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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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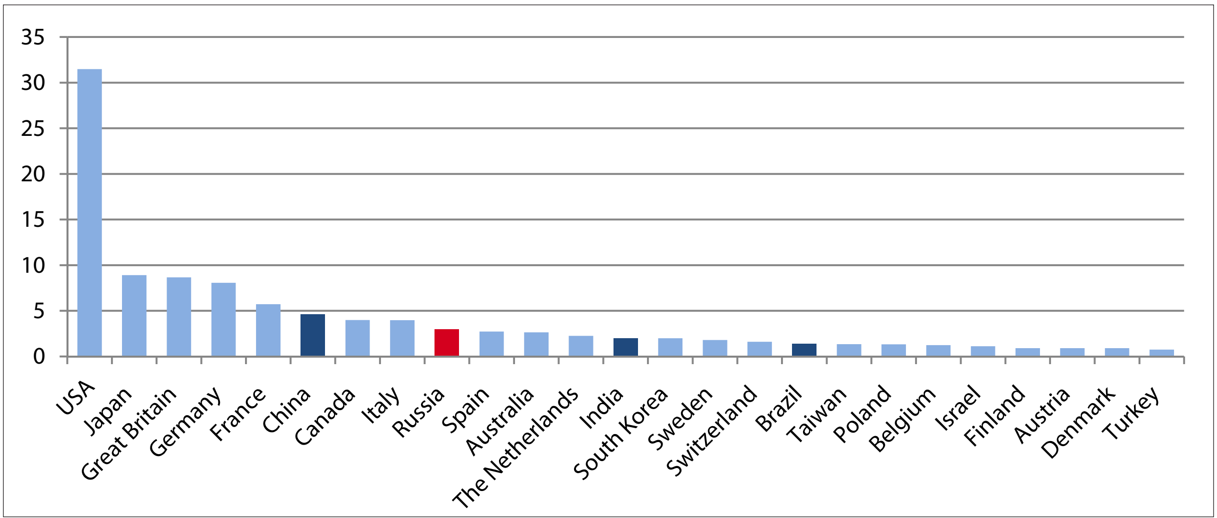
Please see additional data on pp. 7–10

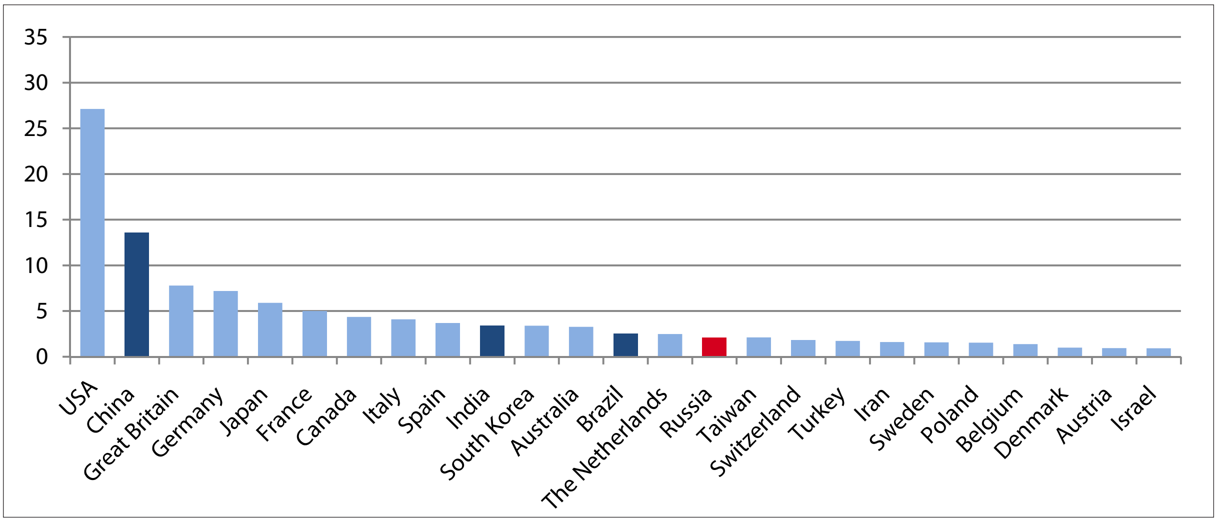
The decline in Russia's publication activity since 1990 is stunning. The Putin regime blames this on the radical neoliberal reforms of the 1990s. Yet Russia's position has declined even further since 2000, despite a significant economic recovery and both the Russian government and foreign grant-making 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>

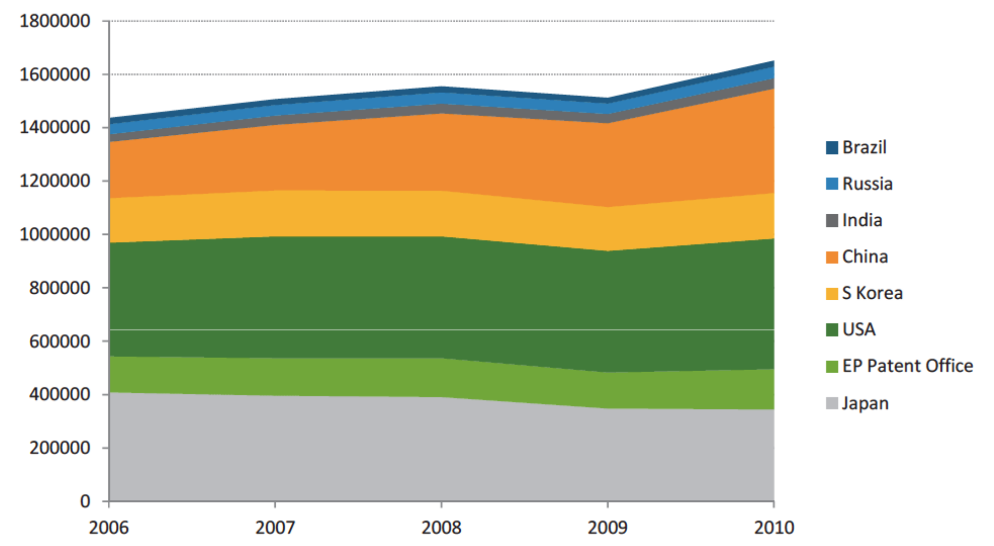
Not only is the Russian share of global publications declining, but Russian papers are less likely to be cited. The global average of citations per publication is 10.57. Russia has an average citation per paper of 4.87. Nearly half (48.6%) of highly cited Russian papers were in physics.

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

ANALYSIS

New Science Policy Measures in Russia: Controversial Observations

By Irina Dezhina, Moscow

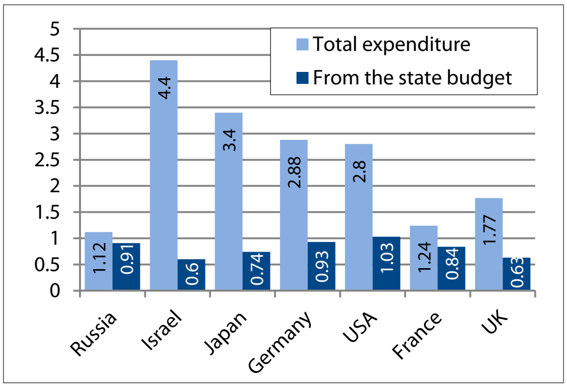
Abstract

In June 2013, a fundamental organizational reform began in Russian science with the transformation of three state Academies—the Russian Academy of Sciences, Russian Academy of Medical Sciences, and Russian Academy of Agricultural Sciences—into one expert "club." The reforms were to be implemented using "shock therapy." However, the first attempts to create something new following the destruction of the old system seem to be inconsistent and controversial. In part, this resulted from the lack of transparency and ill-conceived decisions in government policy.

State of Science and Rationale for Recent Reforms

During the post-soviet years since 1991, the key macro-indicators for the Russian research and development (R&D) complex remained relatively unchanged: Russian science is still funded mostly by the federal budget (Figure 1), while the business sector contributes less than 30% of total R&D expenditures.

Figure 1: Expenditures on R&D, as % of GDP (Russia: 2012; other countries: nearest year available)



Source: Main Science and Technology Indicators, OECD, 2014.

The research workforce continues to shrink, despite several government programs aimed at supporting young researchers, scientific laboratories, and attracting foreign scholars to Russia. Since 2000, the total number of researchers has decreased by 12.5%, and in Academy institutes by 14.5%. The declining workforce by itself would not be an issue if it reflected restructuring of R&D institutions and elimination of "dead wood." However the process was spontaneous. Different sources (anecdotal stories) indicate continuing brain drain, especially among young researchers. The start of the organizational reform gave researchers another reason to search for work abroad. The age structure is another indicator of the continuing stagnation. The proportion of researchers who are 40–60 years old is decreasing steadily and fewer young people are entering the field.

The results of financial, structural and workforce problems are clearly reflected in the bibliometric data: Russia generates fewer publications than other BRIC countries (Brazil, India, China), which are all far behind the world leader, the USA. (Table 1). The number of citations per article (which is an indicator of impact on a research community) for Russia is one third that for the USA.

Table 1: Articles and Citations, BRIC and USA, 2008–2012, World of Science

Country	Number of articles	Citation per article
Russia	135,363	2.56
Brazil	160,443	3.22
India	207,086	3.87
China	699,044	4.01
USA	1,664,136	7.43

Source: Indikatory Nauki: 2014. Statistichesky sbornik (Science Indicators: 2014. Statistical yearbook). M.: National Research University—Higher School of Economics. 2014. p. 373–375.

Thus, the government reforms of the last 22 years failed to produce visible results at the macro level. There are several explanations for this failure. First, significant increases in the federal funding of science, which officials often cite as improvements and achievements, followed the sharp decline and long stagnation in the government funding of R&D after the breakup of the USSR. Such a "catch up" in funding, coming at a low point for Russian science, could not yield fast results, especially because other conditions for research remained unfavorable. Indeed, the scientific workforce has deteriorated, some areas of research either ceased to exist or lagged far behind the world level, and the educational system lost the infrastructure and skills necessary for training modern specialists. Second, the increase in federal funding was not accompanied by support from industry; applied research was in decline and the gap between research and its practical applications, as well as an overall disconnect between science and industry became unresolved issues. Third, the government science policy had few breakthrough ideas while retaining old research-theme priorities (which have barely changed since 1996, when the first "priority list" of major directions in R&D and "critical technologies" was approved by the President) and implementing organizational changes in the science sector at a rather slow pace. The Academy system remained unreformed for a long time, and the universities were managed mainly as a teaching system.

Therefore, recently the government focused on a transformative organizational reform of Russian science, because its outdated structure has been seen as a major reason causing low research productivity. The government proceeded in two primary directions. First, universities were encouraged to do more research, including fundamental studies. Second, after years of confrontation, in 2013, the Academy system, as a quasi-ministry of fundamental research, was abolished and replaced by a new agency—the Federal Agency of Scientific Organizations (FASO), which inherited 1,007 Academy institutes.

Organizational Reform

"Research" Universities

The university system has been the center of government attention since at least 2006, when the first large portion of funding was provided to a select group of universities (57 higher educational institutes). Later, the Ministry of Education and Science bestowed the status of "Research University" on 29 higher education institutes. This status was awarded following a competitive selection process and accompanied by generous financial support for a 5-year period. Finally, in 2013, a new program, called "5 in the top 100" was initiated and 14 universities received generous amounts of additional federal funding. The aim of the government support is to propel 5 of these 14 into the world's top-100 lists by 2020. Thanks to this program, the average yearly budget of "elite" Russian universities has grown from 523 million RUR in 2006 to 1,125 million RUR in 2012.[1]

For the chosen universities, strengthening research is only a part of the agenda. Nevertheless, the set research goals and the conditions for achieving them are not quite in line. These universities have to boost the number of publications and citations, while placing more papers in international journals. Moreover, they have to attract foreign students (their share has to be at least 15% compared to the average 3%) and professors, which in turn, requires more teaching and research to be done in English—a serious challenge since most universities have no adequate capabilities for doing this. In the current political environment (i.e., sanctions), these goals become even more difficult to achieve.

Additionally, while research is encouraged and highly ambitious goals are set for publications, teaching loads for university professors continue to be large compared to Western countries, where universities play an important role in fundamental and applied research. At present, the Ministry of Education and Science, which regulates universities, recommends that teaching loads should not exceed 900 hours per year. Informally, universities take this number as the recommended minimum.[2] A separate recent government order dictates doubling the salaries of the teaching staff at universities relative to the average salary in the respective regions, and that universities "meet this goal" by increasing teaching loads. As a result, at some universities, teaching loads were increased up to 1,000–1,200 hours per year, which does not stimulate university professors to be more involved in research.

The above facts show that the contradictory actions taken by the government to reform science frequently undo its own intentions. New instruments are developed without considering their compatibility with the existing requirements introduced by previous (or even concurrent) government orders.

Academy Transformation

Last year's Academy reform was the most important change the institution faced in the last 100 years. The transformation remains incomplete since the President announced a moratorium for the year 2014 on any property operations as well as workforce changes (personnel cuts) at the former Academy institutes.

Structural changes in the governance of the Russian Academy of Sciences (RAS) were certainly needed. The Academy's problems have been discussed for quite a while. RAS, Russian Academy of Medical Sciences and Russian Academy of Agricultural Sciences were the three largest state institutions in the academic sector. In 2012, RAS covered 436 scientific organizations, employing 48,400 scientists. The average age of the Academy scientists was 51.9 years and steadily increasing over the last ten years. RAS is often compared to the French National Centre for Scientific Research (CNRS) and the German Max Planck Society. RAS is closest to the Max Planck Society in terms of total funding; however, its funding per scientist is half the size of its German counterpart. Consequently, Russian academics produce fewer pub-

1 Data from National Training Fund, 2014.

2 The discussion on this subject many be found at "How to decrease teaching loads of university teachers?"—Troitsky variant, 2014. no. 14. p. 4.

lications: according to 2009 data, a Russian Academy scientist on average had 1.43 publications, whereas scientists employed by the Max Planck Society averaged 9.17. The gap in citations for Max Planck scholars was smaller (11.97 citations versus 2.66 citations for RAS).[3]

As a result of the reform, the Academy lost its network of subordinate research institutes, along with the right to manage the Academy's property. Conflicts of interests among the state Academies, which previously had the power to both distribute and spend resources, were eliminated.

After the reform, the productivity of scientists should eventually grow—at least this was a major reason for implementing the reform. However there are at least three challenges. First, the Academy is "old" in terms of the average age of its scientists. In 2012, 26% of researchers in Russia were over 60 years old, whereas in the Academy, this number was 34.3%.[4] Therefore, serious changes in policies directed toward the workforce should be implemented. Indeed, FASO plans to cut staff, though only those employed in administrative and auxiliary services (from 51.7% (2013) to 40% (2018)) will be affected. FASO also plans to increase the share of young scientists (up to 35 years old) while retaining the same total number of researchers. Enacting workforce changes takes time and so does growth of productivity. Also, this plan implicitly implies that small organizations, which have a greater share of administrative staff, will be either merged with larger organizations or closed. This approach creates a basis for changes in organizational composition without considering the quality of research conducted in affected organizations. Therefore, the quality of research is at risk.

Second, there is an ongoing discussion about future changes in the executive leadership of the former academic institutes. According to the draft legislation, directors and deputy directors will have to retire from their positions at the age of 65. Estimates show that 70–80% of the current leadership will change if the bill is approved.[5] Whether the successors will have enough experience to lead the new institutes remains an open question because many current directors have not groomed potential successors.

Third, FASO plans to evaluate and reconfigure former Academy institutes. As a result, only a part of them will be involved in fundamental research. The idea is to strengthen the practical component and to create organizations that are aimed at solving different tasks:

- Research in areas defined as government priorities;
- Development of technologies that are critically important for technological modernization;
- Scientific support for regional development.

Whether this positively influences scientists' publication record is very doubtful.

Changes in Financing

Along with restructuring the Academy sector, the government introduced a new financial mechanism in the form of the Russian Science Foundation (RSF), established in 2013. Due to the redistribution of government resources (closure of a number of initiatives supporting researchers and research groups within federal targetted programs), RSF received generous budget support and became the largest government science foundation in Russia (Table 2).

Table 2: Science Foundations in Russia: Current and Planned Budgets, billion RUR

Name of the foundation	2014	2015	2016
Russian Science Foundation	11.4	17.2	19.1
Russian Foundation for Basic Research	9.2	10.93	14.3
Russian Foundation for Humanities	1.54	1.82	2.37

Source: Ministry of finance of the RF

The RSF leadership, from the beginning, announced several major principles of operation. First, the Foundation supports fundamental and exploratory research. Second, it intends to support the "best of the best" in terms of research and labs. Third, one of the major criteria for evaluating proposals and assessing the results will be bibliometric data (number and quality of publications). Fourth, RSF will be financing comparatively large projects—starting from 5 million RUR per year (to support research groups up to 10 people). For comparison, an average grant size from the Russian Foundation for Basic Research for a similar research project is 500,000 RUR. Fifth, RSF stated that it would welcome foreign participation in research teams as well as encourage young researchers.

To date (August 2014), RSF completed three types of competitions—to support research groups (grants up

3 Q. Schiermeier, "Russia to Boost University Science," *Nature*, no. 464 (1257), 2010, <www.nature.com/news/2010/100427/full/4641257a.html>.

4 Indikatory Nauki: 2014. Statistichesky sbornik (Science Indicators: 2014. Statistical yearbook). Moscow: National Research University—Higher School of Economics. 2014. p. 48; 183.

5 <https://www.ras.ru/news/shownews.aspx?id=21dd12a4-6b38-4ea0-b081-4dbb9e1743b1>

to 5 million RUR per year, for 3 years), existing laboratories (5–20 million RUR per year per lab), and new laboratories (10–25 million RUR per year per lab). The institutional structure of applicants and grantees is presented in Table 3.

Table 3: RSF Support for Research Groups and Laboratories

Type of organization	Applications, % to total	Grants, % to total
Research groups		
Academy institutes	35	59
Universities	57	32
Existing labs		
Academy institutes	41	58
Universities	49	34
New labs (jointly universities and research institutes)		
Academy institutes	26	34
Universities	62	55

Source: RSF data, <http://www.rscf.ru/>

The results of competitions were widely discussed in the research community and opinions were divided. The table shows that universities are active in submitting proposals while former Academy institutes are more successful in winning grants. This may be a confirmation that the level of fundamental research is higher in Academy than at universities. At the same time, there may be some priorities in the Foundation's work—for example, in the competition for establishing new labs, 21 projects out of 38 supported will be implemented at universities. This shows that the Foundation intends to develop new divisions predominantly at universities.

Other data for the first two competitions show that not all the intentions pronounced by RSF were realized: many principle investigators (PIs) are 60–70 years old (labs: 51%; older than 70: 23%). Thus, young researchers have not been intentionally promoted to project leaders.

Another issue was related to expert evaluation—some PIs are top administrators (rectors, directors, vice minister) (in lab grants: 20.5% of the winners are directors and deputy directors of institutes). Therefore, some raised questions about the quality of the peer-review process. The Foundation intends to organize international peer review sessions, but negotiations take longer than expected. In the end, the major question in regard to the Foundation's activity—"Has anything changed dramatically?"—does not have a clear answer yet.

Conclusion

Despite years of reforms, the Russian R&D complex continues to be funded mainly by the government and the government's role is increasing. One of the biggest problems is the workforce—researchers leave, while those who remain are growing older; the lack of younger people is becoming more apparent. The result is low output, as measured by the number of publications and their citations. The government is attempting to reverse this trend by implementing various measures aimed at either gradual (for universities) or sharp (Academy) organizational changes. Both developments are positive because the organizational structure of Russian science was outdated. At the same time, for achieving the new goals (e.g., creating research universities, increasing productivity of the former Academy institutes), the institutional environment also has to be modified. Otherwise, the government decisions will continue to be ill conceived.

About the Author

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Recommended Reading

For an extended analysis of publication outputs for the Russian Academy and universities and of the recent Academy reform see:

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ANALYSIS

Innovative Entrepreneurship and the Post-Soviet Path-Dependency of Russian Science

By Irina Olimpieva, St. Petersburg

Abstract
This article examines the peculiarities of innovative entrepreneurship in Russia. The institutional path dependency of Russian science is viewed as one of the crucial factors predetermining the slow progress and low efficiency of innovative entrepreneurship. Using empirical data from a comparative study of techno-entrepreneurship in three countries, this analysis shows how the post-soviet inertia of Russian science is reflected in the particular features of innovative entrepreneurship in Russia.

Innovative Entrepreneurship: Underdeveloped Potential

The consensus opinion among experts is that the potential for innovative entrepreneurship among small businesses in Russia is significantly underutilized. Even in the absence of any reliable statistical information about the real state of innovative entrepreneurship in Russia, it is clear that Russia is far behind the technologically advanced countries for this indicator. Hopes that small-business innovative entrepreneurship would become a driver of modernization processes from "below," unfortunately, have not been realized. Both in scale and in market effectiveness, technologically-oriented small business today does not exert the expected influence on industry and the economy in general (even though there is undoubtedly some progress in this sphere).

In trying to explain why Russia does not take advantage of its high scientific potential to develop a stronger innovative small business sector, experts cite numerous reasons. Among them are the undeveloped market economy in contemporary Russia; the catastrophically low technological level of Russian industry, which makes it immune to innovations; the numerous institutional barriers to the development of small business; and the inconsistent and ineffective innovation policy pursued by the government.

Without slighting the significance of these reasons, in this article we want to focus on an additional important factor, namely the institutional inertia of post-Soviet science, which directly and indirectly influences the formation of the small business innovation sector. Our analysis draws on the outcomes of the research project entitled "The influence of individual behavioral models on the success of high-technology enterprises," which was conducted in 2012–2013 and financed by the Rusnano Corporation. In the process of our research, we analyzed the biographical trajectories of techno-entrepreneurs in three countries which were chosen as the most successful developing innovative economies of the "eastern" and "western" types (Taiwan, South Korea, and Finland) and also four Russian regions (St. Petersburg, Tatarstan, Tomsk, and Novosibirsk). In each country and regional case, we conducted about 20 biographical interviews. In the Russian regions, additionally we conducted interviews with experts (up to 10 interviews in each case). This research consciously did not focus on the IT sphere because it is a sui generis form of entrepreneurial activity.

Between "Western" and "Eastern" Models of Innovative Development

Science is the element of innovative systems that predetermines the key distinctions between so-called "eastern" (or Asian) and "western" innovation models. The common feature of innovation models in Asian countries is the backwardness of their fundamental (basic) science. In Asian countries technologically-savvy small business grew out of the wave of quickly developing small business entrepreneurship in the period of modernization through the gradual saturation of the high-tech consumer products sector. Here the emphasis was not so much on creating new scientific potential as on importing ideas and technology and attracting foreign specialists. In our study, the "Asian" model was represented by the cases of Taiwan and South Korea.

The "western" pattern of innovation development, on the contrary, comes from science. In countries with long-term and well-developed institutes of science, techno-entrepreneurship emerges as a mechanism for converting the accumulated (domestic) scientific knowledge into profitable market products. Correspondingly, in the "western" model, science serves as a starting point of innovation by generating scientific ideas which can be implemented in practice. The crucial condition for the efficiency of the "western innovative model" is a well-developed system of market institutions allowing the conversion of scientific knowledge into profit. The "western" model in our study was represented by the case of Finland.

The main distinctive feature of Russia's innovation system is its strong fundamental science and the Academy of Sciences as a stronghold of fundamental research.

The presence of highly developed science in Russia suggests the country will follow the "western" science-driven innovation model. At the same time, unlike western countries with such a science-driven model of innovative development, the commercialization of scientific ideas in Russia is considerably limited because market institutions are underdeveloped. Another problem is that the task of innovation promotion in the Russian context is connected to the task of modernization and bolstering the catastrophically falling technological level of Russian industry. Introducing innovation demands active scientific potential, but modernization and supporting the existing technological level are the most pressing issues for Russia's civilian industry. These obstacles, however, do not prevent Russian science from remaining the leading element in the developing innovation system.

Russian Science as a Source of Innovative Ideas

Contemporary Russian science has largely retained the generic features it inherited from the Soviet institutional system of science. One of the most important among them is the discrepancy between military and civilian research that was reflected in the so-called "technological gap" between military hi-tech and civilian low-tech. The lack of industrial demand for advanced technologies was the main reason why soviet scientists in the beginning of the 1990s could not convert their ideas into a market product. The overwhelming majority of scientific entrepreneurs who established technological firms in the beginning of the 1990s eventually had to turn them into pure commercial enterprises. Those who managed to preserve the technological profile of their firms had to fulfil simple orders for maintaining existing equipment and technologies: *"At the very beginning our activities were narrowed down to addressing the primitive technological problems of industrial plants, roughly speaking, 'to make bedpans' for the enterprises […]"* (Interview with an entrepreneur born in 1952).

The technological gap still exists, as well as the discrepancy between military "hi-tech" and civilian "low-tech." In our data, it can be traced through differences in marketing strategies which are determined by the scientific origins of the techno-entrepreneurs. Informants with a military hi-tech background usually complain about the lack of demand for their products and technologies in Russia: *"…there is no real economic demand for these innovative technologies in our country in principal…"* (entrepreneur, 1956). Nevertheless, according to some informants, the situation has improved a little since the 1990s: *"We did not have a single sale in Russia from 1998 until 2006. Meaning, for eight years. In 2006 there was a slow start, now it's getting more active"* (entrepreneur, 1963).

Actually, as the interviews suggest, there are two basic marketing strategies used by the entrepreneurs with a military, high-tech background. The first one is an orientation on the external market (USA/Israel/Germany or other foreign countries including the post-socialist bloc). The second is a continuing focus on state military contracts or orders from state agencies, such as the Ministry of Internal Affairs or the Emergency Response Ministry, which remain the main customers for high-tech production. Using these strategies in combination or their alternation over the lifetime of the firm is also typical for these kinds of firms. Simultaneously, firms try to develop and sell civilian products and technologies to private companies, but the civilian market efforts are usually only a side-business and constitute a less reliable marketing strategy. Interestingly, in the case of Finland informants also complain about low demand for innovative products on the domestic market. The phenomenon of "born global" (the term used to define small innovative firms with an exclusive orientation on the foreign market) is a distinctive feature of the Finish innovative sector. However if in Finland the lack of demand is predetermined by the small size of the market, in Russia the reason is of a different nature. The demand for the modernization and maintenance of the obsolescent technological base of industry is stronger than the demand for innovations. As a result, the scientific potential of Russian high-tech remains greater than the real possibility for its marketization.

Another "generic feature" of Russian science today is the preservation of the "sectoral" structure typical for the Soviet organizational model of science. Most scientific research is still conducted in the institutes of the Academy of Sciences. Scientific organizations that formerly belonged to the so-called "branch (civilian) sector" and now operate under the umbrella of research universities remain the main producers of technological solutions for domestic civilian industry. The centers for technology transfer (CTT) that were established in almost all research universities report about the creation of multiple spin-offs that are supposed to transfer innovative ideas to industry. However, our interviews with techno-entrepreneurs and experts working in CTTs make it obvious that the newly emerged spin-offs mainly reproduce the model of interactions between science and industry typical for the late 1980s, rather than developing a new innovative "helix" of technology transfer as described in official reports.

The relationships between small innovative firms and scientific organizations are rather specific. Almost all informants mentioned the decline in the scientific potential of research institutes and the insufficient level of support for small innovative firms. Entrepreneurs demonstrate generally low institutional trust in science; they consider personal connections with former colleagues in research institutes to be more important than the level of research in scientific organizations in general: *"We grew out from the [RAS] institute, which … has already changed its name 5 times… the institute these days does anything but scientific research. Secondly, in terms of budget, we have significantly outrun them. Thirdly, people who remained there somehow now come to us. We make joint projects with them. It is not the Institute that is, in this sense, a cause of the progress. The Institute is in that sense a potentially good receiver of grants. In these joint projects, we are the generators of ideas, and it has been this way already for a long time"* (techno-entrepreneur, 1956). This is the reason why some of the most successful entrepreneurs start their own R&D on the company basis, splitting their firm into two subdivisions: a "practically-oriented" department that works on customers' orders and serves as a cash cow for the firm, and a "scientific" department that works for the future development of the product/technology. However, not many firms can afford doing their own research and this practice is more an exception than the rule.

Russian Science as a Source of Innovative Entrepreneurs

The role of science in a science-driven innovative model is not limited to the production of scientific ideas for marketization. Science has always been a main supplier of personnel for techno-entrepreneurship in Russia. The first "scientific cooperatives" at the end of the 1980s, the entrepreneurial "boom" at the beginning of the 1990s, and the following waves of entrepreneurship became possible only due to the entrepreneurial enthusiasm of the former scientific cadres. While in Taiwan and South Korea the majority of techno-entrepreneurs originated from small business or big high-tech corporations, in Russia they almost all have "scientific" origins (former employees of academic institutes and universities or researchers in branch scientific organizations). Almost no entrepreneurs came to techno-business from the consumer sector of the economy, which is quite understandable. As a rule, high-risk and costly techno-business begins to attract attention from entrepreneurs when the more accessible consumer sectors are already filled up and the competition there is high. In Russia, the consumer market is far from being filled; therefore, the entrepreneurs oriented on high profits can always find lucrative market niches, which are not as complicated as working in the techno-sphere.

Innovative entrepreneurs in Russia actually carry a double institutional "load." Alongside the enhanced risks of techno-business, they have to overcome the institutional barriers which are common across the entire Russian business environment. That is why innovative business attracts first of all those entrepreneurs who are interested in the process of research and development as such and who are ready to deal with the high risks of techno-business to realize their interest. Using an expression coined by one of the informants, *"in Russia, the innovation business attracts only crazy people who are capable of doing something in the conditions of Russian [business] reality"* (entrepreneur, 1981).

Similarly, in Finland, which also develops according to the "western innovative model," many techno-entrepreneurs also come to business from science. However, unlike Russia, another equally important source of techno-entrepreneurs in Finland is the former employees of high-tech corporations. Some Russian informants also used to work in the military complex, construction bureaus and former scientific-production complexes. However, the share of these entrepreneurs is small and incomparable with the share of former scientists (or those who initially were planning a scientific career).

Another difference with Finland can be found in entrepreneurs' motivation for going into business. In Russia the "push" factors are dominating. Most informants had to go into business because they could not stay in science, mainly for external reasons—low (or a lack of) financing, a poor organizational environment, the low level of scientific research, etc. This is especially true for the older generation of informants, who were forced to start their business during the economic crises at the beginning of the 1990s, but also for the younger ones who had to leave science in the late 1990s and even the early 2000s, because *"there was not enough 'bread' for everyone"* (entrepreneur, 1979). In the case of Finland, "pull" factors are dominant. Switching to business is explained by the desire to create a market product, to "conquer" the market, or by a desire to use the opportunity and incentives for entrepreneurship provided by various foundations and innovation support programs.

Russian Science as a Source of Innovative Culture

Russian science is the main source of workers for the innovation sphere, providing the institutional and cultural environment which shapes the personality of the future techno-entrepreneur, his or her professional socialization and motivation, and understanding of the meaning of innovative activity. Thus, the specific features of the culture of the Russian science milieu and the system of value-norm regulators in scientific research activities are the key factors determining the innovative culture of Russian techno-entrepreneurship.

Among the generic features inherited from soviet science is a specific culture as a system of norms, values, and attitudes towards science and research activities. The professional culture of the Soviet scientists was built on the ideals of an "unselfish search for truth." Passion for research and disinterest in money were the main virtues of a "real scientist." This ethos was supported by the priority state financing for science and military contracts. Working in science was highly prestigious, and being a scientist was not just a profession, but rather a specific mission, imbuing existence with broader meaning both as a way of life and even as a life ideology. From this point of view, science was never seen as an institute for generating ideas for sale in the market, but rather as a unique environment for the self-realization of extraordinary personalities: *"…in Soviet times there was a 'paradigm' in the scientific community, which implied that 'bowing to market forces' was not 'lordly' or 'royal' for a scientist"* (entrepreneur, 1956). Interestingly, a similar hostility to the marketization of scientific ideas was immanent to American science up to the middle of the last century.[1] However, while American scientists eventually accepted market values under the pressure of economic necessity, the culture of Soviet science was "frozen" within the framework of a planned economy and remained almost intact in academic enclaves. Even today, as was revealed in our study, in some of the most prominent academic institutions, scientific entrepreneurship is still considered to be a "betrayal of science" and for those scientists who left academia for business the "door was slammed shut forever": *"That's it, this is a caste. You are a betrayer of your 'motherland' since you decided to go into business!"* (expert).

In answering the question whether they consider themselves a scholar or entrepreneur, informants from Taiwan and South Korea emphatically chose entrepreneur. Finnish businesspeople spoke of a diversified identity—partly entrepreneur and partly researcher. Generally, the research part shrunk the longer the person stayed in business. Russian informants in every way tried to distance themselves from entrepreneurship. To achieve this purpose, they employed various discursive strategies. Above all, they emphasized the specific character of techno-business and contrasted it sharply with "simple" business in terms of the importance of financial gain: *"Simple businessmen only want to earn money, while entrepreneurs in high-tech want to earn money by developing something new. The principle difference is that it is important for them to get money for their creativity"* (entrepreneur, 1984). Emphasizing such distinctions may be associated with the negative connotation of the term entrepreneur, which is still less prestigious than scientist. Even if the informant admits that he no longer is involved in his own research work, he will definitely emphasize that he continues to monitor and advise the research work of the firm. These narratives often highlight the key role of science in the enterprise and the significance of the scientific background of the innovation entrepreneur, who must have special scientific knowledge.

In the narratives of Russian informants, entrepreneurship often served as an alternative form of self-realization (understood in terms of constructing one's self), intellectual challenge and creativity, which is the defining component of scientific activity: *"What I am actually doing here is marketing. However, my fundamental education allows me to find interesting perspectives in these tasks, some creative elements, because I would feel sick to live without it. One can put it as some principle: it is more interesting for me to develop a shovel than to use it afterwards"* (entrepreneur, 1979).

For many Russian informants engaging in entrepreneurship is a strategy which allows them to continue to engage in scientific activities in conditions where there is little funding for science: *"At a certain moment I understood that if I wanted to engage in scientific activities in the future, it was necessary to leave. I did not want to leave simply because of objective circumstances. Therefore I reasoned that there are other ways to realize one's ambitions than academic activity"* (entrepreneur, 1963).

Our interviews tracked a specific dynamic evolving in the sphere of innovative entrepreneurship. The new generation finds it easy to part with its scientific identity, since it is more frequently guided by efforts to achieve.

Thus, in Russia the science-driven innovation model remains the leading element in the innovation system. It influences the specific features of the development of innovative entrepreneurship directly through the production of scientific ideas and institutional support for innovative entrepreneurship, as well as indirectly, through the innovative culture of Russian techno-entrepreneurs. The success of innovative entrepreneurship in Russia will be determined to a great degree by the level of success in the transformation of Russian science.

About the Author
Irina Olimpieva is a researcher at the Center for Independent Social Research in St. Petersburg.

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1 See Shapin, S. (2008) The Scientific Life: A Moral History of a Late Modern Vocation, Chicago, Ill.: The University of Chicago Press, 2008.

ABOUT THE RUSSIAN ANALYTICAL DIGEST

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Founded in 1982, the Research Centre for East European Studies (Forschungsstelle Osteuropa) at the University of Bremen is dedicated to the interdisciplinary analysis of socialist and post-socialist developments in the countries of Central and Eastern Europe. The major focus is on the role of dissent, opposition and civil society in their historic, political, sociological and cultural dimensions.
With a unique archive on dissident culture under socialism and with an extensive collection of publications on Central and Eastern Europe, the Research Centre regularly hosts visiting scholars from all over the world.
One of the core missions of the institute is the dissemination of academic knowledge to the interested public. This includes regular e-mail newsletters covering current developments in Central and Eastern Europe.

The Center for Security Studies (CSS) at ETH Zurich
The Center for Security Studies (CSS) at ETH Zurich is a Swiss academic center of competence that specializes in research, teaching, and information services in the fields of international and Swiss security studies. The CSS also acts as a consultant to various political bodies and the general public. The CSS is engaged in research projects with a number of Swiss and international partners. The Center's research focus is on new risks, European and transatlantic security, strategy and doctrine, area studies, state failure and state building, and Swiss foreign and security policy.
In its teaching capacity, the CSS contributes to the ETH Zurich-based Bachelor of Arts (BA) in public policy degree course for prospective professional military officers in the Swiss army and the ETH and University of Zurich-based MA program in Comparative and International Studies (MACIS); offers and develops specialized courses and study programs to all ETH Zurich and University of Zurich students; and has the lead in the Executive Masters degree program in Security Policy and Crisis Management (MAS ETH SPCM), which is offered by ETH Zurich. The program is tailored to the needs of experienced senior executives and managers from the private and public sectors, the policy community, and the armed forces.
The CSS runs the International Relations and Security Network (ISN), and in cooperation with partner institutes manages the Crisis and Risk Network (CRN), the Parallel History Project on Cooperative Security (PHP), the Swiss Foreign and Security Policy Network (SSN), and the Russian and Eurasian Security (RES) Network.

The Institute for European, Russian and Eurasian Studies, The Elliott School of International Affairs, The George Washington University
The Institute for European, Russian and Eurasian Studies is home to a Master's program in European and Eurasian Studies, faculty members from political science, history, economics, sociology, anthropology, language and literature, and other fields, visiting scholars from around the world, research associates, graduate student fellows, and a rich assortment of brown bag lunches, seminars, public lectures, and conferences.

The Institute of History at the University of Zurich
The University of Zurich, founded in 1833, is one of the leading research universities in Europe and offers the widest range of study courses in Switzerland. With some 24,000 students and 1,900 graduates every year, Zurich is also Switzerland's largest university. Within the Faculty of Arts, the Institute of History consists of currently 17 professors and employs around a 100 researchers, teaching assistants and administrative staff. Research and teaching relate to the period from late antiquity to contemporary history. The Institute offers its 2,600 students a Bachelor's and Master's Degree in general history and various specialized subjects, including a comprehensive Master's Program in Eastern European History. Since 2009, the Institute also offers a structured PhD-program. For further information, visit at <http://www.hist.uzh.ch/>

Resource Security Institute
The Resource Security Institute (RSI) is a non-profit organization devoted to improving understanding about global energy security, particularly as it relates to Eurasia. We do this through collaborating on the publication of electronic newsletters, articles, books and public presentations.

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