research, does not have scientific schools in this sense: the level of mobility there is extremely high. One can talk not only about the Soviet school of mathematics but also, more specifically, of the Moscow, Leningrad, Kiev, Novosibirsk, Kharkov and other schools. In all these places, there were constellations of distinguished scientists with large numbers of students, conducting regular seminars. These were not merely advisors but also spiritual leaders.

Since 1970s, all the three factors have been gradually fading, and the level of mathematical research in Russia has been gradually declining too. According to [La], the situation has recently stabilzed but at a very low level.

REFERENCES

[1] The two periods are of course not independent. The development of science in between the two periods was obstructed by Stalin's repressions of the late 1930s and the Second World War. In the 1920s–1930s, Leningrad school of mathematics was a continuation of the pre-revolution tradition, whereas mathematicians in Moscow developed under strong influence of the French school.

[2] A letter signed by 99 Moscow mathematicians, addressed to Soviet authorities asking for the release of A. Esenin-Volpin, a prominent mathematician, poet and dissident, who was confined in an asylum against his will and without prior medical examination; see, e.g. [Fu]. Full text of the letter is available at ***http://www.math.ru/history/p99/index.htm*** *(in Russian).*

[De] M. Raussen and Ch. Skau, "Interview with P. Deligne", Notices of Mathematics 2:2014 ***http://www.ams.org/notices/201402/rnoti-p177.pdf***

[Fu] D.B. Fuchs, "On Soviet Mathematics of the 1950s and 1960s", in: Golden Years of Moscow Mathematics, Ed: S. Zdravkovska and P. Duren, AMS and LMS, 2007.

[La] N. Dyomina. Interview with S.L. Lando. "Mmatematicheskoe obrazovanie i marketing reputacij." ***http://www.polit.ru/article/2008/01/23/lando1/***

[Sm] Interview with S.K. Smirnov, SPbSU. ***http://spbu.ru/aboutus/160-interview/god2010/502-20100909.html***

[So] N. Ivanova-Gladilshchikova, "Nizkiy uroven matematiki — udar po oboronosposobnosti strany." Interview with A.B. Sosinsky. ***http://www.gazeta.ru/science/2014/09/06_a_6204525.shtml***

[Ti] V.M. Tikhomirov, "On Moscow Mathematics – Then and Now", in: Golden Years of Moscow Mathematics, Ed: S. Zdravkovska and P. Duren, AMS and LMS, 2007.

[Ts] M.A. Tsfmasman, "Sudby matematiki v Rossii." ***http://www.polit.ru/article/2009/01/30/matematika/***

[Va] V.A. Vassiliev, "Matematika i matematiki podreformennoy Rossii." ***http://polit.ru/article/2013/09/10/vassiliev_math_conf_ras/***

A Metric View on Russian Mathematics and Russian Mathematical Diaspora

(A Study Based on Frequent Russian Surnames)

Vladlen Timorin

Professor and Dean of the Faculty of Mathematics, National Research University Higher School of Economics, Russian Federation
vtimorin@hse.ru

Ivan Sterligov

Head of Scientometric Center, National Research University Higher School of Economics, Russian Federation
isterligov@hse.ru

What happens with Russian mathematics in terms of metric parameters? Where do Russian mathematicians work, where do they publish, how well are they cited?

"Russian" may refer to different things: to one's current workplace or to one's origin. First, let us consider "Russian" in terms of origin. We conducted a numerical experiment, which serves to approximate the dynamics of mathematical research produced by scientists originally from Russia. It is difficult to identify this group of mathematicians in citation databases. Instead, we picked some most popular Russian surnames and checked the publication output of people with these names in the Web of Science database. We hope that the chosen collection of scientists is somewhat representative because the authors with these surnames coauthored almost a third of Russia's articles and reviews across all disciplines in the Web of Science in 2014. We call our collection "frequent Russian surnames," or FRS. As of 1994, about 70% of all FRS-coauthored publications were affiliated with Russian institutions. This indicates indirectly that FRS may provide a fair representation of Russian mathematical community. In particular, we expect that FRS migration correlates with the migration of Russian mathematicians, etc. One drawback of the chosen scheme is that it does not distinguish between Russian and, say, Belorussian scientists (the latter form about 3% of the FRS). It is worth noting that those FRS which are also popular in Bulgaria (Ivanov, Antonov, Markov, etc.) were omitted.

Migration of FRS Mathematicians

We see at Figure 1 that in the 1990s, a significant part of FRS scientists were terminating their Russian affiliations and accepting affiliations outside of Russia. This process stabilized in 1998. The percentage of FRS scientists combining their Russian affiliations with affiliations abroad has been steadily growing.

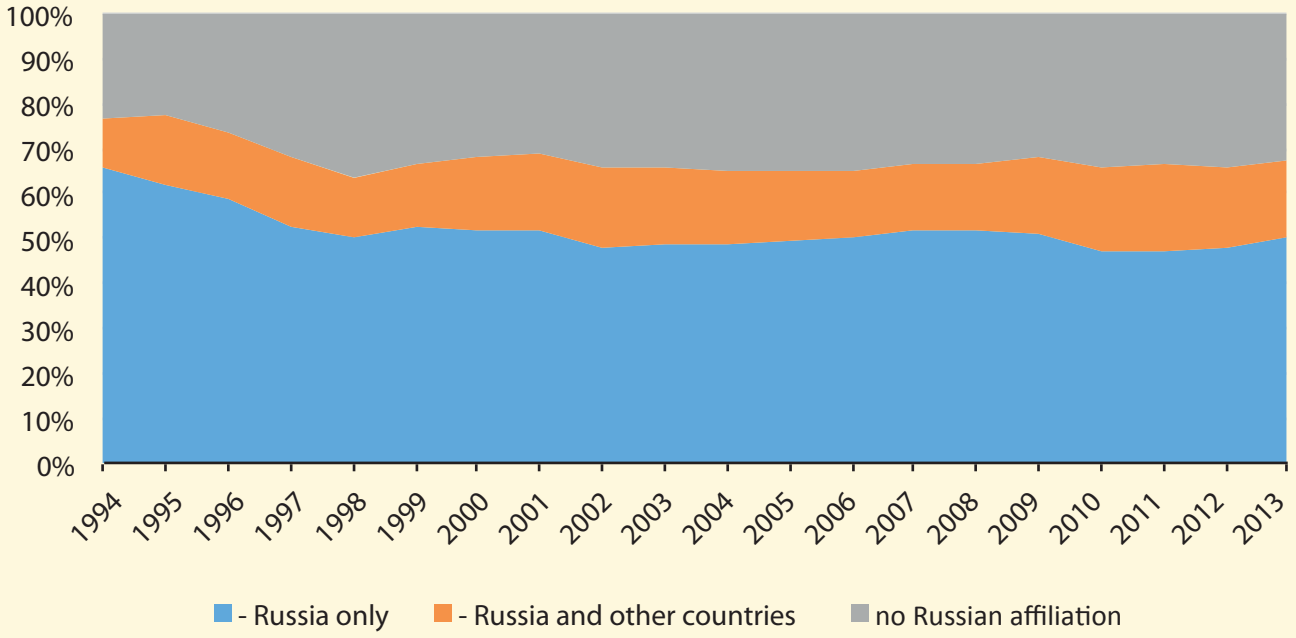

Figure 1. Share of FRS publications by type of affiliation

Figure 2 left shows the most common country affiliations of the part of FRS not affiliated with Russian institutions. Note that a significant part of FRS resides in Belarus and Ukraine, which is natural because many Belorussian and Ukrainian surnames are the same as Russian ones. It is safe to assume that FRS scientists affiliated with Belorussian and Ukrainian institutions did not move there from Russia (with some statistically negligible exceptions).

The most popular emigration destinations were the USA, the UK, Germany, France and Canada, see Figure 2 right. This is not surprising. Note also that the USA alone hosted more than a third of all FRS emigrants

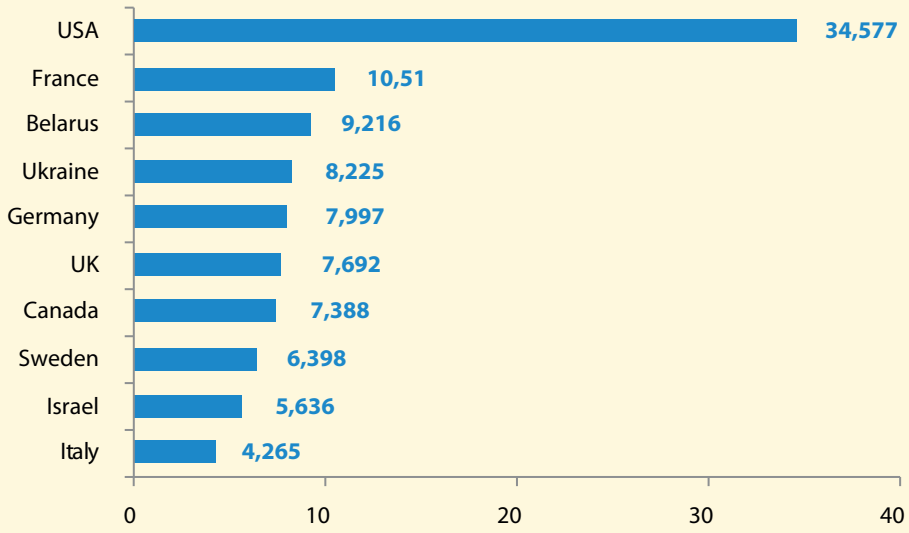

Figure 2. Share of FRS-authored papers by country, 1993-2015

1993-1995			2012-2014		
Countries/Territories	**records**	**% of 42**	**Countries/Territories**	**records**	**% of 185**
USA	19	45.238	USA	83	44.865
FRANCE	7	16.667	UK	28	15.135
ISRAEL	5	11.905	GERMANY	23	12.432
GERMANY	4	9.524	FRANCE	20	10.811
SWEDEN	3	7.143	CANADA	16	8.649
CANADA	3	7.143	IRELAND	14	7.568
			ISRAEL	13	7.027
			SWEDEN	10	5.405

Scientific Output from Within and Outside of Russia

It is interesting to compare scientific output of FRS scientists with and without Russian affiliations. First of all, we looked at the journals where they published. It looks like Russia-based scientists prefer domestic journals, whereas the overseas part of FRS try to publish in high-impact international periodicals. We counted FRS publications in the top 25 pure mathematics journals (based on the MCQ [1]; it may be instructive to observe that the distinction between pure mathematics journals and applied mathematics journals is not obvious, and our specific choice may be questionable). Out of 1027 FRS publications without Russian affiliations, 203 are on the "top-25 journals" list. On the other hand, out of 2747 Russian publications, only 83 are. Russia-based and overseas FRS publications are drastically different in terms of citation numbers. For example, for Russian publications, the average number of citations per item is 2.66, whereas for overseas publications — 7.48. By the way, the average number of publications per author is also lower among the "domestic" part of FRS, although the difference is not that significant.

We can conclude that the overseas part of FRS are more efficient in their research, at least in terms of metric values. We can list several specific reasons for that. It is hard to estimate relative importance of these reasons, though:

- Russian emigrants appearing in our data sheets are those who were able to find good academic positions abroad. This by itself distinguishes them as being scientifically productive or at least respectable at the international level. It is also interesting to note that Russian emigrants appear to be more productive than domestic scientists in their host countries, see e.g. [2].
- There are Russian universities with many publications in mathematics and few internationally recognized mathematicians. Employees of these universities publish a certain amount of papers simply to comply with "publication activity" requirements imposed by their institutions. Note, however, that we are only looking at publications indexed by the Web of Science (WoS), i.e., at publications in reputable journals.
- In Russia, average salaries in mathematics are low. Thus, mathematicians have to combine research with other activities in order to earn a decent living.

Mathematics in Russia: Publications in the Top 25 Journals

Now let's leave the FRS list aside; instead, we will talk about all scientists with Russian affiliations. Figure 3 shows the level of publication activity by country in the top 25 mathematics journals (measured as percentage of the total number of publications in these journals in the WoS; a publication contributes equally to all countries listed in the affiliations of the authors). The Figure shows the top 8 counties except for the USA, whose graph is higher than the upper boundary of the figure; it exhibits a regress from 52.4% to 45%.

Russian mathematical journals were not among the top 25 journals we considered. All the 25 journals are published in the West. When looking at Figure 3, one should keep in mind that it is traditional in Russia to publish in the best Russian journals (like Russian Mathematical Surveys, Mathematical Notes, etc.), which are very competitive at the international level but whose citation-based numerical measures are lowered by several circumstances including the fact that the citations are split between the Russian original and the English translation. Having this in mind, Russian mathematical output stands surprisingly high despite the exodus of a better part of mathematicians. On a negative note, no significant progress is visible (cf. China!).

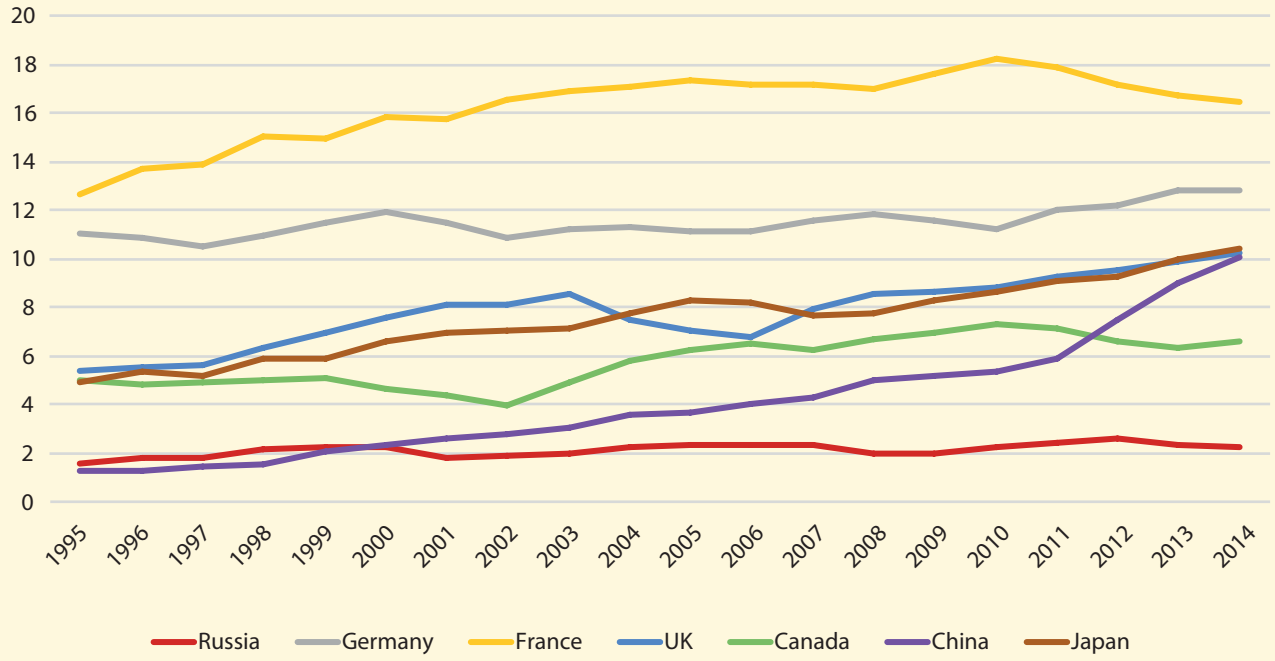

Figure 3. Share of publications in top 25 general interest mathematics journals by country

The Academy of Sciences vs. Top Russian Universities

An important feature of science in Russia is that the Russian Academy of Sciences (RAS) is comparable in its academic output with the totality of all universities. This can be seen from Figure 4 left, where publication activity of the RAS vs. the top 17 universities is shown. [3] It is also clear that Russian scientists have been moving from the academic institutes of the RAS to universities, or at least accepting part-time positions in universities together with their full-time positions within RAS.

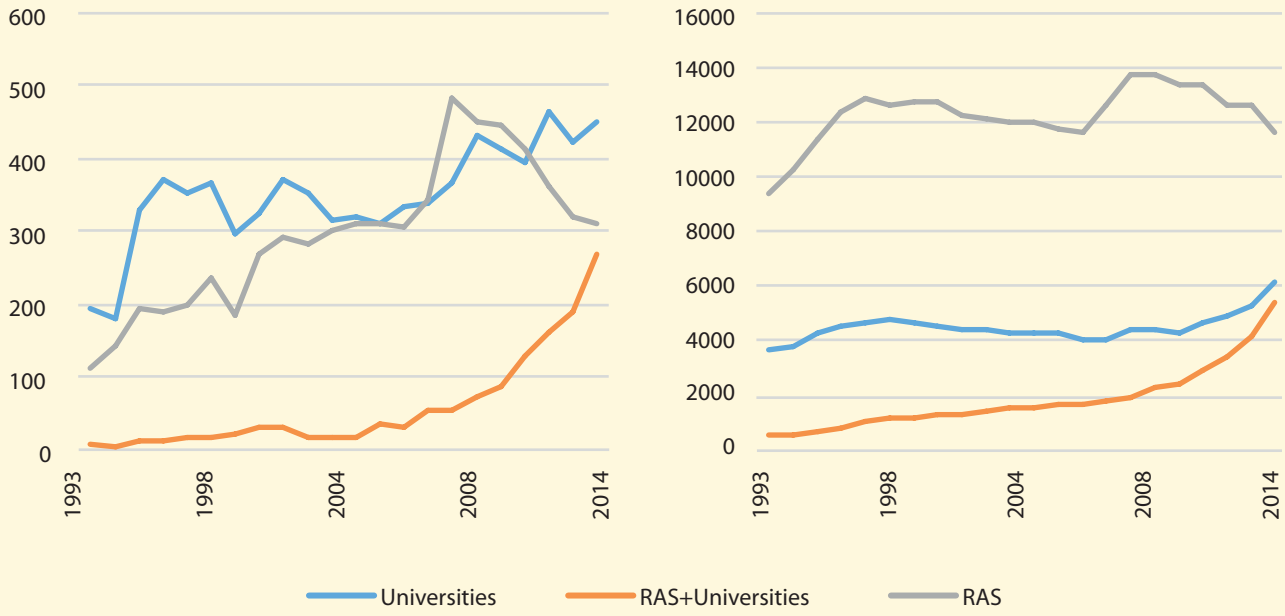

Figure 4. WoS publication counts. RAS vs top 17 Russian universities. Math (left), all disciplines (right).

It is interesting how prominent this process is in mathematics, see Figure 4 right: universities produce a bigger share of publications, they are hiring new faculty or stimulating publication activity of existing faculty more aggressively.

To sum up, we see the following picture based on our numerical study: Russian mathematics has lost its best representatives; nevertheless, it still stands very high at the international level. The decline has come to an end but no significant progress is currently visible. We should stress, though, that metric values give only a very rough picture, oftentimes distorted by various database peculiarities not directly related to the discipline itself. A comparison of particular universities or even particular countries should not be based on such values exclusively.

References

[1] The MCQ is calculated by counting the total number of citations into the journal that have been indexed by Mathematical Reviews over a five-year period, and dividing this total by the total number of papers published by the journal during that five-year period.

[2] George J. Borjas, Kirk B. Doran, THE COLLAPSE OF THE SOVIET UNION AND THE PRODUCTIVITY OF AMERICAN MATHEMATICIANS, The Quarterly Journal of Economics (2012), 1143–1203. doi:10.1093/qje/qjs015

[3] 15 universities initially selected by the RF government for the 5-100 project plus Moscow State University and Saint-Petersburg State University

5-100: Russian academic excellence project, ***http://5top100.ru/***

Math Graduates' Career Prospects in Modern Russia

Alexander Esterov

Associate Professor and Deputy Dean of the Faculty of Mathematics, National Research University Higher School of Economics, Russian Federation
aesterov@hse.ru

"A mathematician will do it better"
Hugo Steinhaus

What can mathematicians do in applied science or other disciplines? First of all, mathematicians teach students of other fields math. Second, they prove theorems. Sooner or later, unexpectedly many of these theorems find some kind of application.

Yet, there is also another obvious answer, which is probably even more important in terms of technological development; it also helps create much more jobs for people with a degree in math. I'm talking about the fact that science and technology in general are becoming more and more mathematized.

We will briefly talk about the mathematization of science in the Soviet and post-Soviet periods and discuss the job prospects mathematicians have in modern Russia.

1. Historical Background

The mathematization of knowledge is one of the major processes going on in culture and science. The level of mathematization of a given discipline is a sign of its academic maturity and applicability.

However, this is a fundamental truth that was forgotten for nearly 1500 years after the end of the Antiquity, when pythagoreanism flourished. In the Middle Ages and during the Renaissance, mathematics was solely viewed as a skill, only required by merchants or engineers. It was taught at professional schools (e.g., "abacus schools" in Italy) but not at universities. Mathematics continued to develop and to slowly penetrate other spheres of knowledge only with the help of some random autodidacts, be it university professors or military engineers.

In the Early Modern Period, the situation changed dramatically. It turned out that math was necessary in order to process the empirical achievements of the Renaissance. One can quote Carl Friedrich Gauss, who said, paraphrasing Newton, "Mathematicians stand on each other's shoulders." When new means of communication became widely accessible to scientists all across Europe, they finally managed to "stand on each other's shoulders" in math. The traditionally low level of mathematical literacy common among professionals was no longer sufficient as it didn't measure up to the challenges of capitalism, gunpowder, and the Age of Discovery.

By the beginning of the XVII century, a new attitude had developed: universities needed pure mathematics, and mathematics graduates could find professional employment in applied spheres. The Age of Reason was starting. Universities were, one after another, opening new chairs of mathematics, the first among them being the Lucasian Chair of Mathematics and the Savilian Chair of Geometry. Some countries joined the process too late, and their universities would later regret their conservatism as they had to give way to schools of applied sciences (e.g., engineering schools in France), which had "sheltered" pure physicists and mathematicians.

Since those times, higher education institutions offer degree programs in mathematics. Some graduates of these programs become pure mathematicians, while others pursue different careers expanding the influence of mathematics on external fields of knowledge that are mature enough