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## Geographical trends of research output

Research Trends Editorial Board

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## Country Trends



# Geographical trends of research output

The publication of journal articles worldwide follows a consistent pattern associated with the number of researchers based in a particular country. Unsurprisingly, the share of world articles is dominated by those countries with the most researchers, with countries such as the United States, Japan, the United Kingdom and Germany ranked highest. The geographical distribution of citations shows a similar pattern, with the same four countries appearing in the top four places according to citations received, albeit in a slightly different order. The growth in Chinese researcher numbers and research output has been previously discussed in [Research Trends](#).

Table 1 illustrates the rank of countries according to their share of world articles and indicates the equivalent rank for each country according to citations received.

Rank by articles	Rank by citations	Country	Articles	Cites	Researchers	% docs	% cites
1	1	United States	3,437,213	43,436,526	7,442,000	25.9%	37.6%
2	4	Japan	983,020	7,167,200	896,211	7.4%	6.2%
3	2	United Kingdom	962,640	9,895,817	313,848	7.3%	8.6%
4	3	Germany	888,287	8,377,298	470,729	6.7%	7.2%
5	13	China, Peoples' Republic of	758,042	1,629,993	1,152,617	5.7%	1.4%
6	5	France	640,163	5,795,531	348,714	4.8%	5.0%
7	6	Canada	473,763	4,728,874	199,060	3.6%	4.1%
8	7	Italy	461,292	3,821,440	164,026	3.5%	3.3%
9	11	Spain	330,399	2,350,185	161,932	2.5%	2.0%
10	17	Russian Federation	330,020	1,064,077	951,569	2.5%	0.9%
11	9	Australia	295,977	2,566,649	118,145	2.2%	2.2%
12	19	India	286,109	994,561	N/A	2.2%	0.9%
13	8	Netherlands	264,565	3,012,291	915,65	2.0%	2.6%
14	18	Korea, Republic of	217,879	1,018,532	194,055	1.6%	0.9%
15	12	Sweden	194,921	2,188,026	72,459	1.5%	1.9%
16	10	Switzerland	188,134	2,384,981	52,250	1.4%	2.1%
17	22	Taiwan, Province of China	164,823	769,206	138,604	1.2%	0.7%
18	23	Brazil	163,550	752,658	N/A	1.2%	0.7%
19	24	Poland	159,536	682,354	78,362	1.2%	0.6%
20	14	Belgium	141,737	1,347,624	52,252	1.1%	1.2%

Table 1 – Geographical distribution of world articles 2004–2007 – top 20 countries. Source: Scopus. Researcher data taken from OECD Main Science & Technology Indicators, 2008 edition; data is for 2004 FTE researchers. US Researcher Data taken from Science & Engineering Indicators 2008, Table 3.1.

## Country Trends

Table 2 illustrates that if the 2004 output of articles in Scopus is compared to researcher numbers in 2004 for these countries, some interesting trends develop. For instance, the number of researchers per research article published varies remarkably. It is important to note that this is different to authors per published article; in this case, we are calculating the ratio of total researchers in a country to the publication output of the country. In many cases there are researchers who never appear on articles as authors, and this is an important distinction to consider.

In Russia, there are 30 researchers for each research article published, while in the US there are 23 researchers. Switzerland has the lowest number of researchers per article at 2.5, followed by the UK at 3.2.

Country	Number of researchers (2004)	Number of articles (2004)	Ratio of researchers per article
Russian Federation	951,569	31,134	30.6
United States	7,442,000	315,161	23.6
China, Peoples' Republic of	1,152,617	101,685	11.3
Japan	896,211	97,579	9.2
Taiwan, Province of China	138,604	20,054	6.9
Korea, Republic of	194,055	28,943	6.7
France	348,714	64,909	5.4
Germany	470,729	91,881	5.1
Spain	161,932	36,849	4.4
Poland	78,362	18,524	4.2
Canada	199,060	50,904	3.9
Australia	118,145	32,837	3.6
Sweden	72,459	20,057	3.6
Belgium	52,252	15,451	3.4
Italy	164,026	49,592	3.3
United Kingdom	313,848	97,671	3.2
Netherlands	91,565	28,309	3.2
Switzerland	52,250	20,623	2.5

Table 2 – Researcher numbers for 2004 (source: OECD, US Data from NSF Science & Engineering Indicators 2008, table 3.1) and articles published in 2004 (source: Scopus).

The question follows, why do these countries have such differences in the researcher per article ratio?

Of course this is a difficult question to answer and has many dimensions, all of which will contribute in different amounts in different countries.

Fundamentally, overall population density, economic factors such as GDP and per capita expenditure and infrastructure will be significant factors in the ability to support research, but we are quick to point out that the countries that have the lower ratios, such as the UK and Switzerland, have some of the highest economic capabilities and strongest infrastructures in the world – this illustrates the issues in trying to understand these differences. Certainly, research funding from both governmental and private sources will affect the maintenance of research institutions and the ability to recruit research personnel. In the US, many research institutions have huge programs that require a substantial amount of staff members, which will increase the researcher numbers in our ratio.

In addition, the ability of a country to actually encourage students to follow a research path can often be problematic – in recent times in the UK there has been commentary on the problems of filling university places in subjects such as chemistry and physics and a study by Olivieri & Rowlands (2006) indicated that acquiring research staff was one of biggest barriers to research performance, which could be a significant factor to understand these interesting ratios between articles and researchers.