ANALYSIS

Innovation in Russia and China Compared

By Harley Balzer, Washington, and Jon Askonas, Oxford

Abstract:

Russia and China are endeavoring to transform Soviet-style R&D systems characterized by separate education, research and business spheres into something more suited to a knowledge economy supporting innovation. The Triple Helix model is an attractive configuration, not only because it derives from the practices of the most successful innovation systems, but particularly in its suggestion that the three key actors—universities, business and the state—might be able to at times substitute for each other. Any model placing the state at the center appeals to non-democratic regimes. This article compares the Chinese and Russian efforts to implement a Triple Helix program by examining institutional change, funding, and the role of the state, using nanotechnolgy as a case study. Despite both nations adopting major programs and spending significant amounts of money, we find that China has been vastly more successful than Russia in promoting collaboration among universities, business and government to encourage research and innovation. We attribute the difference to the quality of state policies that provide incentives for agents and epistemic communities to alter their behavior. China is increasingly achieving bottom–up development, while Russia's system remains overwhelmingly top–down.

Adapting the Soviet Model

Nations aspiring to great power status in the 21st Century share the goal of creating knowledge economies capable of innovation to undergird prosperity and modern military capabilities. The Soviet model of state financing for separate education, basic research, and industrial research institutions failed in this competition. China and Russia provide stark contrasts in adapting the Soviet model to 21st-century requirements.

China adopted the Soviet model with significant assistance from the USSR in the 1950s. Following reforms in the 1980s and 1990s, China in the 2000s has become a world leader in scientific publications and patenting, and is poised to compete in innovation. Russia has steadily declined in global higher education rankings, scientific influence, and technology development. Our solution to this puzzle focuses on China's thick—compared to Russia's thin—international integration, stemming from a combination of state policies, China's industrial dynamism and the behavior of epistemic communities.

The complex interaction of business, the state and higher education to produce innovation has been discussed since the 1950s. In the past two decades, it has been codified in the "Triple Helix" model (Etzkowitz 2008). The Triple Helix literature describes innovation through two explanatory frameworks encompassing the government, academia, and business. The model links institutional and evolutionary explanations of innovation, the former focusing on the configuration of university, industry and government networks, the latter emphasizing selection preferences.

Analysts in China and Russia have embraced the Triple Helix, focusing on the potential for the state to facilitate or foster the creative process. This discussion often ignores the crucial distinction between "facilitating" and "fostering." Any state strong enough to promote innovation also has the capacity to inhibit innovation. What determines when a state successfully encourages (China) rather than deters (Russia) innovation?

We elucidate the China–Russia difference by examining institutional change, funding, and the role of the state, illustrating the difference by comparing efforts in nanotechnology.

Institutional Change

China and Russia are the largest former communist countries, and each can cite significant achievements in science in their past. Both fully adopted the Soviet system based on Academies of Science and industrial research institutes, with universities relegated overwhelmingly to teaching. While neither has fully reformed its system, China has accomplished significantly more.

China was able, over a period of two decades, to reduce the role of its Academy while developing research universities. The shift is far from complete, and expansion of higher education has entailed high costs and risks. The number of stand-alone research institutes has been reduced, and most of those that remain are now controlled by leaders open to collaboration with universities and industry.

If China's reforms remain incomplete, Russia's reforms are far less complete. The Russian Academy of Sciences has never fully accepted the need for radical change. For nearly three decades, most Academy scholars preferred business as usual. Those who favored change left the country or left science. Conservatism is reinforced by Russia's tradition of "scientific schools," which limits mobility across institutions, as does the practice of students remaining at the same university for graduate study and then as faculty.

As Dezhina describes in this issue, the result has been the government radically altering the status of the Academy. A new Federal Agency for Scientific Organizations (FASO) is reorganizing Academy institutes in accord with government priorities. Technologies needed for modernization will be emphasized, and science is to support regional development. These changes will be successful if the Russian state is able to stimulate and monitor the R&D sector without stifling it, but the changes come after a shocking decline in Russian science and technology (See Tables following this article).

The most interesting institutional change in both countries has been the attempt to transform universities from teaching institutions into internationally competitive research universities that partner with business for innovation.

Universities

The advantage of universities in research and innovation derives from regular turnover of undergraduate students, graduate students and some faculty and research associates, stimulating constant questioning of accepted ideas. Many of the ideas generated by students are impractical or lead to dead ends. But sometimes they are "winners." An extensive literature lauds the innovators who dropped out of universities to create companies like Microsoft, Apple, Nintendo and Facebook. Far more innovation derives from collaboration between universities and industry, not to mention Apple's substantial support from government.

In the 1950s, China selected a group of higher education institutions as "key" (*zhongdian*). From 11 in 1956 the number grew to 88 in 1978. In the 1990s, several programs prioritized research universities. In 1993, the 211 Program aimed to transform about 100 Chinese universities into world class institutions by the early 21st Century. Currently, 106 institutions, or about 6% of China's 1,700 higher education institutions, receive funding through the program.

China has successfully embraced a Triple Helix ethos for universities that remains elusive in Russia. Olimpieva in this issue notes that many university and Academy scholars shun involvement in commercial activity. Business leaders find foreign R&D partners to be more helpful than their Russian counterparts.

Russia has its own programs to promote elite universities. In 2006–07, 57 institutions received special funding for innovative educational programs. In 2009, the "research university" program announced 29 winners, and the government funded 7 (later 8) "Federal Universities" in regional centers, along with Moscow and St. Petersburg, for a total of 39. In 2013 the 5/100 program was established to raise five Russian universities into the world's top 100 by 2020. Fifteen successful applicants were invited to submit "road maps" describing how they would reach this goal. It is striking that the number of "elite" institutions has been reduced in each round of competition.

The relative status of Chinese and Russian universities has been reflected in global rankings. Chinese institutions have been rising in most of the major university ranking systems; Russian universities have nearly vanished, with only Moscow State University retaining a rank in the top 300.

Funding

Russia and China have undergone substantial changes in funding science and education since 1978. In the 1980s and 1990s, as China opened and internationalized, private R&D investment began to increase, though China's mostly low- and mid-tech manufacturing did not encourage cutting-edge science. The government established explicit funding guidelines privileging "practical" research over basic science. Over the past twenty years, gross expenditure on R&D (GERD) has skyrocketed, reflecting a 25-fold increase in business expenditures (BERD) concentrated heavily in manufacturing research. Increased spending has been effective in a reformed system that is successfully replacing the Soviet model with competitive grant funding and public-private partnerships.

Russia's R&D sector remains dominated by government financing. The collapse of the USSR produced an economic crisis that devastated science funding. Many of Russia's best scientists moved to the West; many others sought better-paying alternatives. In the 1990s, foreign non-profits and governments stepped in with substantial funds to "save Russian science." Following the August 1998 economic crisis, Russian government and business investment in research began to recover, and has grown considerably since 2000. Yet 70% of Russian science funding comes directly from the state, mainly block allocations to research organizations. Funds for universities have also increased substantially. But rather than the emergence of a self-sustaining, industry-oriented research enterprise, Russia experienced a battle between reformers seeking more competitive government funding mechanisms and entrenched interests lobbying for increased funding for "traditional" institutions.

Dezhina describes poor overall performance and funding mostly from government through outdated structures. These problems are related. Russian grant and special program funding is characterized by excessive controls that promote waste while failing to curb corruption. Much of the money is spent badly. Universities have an absurd lack of discretion in spending government funds. Money is allocated for excessively rigid categories, sometimes arrives half-way through the budget year, yet is given on a "use it or lose it" basis impelling institutions to find ways to spend the funds so that they may request more in the next budget cycle. Accounting procedures are pedantic and time-consuming. Some institutions that receive major government grants must hire a special bookkeeper to deal with the paperwork.

The increase in Chinese spending on R&D (and, by extension, science) over the past twenty years is remarkable. Since 1991, China's GERD has increased 20-fold, from $7.5 billion to $178.2 billion in 2010. While being driven by an economy that is fifteen times what it was in 1991, growth in China's GERD reflects the increased importance accorded to China's rise from a low-wage labor economy to a competitive industrial player. If China spent the same percentage of GDP on R&D today as in1991, it would be investing $75 billion annually in R&D, a dramatic increase from 1991 but 60% below what it is spending today. China's GERD grew from 0.75% of GDP (on par with many developing countries) to 1.75%, only slightly under the European Union average. Maintaining steady growth throughout its economic rise is unmatched by other BRIC countries. From 1993 to 2010, industrial-sourced BERD accounted for 70% of the growth in Chinese research spending; in Russia, 65% of GERD growth came from government spending.

Foreign governments and organizations provided a tremendous amount of support for Russian science after 1991. China probably has received less. However, China has benefitted for a massive inflow of industrial research, with ten times the number of foreign R&D facilities.

Russian sources consistently focus on inputs. Yet the crucial question is not how much is spent but rather how effectively the funds are utilized. The contrast between China and Russia is stark, raising a crucial question about state behavior. Both countries have serious problems with accountability of local officials and corruption. Yet China appears to be coping far better with spending far more often producing visible results: Chinese universities rise in global rankings, scholars publishing in international peer-reviewed journals, and businesses improving the products available to consumers.

Role and Quality of the State

An energizing optimism from the Triple Helix model, especially for developing nations, stems from it being viewed as a way to catch up with developed nations. In some instances, a degree of catching up has been achieved. But creating a competitive 3H infrastructure is a protracted and expensive process, and for many deriving benefits from participating in the global knowledge economy has proved elusive.

The post-Soviet cases provide a unique realm for examining the ways state policies engage the knowledge economy. All had similar institutional systems, and most were viewed as full participants in the "scientific-technical revolution." The similar institutional starting points and ethos of technocracy bequeathed by the Soviet model help sharpen our perspective on the role of the state in successful innovation systems.

A burgeoning literature on 21st century innovation emphasizes the crucial importance of the state role. The state may support innovation in a variety of ways, sometimes taking the lead, substituting for industry or academia. But taking the lead is not the same thing as taking over. The communist experience demonstrated that state-run economies are not particularly effective at promoting innovation. Authoritarian regimes may achieve some priorities (weapons, space launches), but they more often stifle creativity.

The potential for government to substitute for industry or academia assumes a government that is developmental rather than predatory, along with epistemic communities that recognize the benefits of international collaboration and competition. These are not either/or distinctions. Local officials might promote development for a variety of reasons, ranging from altruism or a sense of social responsibility to career advancement or venality. Different projects may involve different combinations of motives. In democracies, elected officials are accountable to voters; in non-democratic systems the crucial factor is an incentive structure that encourages local officials to foster development and limit predation.

Russian policies encourage short time horizons and behavior that satisfies leaders in Moscow. China's leaders certainly do not encourage policies that contradict their views, but they have been more pragmatic in accepting deviations that produce good economic results. The incentive structure in China, particularly in the 1980s and early 1990s, has rewarded local officials for their performance in raising GDP. The Chinese incentive structure encouraged development in three ways: economic success meant career advancement; regions retained a share of the profits from growth; thus officials had a larger economy from which to pilfer (provided they did not take so much that they stifled growth). Anti-corruption efforts have helped to limit the extent of predation. The Chinese system is not an ideal development model, but it has worked, and it is enormously attractive to authoritarian leaders elsewhere.

Nanotechnology

The relative success of the two systems can be seen in nanotechnology. Russian capacity in nanoscience began with Soviet investment in materials science and chemical research. While disadvantaged by underinvestment in laboratory equipment and a closed scientific system, Soviet scientists held their own in the emerging field, contributing foundational work in quantum dots, heterostructures, carbon nanotubes, and graphene.

In 2006, Russia announced a "Program on Coordination of Nanotechnology and Nanomaterials Development," responding to the US National Nanotechnology Initiative in 2000. In 2007, the government introduced two major initiatives: a National Nanotechnology Network to encourage nanoscience research in Russia's universities and institutes, and the Russian Corporation of Nanotechnologies (RusNano), a technology investment company to foster public–private partnerships and spin-off commercialization.

In 2008, as part of Dmitry Medvedev's modernization initiatives, Russian policymakers reaffirmed nanoscience as a promising area, increasing investments. These efforts ranged from substantial research grants for scientists working on nano-scale projects to commercialization and entrepreneurship initiatives. For over four years, Russia led the world in nanoscience research investment (on a PPP basis).

China is not commercializing much new nanotechnology, but neither is anyone else, and it is doing more than Russia. China does run the risk of being trapped in a "Red Queen" pattern, with the profitability of low-cost production blocking stimuli to move up the science-technology ladder. Carbon nanotubes (a technology pioneered in Russia!) provide a good example. China now profits nicely from manufacturing low-cost nanotubes, so there is little incentive (and might be opposition) to introducing new technology.

The Chinese and Russian governments in September 2014 announced plans for joint financing in nanotechnology R&D. This could link Russia's strength in basic research with China's industrial and process innovation capabilities. Success will require overcoming language barriers, different scientific and technical cultures, and issues of trust. Collaboration could help enormously in overcoming both Russia's weakness in technology development described by Olimpieva and the Chinese lag in basic science, but previous efforts in this direction have proven disappointing.

Conclusion: Why China?

Crucial changes introduced in China and lacking in Russia include greater success in reforming the Soviet-type R&D system and integrating research institutions with technology businesses; upgrading the status and quality of universities by making them research centers as well as training facilities; introducing competitive funding and peer review; encouraging regional development through career incentives and revenue-sharing; and creating effective international linkages. Regional development in China has generated industries that have increasingly sought improved technology through cooperation with research institutes and universities. China is shifting from the 1970s model of providing cheap labor for Japan, Taiwan and South Korea as those nations moved up the value-added production chain. Chinese firms now seek lower-wage labor in Cambodia, Burma, Africa and elsewhere as they move to higher value-added activities.

Many accounts of China's remarkable economic and industrial rise have emphasized some version of the "advantages of backwardness." Late industrializers have the benefit of learning from, copying, and stealing from the developed nations. A less sweeping but more plausible explanation focuses on the Chinese government promoting reform, some regional officials pushing the reforms further and faster than Beijing intended, and Beijing accepting successful development rather than insisting on control. Coalitions of government reformers, local cadres, successful entrepreneurs and domestic and foreign investors managed to consistently face down challenges to reform in the 1980s. Nothing comparable has emerged to promote internationalization in ostensibly "democratic" Russia.

If any of China's "initial conditions" made success possible, it was beginning reform immediately after the Cultural Revolution, when academic and political elites, having been "sent down" in droves, lacked professional self-confidence. This presents a sharp contrast to Russia, where the university and Academy scientific communities were strongly entrenched when Gorbachev came to power and have largely resisted reform. Putin has in many ways encouraged their conservatism. Many of the academics most strongly supportive of reform have left Russia. Russia has not matched even China's moderate success in getting some of them to return.

The elephant in the room for all of the articles in this issue is Russia's hydrocarbon economy. Natural resource wealth makes it seem silly for entrepreneurs to devote time and money to risky and competitive technology businesses when much larger profits can be made more easily by exploiting natural resources through political connections. The long-term development problem is that natural resources are finite (even in Russia), prices fluctuate, and they spin off few new businesses. One solution has been to emphasize making the natural resource sector the focus of initial technology development. This has worked reasonably well in Chile and Peru, and would be a reasonable approach for Russia.

Many nations that profited from the expansion of global trade since the 1980s have failed to develop robust R&D sectors. Why is China succeeding? Answers have focused on policy or initial conditions: State control, the advantages of backwardness, China's strength in the sciences earlier in its history, and its proximity to dynamic innovation clusters in Asia. If China's success is due to state policy, then we should expect the state sector to lead the economy. It does not. Historical continuity arguments fail to account for significant interruptions in performance. Proximity to Asia is not necessarily more beneficial than proximity to Europe. Other explanations similarly fail a comparative test.

The crucial elements in China's success in fostering education, research and innovation have been willingness to learn and thick integration with global educational and scientific communities. The Chinese academic community has been more willing to adopt global best practices and implement reforms. The process has hardly been linear or devoid of conflict. Success has been driven by collaboration between government officials and members of the Chinese academic community who perceive globalization as the key to China's development. They have been aided by Chinese returnees who spent significant time abroad and insist on global standards if they are to work in China.

The Chinese story should not be idealized. The process has been difficult and disruptive. Not everyone supports the changes. Corruption remains a problem, and the pressure to publish and patent has encouraged abuse. Some of China's requirements for publication encourage scholars to substitute quantity for quality, while annual quotas for publications deter scientists from publishing truly important articles that require substantial time.

Developing a role in global technology networks requires identifying a niche and learning how to fill it. No nation automatically returns to a lost status due to some cosmic process that restores "natural" positions. The Soviet scientific and technical system was competitive in military technology, but at tremendous cost. The cost was paid in waste, inefficiency and living standards during the Soviet era, and paid again due to thin integration with global processes after 1991. The Soviet legacy still makes Russian professionals and policy makers less inclined to learn, and Putin's turn to nationalism enhances a sense of exceptionalism. Hence the search for some short-cut to an innovation economy via the state playing a major role, substituting for the missing academic, business and regional dynamism. Unfortunately, the Russian state still lacks the capacity to foster creativity rather than stifling initiative. Switching from a control mechanism to a facilitator is not an easy transition, but it remains no less crucial for being elusive.

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Recommended Reading

- Balzer, Harley D. 2010. "Obuchenie innovatsiyam v Rossii i v Kitae" (Learning to Innovate in Russia and China)," *Pro et Contra*, May–June, pp. 52–71. English Version available as Working Paper No. 2011-17, Mortara Center for International Affairs.
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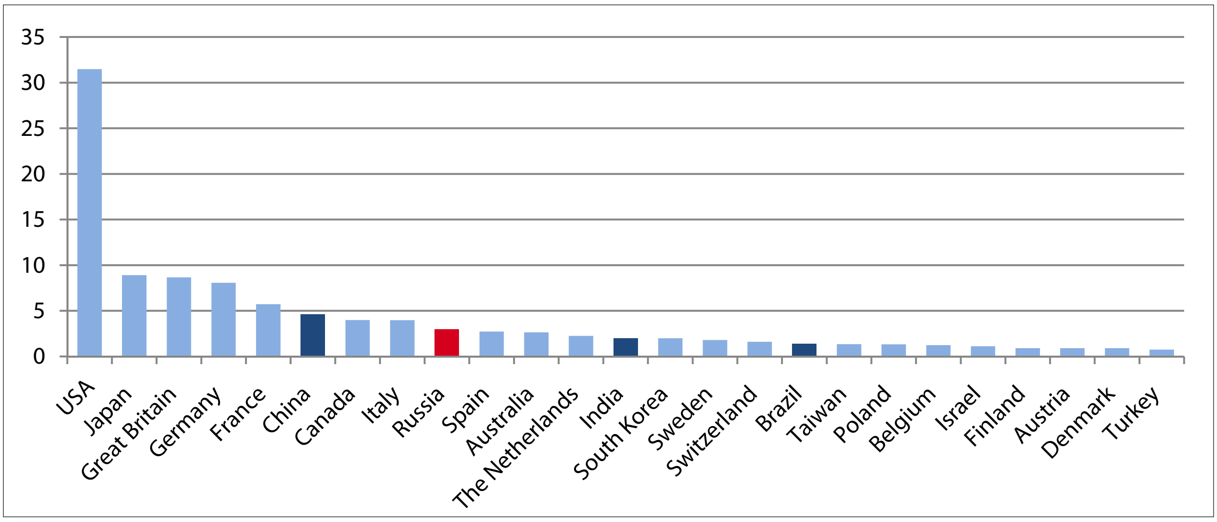
- Kotsemir, M. N. 2012. "Publication Activity of Russian Researches [sic] in Leading International Scientific Journals," *Acta Naturae*, vol. 4 no. 2, pp. 14–34, <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2207297>

Please see additional data on pp. 7–10

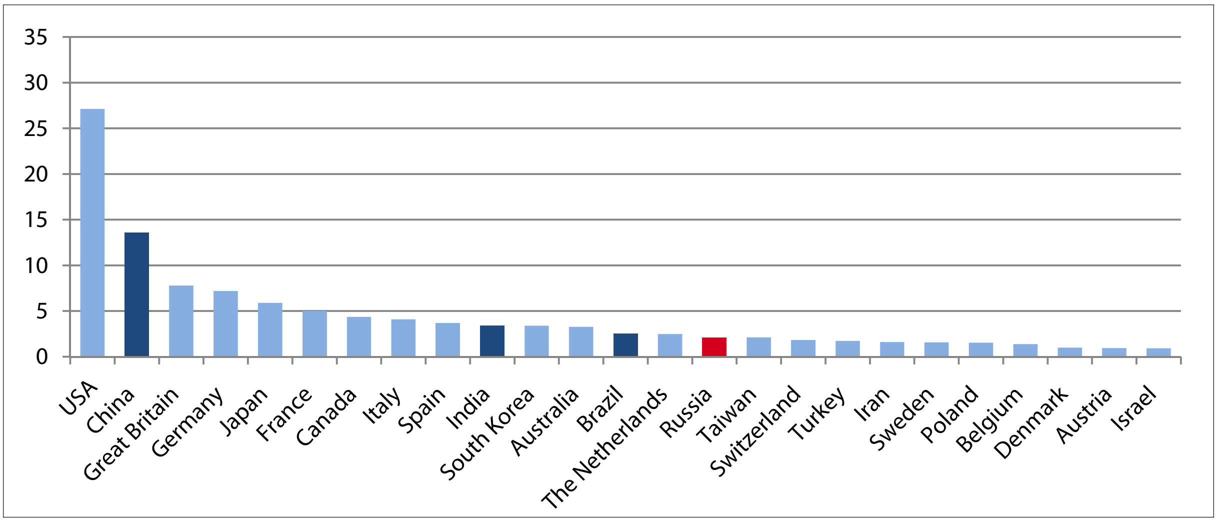
The decline in Russia's publication activity since 1990 is stunning. The Putin regime blames this on the radical neoliberal reforms of the 1990s. Yet Russia's position has declined even further since 2000, despite a significant economic recovery and both the Russian government and foreign grant-making organizations devoting significant funds to research. That much of the Russian funding is wasted or ineffective remains a persistent problem. The smaller share of funds from foreign sources generates more publications, these articles appear in journals with higher impact factors, and are cited more frequently. In 2001, with 28,665, Russia held a 2.97% share of world publications; in 2011, this fell to a 2.12% share with 28,573 publications, Russia thus dropping from 9th to 15th place in its share of global publications. During the same time period, China climbed from 6th to 2nd place in share of world publications, with a 13.62% share. China's increase from 44,575 to 184,029 represented more than a fourfold gain. India rose from 13th to 10th; Brazil rose from 17th to 13th (see Figures 1 and 2 on this page and Table 1 overleaf).

Figure 1: Articles published by Russian scholars in WoS and Essential Science Indicators in Comparison (share in %), 2001



Source: Kotsemir, M. N. 2012. "Publication Activity of Russian Researches [sic] in Leading International Scientific Journals," Acta Naturae, vol. 4 no. 2, pp. 14–34, here p. 17, based on World of Science data, <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2207297>

Figure 2: Articles published by Russian scholars in WoS and Essential Science Indicators in Comparison (share in %), 2011



Source: Kotsemir, M. N. 2012. "Publication Activity of Russian Researches [sic] in Leading International Scientific Journals," Acta Naturae, vol. 4 no. 2, pp. 14–34, here p. 17, based on World of Science data, <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2207297>

Table 1: Articles published by Russian scholars in WoS and Essential Science Indicators in Comparison (rank by country, total number, and share in %), 2001 and 2011

Rank	2001			2011		
	Country	Number of publications by the country	Share of the country in the total world number of publications, %	Country	Number of publications by the country	Share of the country in the total world number of publications, %
1	USA	303,917	31.48	USA	366,507	27.13
2	Japan	86,096	8.92	China	184,029	13.62
3	Great Britain	83,582	8.66	Great Britain	105,411	7.80
4	Germany	77,982	8.08	Germany	97,070	7.19
5	France	55,259	5.72	Japan	79,751	5.90
6	China	44,575	4.62	France	67,990	5.03
7	Canada	38,645	4.00	Canada	58,855	4.36
8	Italy	38,453	3.98	Italy	55,253	4.09
9	Russia	28,667	2.97	Spain	50,256	3.72
10	Spain	26,350	2.73	India	46,172	3.42
11	Australia	25,483	2.64	South Korea	45,971	3.40
12	The Netherlands	21,779	2.26	Australia	44,244	3.28
13	India	19,272	2.00	Brazil	34,122	2.53
14	South Korea	19,194	1.99	The Netherlands	33,523	2.48
15	Sweden	17,422	1.81	Russia	28,577	2.12
16	Switzerland	15,566	1.61	Taiwan	28,553	2.11
17	Brazil	13,324	1.38	Switzerland	24,655	1.83
18	Taiwan	13,018	1.35	Turkey	23,470	1.74
19	Poland	12,824	1.33	Iran	21,768	1.61
20	Belgium	11,964	1.24	Sweden	21,389	1.58
21	Israel	10,836	1.12	Poland	20,818	1.54
22	Finland	8,822	0.91	Belgium	18,686	1.38
23	Austria	8,779	0.91	Denmark	13,468	1.00
24	Denmark	8,754	0.91	Austria	12,852	0.95
25	Turkey	7,233	0.75	Israel	12,493	0.93

Source: Kotsemir, M. N. 2012. "Publication Activity of Russian Researches [sic] in Leading International Scientific Journals," Acta Naturae, vol. 4 no. 2, pp. 14–34, here p. 17, based on World of Science data, <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2207297>

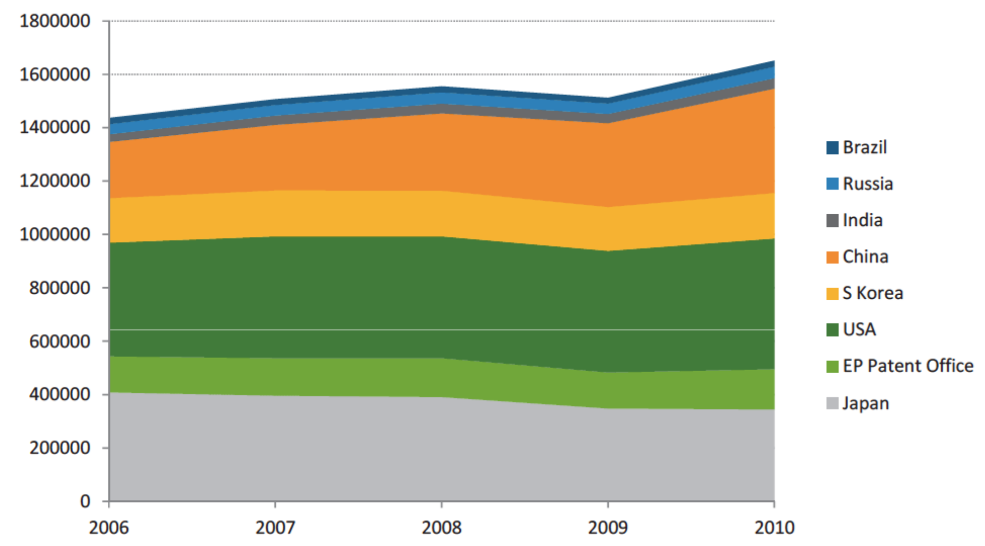
Not only is the Russian share of global publications declining, but Russian papers are less likely to be cited. The global average of citations per publication is 10.57. Russia has an average citation per paper of 4.87. Nearly half (48.6%) of highly cited Russian papers were in physics.

Table 2: Russian Share of Total Global Publications by Field: %

Field	2001–05	2007–11
Physics	8.72	7.22
Space science	7.56	6.69
Geosciences	7.51	6.57
Mathematics	5.35	4.61
Chemistry	5.49	4.44
Materials science	4.06	3.03
All fields	2.99	2.07
Engineering	2.97	1.99
Molecular biology & genetics	2.24	1.91
Multidisciplinary	1.29	1.79
Microbiology	2.28	1.69
Biology & biochemistry	1.97	1.60
Environment/ecology	1.04	1.23
Plant & animal science	1.23	1.14
Computer science	1.21	0.95
Agricultural science	1.14	0.79
Neuroscience and behavior	0.74	0.65
Clinical medicine	0.68	0.57
Pharmacology & toxicology	0.32	0.56
Social science	0.80	0.44
Psychiatry & psychology	0.63	0.42
Immunology	0.35	0.41
Economics & business	0.20	0.23

Source: Kotsemir, M. N. 2012. "Publication Activity of Russian Researches [sic] in Leading International Scientific Journals," Acta Naturae, vol. 4 no. 2, pp. 14–34, here p. 21, <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2207297>

Figure 3: World Patenting Activity



Source: Adams, Jonathan, David Pendlebury, and Bod Stembridge, 2013. "Building BRICKs—Exploring the Global Research And Innovation Impact of Brazil, Russia, India, China And South Korea", p. 18, <http://sciencewatch.com/grr/building-bricks>*, where the source is given as Thomson Reuters Derwent World Patents Index (DWPI). This material is reproduced under a license from Thomson Reuters. You may not copy or re-distribute this material in whole or in part without the prior written consent of Thomson Reuters.*

Table 3: Global Embeddedness—Topic

China (20.5% overall)	Web of Science Categories	Russia (3.5% overall)
22.76%	Materials Science Multidisciplinary	2.26%
16.74%	Physics Applied	2.96%
21.99%	Chemistry Physical	2.46%
15.24%	Physics Condensed Matter	5.43%
24.29%	Chemistry Multidisciplinary	1.35%
20.04%	Nanoscience Nanotechnology	1.95%
24.48%	Polymer Science	1.54%
8.32%	Engineering Electrical Electronic	3.05%
17.28%	Optics	4.74%
26.52%	Electrochemistry	1.56%
16.91%	Materials Science Coatings Films	1.86%
24.53%	Physics Multidisciplinary	1.15%
28.55%	Chemistry Analytical	7.61%
32.40%	Metallurgy Metallurgical Engineering	4.80%
14.25%	Physics Atomic Molecular Chemical	4.01%
22.84%	Engineering Chemical	1.76%
0.00%	Biochemistry Molecular Biology	2.20%
14.16%	Instruments Instrumentation	4.43%
21.25%	Materials Science Ceramics	3.94%
40.00%	Chemistry Inorganic Nuclear	4.49%
29.94%	Crystallography	3.94%
0.00%	Pharmacology Pharmacy	0.00%
32.10%	Chemistry Applied	3.30%
26.14%	Energy Fuels	0.00%
19.42%	Environmental Sciences	0.00%

Source: Thompson Reuters Web of Science