Measuring Excellence in Russia: Highly Cited Papers, Leading Institutions, Patterns of National and International Collaboration

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Abstract
In this study, we aim to discover Russian “centers of excellence” and explore patterns of their collaboration with each other and with foreign partners. Highly cited papers serve as a proxy for “excellence” and co-authored papers as a measure of collaborative efforts. We find that at the moment research institutes (of the Russian Academy of Sciences as well as others) remain the key players, in spite of recent government initiatives to stimulate university science. The contribution of commercial sector to high-impact research is negligible. More than 90% of Russian highly cited papers involve international collaboration, Russian institutions often not playing a dominant role there. Patterns of national (“intra-national”) collaboration differ significantly across different types of organizations, the strongest ties are between three nuclear/particle physics centers. We draw a co-authorship map to visualize collaboration between Russian centers of excellence.

Introduction
Scientometricians choose excellence-based approach to measuring science when they want to pass from the question “whose average is better?” to “whose best is better?”. Comparison of the peak scientific achievements may be more telling than tails analysis involved in the calculation of averages.

According to Zitt, Ramanana-Rahary & Bassecoulard (2005), “highly-cited articles are among the most commonly used indicators” for identifying the “excellence.” For example, King (2004) chooses this indicator to rank 31 countries in his evaluation of scientific impact of nations, preferring it to raw publication or citation counts. He, however, remarks that rank order would not be seriously affected if the plain citation indicator had been used, which is in line with findings of Aksnes & Sivertsen (2004) who showed that a significant share of the national citation impact may be due to the effect of a few highly cited papers.

Recently highly cited papers indicators emerged in a new role, important for science and higher education policy. They have become a component of some of the global university and institutions rankings, either directly, as in a new Leiden Ranking (Waltman & al., 2012; Leydesdorff & Bornmann, in press), or indirectly—through a number of highly cited authors, as in ARWU (Liu & Cheng, 2005), or a number of papers published in the “best journals”, as in Scimago Institutions Rankings (Scimago Research Group, 2011).

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The objective of this study is to examine Russian science from the perspective of highly cited papers. To find out national centers of excellence is an interesting problem by itself. But in the case of Russia a highly cited papers approach is particularly appropriate, as soon as it gives more correct and interpretable results than analysis of the whole national output. Conclusions of a bibliometric investigation of Russian science are often declared to be inadequate within Russia itself, on the basis of insufficient availability of its national journals in international scientometric databases. Really, this factor may play a role when we count a total number of papers and/or citations. But an analysis in terms of highly cited papers is almost completely free from this bias. The overwhelming majority of highly cited papers are published in international journals, or at least in national journals with high visibility. The latter are already included into Web of Science. Thus, addition of peripheral Russian journals to databases will not increase a number of Russian highly cited papers. Indicators based on high-impact articles are, one might say, almost coverage-independent for large international scientometric indexes.

Russian highly cited papers have received little attention in the literature. Only the classic work by Narin, Frame & Carpenter (1983) explored Soviet high-impact research in detail, although their definition of a highly cited paper was somewhat different from that which we use here. They arrive at a conclusion that Soviet science is “isolated” and its level of citedness is dramatically low. Additional value of this survey for us is that its authors addressed the same problem of finding “centers of excellence” in the Soviet Union. We will compare the results of our study with those obtained by Narin, Frame & Carpenter in the final section of the present paper. In another more recent work (Markusova, Ivanov & Varshavskii, 2009) highly cited papers were discussed in the context of study of the Russian Academy of Sciences output.

The structure of this study is as follows. First of all we will investigate general characteristics of Russian highly cited papers, their total number and disciplinary structure. Next, we will explore the role of international collaboration in the process of creating a highly cited paper coauthored by Russian scientists. This interest is motivated by two factors:

(a) highly cited papers often involve extensive international collaboration (Aksnes, 2003);
(b) international co-authorship typically increases visibility of Russian papers and proves to be “profitable” in terms of citations (Pislyakov, 2010).

Thus, our hypothesis is that the combination of these factors will cause international collaboration to play a key role in Russian highly cited papers. If this is confirmed, it will be essential to investigate the relative share that Russian institutions have in the process of international collaboration which results in publishing a highly cited paper. To what extent can we say that Russian authors dominate or are dominated in such a collaborative work?

Further, we will focus on Russian “centers of excellence” prolific in producing highly cited papers. They will be considered by type of institution: research institutes of the Russian Academy of Sciences / Russian Academy of Medical Sciences (RAS/RAMS), non-RAS institutes, and higher education sector.

Our last research question will be how these leaders interact with each other. Are there any patterns of intra-national collaboration between Russian institutions which frequently result in highly cited papers? We approach this issue from two perspectives, first on the level of cooperation between different types of institutions and then on the level of co-authorship between individual organizations. Finally, we draw a map to visualize the latter type of collaboration.
**Methods**

Thomson Reuters *Essential Science Indicators (ESI)* database was used to identify highly cited papers. This product contains publication counts and citation data for countries, organizations, journals, and scientists. It indexes more than 10 thousand journals in the areas of science, technology, medicine, and social sciences. It does not include arts and humanities journals. Only two document types are indexed by ESI, namely scientific articles and reviews. All letters to the editor, errata, biographical items etc. are omitted.

All journals in ESI are categorized into one of 21 broad fields of research, with no journal being assigned to more than one field. Multidisciplinary journals (such as *Science*, *Nature* or *PNAS*) form the 22nd category. Each paper inherits its field category from the journal where it is published. Papers from multidisciplinary journals form an exception. They are reclassified into specific fields by an automated procedure which takes into account field representation of the journals citing these papers and journals cited by them. If this method does not produce a reliable result, the paper remains in a “multidisciplinary” category.

A special section of ESI lists highly cited papers. By definition, “highly cited paper” in ESI is a paper which ranks among top 1% most cited articles. Since citation rates vary significantly by scientific field (e.g., Glänzel & Moed, 2002) and also recent papers have had less time to be cited than older ones, ESI adjusts for this. For each year of publication and for each field citation thresholds are calculated. Those papers that reach these thresholds fall into top 1% most cited ones among all articles published in a given year/field and defined as “highly cited”. As the thresholds are integer numbers, the actual share of highly cited papers may be slightly greater (1.02% in our case). The thresholds may differ significantly from field to field, for example at the time of our investigation a paper in neuroscience published in 2000 should have received 273 citations to be listed as highly cited, while a similar paper in mathematics had a threshold of only 60 citations.

Our data were collected in March 2011 when ESI contained papers which have been added into database from 2000 till 2010. Only documents published in 2000-2009 were included into our study. Most recent highly cited papers were omitted to avoid edge effects, as citation thresholds for 2010 papers were too low and a paper could become highly cited due to temporary circumstances.

Papers were attributed to countries according to their authors’ affiliations. For example, if country of at least one institutional affiliation of article’s authors was “Russia,” then it was considered as “Russian paperé” Due to international co-authorship the same paper in this terminology may be “Russian,” “French,” “German” etc. This is so-called “whole counting” method. Still, when relative role of a country or institution in highly cited paper’s authorship was analyzed, another method was implemented, “institutional fractional counting.” If a paper had N different institutional affiliations, each institution was assumed to have a contribution of 1/N. This did not apply to subdivisions (departments, laboratories) which all were considered as one institution. A more thorough method of “author fractional counting,” when institutions’ contributions are divided in proportion to the number of authors from each organization could not be applied because there was no association between each author and each affiliation in ESI.
ESI tries to standardize institutional names and make them appear identically in the database even if different authors used different English versions of the same organization’s name. Unfortunately, this problem is often not resolved satisfactorily for institutions from non-English-speaking countries. Additional obstacle with Russian research organizations is that the institutes of the Russian Academy of Sciences (RAS) are all united in ESI into one organization, RAS. Moreover, for some papers ESI misses this attribution, so the data for RAS as a whole is also incorrect in the database. We had to perform this process manually for all 900+ Russian highly cited papers. Thus, all Russian papers were attributed to institutions with 100% certainty. The final processed data was input into MS Access database.

Visualization of the institutional co-authorship was done with the Pajek program. This freeware product visualizes social networks and makes it possible to create “energized” graphs (de Nooy, Mrvar & Batagelj, 2005, p.16). We consider institutions as nodes and number of collaborative papers as the strength of ties between them. After energizing, the distance between nodes indicates the activity of the collaboration between corresponding organizations. The closer the nodes to each other, the more highly cited papers were published in collaboration. Fruchterman-Reingold (Fruchterman & Reingold, 1991) energizing algorithm was implemented.

**Results and Discussion**

There are 927 highly cited papers (co-)authored by Russian scientists and published in 2000-2009. They constitute 1.0% of the total amount of highly cited articles listed for these years. According to ESI, share of all Russian papers in the total world output in 2000-2009 is about 2.8%. Thus, Russian contribution to the corpus of highly authoritative scientific literature is almost 3 times lower than its share in the whole set of ESI-indexed papers. Only one out of 272 Russian papers becomes highly cited. Most active partners of Russia—Germany, USA and France—have many more highly cited articles 10,112, 52,521 and 6,362 respectively.

**Disciplinary structure**

Table 1 shows distribution of Russian highly cited papers across scientific fields. The most striking characteristic of this distribution is a strong domination of physics which accounts for a half of all papers. Six times less papers are attributed to each of the next two fields, engineering and clinical medicine. More than 50 highly cited articles were published in each of the other two fields, chemistry and geosciences. At the other end of the scale, during ten years only one Russian paper became highly cited in economics/business and in immunology. Similarly poor performance can be observed in computer science, pharmacology, agriculture, neuroscience and psychiatry.

Small number of highly cited papers in some of the categories may be the result of modest total output of Russia there. To correct for this, the shares of Russian papers which have become highly cited were calculated for each scientific field. The leader remains unchanged, physics, with 0.68% of all papers in this category becoming highly cited. Note that even the most advanced Russian discipline lags behind the world in terms of share of highly cited papers in total scientific output. Medicine with its 0.61% becomes the closest rival, followed by biology/biochemistry (0.43%), engineering (0.40%) and space science (0.32%; to exclude outliers, we limit ourselves to categories with more than 20 papers). Mathematics, which Russian scientific school is traditionally considered as “strong” (e.g. Karp & Vogeli, 2010), shows poor
performance as in terms of absolute number of highly cited papers, so of their share in national output (0.22%). Another unexpected example is chemistry, where proportion of Russian papers becoming highly cited (0.11%) is one of the lowest among scientific fields. This is surprising, given that chemistry occupies the second place by number of papers and citations in total Russian output and the fourth place by number of highly cited papers.

Table 1. Distribution of Russian highly cited papers across scientific fields (total number of papers: 927).

<table>
<thead>
<tr>
<th>Field</th>
<th>Papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics</td>
<td>468</td>
</tr>
<tr>
<td>Engineering</td>
<td>78</td>
</tr>
<tr>
<td>Clinical medicine</td>
<td>74</td>
</tr>
<tr>
<td>Chemistry</td>
<td>62</td>
</tr>
<tr>
<td>Geosciences</td>
<td>57</td>
</tr>
<tr>
<td>Biology &amp; biochemistry</td>
<td>43</td>
</tr>
<tr>
<td>Materials science</td>
<td>29</td>
</tr>
<tr>
<td>Space science</td>
<td>27</td>
</tr>
<tr>
<td>Mathematics</td>
<td>26</td>
</tr>
<tr>
<td>Molecular biology &amp; genetics</td>
<td>13</td>
</tr>
<tr>
<td>Environment/ ecology</td>
<td>12</td>
</tr>
<tr>
<td>Plant &amp; animal science</td>
<td>9</td>
</tr>
<tr>
<td>Microbiology</td>
<td>6</td>
</tr>
<tr>
<td>Social sciences</td>
<td>6</td>
</tr>
<tr>
<td>Agricultural sciences</td>
<td>3</td>
</tr>
<tr>
<td>Neuroscience &amp; behavior</td>
<td>3</td>
</tr>
<tr>
<td>Psychiatry/psychology</td>
<td>3</td>
</tr>
<tr>
<td>Computer science</td>
<td>2</td>
</tr>
<tr>
<td>Multidisciplinary</td>
<td>2</td>
</tr>
<tr>
<td>Pharmacology &amp; toxicology</td>
<td>2</td>
</tr>
<tr>
<td>Economics &amp; business</td>
<td>1</td>
</tr>
<tr>
<td>Immunology</td>
<td>1</td>
</tr>
</tbody>
</table>

International collaboration and share of Russian institutions

It was mentioned above that international collaboration is often a prerequisite for a high-impact research. Intuitively, this would be more pronounced for scientifically peripheral countries. For example, Aksnes (2003) finds that 63% of Norwegian highly cited papers have co-authors from other countries. But in case of Russia we get an astonishing result: only 75 out of 927 papers that we analyzed were written by Russian scientists only. About 92% of Russian highly cited papers involved international collaboration, which is several times higher than this share in the overall Russian output (35%). In some disciplines the share of internationally co-authored papers reaches 100%. All 57 Russian papers that have become highly cited in geosciences, 27 in space science, 13 in molecular biology and 12 in ecology have foreign co-authors, speaking of the categories with more than 10 highly cited articles.

This observation motivates us to study internationally co-authored Russian highly cited papers in more detail to gain a better understanding of the relative role of Russian authors in them.

Most often Russian highly cited papers have co-author(s) from one foreign institution (23%). We also found a paper which has 188 institutional co-authors from abroad. If we consider only papers which involved international co-authorship, the average number of international collaborators will be 12.3, the median—3.

If we apply institutional fractional counting to Russian highly cited papers, their number will be reduced from 927 to 312. Average share of Russian authors (in the sense of our institutional approach) in highly cited papers is about one third (34%) and approximately coincides with its median (33%).
It is more illuminating, however, to look at the characteristics of collaborative papers only. Fig. 1 separates purely Russian papers and shows distribution of all other articles by quintiles of proportion of Russian institutions in the list of their authors’ affiliations. It is clear that Russia is generally dominated by other countries in collaborative highly cited papers. Most often Russian institutions account for less than 20% of authors’ addresses (the first quintile—37%). For collaborative papers average share of Russian institutions is 28%, median is 25%.

![Graph showing distribution of Russian institutions in collaborative highly cited papers.](image)

**Figure 1.** Percentage of Russian highly cited papers with a corresponding share of Russian organizations in total number of institutional affiliations, by quintiles. Share of articles written exclusively by Russian authors (100%) is shown separately.

Share of Russian institutions’ participation in highly cited papers differs significantly across disciplines. If we limit ourselves to fields of science with more than 20 Russian highly cited papers (in terms of whole counting, all papers and not only collaborative ones are considered), there will be the highest average share of Russian organizations in chemistry and mathematics (54%) and the lowest in clinical medicine (15%). Physics, the most productive discipline, demonstrates a moderate 32% share. Transition to fractional counting also affects rankings of Table 1. The greatest changes are observed for mathematics (3 positions up) and clinical medicine (5 positions down).

On the one hand, this shows a significant contribution of Russian authors to the highly cited papers in chemistry and mathematics, and their rather subsidiary role in medicine. On the other hand, this may be interpreted as a lack of “internationalization” of the former disciplines. It is to be noted that the second argumentation wins in terms of percentage of highly cited papers in the total national output. As it was mentioned earlier, 0.61% of Russian papers in medicine have become highly cited, while for chemistry and mathematics this share is only 0.11% and 0.22% respectively.

**Russian institutions and leaders among them**

A total of 479 Russian organizations authored at least one highly cited paper. 128 of them are institutes of the Russian Academy of Sciences (RAS) or Russian Academy of Medical Sciences (RAMS), 45 are “non-RAS” institutes and research centers, 43 are higher education institutions.
The remaining 43 organizations, which do not fall into this classification, include commercial companies, state enterprises, hospitals, museums, etc. and are referred to as “other” (here we have even met one home address!).

The majority of highly cited papers, 664, were authored by institutions located in Moscow. Organizations located in Moscow region (excluding Moscow itself) published 293 high-impact articles. Then follows Saint Petersburg (161, without its region which accounts for 65 papers), Novosibirsk with its region (87), Tomsk with its region (22) and Ekaterinburg with its region (20). Institutions from only 35 out of 83 Russian regions authored at least one highly cited paper. Russian scientific “centers of excellence” are highly concentrated around “two capitals” (Moscow and St. Petersburg), the only possible exception is Novosibirsk, a large scientific city, where Siberian Branch of RAS is centered and Novosibirsk State University, one of the leading Russian universities, is located.

Table 2 shows Russian organizations, subdivided by their type, which published not less than 20 highly cited papers.

Almost all research organizations in Table 2 are physics institutes, which is only natural considering that the majority of Russian highly cited papers belong to this discipline. The only exception is Russian Cancer Research Center with 22 papers in medicine, although it has less than 10% average share in institutional co-authorship.

Nuclear physics as a field of specialization dominates in Table 2. However, Russian nuclear physics institutes generally have a small authorship share in highly cited papers, some of them account for only 10% of affiliations on average or even less. If we apply fractional counting, the leading position among all research institutions will come to Ioffe Physical Technical Institute, which scientific profile is broader, including several high impact papers in condensed matter physics, optics and nanoscience.

The largest university in Russia, Moscow State University, heads the list of higher education institutions and, in terms of fractional counting, the list of all Russian organizations. Every ninth Russian first-class paper is (co)authored by scientists from MSU. It is followed by “MEPhI”, which has again a strong focus on nuclear physics. Two St. Petersburg universities close this section. All four leaders have special status in Russian higher education system. They are either “Federal Universities” (MSU, SPbSU) or “National Research Universities” (MEPhI, SPbSPU), cf. (Schiermeier, 2010). This is not the case for the subsequent ranks: universities occupying 5th and 6th positions have not gained any special status.

According to Table 2, in general the share of universities in institutional collaboration is greater than that of research institutes. But here the picture is far from being homogeneous again. Strikingly, two Petersburg universities which published the same number of highly cited papers show diametrical contrast, with 26% average share in authorship for classical university and 2% for technical one.
Table 2. Russian institutions with not less than 20 highly cited papers (in terms of whole counting).

<table>
<thead>
<tr>
<th>Organization</th>
<th>Papers (whole counting)</th>
<th>Papers (fractional counting)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Russian Academy of Sciences / Medical Sciences</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Konstantinov Petersburg Nuclear Physics Institute, RAS</td>
<td>62</td>
<td>6.2</td>
</tr>
<tr>
<td>Lebedev Physical Institute, RAS</td>
<td>54</td>
<td>12.5</td>
</tr>
<tr>
<td>Ioffe Physical Technical Institute, RAS</td>
<td>45</td>
<td>14.7</td>
</tr>
<tr>
<td>Budker Institute of Nuclear Physics, RAS (Siberian Branch)</td>
<td>39</td>
<td>2.1</td>
</tr>
<tr>
<td>Institute for Nuclear Research, RAS</td>
<td>29</td>
<td>8.2</td>
</tr>
<tr>
<td>Landau Institute for Theoretical Physics, RAS</td>
<td>28</td>
<td>11.0</td>
</tr>
<tr>
<td>Blokhin Russian Cancer Research Center, RAMS</td>
<td>22</td>
<td>2.1</td>
</tr>
<tr>
<td><strong>Total for all RAS/RAMS institutes:</strong></td>
<td><strong>658</strong></td>
<td><strong>172.8</strong></td>
</tr>
<tr>
<td><strong>Non-RAS institutes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joint Institute for Nuclear Research</td>
<td>116</td>
<td>12.0</td>
</tr>
<tr>
<td>Institute for High Energy Physics</td>
<td>81</td>
<td>3.5</td>
</tr>
<tr>
<td>Institute for Theoretical and Experimental Physics</td>
<td>79</td>
<td>13.1</td>
</tr>
<tr>
<td>National Research Centre “Kurchatov Institute”</td>
<td>55</td>
<td>8.9</td>
</tr>
<tr>
<td><strong>Total for all non-RAS institutes:</strong></td>
<td><strong>280</strong></td>
<td><strong>50.0</strong></td>
</tr>
<tr>
<td><strong>Universities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lomonosov Moscow State University</td>
<td>108</td>
<td>36.1</td>
</tr>
<tr>
<td>National Research Nuclear University MEPhI</td>
<td>40</td>
<td>6.25</td>
</tr>
<tr>
<td>St. Petersburg State Polytechnical University</td>
<td>20</td>
<td>0.43</td>
</tr>
<tr>
<td>St. Petersburg State University</td>
<td>20</td>
<td>5.22</td>
</tr>
<tr>
<td><strong>Total for all higher education institutions:</strong></td>
<td><strong>263</strong></td>
<td><strong>80.5</strong></td>
</tr>
</tbody>
</table>

As for “other” organizations, which do not fall into the classification of Table 2, each of them has published no more than 3 papers. Their overall contribution is more than modest, 39 papers (10.0 by fractional counting). This demonstrates that the role of the commercial sector in producing high-impact papers is almost negligible in Russia.

**Collaboration between Russian institutions**

We may find intra-national co-authorship between Russian organizations in 258 out of 927 highly cited papers (28%). Among those papers which involve intra-national collaboration, the majority (140 papers) have only two Russian institutions in the list of affiliations. There is one paper which is co-authored by 10 Russian organizations, it is in biology/biochemistry.

Average number of Russian institutions in all Russian highly cited papers is 1.51. Interestingly, if we consider only papers where all authors are from Russia, this figure will change only marginally (1.56). This means that the international collaboration does not seriously affect the intra-national one.
Among disciplines physics, biology and engineering are the most “intra-collaborative” in terms of the average number of Russian institutions, chemistry and space science are the least. The former three disciplines also have the smallest proportion of articles with only one Russian affiliation (as usual, here we limit ourselves to the disciplines with more than 20 papers).

Table 3 shows the structure of co-authorship between different types of Russian institutions in highly cited papers. We observe a concentration of intra-national collaboration around research institutes. They generally publish highly cited papers in cooperation with each other rather than with universities. Higher education institutions show a significant share of intra-collaborative papers, but almost all of them are in co-authorship with research organizations. Only 12 highly cited papers (!) involved two different universities as partners, less than 5% of the total higher education sector high-impact output. In total research-higher education partnership produced 109 papers, which constitutes 90% of the universities’ intra-collaborative output and 45% of that of the research institutes. By now research institutions remain more important internal partners for universities than vice versa.

Table 3. Intra-national collaboration, by type of institution. For each institution type the share of all intra-collaborative papers and shares of papers in collaboration with different types of Russian institutions are shown (%).

<table>
<thead>
<tr>
<th>Type of institution</th>
<th>Total intra-collaborative</th>
<th>RAS/RAMS</th>
<th>Non-RAS</th>
<th>H.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAS/RAMS</td>
<td>29</td>
<td>9</td>
<td>17</td>
<td>11</td>
</tr>
<tr>
<td>Non-RAS</td>
<td>59</td>
<td>41</td>
<td>36</td>
<td>29</td>
</tr>
<tr>
<td>Higher education</td>
<td>46</td>
<td>28</td>
<td>30</td>
<td>5</td>
</tr>
</tbody>
</table>

As for the “other” organizations, they wrote the majority of their highly cited papers (64%) in intra-collaboration. If we look at the commercial organizations within the “other” category, we will find that there are only 9 papers co-authored by research institute and 2 by university. The cooperation between commercial and research/education sectors is very low.

Fig. 2 shows the map of intra-collaboration between Russian institutions in producing highly cited papers. The more papers were published by institutions in co-authorship, the less is the distance between them. We left only institutions with not less than 20 papers. Additionally, two organizations with only one paper written in collaboration with some of the other institutions from Fig. 2 were omitted.
Several properties of the internal collaboration of Russian institutions are clearly illustrated by the map:

(a) the center is occupied by three research institutes which form the backbone of the network. These are Joint Institute for Nuclear Research, Institute for High Energy Physics and Petersburg Nuclear Physics Institute, all focused on nuclear and particle physics;
(b) except for PNPI case, the geographical segregation is easily seen. Other Petersburg institutions (Ioffe, SPbSPU, SPbSU) as well as the only one from Novosibirsk (Budker) are found at the periphery of the map;
(c) there are weak collaboration ties between universities. In most cases they are closer to research institutes than to each other;
(d) in general, the level of intra-collaboration is higher for research institutions than for higher education sector. As a result, even the MSU, which ranks second in terms of the number of highly cited papers, is positioned not very close to the center of the collaboration map.

Conclusion
A number of studies have reported that Russian scientific productivity lags behind the world trend, e.g. the most recent work of Kirchik, Gingras & Larivière (in press). Our analysis extends these conclusions showing that the lag is particularly noticeable in the upper part of the pyramid of science, where, in the word of Bonitz (2002), “Olympic games in science” are held. There is no easy solution to improving the situation, obviously, major changes in the overall Russian science policy are needed. If we compare our results with those of Narin, Frame & Carpenter (1983), we may modestly assume that in terms of highly cited papers the relative position of Russia has slightly improved since 1970s. But all “centers of excellence” remained the same. Among research institutions in Table 2 the only exception is Budker Institute of Nuclear Physics which has not been listed by Narin et al. The “first-class science” continues to be made in the old renowned ex-Soviet research centers.

The widely accepted view is that international collaboration is almost a requirement for producing highly cited papers. This pattern is probably typical not only for scientifically peripheral countries. For example, Daraio & Moed (2011) conclude that for most EU countries “the quality of scientific production goes hand-in-hand with international collaborations”. However, our study shows that in the case of Russia this correlation reaches its extreme, when only 8% of highly cited papers are written exclusively by Russian authors. To some extent our study implies that all “successfulness” of the discipline may arise from activity of the international partnership in it, as it was shown for medicine, chemistry and mathematics. This effect may be observed not only for highly cited papers, but also for “ordinary” publications of a country, for example Pislyakov & Dyachenko (2010) find it for Russian articles in physics and chemistry.

Thus, if we tried to formulate, on the basis of the present study, some recommendations for policy makers, the first and most definite one would be to reinforce collaboration with the leading foreign centers. Quest for excellence should be international. Second, the collaboration between Russian research centers which tend to publish a significant number of highly cited papers together (e.g. those that form “the triangle of successful collaboration” on our map) also should be encouraged. These are two points in the category “how to make the good better”. If we had to put forward something in the “how to improve the bad” style, we would suggest that cooperation between Russian universities be strengthened, especially in the high-impact research. This type of collaboration, at the moment severely underrepresented in the Russian highly cited papers, also has strong potential for advancement of the national system of science and education.

References

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