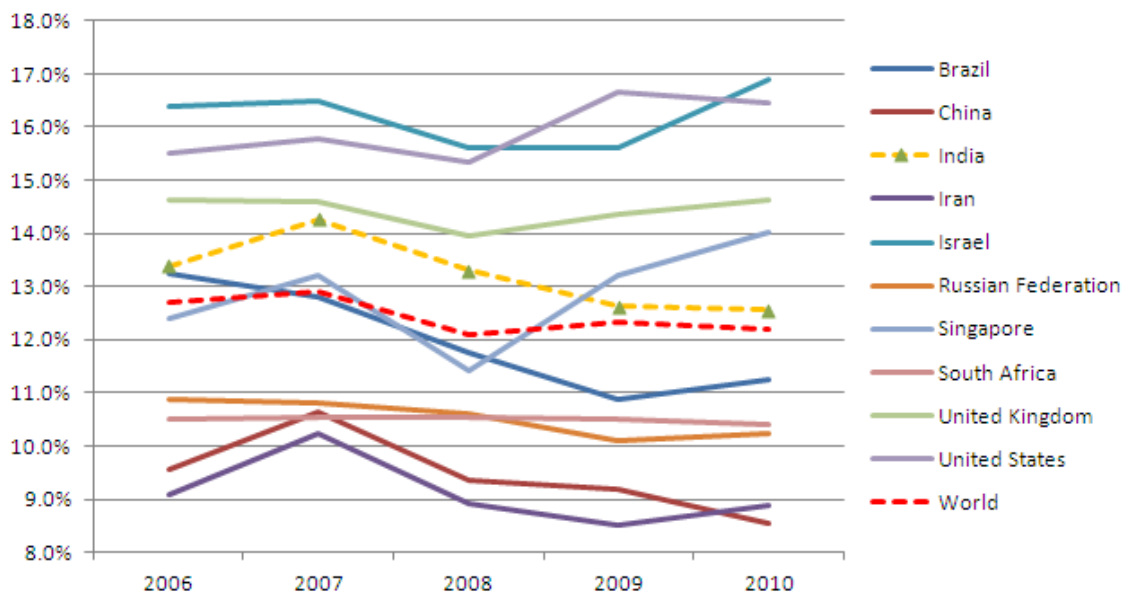
Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
South Africa	403	420	416	421	423	451	460	542	584	632	763	806	883	965	986
Singapore	239	295	286	323	331	383	477	726	1014	1063	1268	1376	1311	1550	1845
Iran	70	75	81	114	132	182	243	364	485	594	937	1418	1601	1842	2249
Israel	1581	1698	1642	1572	1601	1643	1698	2038	2133	2026	2258	2311	2238	2194	2426
Russian Federation	3293	3518	3798	3643	3943	3660	3662	3901	3530	3673	3442	3545	3546	3390	3561
Brazil	1282	1331	1586	1572	1747	1810	2191	2710	3029	3042	3931	4229	4419	4429	4859
India	2370	2512	2437	2572	2345	2596	2996	3724	4088	4960	5517	6555	6802	7186	8228
United Kingdom	12868	13034	12914	12201	12140	11799	11950	14477	15036	14794	16164	17011	16472	17202	18095
China	2616	2964	3116	3629	3713	4067	4697	7533	10597	13048	18916	23579	24036	27205	28217
United States	59063	56141	56032	51511	50929	51301	51980	58969	62590	62785	66924	69760	69169	75379	76566
World	152189	152287	153071	144951	146791	149134	151639	170698	183460	187538	210374	224571	217584	229777	236263

**Figure 2.5** – Number of publications per year in Biochemistry & Molecular Biology

Country	Percentage of Country Total Output					World Normalized Citation Impact 2006-2010
	2006	2007	2008	2009	2010	
Brazil	13.2%	12.8%	11.8%	10.9%	11.3%	0.60
China	9.6%	10.7%	9.4%	9.2%	8.5%	0.5
India	13.4%	14.3%	13.3%	12.6%	12.6%	0.53
Iran	9.1%	10.2%	8.9%	8.5%	8.9%	0.47
Israel	16.4%	16.5%	15.6%	15.6%	16.9%	1.29
Russian Federation	10.9%	10.8%	10.6%	10.1%	10.2%	0.41
Singapore	12.4%	13.2%	11.4%	13.2%	14.0%	1.2
South Africa	10.5%	10.5%	10.5%	10.5%	10.4%	0.74
United Kingdom	14.6%	14.6%	14.0%	14.4%	14.6%	1.46
United States	15.5%	15.8%	15.3%	16.7%	16.5%	1.5
World	12.7%	12.9%	12.1%	12.3%	12.2%	1

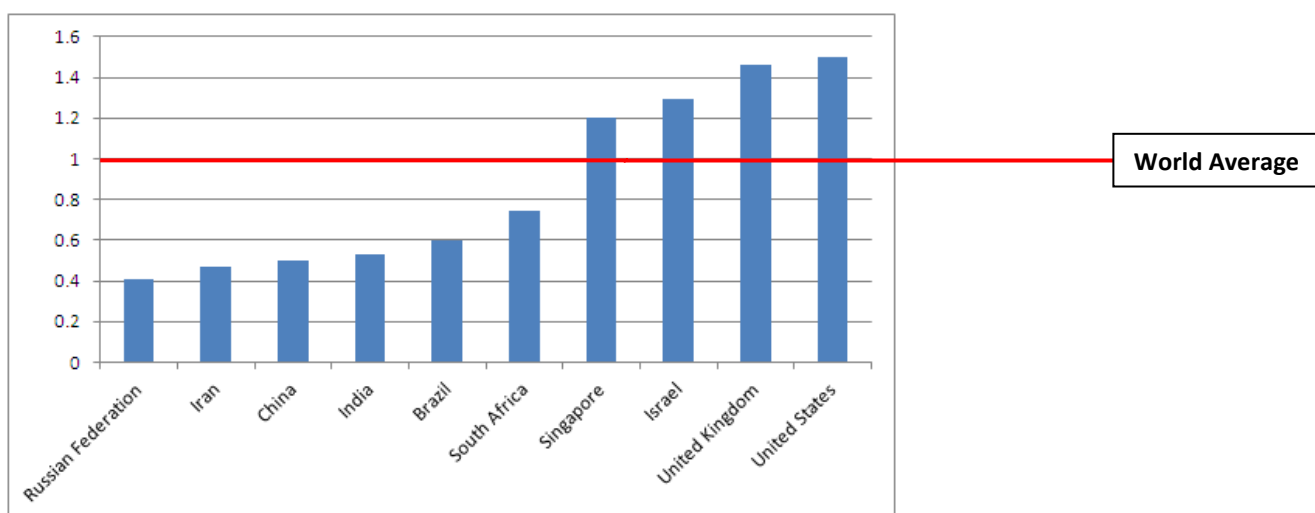
**Figure 2.6** – Percentage of each country's total output and world normalized citation impact for Biochemistry & Molecular Biology





**Figure 2.7 - Percentage of each country's total output for Biochemistry, Genetics & Molecular Biology**

In Figure 2.7 above we see that the India publication output in Biochemistry, Genetics & Molecular Biology is declining purely in terms of India's total output (from 14.3% in 2007 to 12.6% in 2010). This is still an overall marginally higher percentage than we see for the world, where approximately 12% of the publications are Biochemistry, Genetics & Molecular Biology. In Figure 2.8 below we see that India's world normalized citation impact in this subject area is below average (0.53).



**Figure 2.8 - World normalized citation impact 2006-2010 (Biochemistry, Genetics & Molecular Biology)**

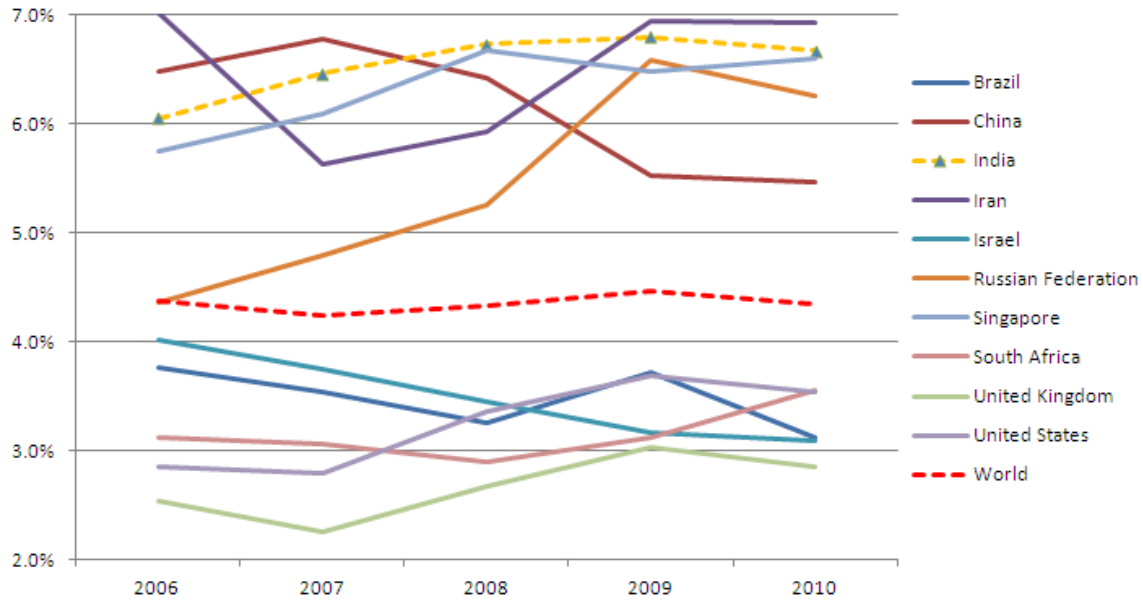
## Chemical Engineering

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
South Africa	105	95	125	98	104	108	139	132	169	197	227	234	243	287	337
Israel	390	328	299	341	456	453	491	485	456	453	553	525	495	446	443
Singapore	100	111	147	214	263	252	315	354	421	493	588	636	767	760	868
Brazil	300	387	454	480	678	711	678	722	937	869	1119	1170	1221	1518	1348
Iran	54	74	70	82	113	130	165	228	335	476	725	779	1065	1503	1757
Russian Federati	1645	1586	1739	1503	1507	1588	1563	1588	1654	1579	1382	1571	1757	2216	2183
United Kingdom	1927	2022	1920	1958	2217	2056	2125	2202	2318	2381	2805	2634	3147	3626	3524
India	1150	1193	1318	1256	1375	1353	1403	1514	1940	2093	2495	2969	3441	3871	4368
United States	8483	8472	8019	8298	9255	7841	8532	9729	10331	10214	12285	12354	15131	16701	16492
China	1788	2451	2539	2744	3352	4173	3751	4848	7370	10973	12823	15007	16483	16348	18100
World	36683	38295	39014	42917	60666	52523	51338	55494	59775	63441	72543	73850	78007	83229	84087

**Figure 2.9** – Number of publications per year in Chemical Engineering

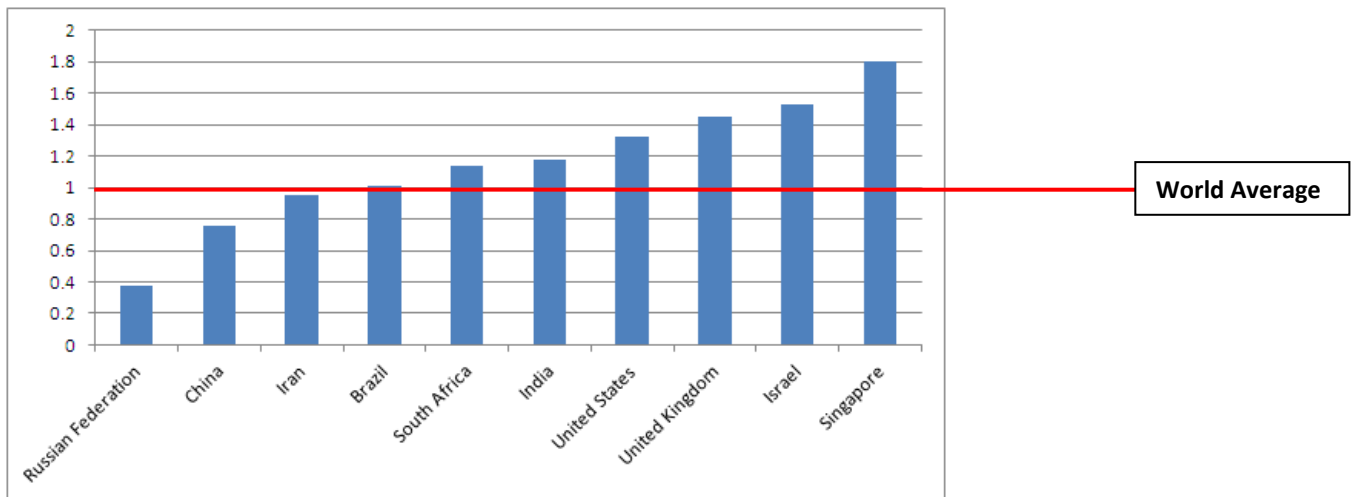
Country	Percentage of Country Total Output					World Normalized Citation Impact 2006-2010
	2006	2007	2008	2009	2010	
Brazil	3.8%	3.5%	3.3%	3.7%	3.1%	1.01
China	6.5%	6.8%	6.4%	5.5%	5.5%	0.76
India	6.1%	6.5%	6.7%	6.8%	6.7%	1.18
Iran	7.0%	5.6%	5.9%	6.9%	6.9%	0.95
Israel	4.0%	3.7%	3.5%	3.2%	3.1%	1.53
Russian Federation	4.4%	4.8%	5.2%	6.6%	6.3%	0.38
Singapore	5.7%	6.1%	6.7%	6.5%	6.6%	1.8
South Africa	3.1%	3.1%	2.9%	3.1%	3.6%	1.14
United Kingdom	2.5%	2.3%	2.7%	3.0%	2.9%	1.45
United States	2.8%	2.8%	3.4%	3.7%	3.5%	1.32
World	4.4%	4.2%	4.3%	4.5%	4.3%	1

**Figure 2.10** – Percentage of each country's total output and world normalized citation impact for Chemical Engineering



**Figure 2.11** - Percentage of each country's total output for Chemical Engineering

In Figure 2.11 above we see that the India publication output in *Chemical Engineering* is increasing marginally, purely in terms of India's total output (from 6.1% in 2006 to 6.7% in 2010). This is a higher percentage than we see for the world, where approximately 4% of the publications are *Chemical Engineering*. It is also a higher percentage than most comparator countries show. In Figure 2.12 below we see that India's world normalized citation impact in this subject area is above average (1.18).



**Figure 2.12** - World normalized citation impact 2006-2010 (*Chemical Engineering*)

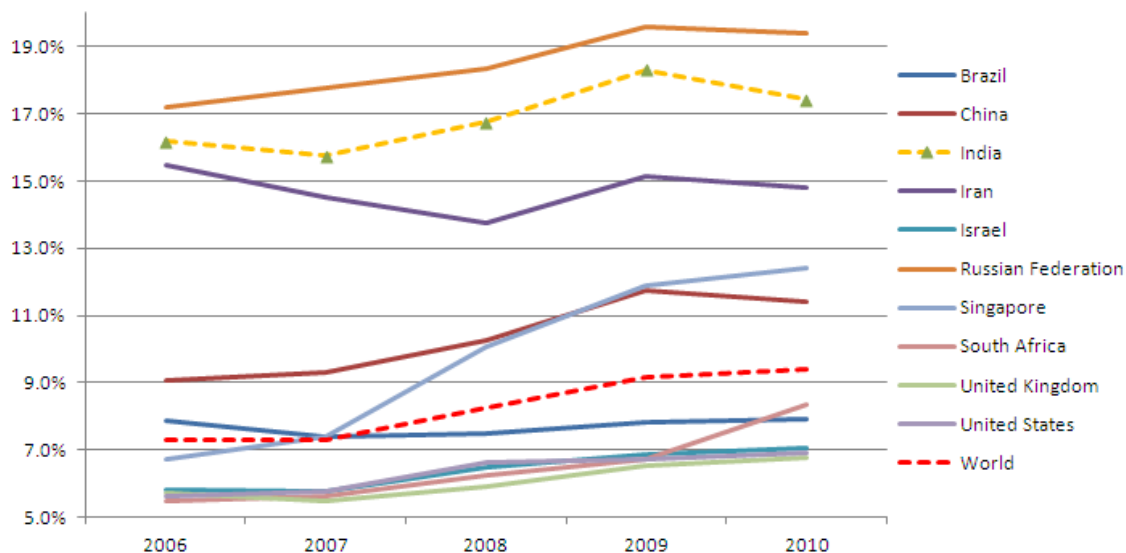
## Chemistry

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
South Africa	267	286	276	277	276	274	261	308	364	359	398	432	524	620	793
Israel	621	661	603	660	767	655	679	773	731	767	802	811	930	964	1014
Singapore	183	194	263	313	303	336	351	466	588	612	688	770	1157	1397	1636
Brazil	690	1007	992	1218	1318	1390	1564	1613	1822	2133	2334	2441	2807	3197	3419
Iran	151	178	249	354	420	534	682	895	1068	1350	1598	2007	2475	3276	3757
Russian Federation	5857	5785	5927	5578	5598	5711	5156	5686	5753	5852	5440	5825	6142	6580	6764
United Kingdom	6077	6006	6045	5775	5821	5350	5591	5818	6093	5913	6338	6413	6950	7812	8351
India	3572	3217	3380	3607	3484	3760	4372	4865	5206	5728	6661	7241	8563	10417	11406
United States	19482	18526	18674	17909	17807	17293	19240	19582	21574	22350	24226	25606	29969	30376	32292
China	5077	5503	5565	6415	7188	8204	8764	9792	12680	15782	17963	20556	26327	34736	37753
World	88710	88355	90800	89858	91637	93544	97557	98936	107968	113176	121254	127404	148668	171223	181712

**Figure 2.13** – Number of publications per year in Chemistry

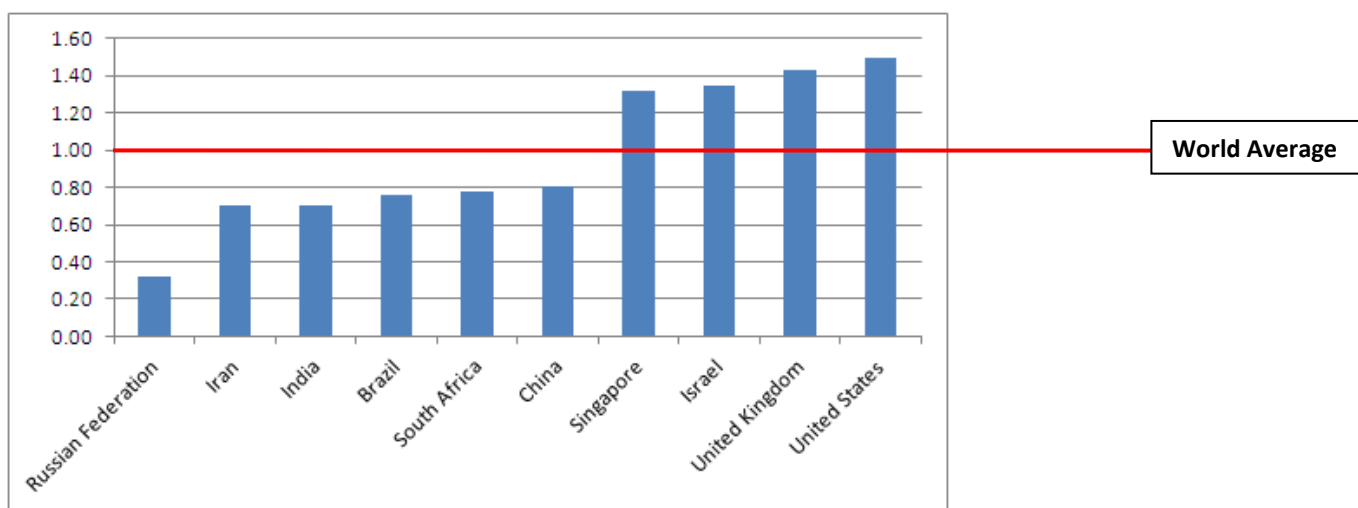
Country	Percentage of Country Total Output					World Normalized Citation Impact 2006-2010
	2006	2007	2008	2009	2010	
Brazil	7.9%	7.4%	7.5%	7.8%	7.9%	0.76
China	9.1%	9.3%	10.3%	11.7%	11.4%	0.81
India	16.2%	15.8%	16.7%	18.3%	17.4%	0.71
Iran	15.5%	14.5%	13.8%	15.1%	14.8%	0.70
Israel	5.8%	5.8%	6.5%	6.9%	7.1%	1.34
Russian Federation	17.2%	17.8%	18.4%	19.6%	19.4%	0.32
Singapore	6.7%	7.4%	10.1%	11.9%	12.4%	1.32
South Africa	5.5%	5.6%	6.3%	6.7%	8.4%	0.78
United Kingdom	5.7%	5.5%	5.9%	6.5%	6.8%	1.43
United States	5.6%	5.8%	6.7%	6.7%	6.9%	1.49
World	7.3%	7.3%	8.3%	9.2%	9.4%	1

**Figure 2.14** – Percentage of each country's total output and world normalized citation impact for Chemistry



**Figure 2.15** - Percentage of each country's total output for Chemistry

In Figure 2.15 above we see that the India's publication output in *Chemistry* has increased purely in terms of India's total output (from 16.2% in 2006 to 17.4% in 2010). This is a higher percentage than we see for the world, where approximately 9% of the publications are *Chemistry*. It is also a higher percentage than we see for comparator countries except for the Russian Federation where over 19% of total output is related to Chemistry. In Figure 2.16 below we see that India's world normalized citation impact in this subject area is below average (0.71).



**Figure 2.16** - World normalized citation impact 2006-2010 (Chemical Engineering)

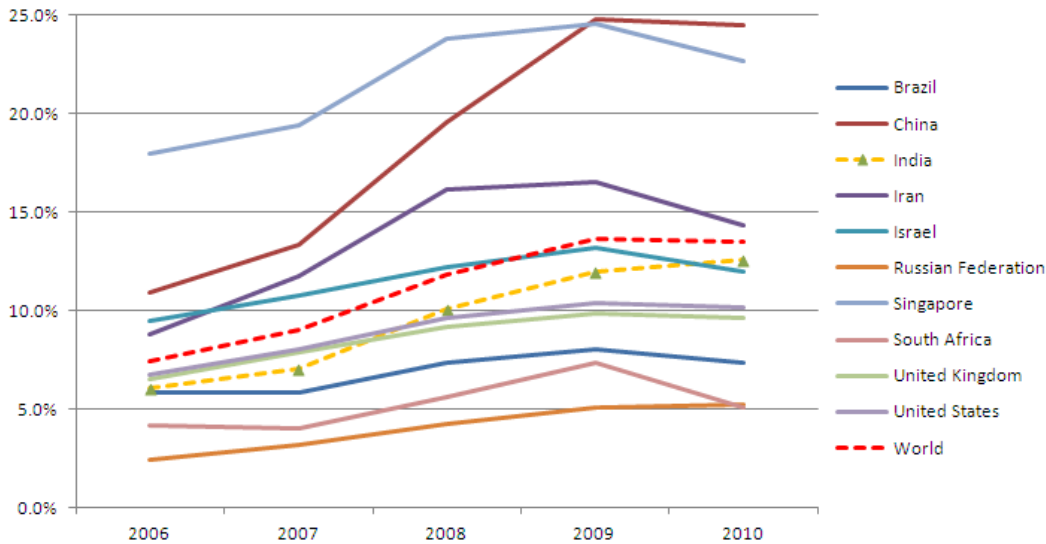
## Computer Science

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
South Africa	75	94	165	76	88	114	91	131	139	158	304	311	469	678	482
Israel	530	699	596	573	505	610	589	913	967	1085	1306	1506	1751	1853	1725
Russian Federation	845	963	718	590	576	599	570	929	687	835	775	1052	1426	1719	1822
Singapore	364	586	412	456	566	579	673	1000	1240	1309	1836	2028	2735	2881	2979
Brazil	191	341	317	366	434	468	518	817	1012	1050	1726	1937	2778	3289	3166
Iran	33	57	52	57	83	92	121	256	285	465	908	1632	2911	3583	3633
India	603	644	610	534	633	513	599	855	1153	1323	2488	3242	5149	6805	8234
United Kingdom	2542	2784	2962	2572	2841	2849	2987	4532	4773	5360	7198	9187	10849	11845	11902
United States	16752	18573	17416	14403	14987	14423	16109	21684	20634	24100	29016	35578	43536	47177	47417
China	2059	1727	2752	2093	2374	3472	3217	6291	8521	14256	21641	29540	50253	73323	80993
World	44601	50708	47661	42899	45263	48876	50094	73775	76363	90454	123483	157434	213078	254609	261949

**Figure 2.17** – Number of publications per year in Computer Science

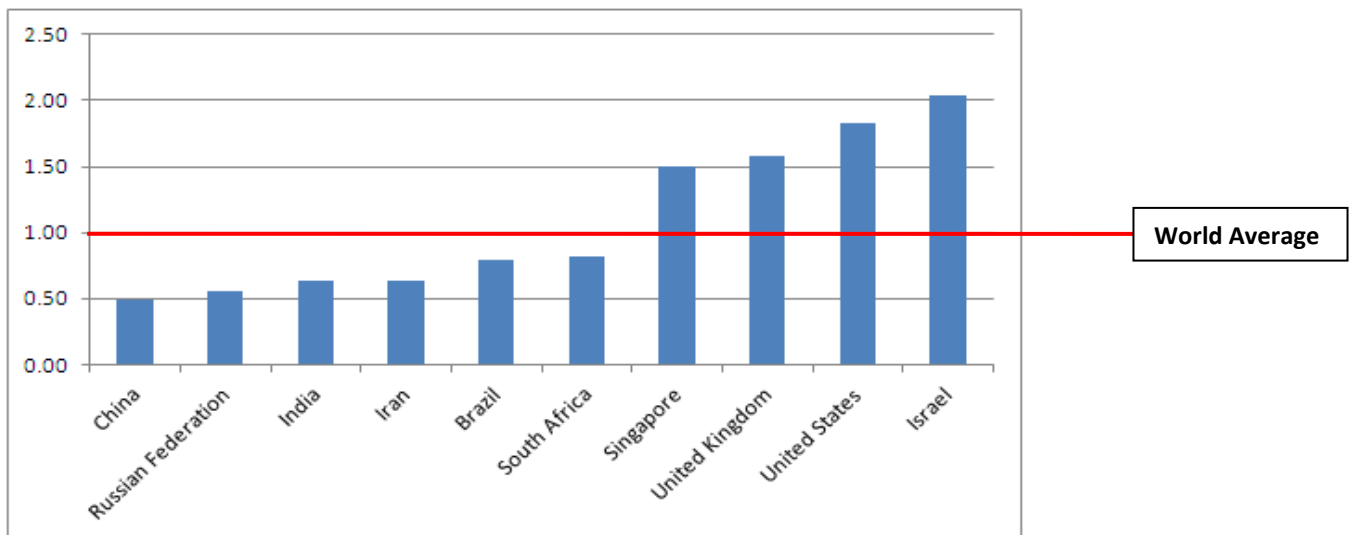
Country	Percentage of Country Total Output					World Normalized Citation Impact 2006-2010
	2006	2007	2008	2009	2010	
Brazil	5.8%	5.9%	7.4%	8.1%	7.3%	0.79
China	10.9%	13.3%	19.6%	24.8%	24.5%	0.50
India	6.0%	7.1%	10.1%	12.0%	12.6%	0.63
Iran	8.8%	11.8%	16.2%	16.6%	14.3%	0.64
Israel	9.5%	10.7%	12.2%	13.2%	12.0%	2.04
Russian Federation	2.4%	3.2%	4.3%	5.1%	5.2%	0.56
Singapore	17.9%	19.4%	23.8%	24.6%	22.6%	1.50
South Africa	4.2%	4.1%	5.6%	7.4%	5.1%	0.82
United Kingdom	6.5%	7.9%	9.2%	9.9%	9.6%	1.58
United States	6.7%	8.0%	9.7%	10.4%	10.2%	1.83
World	7.5%	9.0%	11.8%	13.7%	13.5%	1

**Figure 2.18** – Percentage of each country's total output and world normalized citation impact for Computer Science



**Figure 2.19** - Percentage of each country's total output for Computer Science

In Figure 2.19 above we see that the India's publication output in *Computer Science* has increased purely in terms of India's total output (from 6% in 2006 to 12.6% in 2010). This is a higher percentage than we see for the world where we see *Computer Science* growing in a similar rate in terms of percentage of all output. This is clearly a subject area that is growing worldwide. In Figure 2.20 below we see that India's world normalized citation impact in this subject area is below average (0.63).



**Figure 2.20** - World normalized citation impact 2006-2010 (*Computer Science*)

## Earth and Planetary Sciences

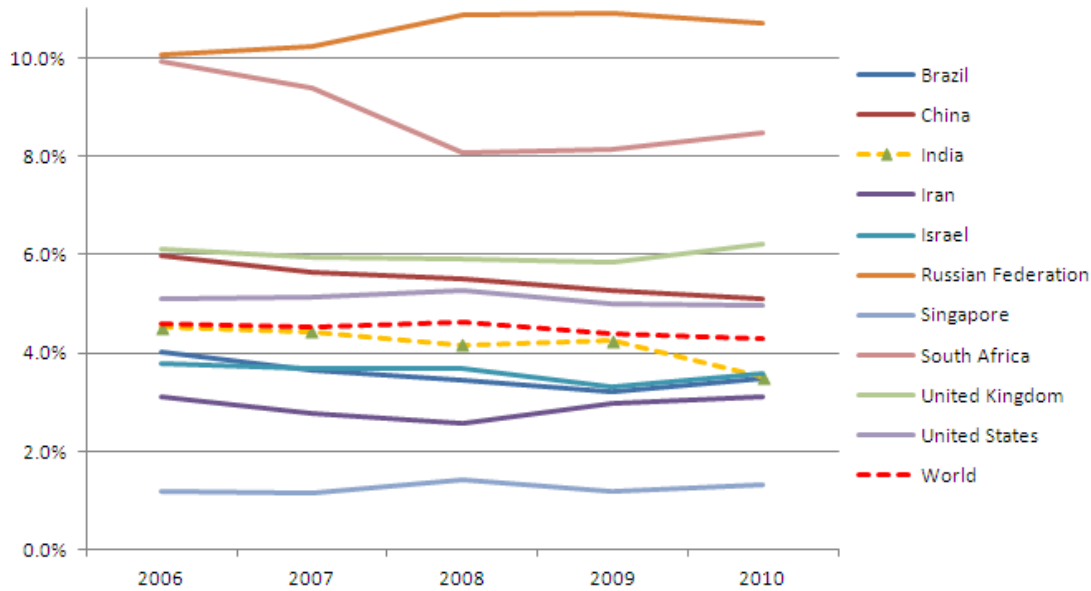
Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Singapore	59	88	61	103	85	102	109	121	120	106	121	120	164	138	172
Israel	391	379	347	334	377	380	387	415	442	430	522	515	530	464	516
Iran	56	45	40	58	80	63	89	147	171	214	321	386	464	643	785
South Africa	561	575	437	524	466	481	607	572	654	706	722	718	677	749	804
Brazil	444	567	521	544	564	535	781	773	898	1040	1191	1206	1293	1315	1497
India	1401	1343	1145	1226	1255	1274	1321	1365	1429	1576	1861	2036	2127	2414	2293
Russian Federation	3443	2962	2955	3106	3231	2836	2992	3064	3401	3396	3183	3347	3636	3664	3730
United Kingdom	4908	4895	4698	4728	4789	4380	4696	5319	5534	5796	6763	6947	6976	7015	7668
China	1918	2182	2501	2766	3058	4672	4051	4899	7168	11102	11824	12487	14112	15614	16899
United States	16747	16394	15932	15359	16940	15748	16677	18720	19805	19236	22020	22637	23811	22603	23124
World	56523	56351	52429	54129	59522	56959	58896	61968	64792	69522	76225	79029	83502	81750	82751

**Figure 2.21** – Number of publications per year in Earth & Planetary Sciences

Country	Percentage of Country Total Output					World Normalized Citation Impact 2006-2010
	2006	2007	2008	2009	2010	
Brazil	4.0%	3.6%	3.4%	3.2%	3.5%	0.90
China	6.0%	5.6%	5.5%	5.3%	5.1%	0.51
India	4.5%	4.4%	4.2%	4.2%	3.5%	0.65
Iran	3.1%	2.8%	2.6%	3.0%	3.1%	0.51
Israel	3.8%	3.7%	3.7%	3.3%	3.6%	1.94
Russian Federation	10.1%	10.2%	10.9%	10.9%	10.7%	0.56
Singapore	1.2%	1.2%	1.4%	1.2%	1.3%	0.86
South Africa	9.9%	9.4%	8.1%	8.1%	8.5%	1.28
United Kingdom	6.1%	6.0%	5.9%	5.9%	6.2%	1.96
United States	5.1%	5.1%	5.3%	5.0%	5.0%	1.70
World	4.6%	4.5%	4.6%	4.4%	4.3%	1

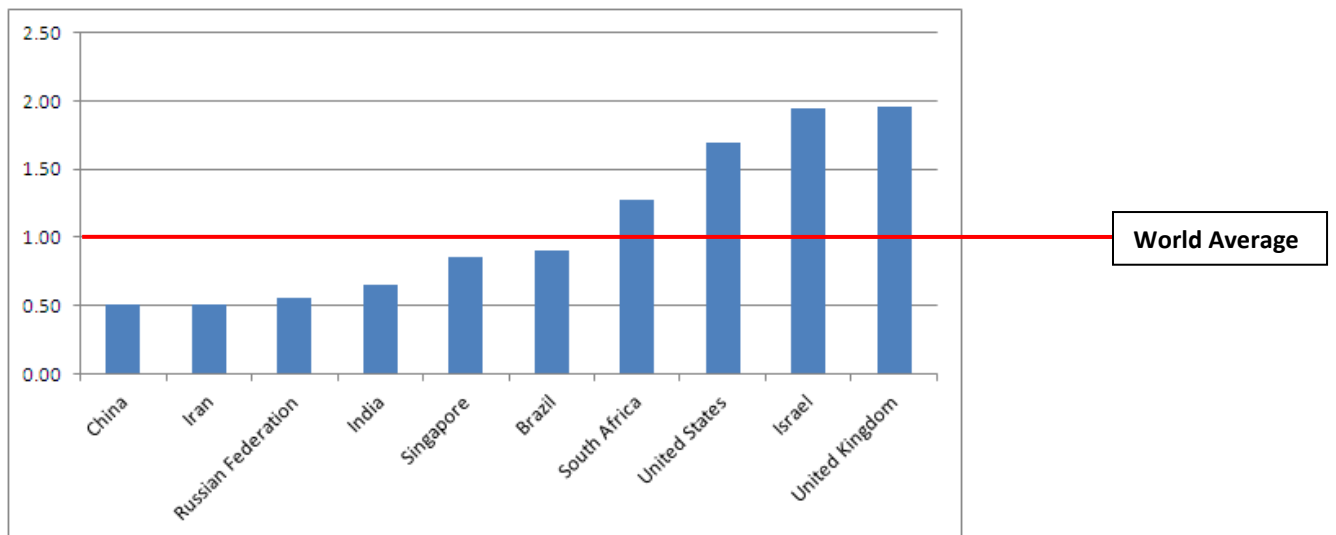
**Figure 2.22** – Percentage of each country's total output and world normalized citation impact for Earth & Planetary Sciences





**Figure 2.23** - Percentage of each country's total output for Earth & Planetary Sciences

In Figure 2.23 above we see that the India's publication output in *Earth & Planetary Sciences* show a slight decline purely in terms of India's total output, but remain similar to world levels, i.e. approximately 5%. In Figure 2.24 below we see that India's world normalized citation impact in this subject area is below average (0.65).



**Figure 2.24** - World normalized citation impact 2006-2010 (Earth & Planetary Sciences)

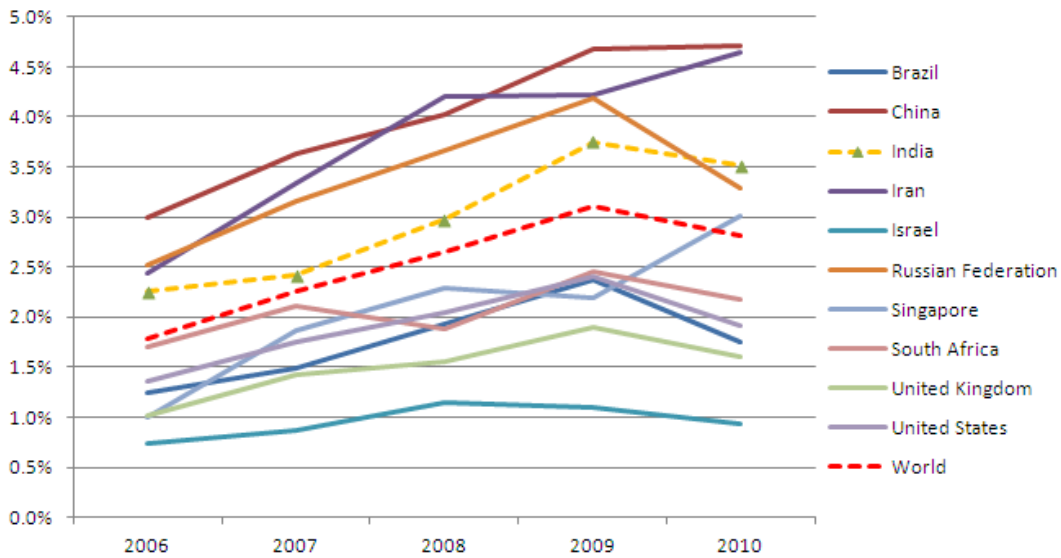
## Energy

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Israel	101	68	80	73	79	62	87	72	101	57	102	121	164	155	134
South Africa	56	36	48	39	51	59	67	69	61	106	123	162	157	226	206
Singapore	35	46	75	46	64	76	72	65	83	103	102	194	264	257	396
Brazil	110	118	199	172	206	260	223	237	303	313	369	495	725	966	759
Russian Federation	810	804	777	597	430	892	1069	1084	993	1088	795	1034	1229	1406	1145
Iran	18	32	25	26	28	55	70	82	120	134	251	463	756	913	1176
United Kingdom	992	883	907	855	1096	1089	915	861	1037	1113	1114	1660	1843	2274	1991
India	469	450	450	408	501	394	491	463	515	553	928	1111	1521	2136	2298
United States	4033	3461	3542	2951	3884	3713	3694	3820	5495	5573	5877	7755	9216	10910	8877
China	1093	1129	1410	1549	1526	1852	1852	1919	3633	6007	5931	8040	10321	13844	15570
World	16221	16134	17274	16288	25581	22289	22420	22382	24972	28283	29540	39314	47614	57856	54615

**Figure 2.25** – Number of publications per year in Energy

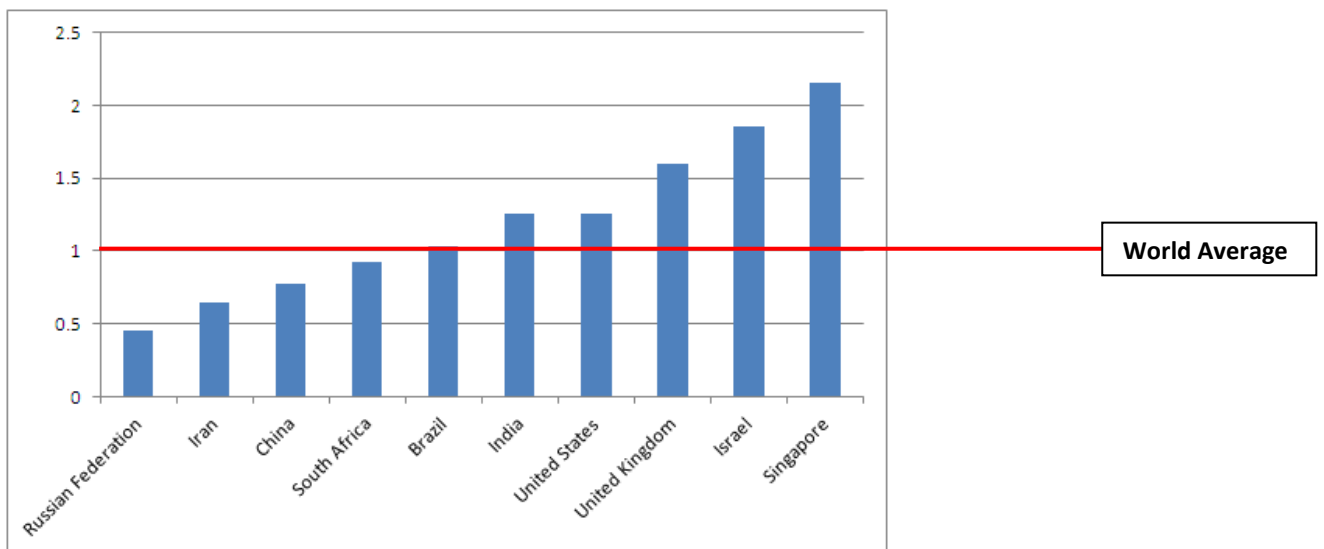
Country	Percentage of Country Total Output					World Normalized Citation Impact 2006-2010
	2006	2007	2008	2009	2010	
Brazil	1.2%	1.5%	1.9%	2.4%	1.8%	1.03
China	3.0%	3.6%	4.0%	4.7%	4.7%	0.77
India	2.3%	2.4%	3.0%	3.8%	3.5%	1.26
Iran	2.4%	3.3%	4.2%	4.2%	4.6%	0.65
Israel	0.7%	0.9%	1.1%	1.1%	0.9%	1.86
Russian Federation	2.5%	3.2%	3.7%	4.2%	3.3%	0.45
Singapore	1.0%	1.9%	2.3%	2.2%	3.0%	2.15
South Africa	1.7%	2.1%	1.9%	2.5%	2.2%	0.93
United Kingdom	1.0%	1.4%	1.6%	1.9%	1.6%	1.60
United States	1.4%	1.8%	2.0%	2.4%	1.9%	1.26
World	1.8%	2.3%	2.6%	3.1%	2.8%	1

**Figure 2.26** – Percentage of each country's total output and world normalized citation impact for Energy



**Figure 2.27** - Percentage of each country's total output for Energy

Energy is clearly a subject area that is growing world-wide. In Figure 2.27 above we see that the India's publication output in *Energy* has increased purely in terms of India's total output (from 2.3% in 2006 to 3.5% in 2010). This is a higher percentage than we see for the world where we see *Energy* also growing in a similar rate in terms of percentage of all output. In Figure 2.28 below we see that India's world normalized citation impact in this subject area is above average (1.26).



**Figure 2.28** - World normalized citation impact 2006-2010 (*Energy*)

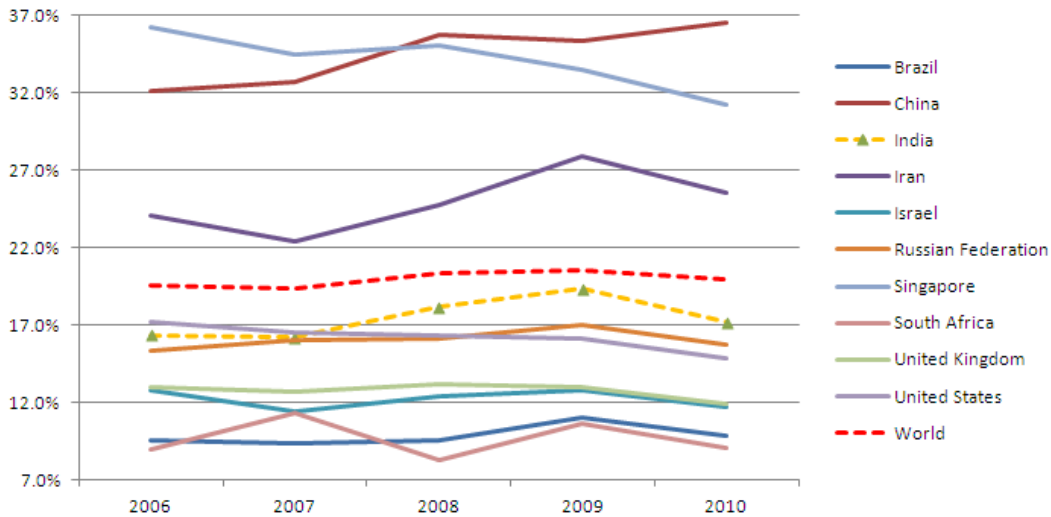
## Engineering

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
South Africa	480	306	372	406	308	299	437	393	669	722	650	870	692	974	862
Israel	1122	1179	1030	943	1022	989	1006	1205	1808	1638	1765	1609	1774	1796	1687
Singapore	960	1314	1231	1665	1987	2046	2079	2352	3900	3780	3707	3591	4031	3924	4111
Brazil	747	1122	1052	1189	1322	1415	1518	1858	2662	2927	2847	3100	3607	4507	4251
Russian Federation	5354	5023	4852	4597	4359	5056	5659	4947	6590	6393	4870	5257	5414	5715	5471
Iran	160	190	169	206	322	435	555	881	1485	1920	2483	3106	4454	6028	6477
India	2639	2578	2519	2742	3025	2779	3305	3497	4853	5655	6733	7443	9293	11008	11240
United Kingdom	9987	9950	9362	8941	9135	8457	8645	9472	13750	14588	14322	14830	15535	15517	14709
United States	49934	50975	47452	44070	45907	44992	48180	53270	79289	84074	74292	73159	73802	72925	68977
China	9790	10115	12781	10604	13435	19486	18223	20113	37450	54706	63542	72515	91651	104629	120864
World	163628	167751	163425	152630	164277	189096	193505	205712	291698	330101	323740	337724	367261	383373	387127

**Figure 2.29** – Number of publications per year in Engineering

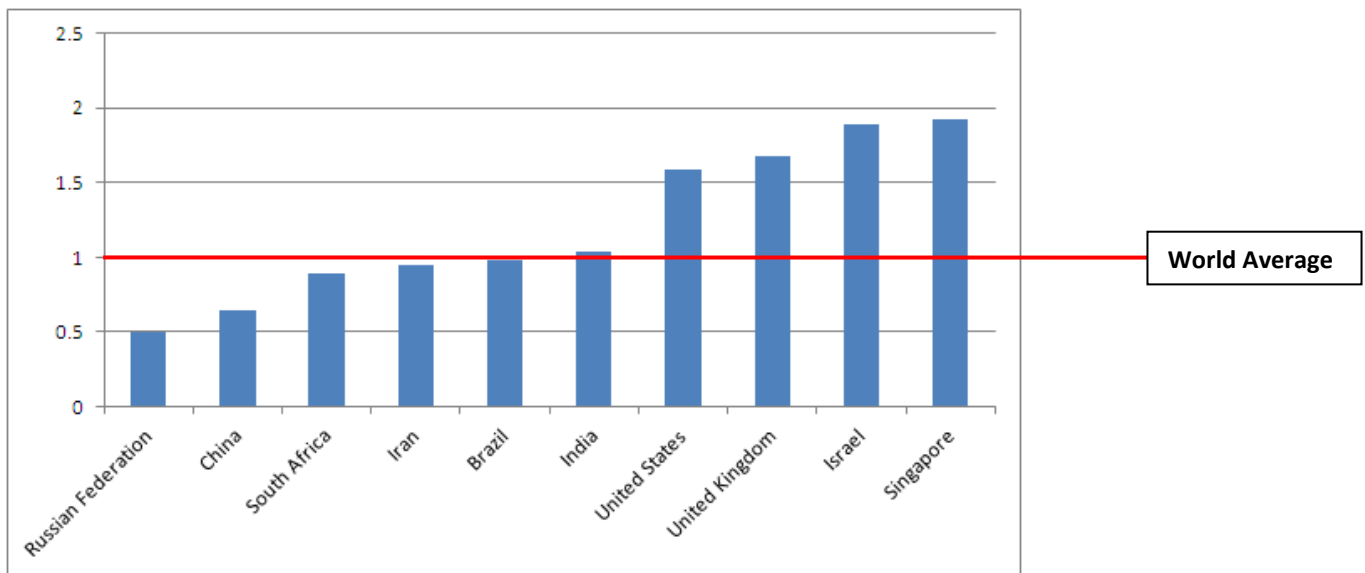
Country	Percentage of Country Total Output					World Normalized Citation Impact 2006-2010
	2006	2007	2008	2009	2010	
Brazil	9.6%	9.4%	9.6%	11.1%	9.8%	0.99
China	32.1%	32.8%	35.7%	35.4%	36.5%	0.64
India	16.3%	16.2%	18.2%	19.3%	17.2%	1.04
Iran	24.1%	22.4%	24.8%	27.9%	25.6%	0.95
Israel	12.8%	11.5%	12.4%	12.8%	11.8%	1.89
Russian Federation	15.4%	16.0%	16.2%	17.0%	15.7%	0.49
Singapore	36.2%	34.4%	35.1%	33.5%	31.3%	1.92
South Africa	9.0%	11.4%	8.3%	10.6%	9.1%	0.89
United Kingdom	13.0%	12.7%	13.2%	13.0%	11.9%	1.68
United States	17.2%	16.5%	16.4%	16.1%	14.8%	1.59
World	19.5%	19.4%	20.4%	20.6%	20.0%	1

**Figure 2.30** – Percentage of each country's total output and world normalized citation impact for Engineering



**Figure 2.31** - Percentage of each country's total output for Engineering

In Figure 2.31 above we see that the India's publication output in *Engineering* has increased marginally in terms of India's total output (from 16.3% in 2006 to 17.2% in 2010). This is a lower percentage than we see for the world, where we see *Engineering* representing approximately 20% of all output. In Figure 2.32 below we see that India's world normalized citation impact in this subject area is just above average (1.04) and highest of the BRIC countries.



**Figure 2.32** - World normalized citation impact 2006-2010 (Engineering)

## Environmental Science

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Singapore	101	148	107	94	127	129	157	197	214	209	255	228	257	310	339
Israel	332	348	294	254	310	260	290	369	369	371	416	400	393	408	437
South Africa	422	389	342	470	388	391	478	540	552	561	739	742	712	756	770
Russian Federation	966	949	816	789	959	877	996	1009	985	964	866	958	973	1013	967
Iran	37	43	38	62	59	58	107	129	195	244	345	568	758	1104	1404
Brazil	401	421	430	445	509	541	579	702	825	979	1244	1428	1473	1731	2116
India	1238	1322	1118	1342	1496	1725	1620	1915	1962	2380	2577	2972	3322	4178	4215
United Kingdom	4279	3904	3899	4030	3977	3634	3779	4187	4202	4391	5003	5446	5242	5497	5689
China	1063	1235	1291	1589	1448	2113	2173	2621	3096	5336	6720	7489	8825	12856	13586
United States	15528	14570	13290	13382	14179	13458	13813	15708	16899	17355	19746	19942	19856	19669	19809
World	50001	50042	44389	47098	46537	48693	49839	53071	55689	60184	69162	73225	75859	84552	85971

**Figure 2.33** – Number of publications per year in Environmental Science

Country	Percentage of Country Total Output					World Normalized Citation Impact 2006-2010
	2006	2007	2008	2009	2010	
Brazil	4.2%	4.3%	3.9%	4.2%	4.9%	1.01
China	3.4%	3.4%	3.4%	4.3%	4.1%	0.67
India	6.3%	6.5%	6.5%	7.3%	6.4%	0.63
Iran	3.3%	4.1%	4.2%	5.1%	5.5%	0.68
Israel	3.0%	2.9%	2.7%	2.9%	3.0%	1.17
Russian Federation	2.7%	2.9%	2.9%	3.0%	2.8%	0.47
Singapore	2.5%	2.2%	2.2%	2.6%	2.6%	1.23
South Africa	10.2%	9.7%	8.5%	8.2%	8.1%	1.15
United Kingdom	4.5%	4.7%	4.4%	4.6%	4.6%	1.55
United States	4.6%	4.5%	4.4%	4.3%	4.3%	1.37
World	4.2%	4.2%	4.2%	4.5%	4.4%	1

**Figure 2.34** – Percentage of each country's total output and world normalized citation impact for Environmental Science

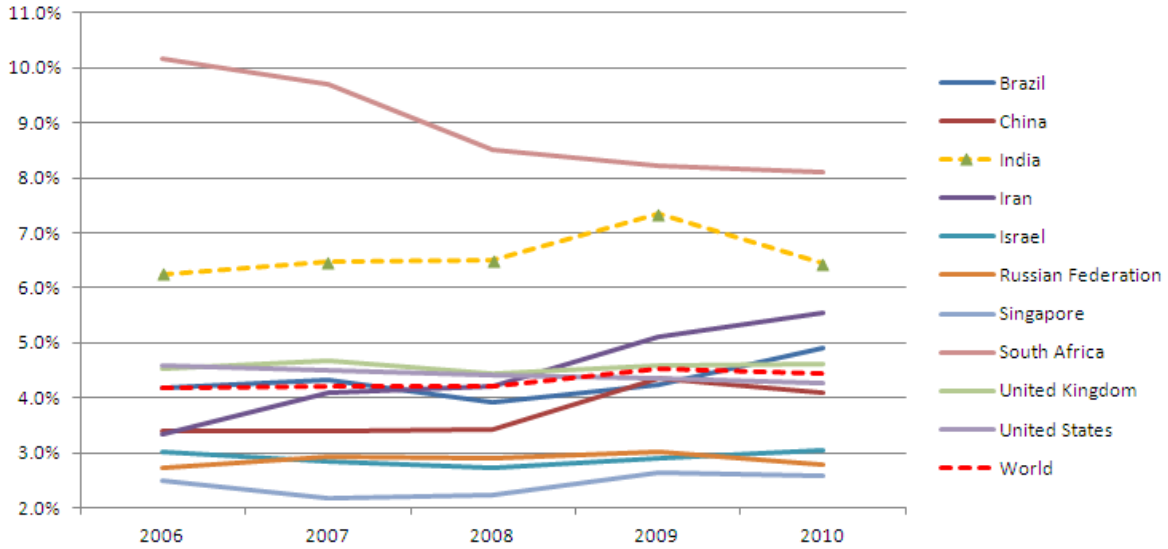


Figure 2.35 - Percentage of each country's total output for Environmental Science

In Figure 2.35 above we see that the India's publication output in *Environmental Science* has increased marginally in terms of India's total output (from 6.3% in 2006 to 6.4% in 2010, with a peak of 7.3% in 2009). This is a higher percentage than we see for the world, where we see *Environmental Science* representing approximately 4.5% of all output. In Figure 2.36 below we see that India's world normalized citation impact in this subject area is below average (0.63).

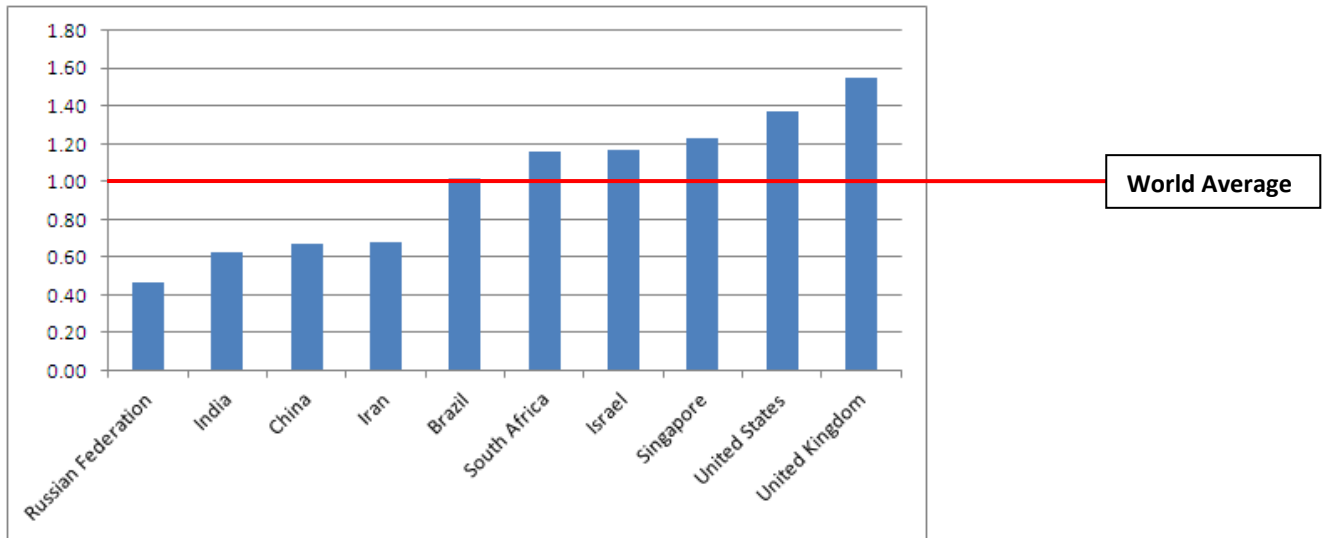


Figure 2.36 - World normalized citation impact 2006-2010 (Environmental Science)

## Immunology and Microbiology

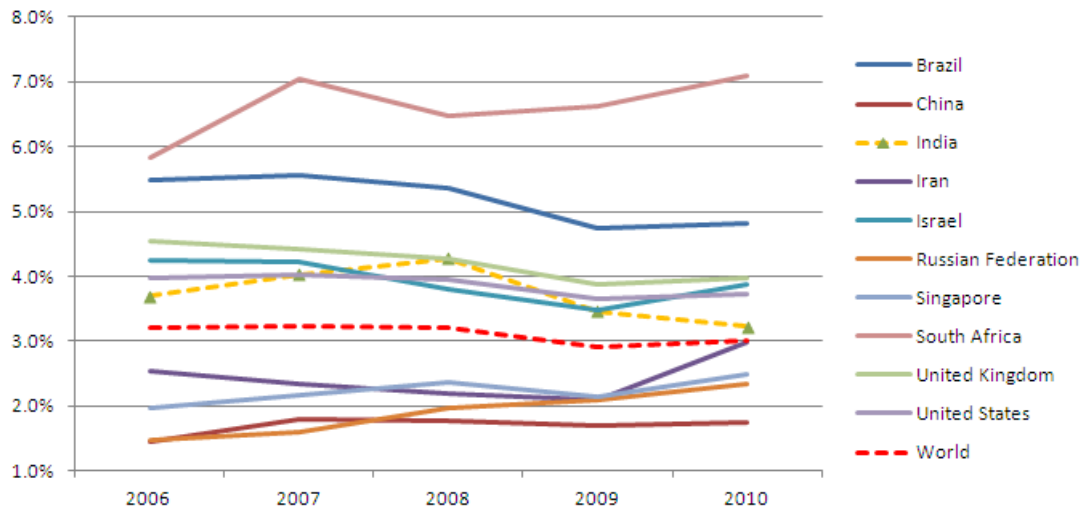
Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Singapore	59	84	69	85	101	109	122	147	181	201	202	226	271	251	326
Israel	424	446	470	511	445	455	491	575	591	541	586	593	544	488	555
South Africa	180	215	218	224	211	228	221	301	324	395	423	539	542	609	673
Iran	17	29	27	22	37	48	81	111	114	154	263	324	392	453	758
Russian Federation	818	783	913	900	994	902	810	888	729	609	466	522	655	705	811
Brazil	702	698	846	924	852	946	1059	1281	1249	1338	1630	1833	2015	1932	2081
India	670	670	668	732	756	744	948	1129	1226	1379	1524	1851	2187	1968	2111
United Kingdom	4317	4414	4729	4766	4691	4400	4290	4777	4972	4817	5008	5146	5024	4627	4902
China	424	442	475	516	573	619	755	1254	1526	2355	2871	3961	4547	4985	5799
United States	14400	14611	14076	14578	14361	13718	13706	15580	16448	17014	17152	17778	17810	16482	17305
World	41650	43397	43124	44220	44613	45536	45172	46888	48629	50793	53051	56417	57670	54207	58236

**Figure 2.37** – Number of publications per year in Immunology & Microbiology

Country	Percentage of Country Total Output					World Normalized Citation Impact 2006-2010
	2006	2007	2008	2009	2010	
Brazil	5.5%	5.5%	5.4%	4.7%	4.8%	0.63
China	1.5%	1.8%	1.8%	1.7%	1.8%	0.48
India	3.7%	4.0%	4.3%	3.5%	3.2%	0.52
Iran	2.5%	2.3%	2.2%	2.1%	3.0%	0.34
Israel	4.3%	4.2%	3.8%	3.5%	3.9%	1.24
Russian Federation	1.5%	1.6%	2.0%	2.1%	2.3%	0.47
Singapore	2.0%	2.2%	2.4%	2.1%	2.5%	1.14
South Africa	5.8%	7.0%	6.5%	6.6%	7.1%	1.08
United Kingdom	4.5%	4.4%	4.3%	3.9%	4.0%	1.41
United States	4.0%	4.0%	4.0%	3.6%	3.7%	1.50
World	3.2%	3.2%	3.2%	2.9%	3.0%	1

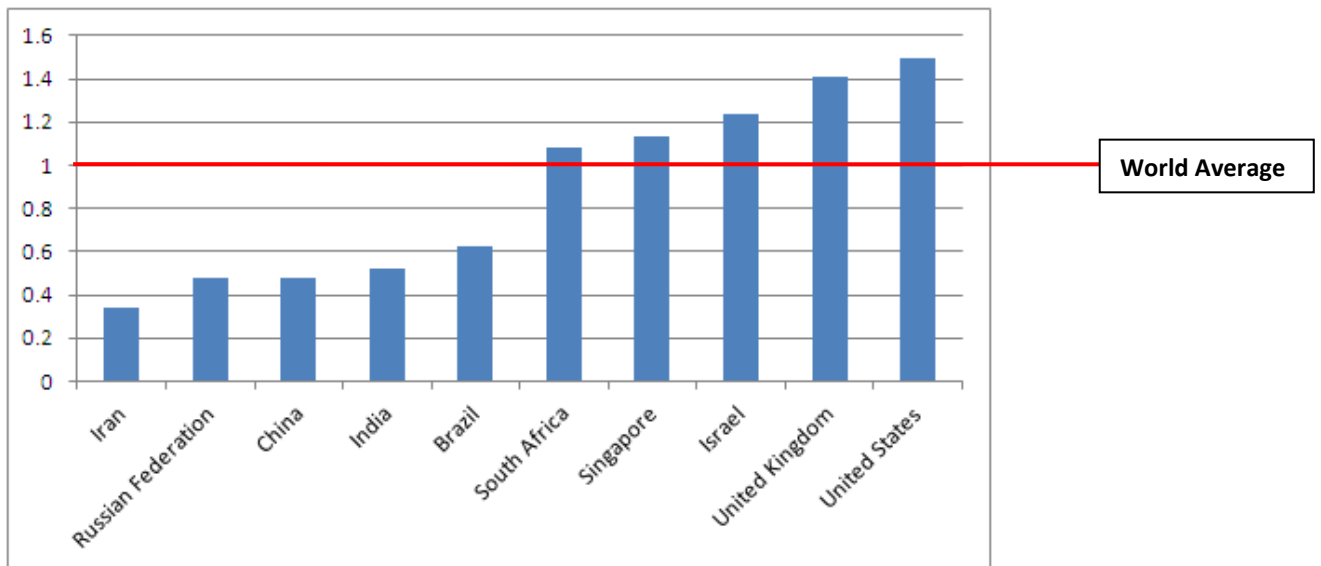
**Figure 2.38** - Percentage of each country's total output and world normalized citation impact for Immunology & Microbiology





**Figure 2.39** - Percentage of each country's total output for Immunology & Microbiology

In Figure 2.39 above we see that the India's publication output in *Immunology & Microbiology* has peaked in 2008 at 4.3% and declined to 3.2% in 2010. This is very near the world level, where we see *Immunology & Microbiology* representing approximately 3% of all output. In Figure 2.40 below we see that India's world normalized citation impact in this subject area is below average (0.52).



**Figure 2.40** - World normalized citation impact 2006-2010 (*Immunology & Microbiology*)

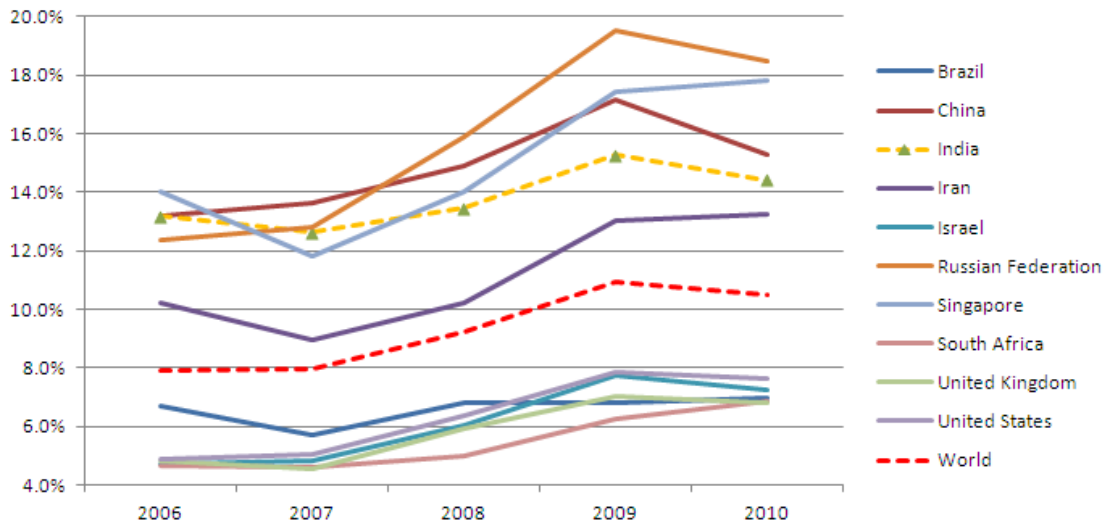
## Materials Science

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
South Africa	198	219	203	251	252	259	257	257	234	282	340	351	418	575	652
Israel	531	624	541	543	576	562	549	544	605	577	652	677	863	1086	1043
Singapore	315	555	435	738	760	862	906	967	1073	1116	1436	1234	1613	2045	2345
Brazil	588	713	845	1001	985	1289	1302	1561	1503	1562	1988	1883	2561	2774	3024
Iran	71	103	105	114	162	232	294	451	557	736	1055	1238	1835	2816	3363
Russian Federation	4931	5530	5093	4602	4717	5210	5295	5262	5081	4758	3918	4203	5309	6568	6430
United Kingdom	4771	5056	4729	4728	4990	4536	4349	4793	4962	4835	5355	5311	6995	8451	8416
India	2584	2541	2374	2589	2765	2888	3151	3491	3829	4459	5425	5810	6877	8688	9436
United States	17429	20091	17440	16251	16853	15145	15604	17271	17207	18314	21024	22242	28649	35468	35435
China	5613	6639	7256	7036	8428	9885	9923	11060	15270	22672	26062	30129	38175	50783	50591
World	79003	89058	83473	83032	87480	95814	96184	102321	107739	115840	131055	138288	165922	203743	202862

**Figure 2.41** – Number of publications per year in Materials Science

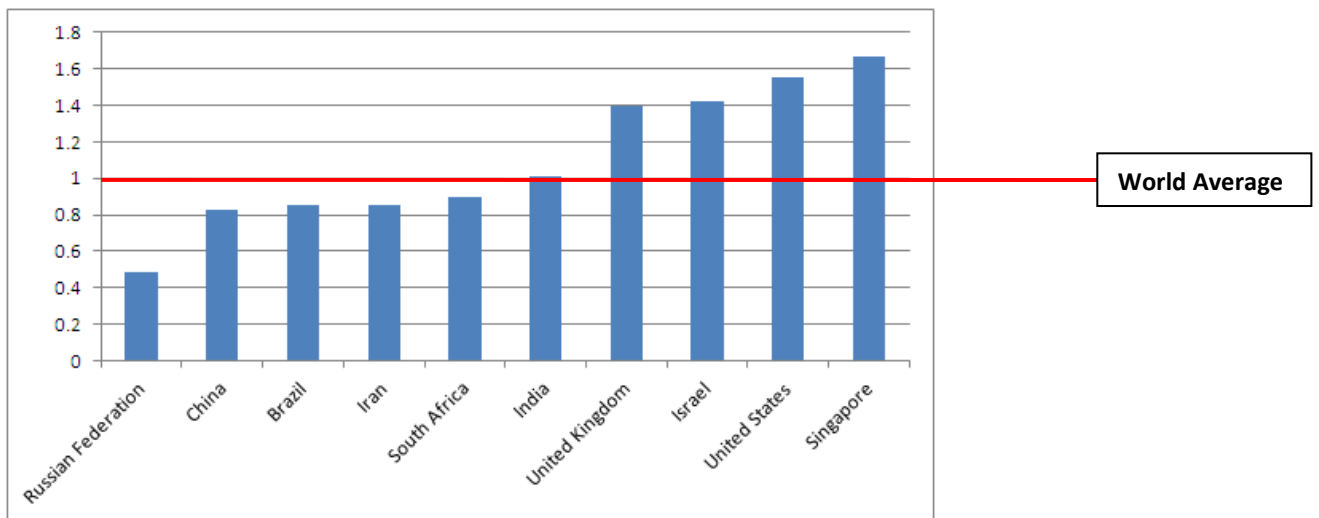
Country	Percentage of Country Total Output					World Normalized Citation Impact 2006-2010
	2006	2007	2008	2009	2010	
Brazil	6.7%	5.7%	6.8%	6.8%	7.0%	0.85
China	13.2%	13.6%	14.9%	17.2%	15.3%	0.82
India	13.2%	12.6%	13.5%	15.3%	14.4%	1.01
Iran	10.2%	8.9%	10.2%	13.0%	13.3%	0.86
Israel	4.7%	4.8%	6.0%	7.7%	7.3%	1.42
Russian Federation	12.4%	12.8%	15.9%	19.5%	18.5%	0.49
Singapore	14.0%	11.8%	14.0%	17.4%	17.8%	1.67
South Africa	4.7%	4.6%	5.0%	6.3%	6.9%	0.89
United Kingdom	4.8%	4.6%	5.9%	7.1%	6.8%	1.39
United States	4.9%	5.0%	6.4%	7.8%	7.6%	1.55
World	7.9%	7.9%	9.2%	10.9%	10.5%	1

**Figure 2.42** - Percentage of each country's total output and world normalized citation impact for Materials Science



**Figure 2.43** - Percentage of each country's total output for Materials Science

Materials science showed worldwide growth and a peak in 2009. In Figure 2.43 above we see that the India's publication output in *Materials Science* has peaked in 2009 at 15.3% and declined to 14.4% in 2010. The percentage of world publications which are *Materials Science* is approximately 10%. In Figure 2.44 below we see that India's world normalized citation impact in this subject area is just about equal to world average (1.01).



**Figure 2.44** - World normalized citation impact 2006-2010 (*Materials Science*)

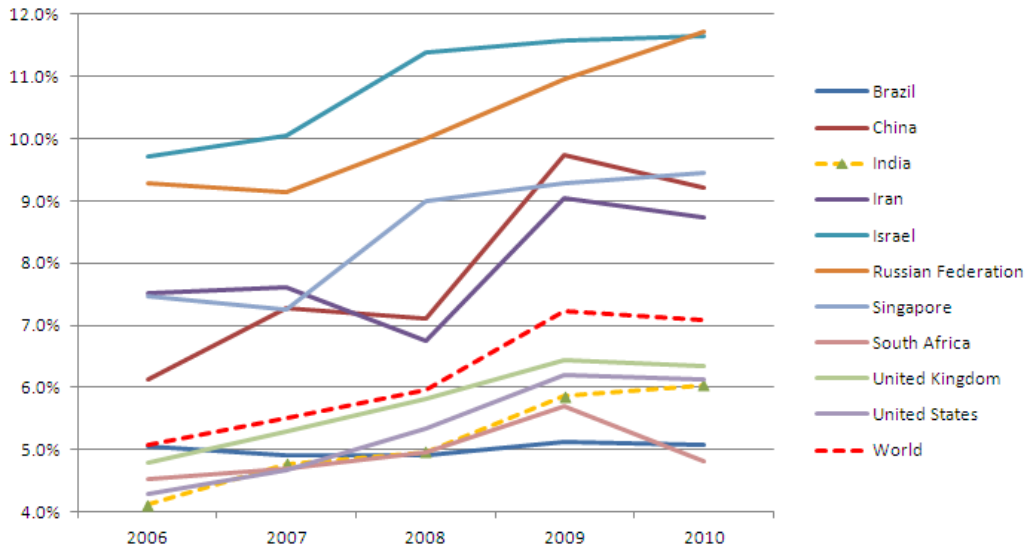
## Mathematics

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
South Africa	121	132	142	169	153	139	165	196	220	247	328	359	416	524	457
Singapore	204	270	245	279	303	276	369	445	608	519	765	757	1035	1088	1243
Israel	847	951	887	848	794	829	896	1050	1091	1043	1338	1410	1631	1628	1672
Brazil	490	591	715	734	805	809	962	1086	1428	1240	1501	1623	1845	2090	2198
Iran	49	79	82	108	113	129	171	243	389	556	776	1054	1215	1958	2211
India	872	963	922	932	968	931	1056	1249	1356	1478	1695	2191	2539	3336	3956
Russian Federation	2036	2420	2055	2023	2085	2063	1970	2237	2527	2671	2938	2996	3347	3684	4081
United Kingdom	2335	2439	2454	2329	2598	2505	2633	3719	3926	4011	5281	6177	6874	7712	7842
United States	11983	14233	12312	11059	11297	11170	11580	14583	15020	15832	18485	20684	24117	28119	28461
China	1909	2087	2395	2431	2589	3339	3391	4093	6534	7862	12105	16102	18253	28775	30476
World	39481	44574	41571	40164	41799	43193	44138	55899	63353	65337	83975	95842	107438	134678	137188

**Figure 2.45** – Number of publications per year in Mathematics

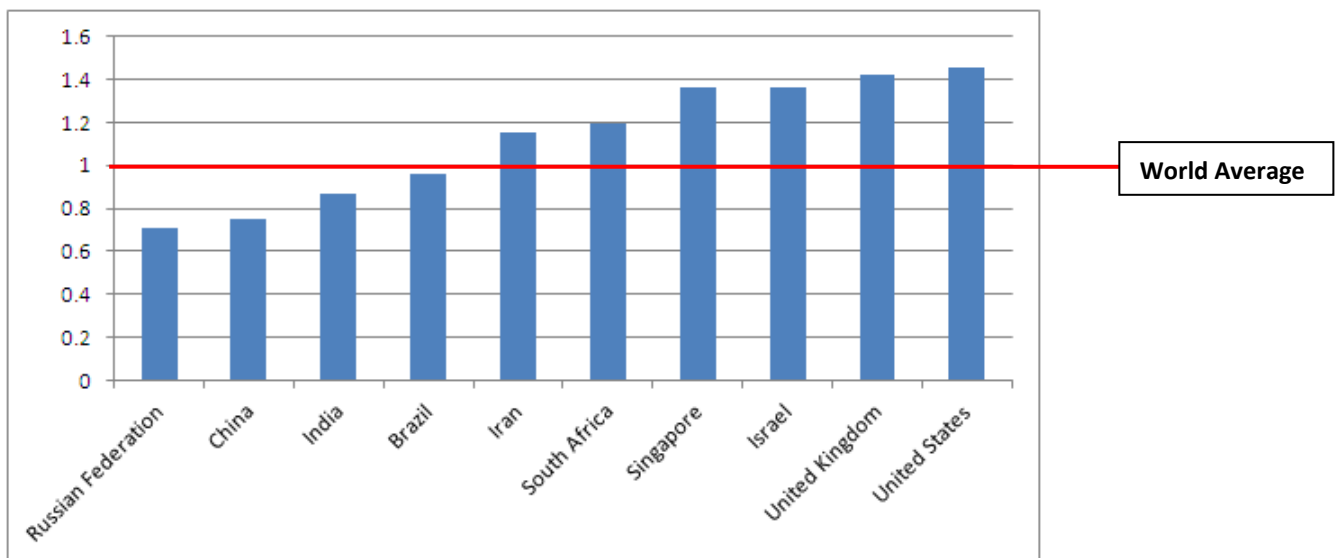
Country	Percentage of Country Total Output					World Normalized Citation Impact 2006-2010
	2006	2007	2008	2009	2010	
Brazil	5.1%	4.9%	4.9%	5.1%	5.1%	0.96
China	6.1%	7.3%	7.1%	9.7%	9.2%	0.75
India	4.1%	4.8%	5.0%	5.9%	6.0%	0.87
Iran	7.5%	7.6%	6.8%	9.0%	8.7%	1.15
Israel	9.7%	10.1%	11.4%	11.6%	11.6%	1.37
Russian Federation	9.3%	9.1%	10.0%	11.0%	11.7%	0.71
Singapore	7.5%	7.3%	9.0%	9.3%	9.4%	1.36
South Africa	4.5%	4.7%	5.0%	5.7%	4.8%	1.20
United Kingdom	4.8%	5.3%	5.8%	6.4%	6.3%	1.42
United States	4.3%	4.7%	5.4%	6.2%	6.1%	1.46
World	5.1%	5.5%	6.0%	7.2%	7.1%	1

**Figure 2.46** - Percentage of each country's total output and world normalized citation impact Mathematics



**Figure 2.47** - Percentage of each country's total output for Mathematics

In Figure 2.47 above we see that the India's publication output in *Mathematics* has increased from 4.1% in 2006 in to 6% in 2010. This is below world level, where we see *Mathematics* representing approximately 7% of all output. In Figure 2.48 below we see that India's world normalized citation impact in this subject area is below average (0.87).



**Figure 2.48** - World normalized citation impact 2006-2010 (*Mathematics*)

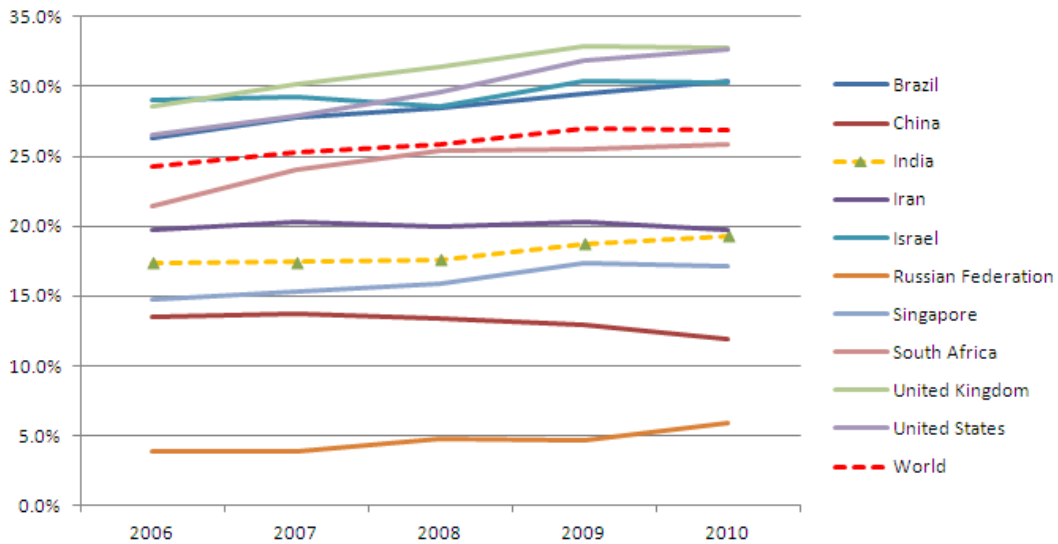
## Medicine

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Russian Federation	1094	1172	1262	1214	1451	1353	1281	1295	939	1150	1214	1260	1588	1577	2064
Singapore	599	641	697	682	786	740	811	989	1171	1295	1512	1594	1826	2037	2247
South Africa	882	941	912	913	897	973	920	1044	1117	1361	1558	1837	2127	2344	2450
Israel	2859	2961	2824	2982	3289	3206	3264	3589	3660	3756	3989	4105	4096	4278	4351
Iran	96	162	149	141	155	223	409	609	699	1346	2040	2804	3598	4393	5002
India	2874	3184	3307	3530	3517	3790	4385	5211	5363	6095	7163	8010	9010	10684	12648
Brazil	2435	2600	2772	2782	2946	3471	4041	4536	5393	6092	7824	9186	10705	12006	13147
China	3739	4175	4815	4772	5624	6720	8571	10712	14403	22167	26652	30263	34471	38288	39460
United Kingdom	22434	23027	23522	22683	24433	23765	23284	25492	27013	28321	31531	35120	37006	39349	40436
United States	85737	86134	83217	84007	85091	89406	85183	91757	97977	104303	114463	123174	133376	144121	151959
World	276629	288493	286940	287483	295615	308826	299959	313465	327630	357479	402525	440802	466403	502845	520678

Figure 2.49 – Number of publications per year in Medicine

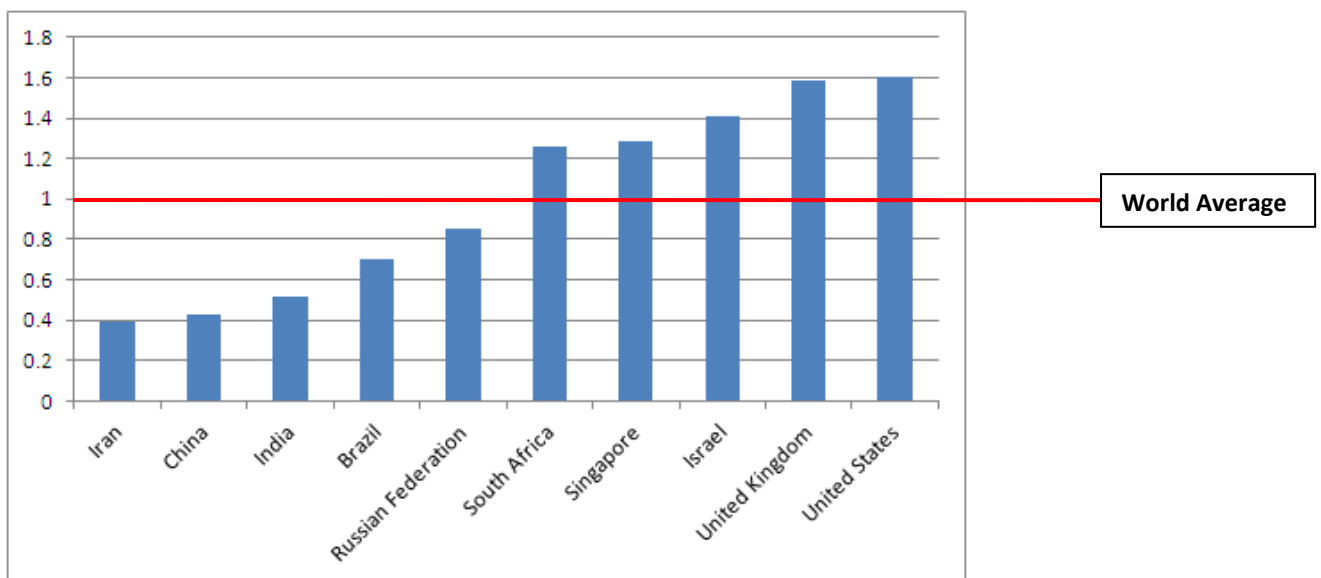
Country	Percentage of Country Total Output					World Normalized Citation Impact 2006-2010
	2006	2007	2008	2009	2010	
Brazil	26.4%	27.8%	28.5%	29.5%	30.4%	0.71
China	13.5%	13.7%	13.4%	12.9%	11.9%	0.43
India	17.4%	17.4%	17.6%	18.8%	19.3%	0.52
Iran	19.8%	20.3%	20.0%	20.3%	19.7%	0.39
Israel	29.0%	29.3%	28.6%	30.4%	30.3%	1.41
Russian Federation	3.8%	3.8%	4.7%	4.7%	5.9%	0.85
Singapore	14.8%	15.3%	15.9%	17.4%	17.1%	1.28
South Africa	21.5%	24.0%	25.4%	25.5%	25.8%	1.26
United Kingdom	28.6%	30.1%	31.4%	32.9%	32.7%	1.59
United States	26.5%	27.9%	29.6%	31.8%	32.7%	1.60
World	24.3%	25.3%	25.9%	27.0%	26.9%	1

Figure 2.50 - Percentage of each country's total output and world normalized citation impact for Medicine



**Figure 2.51 - Percentage of each country's total output for Medicine**

In Figure 2.51 above we see that the India's publication output in *Medicine* has increased from 17.4% in 2006 to 19.3% in 2010. This is below the world level, where we see *Medicine* representing over 25% of all output. In Figure 2.52 below we see that India's world normalized citation impact in this subject area is below average (0.52).



**Figure 2.52 - World normalized citation impact 2006-2010 (Medicine)**

## Pharmacology, Toxicology and Pharmaceuticals

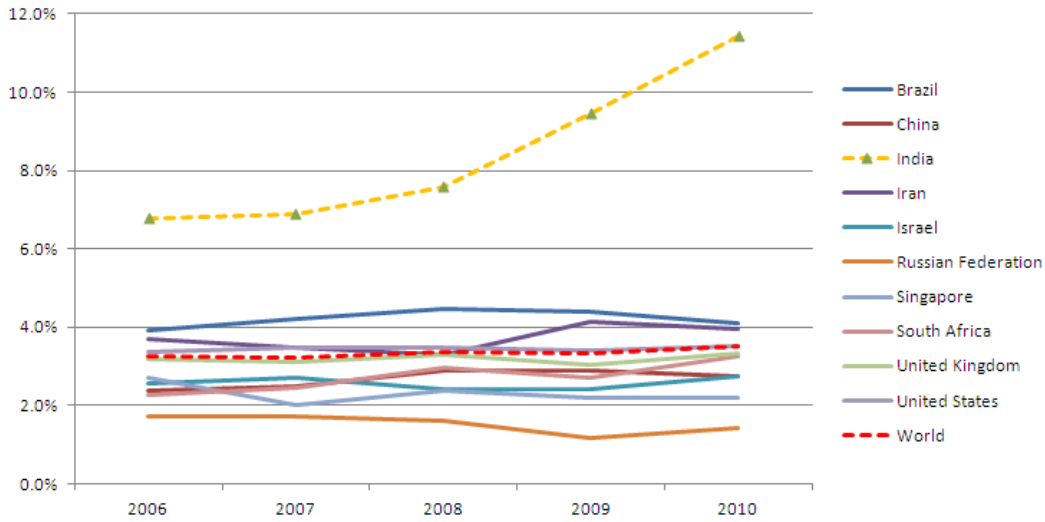
Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Singapore	57	74	67	67	74	77	111	123	145	193	277	212	273	258	290
South Africa	124	139	149	129	153	135	111	143	164	164	164	189	247	250	310
Israel	273	300	303	320	327	295	291	325	329	339	351	379	348	342	396
Russian Federation	516	510	671	702	629	615	656	545	510	537	551	560	542	391	500
Iran	27	37	59	76	83	89	144	176	249	274	383	482	595	896	1002
Brazil	402	462	451	577	613	551	705	778	907	1035	1159	1387	1682	1789	1775
United Kingdom	3768	3467	3397	3581	3587	3224	3262	3357	3609	3519	3521	3616	3906	3643	4122
India	1059	1198	1183	1353	1238	1380	1648	1934	1913	2196	2798	3168	3881	5386	7488
China	1119	1073	1139	1514	1591	1569	1751	2681	2853	3884	4718	5504	7444	8577	9140
United States	12516	11983	11707	12364	11597	11637	12397	13051	13758	14234	14622	15407	15709	15384	16301
World	44160	43846	43545	45446	43094	42905	45178	46712	48366	50647	53832	56112	60767	62072	67930

**Figure 2.53** – Number of publications per year in Pharmacology, Toxicology and Pharmaceuticals

Country	Percentage of Country Total Output					World Normalized Citation Impact 2006-2010
	2006	2007	2008	2009	2010	
Brazil	3.9%	4.2%	4.5%	4.4%	4.1%	0.78
China	2.4%	2.5%	2.9%	2.9%	2.8%	0.58
India	6.8%	6.9%	7.6%	9.5%	11.4%	0.60
Iran	3.7%	3.5%	3.3%	4.1%	4.0%	0.68
Israel	2.5%	2.7%	2.4%	2.4%	2.8%	1.38
Russian Federation	1.7%	1.7%	1.6%	1.2%	1.4%	0.53
Singapore	2.7%	2.0%	2.4%	2.2%	2.2%	1.42
South Africa	2.3%	2.5%	3.0%	2.7%	3.3%	0.91
United Kingdom	3.2%	3.1%	3.3%	3.0%	3.3%	1.44
United States	3.4%	3.5%	3.5%	3.4%	3.5%	1.42
World	3.2%	3.2%	3.4%	3.3%	3.5%	1

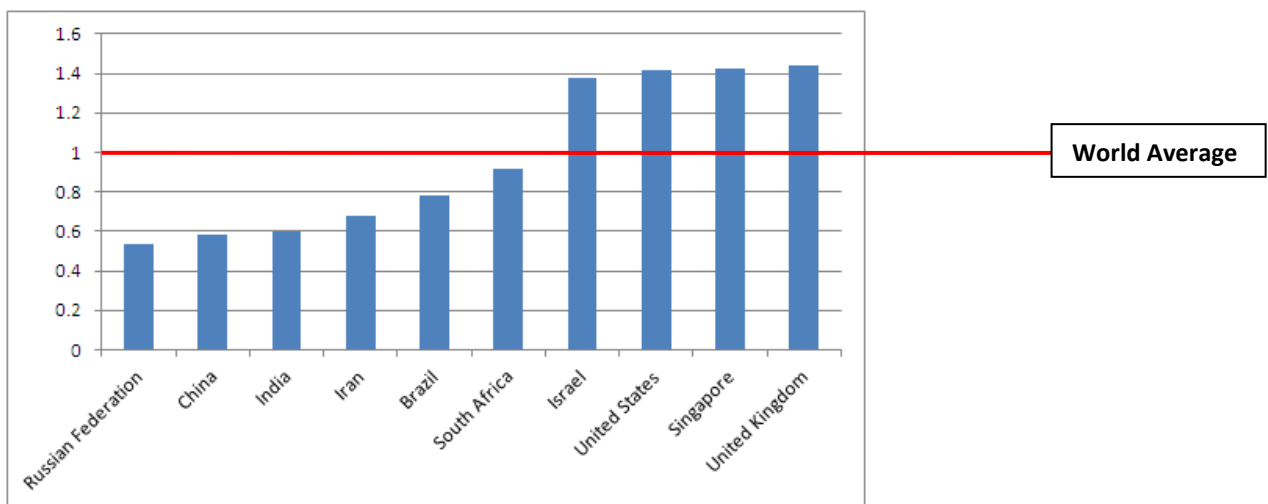
**Figure 2.54** - Percentage of each country's total output and world normalized citation impact for Pharmacology, Toxicology and Pharmaceuticals





**Figure 2.55** - Percentage of each country's total output for Pharmacology, Toxicology and Pharmaceutics

In Figure 2.55 above we see that the India's publication output in *Pharmaceutics, Toxicology and Pharmaceutics* is higher than world level, and that of comparator countries in terms of the percentage of their total output which it represents. We see a rise from 6.8% in 2006 to 11.4% in 2010, while for world and comparators it remains below 6% of total output. In Figure 2.56 below we see that India's world normalized citation impact in this subject area is below average (0.60).



**Figure 2.56** - World normalized citation impact 2006-2010 (*Pharmacology, Toxicology and Pharmaceutics*)

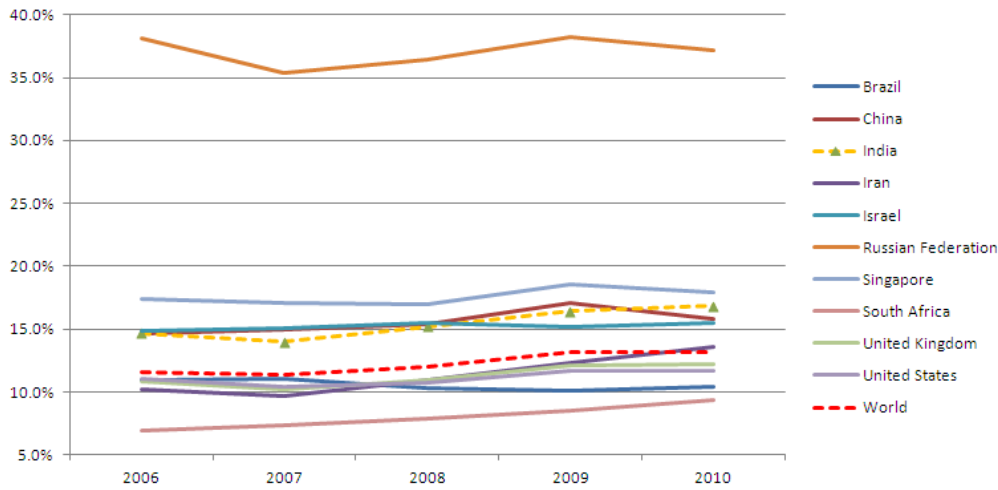
## Physics and Astronomy

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
South Africa	307	297	352	376	315	289	305	334	413	448	501	558	662	782	889
Israel	1626	1731	1735	1753	1715	1570	1705	1839	1894	1869	2047	2113	2212	2134	2225
Singapore	313	454	540	819	1063	1121	1135	1177	1462	1624	1774	1775	1955	2182	2354
Iran	81	118	154	162	198	228	336	415	568	688	1052	1340	1965	2660	3444
Brazil	1506	1846	2066	2222	2205	2542	2596	2650	3078	3128	3257	3660	3871	4100	4502
India	3189	3127	3332	3276	3421	3282	3822	3943	4229	5135	6035	6434	7755	9354	11015
Russian Federation	10403	11218	10879	11398	11215	11179	10885	10479	11047	11856	12079	11593	12190	12844	12935
United Kingdom	8270	8521	8660	8919	9514	8311	8693	9555	10445	10942	11988	11831	12864	14478	15066
China	6665	7287	8664	8384	9382	10269	10776	12259	16013	26243	28898	33096	39578	50553	52247
United States	34247	36031	36605	36915	36426	35182	36899	38869	42303	44453	47468	46095	48243	52686	54162
World	122661	128894	131352	137176	140660	140887	148510	147915	162090	179222	191955	198446	216641	244877	255730

**Figure 2.57** – Number of publications per year in Physics and Astronomy

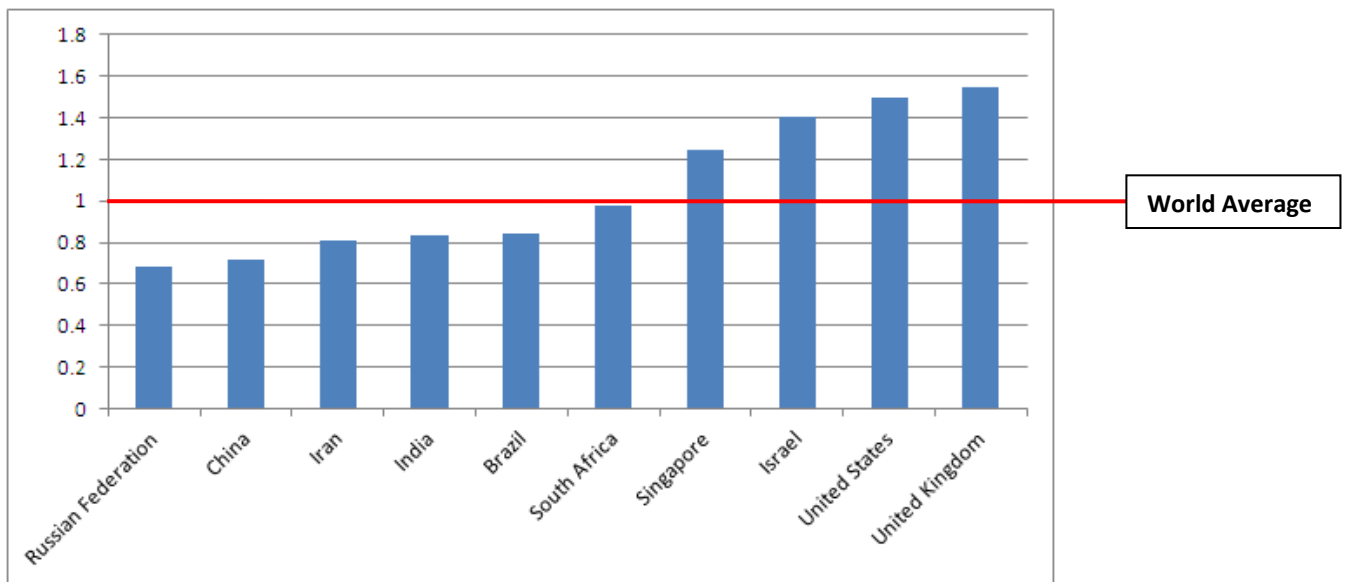
Country	Percentage of Country Total Output					World Normalized Citation Impact 2006-2010
	2006	2007	2008	2009	2010	
Brazil	11.0%	11.1%	10.3%	10.1%	10.4%	0.84
China	14.6%	15.0%	15.4%	17.1%	15.8%	0.72
India	14.6%	14.0%	15.2%	16.4%	16.8%	0.83
Iran	10.2%	9.7%	10.9%	12.3%	13.6%	0.81
Israel	14.9%	15.1%	15.4%	15.2%	15.5%	1.40
Russian Federation	38.2%	35.4%	36.4%	38.2%	37.1%	0.68
Singapore	17.3%	17.0%	17.0%	18.6%	17.9%	1.24
South Africa	6.9%	7.3%	7.9%	8.5%	9.4%	0.98
United Kingdom	10.9%	10.2%	10.9%	12.1%	12.2%	1.54
United States	11.0%	10.4%	10.7%	11.6%	11.6%	1.50
World	11.6%	11.4%	12.0%	13.1%	13.2%	1

**Figure 2.58** - Percentage of each country's total output and world normalized citation impact for Physics and Astronomy



**Figure 2.59** - Percentage of each country's total output for Physics and Astronomy

In Figure 2.59 above we see that the India's publication output in *Physics and Astronomy* has increased from 14.6% in 2006 to 16.8% in 2010, and is above the world level which is approximately 13%. The Russian Federation stands out as over 35% of their total publication output is related to *Physics and Astronomy*. In Figure 2.60 below we see that India's world normalized citation impact in this subject area is below average (0.83).



**Figure 2.60** - World normalized citation impact 2006-2010 (*Physics and Astronomy*)

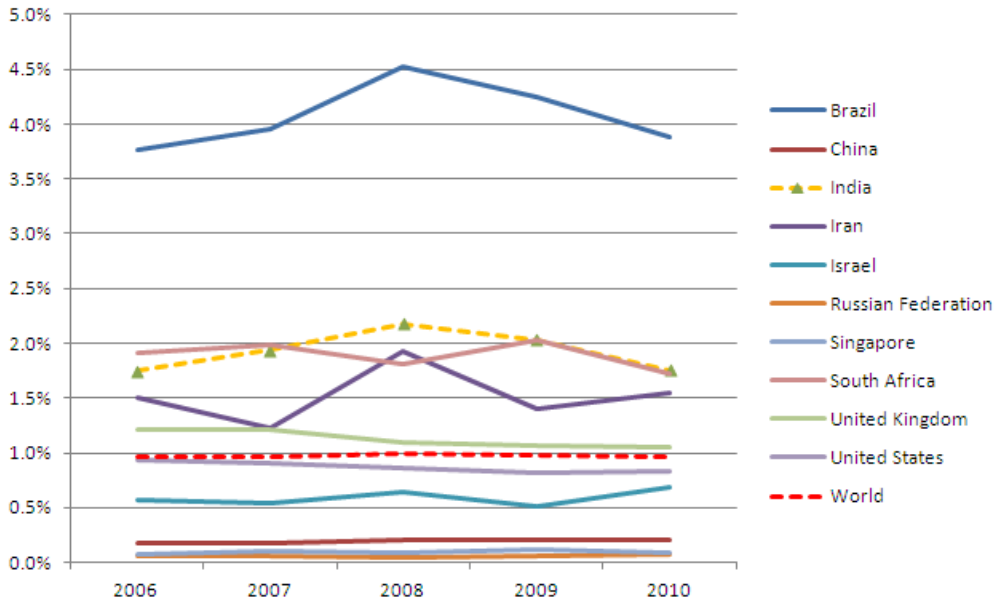
## Veterinary Science

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Singapore	5	4	5	3	5	11	12	8	9	7	7	11	11	14	12
Russian Federation	11	5	19	11	8	11	7	17	19	10	18	18	15	18	27
Israel	73	76	74	72	66	73	91	84	90	81	78	76	93	73	98
South Africa	114	112	111	96	122	119	115	120	131	140	139	152	152	186	163
Iran	25	25	40	32	36	28	38	56	73	88	155	169	346	302	393
China	38	50	48	40	53	56	62	92	113	159	342	406	524	607	680
India	609	672	785	699	725	748	760	780	730	683	719	892	1112	1156	1150
United Kingdom	1113	1047	1106	1072	1054	1054	1008	1081	1197	1266	1343	1420	1287	1281	1293
Brazil	239	310	393	384	453	355	506	558	538	563	1118	1307	1697	1730	1679
United States	3395	3203	3328	3192	3183	3204	3361	3452	3595	3641	4006	3987	3884	3735	3865
World	11317	10923	11706	11701	11752	11833	12581	13014	13676	14064	15877	16818	17775	18115	18714

Figure 2.61 – Number of publications per year in Veterinary Science

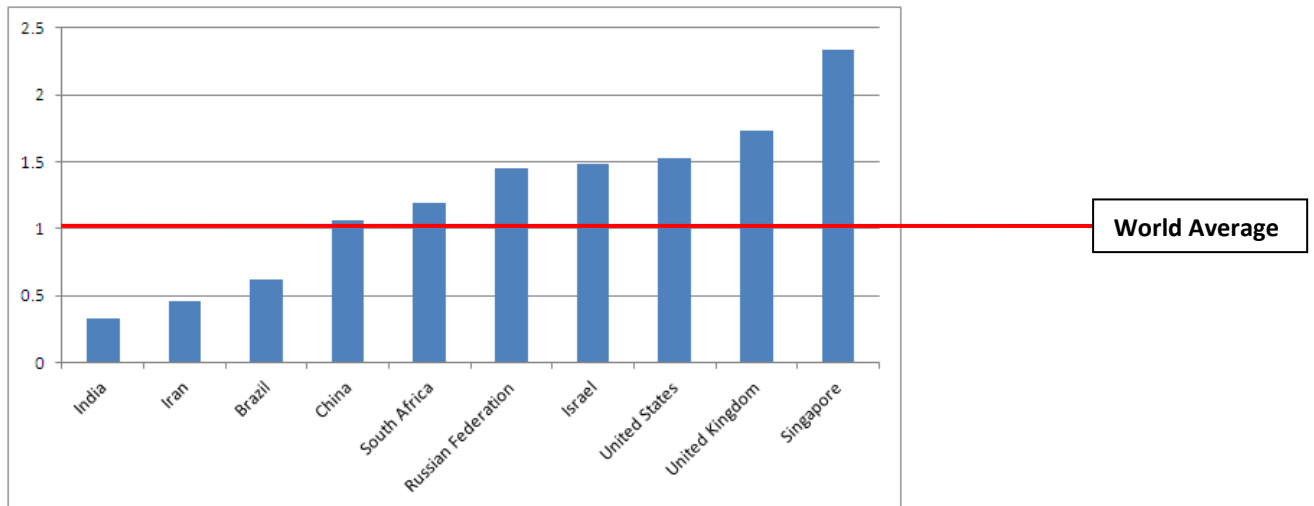
Country	Percentage of Country Total Output					World Normalized Citation Impact 2006-2010
	2006	2007	2008	2009	2010	
Brazil	3.8%	4.0%	4.5%	4.2%	3.9%	0.62
China	0.2%	0.2%	0.2%	0.2%	0.2%	1.06
India	1.7%	1.9%	2.2%	2.0%	1.8%	0.33
Iran	1.5%	1.2%	1.9%	1.4%	1.6%	0.46
Israel	0.6%	0.5%	0.6%	0.5%	0.7%	1.49
Russian Federation	0.1%	0.1%	0.0%	0.1%	0.1%	1.45
Singapore	0.1%	0.1%	0.1%	0.1%	0.1%	2.34
South Africa	1.9%	2.0%	1.8%	2.0%	1.7%	1.20
United Kingdom	1.2%	1.2%	1.1%	1.1%	1.0%	1.73
United States	0.9%	0.9%	0.9%	0.8%	0.8%	1.53
World	1.0%	1.0%	1.0%	1.0%	1.0%	1

Figure 2.62 - Percentage of each country's total output and world normalized citation impact for Veterinary Science



**Figure 2.63** - Percentage of each country's total output for Veterinary Science

In Figure 2.63 above we see that the India's publication output in *Veterinary Science* has peaked in 2008 at 2.2% and declined to 1.8% in 2010. This is above world level, where we see *Veterinary Science* representing approximately 1% of all output. In Figure 2.64 below we see that India's world normalized citation impact in this subject area is below average (0.33).



**Figure 2.64** - World normalized citation impact 2006-2010 (*Veterinary Science*)

## Appendix A: Additional Tables

### Total number of publications 1996-2010

	South Africa	Singapore	Israel	Iran	Russian Federation	Brazil	India	United Kingdom	China	United States	WORLD
1996	4155	2782	9821	721	31575	8621	20262	78624	35638	323454	1066035
1997	4137	3585	10108	925	31388	10152	20472	80689	39653	320996	1092349
1998	4196	3562	9841	1021	32074	11124	20736	81119	45263	313562	1090382
1999	4342	4356	9982	1257	30902	11954	22033	80370	46546	306806	1086282
2000	4195	5039	10379	1552	31548	13078	22484	84046	53462	311565	1135002
2001	4208	5214	10279	1903	31927	13937	23171	78595	67512	308797	1180037
2002	4800	5625	10757	2638	31806	16140	25159	80538	68030	323968	1218497
2003	5128	6639	12072	3835	32651	18242	28715	89758	81711	355692	1292226
2004	5922	9033	12817	5230	34296	21358	31361	98211	120284	399385	1435756
2005	6461	9537	12963	7241	35547	23533	35419	104120	170850	422705	1567787
2006	7259	10232	13768	10321	31654	29682	41200	110413	197802	431612	1656611
2007	7658	10429	14027	13844	32754	33058	45958	116558	221348	442243	1741417
2008	8371	11497	14333	17984	33468	37569	51128	117991	256546	450621	1801496
2009	9194	11730	14060	21638	33609	40745	56923	119778	295663	452619	1864445
2010	9490	13155	14352	25346	34843	43188	65487	123594	330818	465262	1935954

The table above shows the total number of publications for each country and the world per year (1996-2010) in all subject areas.

### Total number of citations 1996-2010

	South Africa	Singapore	Israel	Iran	Russian Federation	Brazil	India	United Kingdom	China	United States	WORLD
1996-2000	42172	34713	189029	5771	205843	97002	129586	1647371	198288	7360814	15392521
1997-2001	47007	41857	205622	8157	218955	113856	142746	1785097	248003	7783877	16605825
1998-2002	52054	50206	220993	10963	223118	135010	163598	1911510	302010	8222911	17838749
1999-2003	56047	59499	235342	14815	225513	151092	185695	2016144	381246	8653802	19143065
2000-2004	61446	77904	258301	19820	236003	177718	218465	2162697	505051	9258887	20766964
2001-2005	69429	99925	286630	28235	259689	209983	263261	2324103	686810	10054620	22666154
2002-2006	83697	132752	314260	42718	293133	263611	328935	2616950	936332	11087681	24956384
2003-2007	103634	168205	349212	63084	322346	316084	403593	2911452	1251301	12012983	26977176
2004-2008	123875	200389	365259	88922	329750	373799	472449	3116719	1607791	12637130	28917095
2005-2009	140518	226483	371037	127828	316590	433805	548471	3294964	2013578	12950674	30503533
2006-2010	159503	248469	376067	174664	301554	487756	628177	3459875	2426657	13190236	31828426

The table above shows the total number of citations for each country and the world per roof-tile of years (1996-2010) in all subject areas.

### Relative Citation Impact All subjects (2006-2010)

Country	CPP 2006-2010	Relative Citation Impact 2006-2010
United Kingdom	5.94	1.66
India	2.44	0.68
Iran	1.99	0.56
Israel	5.38	1.51
United States	5.94	1.66
Brazil	2.68	0.75
China	1.89	0.53
Russian Federation	1.83	0.51
South Africa	3.84	1.08
Singapore	4.40	1.23
WORLD	3.57	1.00

This table shows the Citations per Paper for each country and the WORLD for the period 2006-2010 in ALL subject areas, and the Relative Citation Impact, defined as CPP Country / CPP WORLD

## Share International Collaboration All Subjects

Country	2006	2007	2008	2009	2010	2006-2010
Brazil	24.7%	24.3%	24.1%	22.7%	23.1%	23.7%
China	12.6%	13.2%	13.2%	13.0%	13.4%	13.1%
India	18.4%	17.9%	17.6%	17.2%	17.4%	17.6%
Iran	19.0%	19.2%	17.4%	16.9%	17.1%	17.7%
Israel	39.3%	40.1%	41.0%	41.0%	43.9%	41.1%
Russian Federation	33.3%	32.6%	30.5%	30.3%	28.7%	31.0%
Singapore	42.2%	44.2%	45.8%	47.5%	49.2%	46.0%
South Africa	41.1%	43.5%	42.7%	43.5%	44.9%	43.2%
United Kingdom	39.9%	41.0%	42.8%	43.9%	45.5%	42.7%
United States	24.4%	25.5%	26.4%	27.2%	28.5%	26.5%

This table shows the percentage of publications that have at least one author from another country

## Share International Collaboration per Subject Area

Share International Collaboration 2006-2010	Brazil	China	India	Iran	Israel	Russian Federation	Singapore	South Africa	United Kingdom	United States
Agricultural and Biological Sciences	19.4%	21.7%	14.5%	21.2%	48.5%	34.7%	64.4%	48.9%	58.1%	33.9%
Biochemistry, Genetics and Molecular Biology	28.6%	20.5%	20.2%	23.3%	47.4%	29.8%	53.0%	50.4%	52.3%	31.8%
Chemical Engineering	23.7%	11.1%	15.7%	16.9%	30.8%	19.0%	43.4%	37.9%	45.0%	24.3%
Chemistry	23.7%	14.0%	17.2%	14.5%	42.6%	23.1%	43.8%	43.7%	48.6%	30.3%
Computer Science	27.4%	10.7%	17.3%	17.3%	43.5%	29.7%	44.9%	33.2%	42.9%	27.4%
Earth and Planetary Sciences	43.7%	17.6%	26.1%	38.2%	56.7%	32.7%	57.3%	55.9%	64.3%	43.3%
Energy	24.4%	9.6%	14.5%	18.4%	39.1%	19.8%	47.4%	32.0%	44.1%	22.6%
Engineering	27.9%	9.2%	17.0%	18.0%	38.4%	25.7%	41.5%	35.5%	42.0%	23.4%
Environmental Science	31.6%	18.3%	13.7%	20.3%	44.4%	30.8%	47.9%	43.9%	48.6%	28.1%
Immunology and Microbiology	28.6%	23.0%	19.4%	25.1%	45.9%	37.2%	59.3%	59.6%	58.8%	36.0%
Materials Science	30.0%	11.8%	22.0%	18.1%	44.0%	32.7%	42.6%	40.7%	50.9%	31.7%
Mathematics	37.8%	16.0%	26.4%	20.9%	48.6%	28.7%	54.4%	46.1%	49.1%	34.3%
Medicine	19.6%	13.5%	14.6%	13.9%	33.2%	39.0%	44.9%	48.0%	36.5%	22.7%
Pharmacology, Toxicology and Pharmaceutics	18.3%	14.7%	8.9%	13.6%	38.2%	29.3%	47.9%	45.4%	44.6%	25.9%
Physics and Astronomy	39.0%	14.8%	28.5%	21.1%	52.4%	40.9%	47.6%	54.7%	58.9%	37.9%
Veterinary Science	11.9%	22.0%	5.2%	12.9%	35.2%	66.7%	78.2%	49.8%	43.9%	26.7%



### Relative Citation Impact per subject area (2006-2010)

Country name	Country CPP	WORLD CPP	Period	Subject	Relative Citation Impact 2006-2010
Brazil	2.105	3.698	2006-2010	Agricultural and Biological Sciences	0.57
China	2.396	3.698	2006-2010	Agricultural and Biological Sciences	0.65
India	2.142	3.698	2006-2010	Agricultural and Biological Sciences	0.58
Iran	1.526	3.698	2006-2010	Agricultural and Biological Sciences	0.41
Israel	5.279	3.698	2006-2010	Agricultural and Biological Sciences	1.43
Russian Federation	1.872	3.698	2006-2010	Agricultural and Biological Sciences	0.51
Singapore	5.66	3.698	2006-2010	Agricultural and Biological Sciences	1.53
South Africa	3.61	3.698	2006-2010	Agricultural and Biological Sciences	0.98
United Kingdom	6.655	3.698	2006-2010	Agricultural and Biological Sciences	1.80
United States	5.339	3.698	2006-2010	Agricultural and Biological Sciences	1.44

This table shows the relative citation impact between 2006-2010 using a WORLD benchmark

Country name	Country CPP	WORLD CPP	Period	Subject	Relative Citation Impact 2006-2010
United Kingdom	10.333	7.06	2006-2010	Biochemistry, Genetics and Molecular Biology	1.46
India	3.761	7.06	2006-2010	Biochemistry, Genetics and Molecular Biology	0.53
Iran	3.346	7.06	2006-2010	Biochemistry, Genetics and Molecular Biology	0.47
Israel	9.094	7.06	2006-2010	Biochemistry, Genetics and Molecular Biology	1.29
United States	10.578	7.06	2006-2010	Biochemistry, Genetics and Molecular Biology	1.50
Brazil	4.249	7.06	2006-2010	Biochemistry, Genetics and Molecular Biology	0.60
China	3.504	7.06	2006-2010	Biochemistry, Genetics and Molecular Biology	0.50
Russian Federation	2.926	7.06	2006-2010	Biochemistry, Genetics and Molecular Biology	0.41
South Africa	5.191	7.06	2006-2010	Biochemistry, Genetics and Molecular Biology	0.74
Singapore	8.507	7.06	2006-2010	Biochemistry, Genetics and Molecular Biology	1.20

This table shows the relative citation impact between 2006-2010 using a WORLD benchmark

Country name	Country CPP	WORLD CPP	Period	Subject	Relative Citation Impact 2006-2010
United Kingdom	4.694	3.232	2006-2010	Chemical Engineering	1.45
India	3.824	3.232	2006-2010	Chemical Engineering	1.18
Iran	3.078	3.232	2006-2010	Chemical Engineering	0.95
Israel	4.929	3.232	2006-2010	Chemical Engineering	1.53
United States	4.256	3.232	2006-2010	Chemical Engineering	1.32
Brazil	3.27	3.232	2006-2010	Chemical Engineering	1.01
China	2.469	3.232	2006-2010	Chemical Engineering	0.76
Russian Federation	1.24	3.232	2006-2010	Chemical Engineering	0.38
South Africa	3.684	3.232	2006-2010	Chemical Engineering	1.14
Singapore	5.805	3.232	2006-2010	Chemical Engineering	1.80

This table shows the relative citation impact between 2006-2010 using a WORLD benchmark

Country name	Country CPP	WORLD CPP	Period	Subject	Relative Citation Impact 2006-2010
United Kingdom	7.083	4.957	2006-2010	Chemistry	1.43
India	3.496	4.957	2006-2010	Chemistry	0.71
Iran	3.467	4.957	2006-2010	Chemistry	0.70
Israel	6.663	4.957	2006-2010	Chemistry	1.34
United States	7.405	4.957	2006-2010	Chemistry	1.49
Brazil	3.743	4.957	2006-2010	Chemistry	0.76
China	4.004	4.957	2006-2010	Chemistry	0.81
Russian Federation	1.607	4.957	2006-2010	Chemistry	0.32
South Africa	3.849	4.957	2006-2010	Chemistry	0.78
Singapore	6.543	4.957	2006-2010	Chemistry	1.32

This table shows the relative citation impact between 2006-2010 using a WORLD benchmark

Country name	Country CPP	WORLD CPP	Period	Subject	Relative Citation Impact 2006-2010
United Kingdom	2.263	1.428	2006-2010	Computer Science	1.58
India	0.902	1.428	2006-2010	Computer Science	0.63
Iran	0.915	1.428	2006-2010	Computer Science	0.64
Israel	2.914	1.428	2006-2010	Computer Science	2.04
United States	2.616	1.428	2006-2010	Computer Science	1.83
Brazil	1.134	1.428	2006-2010	Computer Science	0.79
China	0.71	1.428	2006-2010	Computer Science	0.50
Russian Federation	0.801	1.428	2006-2010	Computer Science	0.56
South Africa	1.175	1.428	2006-2010	Computer Science	0.82
Singapore	2.14	1.428	2006-2010	Computer Science	1.50

This table shows the relative citation impact between 2006-2010 using a WORLD benchmark

Country name	Country CPP	WORLD CPP	Period	Subject	Relative Citation Impact 2006-2010
United Kingdom	7.447	3.798	2006-2010	Earth and Planetary Sciences	1.96
India	2.483	3.798	2006-2010	Earth and Planetary Sciences	0.65
Iran	1.946	3.798	2006-2010	Earth and Planetary Sciences	0.51
Israel	7.381	3.798	2006-2010	Earth and Planetary Sciences	1.94
United States	6.453	3.798	2006-2010	Earth and Planetary Sciences	1.70
Brazil	3.413	3.798	2006-2010	Earth and Planetary Sciences	0.90
China	1.923	3.798	2006-2010	Earth and Planetary Sciences	0.51
Russian Federation	2.131	3.798	2006-2010	Earth and Planetary Sciences	0.56
South Africa	4.844	3.798	2006-2010	Earth and Planetary Sciences	1.28
Singapore	3.256	3.798	2006-2010	Earth and Planetary Sciences	0.86

This table shows the relative citation impact between 2006-2010 using a WORLD benchmark

Country name	Country CPP	WORLD CPP	Period	Subject	Relative Citation Impact 2006-2010
United Kingdom	3.275	2.046	2006-2010	Energy	1.60
India	2.57	2.046	2006-2010	Energy	1.26
Iran	1.321	2.046	2006-2010	Energy	0.65
Israel	3.797	2.046	2006-2010	Energy	1.86
United States	2.572	2.046	2006-2010	Energy	1.26
Brazil	2.104	2.046	2006-2010	Energy	1.03
China	1.579	2.046	2006-2010	Energy	0.77
Russian Federation	0.921	2.046	2006-2010	Energy	0.45
South Africa	1.894	2.046	2006-2010	Energy	0.93
Singapore	4.403	2.046	2006-2010	Energy	2.15

This table shows the relative citation impact between 2006-2010 using a WORLD benchmark

Country name	Country CPP	WORLD CPP	Period	Subject	Relative Citation Impact 2006-2010
United Kingdom	2.511	1.499	2006-2010	Engineering	1.68
India	1.555	1.499	2006-2010	Engineering	1.04
Iran	1.423	1.499	2006-2010	Engineering	0.95
Israel	2.838	1.499	2006-2010	Engineering	1.89
United States	2.378	1.499	2006-2010	Engineering	1.59
Brazil	1.478	1.499	2006-2010	Engineering	0.99
China	0.96	1.499	2006-2010	Engineering	0.64
Russian Federation	0.74	1.499	2006-2010	Engineering	0.49
South Africa	1.33	1.499	2006-2010	Engineering	0.89
Singapore	2.879	1.499	2006-2010	Engineering	1.92

This table shows the relative citation impact between 2006-2010 using a WORLD benchmark

Country name	Country CPP	WORLD CPP	Period	Subject	Relative Citation Impact 2006-2010
United Kingdom	5.808	3.741	2006-2010	Environmental Science	1.55
India	2.35	3.741	2006-2010	Environmental Science	0.63
Iran	2.533	3.741	2006-2010	Environmental Science	0.68
Israel	4.359	3.741	2006-2010	Environmental Science	1.17
United States	5.129	3.741	2006-2010	Environmental Science	1.37
Brazil	3.795	3.741	2006-2010	Environmental Science	1.01
China	2.508	3.741	2006-2010	Environmental Science	0.67
Russian Federation	1.753	3.741	2006-2010	Environmental Science	0.47
South Africa	4.319	3.741	2006-2010	Environmental Science	1.15
Singapore	4.616	3.741	2006-2010	Environmental Science	1.23

This table shows the relative citation impact between 2006-2010 using a WORLD benchmark

Country name	Country CPP	WORLD CPP	Period	Subject	Relative Citation Impact 2006-2010
United Kingdom	10.617	7.531	2006-2010	Immunology and Microbiology	1.41
India	3.93	7.531	2006-2010	Immunology and Microbiology	0.52
Iran	2.571	7.531	2006-2010	Immunology and Microbiology	0.34
Israel	9.308	7.531	2006-2010	Immunology and Microbiology	1.24
United States	11.272	7.531	2006-2010	Immunology and Microbiology	1.50
Brazil	4.72	7.531	2006-2010	Immunology and Microbiology	0.63
China	3.613	7.531	2006-2010	Immunology and Microbiology	0.48
Russian Federation	3.566	7.531	2006-2010	Immunology and Microbiology	0.47
South Africa	8.153	7.531	2006-2010	Immunology and Microbiology	1.08
Singapore	8.554	7.531	2006-2010	Immunology and Microbiology	1.14

This table shows the relative citation impact between 2006-2010 using a WORLD benchmark

Country name	Country CPP	WORLD CPP	Period	Subject	Relative Citation Impact 2006-2010
United Kingdom	3.83	2.751	2006-2010	Materials Science	1.39
India	2.782	2.751	2006-2010	Materials Science	1.01
Iran	2.358	2.751	2006-2010	Materials Science	0.86
Israel	3.908	2.751	2006-2010	Materials Science	1.42
United States	4.269	2.751	2006-2010	Materials Science	1.55
Brazil	2.341	2.751	2006-2010	Materials Science	0.85
China	2.263	2.751	2006-2010	Materials Science	0.82
Russian Federation	1.34	2.751	2006-2010	Materials Science	0.49
South Africa	2.456	2.751	2006-2010	Materials Science	0.89
Singapore	4.587	2.751	2006-2010	Materials Science	1.67

This table shows the relative citation impact between 2006-2010 using a WORLD benchmark

Country name	Country CPP	WORLD CPP	Period	Subject	Relative Citation Impact 2006-2010
United Kingdom	2.452	1.727	2006-2010	Mathematics	1.42
India	1.494	1.727	2006-2010	Mathematics	0.87
Iran	1.985	1.727	2006-2010	Mathematics	1.15
Israel	2.36	1.727	2006-2010	Mathematics	1.37
United States	2.521	1.727	2006-2010	Mathematics	1.46
Brazil	1.656	1.727	2006-2010	Mathematics	0.96
China	1.297	1.727	2006-2010	Mathematics	0.75
Russian Federation	1.218	1.727	2006-2010	Mathematics	0.71
South Africa	2.066	1.727	2006-2010	Mathematics	1.20
Singapore	2.35	1.727	2006-2010	Mathematics	1.36

This table shows the relative citation impact between 2006-2010 using a WORLD benchmark

Country name	Country CPP	WORLD CPP	Period	Subject	Relative Citation Impact 2006-2010
United Kingdom	7.066	4.452	2006-2010	Medicine	1.59
India	2.319	4.452	2006-2010	Medicine	0.52
Iran	1.752	4.452	2006-2010	Medicine	0.39
Israel	6.263	4.452	2006-2010	Medicine	1.41
United States	7.143	4.452	2006-2010	Medicine	1.60
Brazil	3.142	4.452	2006-2010	Medicine	0.71
China	1.907	4.452	2006-2010	Medicine	0.43
Russian Federation	3.804	4.452	2006-2010	Medicine	0.85
South Africa	5.594	4.452	2006-2010	Medicine	1.26
Singapore	5.707	4.452	2006-2010	Medicine	1.28

This table shows the relative citation impact between 2006-2010 using a WORLD benchmark

Country name	Country CPP	WORLD CPP	Period	Subject	Relative Citation Impact 2006-2010
United Kingdom	7.15	4.957	2006-2010	Pharmacology, Toxicology and Pharmaceutics	1.44
India	2.956	4.957	2006-2010	Pharmacology, Toxicology and Pharmaceutics	0.60
Iran	3.359	4.957	2006-2010	Pharmacology, Toxicology and Pharmaceutics	0.68
Israel	6.825	4.957	2006-2010	Pharmacology, Toxicology and Pharmaceutics	1.38
United States	7.031	4.957	2006-2010	Pharmacology, Toxicology and Pharmaceutics	1.42
Brazil	3.857	4.957	2006-2010	Pharmacology, Toxicology and Pharmaceutics	0.78
China	2.885	4.957	2006-2010	Pharmacology, Toxicology and Pharmaceutics	0.58
Russian Federation	2.642	4.957	2006-2010	Pharmacology, Toxicology and Pharmaceutics	0.53
South Africa	4.531	4.957	2006-2010	Pharmacology, Toxicology and Pharmaceutics	0.91
Singapore	7.046	4.957	2006-2010	Pharmacology, Toxicology and Pharmaceutics	1.42

This table shows the relative citation impact between 2006-2010 using a WORLD benchmark

Country name	Country CPP	WORLD CPP	Period	Subject	Relative Citation Impact 2006-2010
United Kingdom	4.553	2.95	2006-2010	Physics and Astronomy	1.54
India	2.458	2.95	2006-2010	Physics and Astronomy	0.83
Iran	2.387	2.95	2006-2010	Physics and Astronomy	0.81
Israel	4.13	2.95	2006-2010	Physics and Astronomy	1.40
United States	4.418	2.95	2006-2010	Physics and Astronomy	1.50
Brazil	2.476	2.95	2006-2010	Physics and Astronomy	0.84
China	2.115	2.95	2006-2010	Physics and Astronomy	0.72
Russian Federation	2.009	2.95	2006-2010	Physics and Astronomy	0.68
South Africa	2.889	2.95	2006-2010	Physics and Astronomy	0.98
Singapore	3.672	2.95	2006-2010	Physics and Astronomy	1.24

This table shows the relative citation impact between 2006-2010 using a WORLD benchmark



Country name	Country CPP	WORLD CPP	Period	Subject	Relative Citation Impact 2006-2010
United Kingdom	4.279	2.474	2006-2010	Veterinary Sciences	1.73
India	0.811	2.474	2006-2010	Veterinary Sciences	0.33
Iran	1.145	2.474	2006-2010	Veterinary Sciences	0.46
Israel	3.68	2.474	2006-2010	Veterinary Sciences	1.49
United States	3.773	2.474	2006-2010	Veterinary Sciences	1.53
Brazil	1.538	2.474	2006-2010	Veterinary Sciences	0.62
China	2.617	2.474	2006-2010	Veterinary Sciences	1.06
Russian Federation	3.589	2.474	2006-2010	Veterinary Sciences	1.45
South Africa	2.96	2.474	2006-2010	Veterinary Sciences	1.20
Singapore	5.778	2.474	2006-2010	Veterinary Sciences	2.34

This table shows the relative citation impact between 2006-2010 using a WORLD benchmark



# APPENDIX B: Methodology

## Methodology and Rationale

Our methodology is founded upon the theoretical principles and best practices developed in the field of quantitative science and technology studies, particularly in science and technology indicators research. The *Handbook of Quantitative Science and Technology Research: The Use of Publication and Patent Statistics in Studies of S&T Systems* (Moed, Glänzel and Schmoch, 2004)<sup>5</sup> gives a good overview of this field and is based on the pioneering work of Derek de Solla Price (1978)<sup>6</sup>, Eugene Garfield (1979)<sup>7</sup> and Francis Narin (1976)<sup>8</sup> in the USA, and Christopher Freeman, Ben Martin and John Irvine in the UK (1981, 1987)<sup>9</sup>, and in several European institutes including the Centre for Science and Technology Studies at Leiden University, the Netherlands, and the Library of the Academy of Sciences in Budapest, Hungary.

The analyses of bibliometric data in this report are based upon recognised advanced indicators (e.g., the concept of relative citation impact rates). Our base assumption holds that such indicators are useful and valid, though imperfect and partial measures, in the sense that their numerical values are determined by research performance and related concepts, but also by other, influencing factors that may cause systematic biases. In the past decade, the field of indicators research has developed a best practice as to how indicator results should be interpreted and which influencing factors should be taken into account. With our methodology we build further on these practices.

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<sup>5</sup> Moed H., Glänzel W., & Schmoch U. (2004), *Handbook of Quantitative Science and Technology Research*, Kluwer, Dordrecht.

<sup>6</sup> de Solla Price, D.J. (1977–1978) "Foreword", *Essays of an Information Scientist*, Vol. 3, pp. v–ix.

<sup>7</sup> Garfield, E. (1979). Is citation analysis a legitimate evaluation tool? *Scientometrics*, 1 (4), 359-375.

<sup>8</sup> Pinski, G., & Narin, F. (1976). Citation influence for journal aggregates of scientific publications: Theory with application to literature of physics. *Information Processing & Management* 12 (5): 297–312.

<sup>9</sup> Irvine, J., Martin, B. R., Abraham, J. & Peacock, T. (1987). Assessing basic research: Reappraisal and update of an evaluation of four radio astronomy observatories. *Research Policy*, 16(2-4), 213-227.



**Article types:** For all bibliometric analysis, only the following document types are considered: Article (ar), Review (re) and Conference Proceeding (cp).

**CAGR: Compound Annual Growth Rate.** The year-over-year constant growth rate over a specified period of time. Starting with the first value in any series and applying this rate for each of the time intervals would yield the amount in the final value of the series.

**Counting:** All analyses make use of whole counting instead of fractional counting.

### Data Source

Scopus was used as the data source for this study. Developed by Elsevier, Scopus is the largest abstracting and citation database of peer-reviewed literature. In 2011 it contained records of articles from 18,000 academic journals. The snapshot of Scopus used in this analysis is from 2011 and made use of citation analysis to redistribute publications in multidisciplinary journals into the subject focussed fields, independently of the journal they are published in.

### Research Quantity and Quality Indicators

1. Publication output: Number of publications per country with at least one author from that country figures among the authors listed
2. Publication share: Global share of publications for a specific country
3. Citation share: Global share of citations for a specific country
4. World Normalized Citation Impact is calculated by normalizing the average citations per article against the average citations for the **world** in that specific subject category.

**Subject classification:** For the subject specific analyses in this report, we have used the All Science Journal Classification (ASJC) which overall consists of 17 main subject areas, where 16 of those subject areas were selected by the Department of Science and Technology for inclusion in the report.

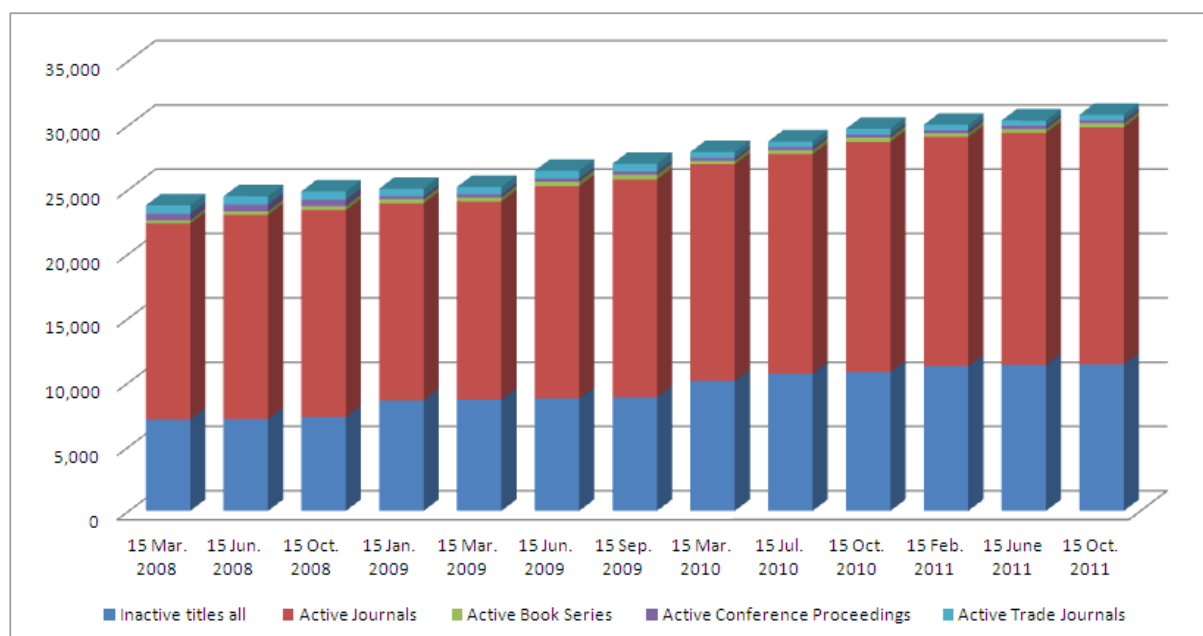
**Time periods:** For all bibliometric analysis, a "citation roof tile" approach has been applied. This employs a sliding 5-years publication and citation window. For example: the citation roof tile 2006-10 considers citations received in the period 2006-10 inclusive to all articles published in the same period, 2006- 10.



## APPENDIX C: Journal Coverage in Scopus

Number of publications	15 Mar. 2008	15 Jun. 2008	15 Oct. 2008	15 Jan. 2009	15 Mar. 2009	15 Jun. 2009	15 Sep. 2009	15 Mar. 2010	15 Jul. 2010	15 Oct. 2010	15 Feb. 2011	15 June 2011	15 Oct. 2011
Inactive titles all	7,114	7,144	7,300	8,583	8,657	8,727	8,824	10,100	10,674	10,795	11,243	11,342	11,394
Active Journals	15,229	15,863	16,076	15,320	15,400	16,521	16,936	16,852	17,056	17,888	17,827	18,043	18,436
Active Book Series	237	283	317	330	314	352	379	275	311	335	288	303	296
Active Conference Proceedi	522	522	492	240	240	240	241	230	230	231	246	251	251
Active Trade Journals	646	647	651	574	575	603	611	445	446	446	414	414	417
<b>Total publications</b>	<b>23,748</b>	<b>24,459</b>	<b>24,836</b>	<b>25,047</b>	<b>25,186</b>	<b>26,443</b>	<b>26,991</b>	<b>27,902</b>	<b>28,717</b>	<b>29,707</b>	<b>30,018</b>	<b>30,353</b>	<b>30,794</b>

This table shows the number of journals in Scopus since 2008







## NOTES

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