GLOBAL RESEARCH REPORT

RUSSIA

Research and collaboration in the new geography of science

JANUARY 2010

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THE NEW GEOGRAPHY OF SCIENCE:

RESEARCH AND COLLABORATION IN RUSSIA : JANUARY 2010

INTRODUCTION

This report is part of series launched by Thomson Reuters to inform policymakers about the changing landscape and dynamics of the global research base.

Previous Global Research Reports have examined Brazil, India, and China—three quarters of the so-called "BRIC" group of nations, a bloc currently in the process of advancing to the forefront of the world's economies thanks to their vast resources and abundant potential for growth. Tied to this economic expansion will be increasing visibility and influence in research and innovation, and significant changes in the current map of world science.

In this report, we turn to the fourth constituent of the BRIC group: Russia.

Russia is perhaps unique among its BRIC counterparts in terms of the seismic political upheaval the country has recently undergone. As a single geopolitical entity, today's Russia has existed for barely twenty years. The old Soviet Union was, of course, a scientific force to be reckoned with. The 1957 launch of the Sputnik satellite, as a *Nature* commentator observed on the occasion of the mission's fiftieth anniversary, literally changed the practice of world science, spurring not only the "space race" with the United States but a new global era of government investment in science and technology.[1]

The 1991 dissolution of the Soviet Union, not surprisingly, brought drastic political, economic and intellectual changes with which Russia has continued to grapple. Those forces have combined with particular effect on its research base. For one thing, budgets for science and technology have been sharply reduced. By one 2007 account, a few of the best Russian research institutes have budgets for research amounting to 3-5% of comparably sized institutes in the United States.[2]

The systemic problems are not confined to funding. As a group, Russian scientists are aging—the average age for a member of the Russian Academy of Science is reportedly over 50. And, in opposition to the trend in growing research-based economies, their ranks are currently being depleted without sufficient replenishment by a new generation. In a 2006 Russian poll, only 1% of 1,600 respondents named science as a prestigious career, compared to work in the nation's petroleum industry, or politics, or other fields. A serious "brain drain" dates from the early 1990s, when, according to some estimates, upwards of 80,000 talented and able scientists left the country in search of better earnings, funding, and facilities abroad—to the benefit of Western Europe in particular.

In October 2009, scores of expatriate Russian scientists signed their names to an open letter to Russian President Dmitry Medvedev and Prime Minister Vladimir Putin. The letter warned of a "looming collapse" in science, citing such factors as an inadequacy of funding, a lack of strategic planning, a decline in the prestige of science as a profession, together with a drop in the standards of teaching in the sciences. The letter urged increased financing for basic science, the identification and support of critical areas, and the mustering of international support for scientific projects in Russia. In response to the letter, officials at the Russian Academy of Sciences told the BBC that despite problems, Russian science is still very much alive.[3]

Assessing the precise vitality of Russia's research base is a task to which we can now apply Thomson Reuters analytics.

THE NEW GEOGRAPHY OF SCIENCE:
RESEARCH AND COLLABORATION IN RUSSIA

It is sure to come as a surprise to many analysts that Russia, often a byword for its focus on technology and science, now has a formal publication output that is on a scale with countries that have fewer resources as well as a shorter history of strong research investment.

DATA ON RESEARCH

The data analyzed in this report are drawn from the databases of Thomson Reuters, which regularly indexes data on articles in about 10,500 journals published worldwide. Numerous studies have confirmed that Thomson Reuters data-management policy ensures that its databases cover serials regarded by researchers as the most significant in their field.

The Thomson Reuters data allow us to examine Russia's particular areas of concentration and strength, as well as the nation's international links. International collaboration is an important marker of the significance of research activity to partners and of those other countries' ability to engage with the domestic research base.

Joint projects, and specific data on funding for joint research, are valuable information but tend to be collated inconsistently and incompletely. By contrast, joint publications are a sound and valid marker. Publications data are readily available, cover a wide range of countries, and can be grouped by year and subject. Every research paper includes the names and addresses of the authors. Thus, both the country of origin of authors and the association between co-authoring nations can be indexed and evaluated.

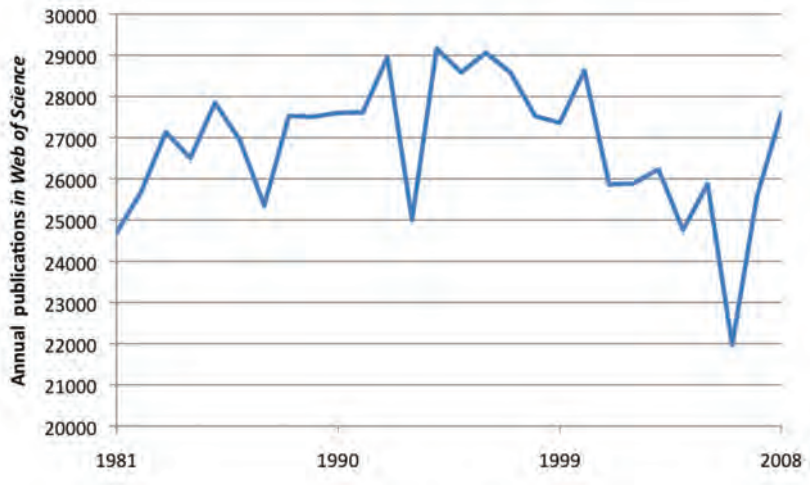
RUSSIA AND RESEARCH PUBLICATIONS

Previously part of the USSR, Russia has existed as a distinct entity in the Thomson Reuters database since the early 1990s. However, to provide continuity in the analysis of Russian scientific output, Thomson Reuters analysts went back as far as 1981, retroactively examining and unifying regional and institutional addresses in order to provide publication figures corresponding to today's Russia.

Figure 1 shows the annual output for the years 1981 through 2008. After reaching a peak of just over 29,000 papers in 1994, output mostly declined over the next decade to reach a low of 22,000 in 2006. On a positive note, the last two years would seem to indicate a rebound with 25,500 papers in 2007 and 27,600 in 2008.

FIGURE 1

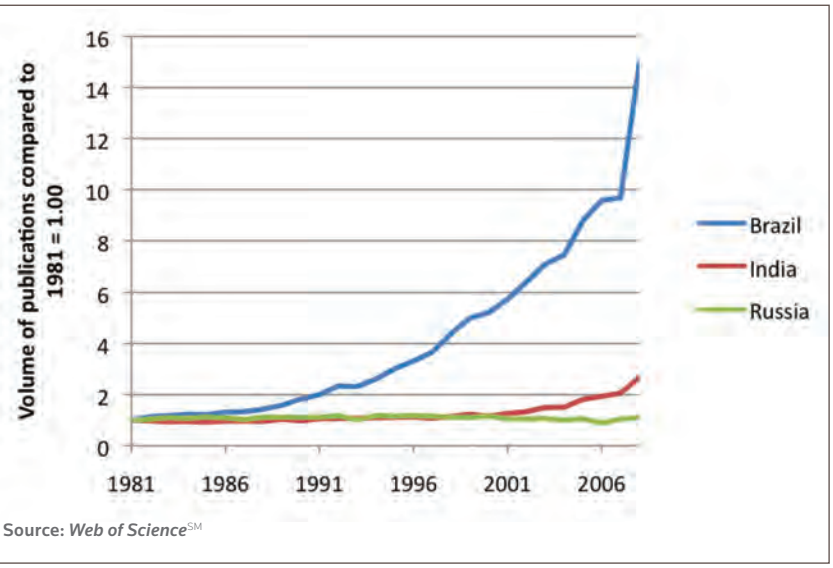
Going back to 1981, Russia's annual number of publications has fluctuated, but has never exceeded 30,000 papers



Source: *Web of Science*SM

FIGURE 2

Russia's year-by-year growth lags that of two of its BRIC counterparts, Brazil and India



Source: *Web of Science*SM

Russia's progression seems equally bleak when gauged by "relative growth," a measure obtained by calculating the nation's annual volume of publication output in the *Web of Science*SM against a benchmark figure of its 1981 paper total, set as "1," and then working forwards. Figure 2 compares Russia's relative growth against two of its counterparts in the BRIC group of nations; India and Brazil. It can be seen that output for Russia is mostly flat, even falling off toward the end of the period, whereas output for India rises and for Brazil it grows robustly. A comparable graph line for China, as we noted in a previous report, would dwarf these nations and all others, including a baseline figure representing the world.

Over a recent five-year period, Russia produced roughly 127,000 papers in all fields of science, accounting for approximately 2.6% of the world's papers published in journals indexed by Thomson Reuters. For comparison, this is more than Brazil (102,000 papers, 2.1% of world) but less than India (144,000 papers, 2.9%) and far less than China (415,000 papers, 8.4%). Looking around the world, it is also less than Australia (150,000 papers, 3.0%), Canada (232,000 papers, 4.7%) and only slightly more than the Netherlands (125,000 papers, 2.5%).

WHERE IS RUSSIA FOCUSED?

It is sure to come as a surprise to many analysts that Russia, often a byword for its focus on technology and science, now has a formal publication output that is on a scale with countries that have fewer resources as well as a shorter history of strong research investment.

Even if Russian scientific output has generally weakened in recent years, we can still assess its fields of concentration and gauge how these areas map to the rest of the world.

We examined Russia from two different levels of focus: first, a broad overview across the twenty-two major areas in Thomson Reuters *Essential Science Indicators*SM; then, a more detailed examination based on the 250 specific subfields covered in *Web of Science*.

As noted above Russia produces on average around 2.6% of world output at about 25,000 indexed research papers per year. Table 1 specifies how that share is apportioned across different subject areas.

TABLE 1

Russia's share of world publications in selected main fields covered by Thomson Reuters

	1999-2003		2004-2008		Rank	
Field	Count	Share(%)	Count	Share(%)	Share	Growth
Physics	37,796	9.68	34,548	7.39	1	11
Space Science	4,143	7.66	4,122	6.90	2	10
Geosciences	8,677	8.07	9,213	6.76	3	5
Chemistry	29,498	6.15	28,564	4.87	4	12
Mathematics	5,638	5.68	5,795	4.63	5	8
Materials Science	8,078	4.73	7,594	3.28	6	15
Engineering	11,586	3.84	9,095	2.30	7	19
Microbiology	1,606	2.41	1,622	1.99	8	9
Molecular Biology & Genetics	2,855	2.48	2,729	1.97	9	8
Biology & Biochemistry	5,509	2.19	4,998	1.84	10	17
Neuroscience & Behavior	1,126	0.88	1,699	1.16	11	1
Plant & Animal Science	3,044	1.34	3,163	1.17	12	7
Environment/Ecology	1,125	1.16	1,411	1.07	13	3
Computer Science	1,570	1.81	1,481	0.99	14	14
Agricultural Sciences	906	1.24	879	0.88	15	11
Clinical Medicine	5,946	0.70	6,219	0.62	16	6

Source: ***Web of Science***SM

Russia's publications are analyzed here for two successive five-year periods. The top sixteen categories are ranked by Russia's share of world publications in 2004-2008, together with comparative figures for the previous 1999-2003 period.

The table highlights Russia's historical concentration in the physical sciences, notably in its traditional strongholds of physics and space science. In these fields, however, the absolute number of papers actually fell in the 2004-2008 span compared with the previous period. In every area where Russia has an above-average share of world output during 1999–2003, that share was lower in the later period.

Russia's greatest growth between the two periods actually took place in the Neuroscience & Behavior field, where its previous share 0.88% of world output grew to 1.16% in 2004-2008 (but is still well below its average). Although the right-most column ranks the percent change between the totals for the two periods, any "growth" ranked worse than 9 (i.e., numerically higher than 9) actually indicates negative growth.

To more closely analyze Russia's areas of concentration; we can turn to the numerous subfields covered in the *Web of Science*. Table 2 lists ten specialty areas according to Russia's share of world output in each for 2004-2008.

Table 2 further underscores Russia's concentration in the physical sciences, with three specialties of Nuclear Physics, Particle & Fields, and Multidisciplinary Physics especially prominent. Strong representation in the fields of Petroleum Engineering and Geochemistry & Geophysics are consistent with the nation's oil reserves and the attendant economic leverage.

TABLE 2

Russia's share of world output in ten fields

Field	Share (% of world)	Volume (papers 2004-08)
Nuclear Physics	10.28	3,131
Mineralogy	10.10	922
Physics: Particles & Fields	9.94	4,880
Paleontology	9.09	933
Computer Science: Cybernetics	8.97	473
Petroleum Engineering	8.69	537
Multidisciplinary Physics	8.02	8,489
Geochemistry & Geophysics	7.91	2,828
Spectroscopy	7.58	2,710
Instruments & Instrumentation	7.42	3,571

Source: *Web of Science*SM

COLLABORATION WITH RUSSIA

Table 3 lists Russia's international research partners over the last decade, ranked by number of collaborative papers in two successive five-year periods. Notably, the USA moved from second place during the 1999-2003 period into first, making it Russia's most frequent collaborative nation during 2004-08, and replacing Germany.

The next few positions have remained stable, and the general trend is similar to that seen globally with a substantial relative increase in collaboration for the UK, France and Italy. Further down the table, Poland and Switzerland move up, while Finland and the Ukraine—perhaps not surprisingly given other political changes—have dropped out entirely. Significantly, there are also rapid risers: the last five years have seen both China and South Korea increase their scientific partnership with Russia.

TABLE 3

Russia's leading international research partners in the last decade

Papers collaborative with Russia				Share (%) of Russia Total
1999-2003		2004-2008		
Germany	12,005	USA	12,989	10.3
USA	11,515	Germany	12,728	10.1
France	5,630	France	6,641	5.3
UK	4,412	UK	5,420	4.3
Italy	3,459	Italy	4,337	3.4
Japan	3,440	Japan	3,712	3.0
Sweden	2,427	Poland	2,695	2.1
Poland	2,250	Switzerland	2,526	2.0
Netherlands	2,072	Netherlands	2,469	2.0
Switzerland	2,006	Sweden	2,351	1.9
Ukraine	1,663	Spain	2,347	1.9
Canada	1,659	Canada	2,311	1.8
Spain	1,656	China	1,880	1.5
Finland	1,444	South Korea	1,841	1.5

Source: *Web of Science*SM

Table 4 provides a finer-scale look at some of Russia's research collaborators over the last five years, based on number of co-authored papers. The list is not a complete representation of just the top ten institutions, but has been selectively edited to convey an impression of the international organizations that have collaborated most frequently with Russia-based institutions.

The strong presence of the Max Planck Society, the Czech Academy, and the Polish Academy are reminders of the cultural links that remain in place between Russian institutions and partner institutions in Eastern Europe. Despite the diversification across international networks, these well-founded historical ties continue to provide strong support for the Russian research base.

The particularly high-levels of collaboration with CERN, CEA and INFN reflect Russian strengths in Nuclear and Particle Physics.

TABLE 4

International organizations collaborating frequently with Russia

Organization	Country	Number of co-authored papers
Max Planck Society	Germany	4,040
Istituto Nazionale di Fisica Nucleare (INFN)	Italy	2,813
Commissariat à l'Énergie Atomique (CEA)	France	2,018
MIT	USA	1,380
European Organisation for Nuclear Research (CERN)	Switzerland	1,331
University of Tokyo	Japan	1,231
Academy of Sciences of the Czech Republic	Czech Republic	1,174
Polish Academy of Sciences	Poland	1,166
University of Lund	Sweden	1,143
Imperial College London	UK	1,114

Source: ***Web of Science***[SM]

OVERVIEW

Russia's research base has a problem, and it shows little sign of a solution.

Russia has been a leader in scientific research and intellectual thinking across Europe and the world for so long that it comes not only as a surprise but a shock to see that it has a small and dwindling share of world activity as well as real attrition of its core strengths. For scientists who collaborate with the Russian research base, the data we present will no doubt confirm what they have already heard from their colleagues.

For policy experts, the signs have been increasingly clear over the past decade. The UK Government's annual report on the international comparative performance of the UK research base has historically included a focus on Russia as a member of the G8 group of leading research economies. But, in 2008, Russia disappeared from the report's graphs and was replaced by China.[4]

While other countries have been increasing their research output, in some cases by dramatic volumes, Russia has struggled to maintain its output in absolute terms and has slipped backwards in relative terms. There have been notable reductions in relative output in areas which were historically its core strengths, such as physical sciences and engineering.

It is not however all doom and gloom. Russia's core strengths were, after all, the sciences of the 20th century. The 21st century is life sciences and the environment. Here, at least, Russia has maintained and even slightly increased its published volume of activity—albeit at a slower rate than others.

The BRIC nations have been a focus of international policy analysis because they are large and potentially rich economies and by virtue of their natural and human resources are likely to have a profound influence in the next few decades. The growth of research in Brazil, India and China is rapid and diverse and will change the geography of knowledge centers around the world.

Russia remains rich in intellectual resources and talent and it is encouraging to see that Russia has not lost its connections with world knowledge networks. It has retained strong links with partner institutions in Eastern Europe while increasing the spread of links in a global network that includes former competitors in the USA and China. This, then, must be the way forward for Russia to regain its position in world science and reassert the contribution it can undoubtedly make.

The opportunities for other countries to link to Russia's institutions of learning must be extensive. The growth of links with major European Community countries shows that this has started and can be enhanced. The gains for partners are likely to be significant, based simply on Russia's historical contributions. But partners may need to bring resources to the party to enable Russia to participate. The financial return on that investment will be a welcome intellectual return to the world stage of a major player.

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[4] Performance of the UK Research base. The 2009 report compares the UK's research performance against 25 other nations. Russia is included in the analysis but no longer in any graphical presentation. The report includes data from such sources as the Organisation for Economic Co-operation and Development, Eurostat, the UN, Thomson Reuters and the statistics portals of individual national governments. It is available at http://www.dius.gov.uk/science/science_funding/science_budget/uk_research_base

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