Disciplinary Differences in Publication Output between Ex-COMECON Countries

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We continue a series of essays on scientometrics of the former Eastern Bloc member states, started in HERB №02 (see 25 Years After the Fall: Indicators of Post-communist Science by Ivan Sterligov and Alfia Enikeeva). This essay compares publication output in broad subject fields for all ex-COMECON states, examining complex dynamics of transition across a wide range of different economies and cultures. Presented data highlight major differences between several subgroups of countries.

Introduction

Disciplinary structure of various nations' publication output has long attracted attention of scholars and policy analysts alike. It is commonly understood that this structure is influenced by culture, geography and political regime of a given country but several studies show that for leading countries, this structure is often similar. Those countries that are catching up, i.e., quickly increasing publication output, are very likely to shift their disciplinary structure to this dynamic international standard. The most notable exception is Russia. According to Yang et al. (2012),[1] Russia is the only BRIC country that maintained its disciplinary structure in the Web of Science in 1991–2009 virtually the same, while the rest have galloped towards G7 average. Here we present an updated outlook of disciplinary shifts for a broad range of ex-COMECON countries using the wide-coverage Scopus database to find out if this is still the case for Russia. We also examine whether its former allies show similarly conservative trends.

Communist Legacy

To help our readers better understand the following bibliometrics data, we have to first add a few words to our aforementioned outline of Soviet R&D traits. We will focus on the things that use to influence disciplinary structure and those that are still relevant for many ex-COMECON countries.

Soviet academia was vastly different from its Western counterpart in many aspects, one of them being its combination of academic disciplines. Although USSR pursued research in virtually all branches of science and humanities, some were greatly prioritized over others.

To put it simple, strategic weapons and strategic defence were paramount. I. Tamm, L. Landau, S. Kapitsa, N. Semenov, I. Frank, V. Ginzburg — nearly all Soviet Nobel prize winners in the field of STEM were working on nuclear weapons at some point in their careers. A. Prokhorov and N. Basov, who shared this prize for their pioneering research on lasers with C.H. Townes, led two competing large-scale projects on laser missile defence. E. Slavsky, a long-time head of the Soviet nuclear R&D and industry, is believed to have said that his institutes employed more members of the USSR Academy of Sciences than a hundred institutes of the Academy itself.

Soviet leaders understood well that bombs, planes and rockets are impossible without broad-spectrum basic research in physics, chemistry, earth & planetary sciences, and mathematics. By contrast, biology and biomedicine were not nearly as significant and suffered from the consequences of sweeping repressions against geneticists during Stalin's reign. It's important to note that it was possible to publish basic research in Western journals in all STEM subjects but with certain restrictions.

Social sciences and humanities (SSH) were special in a different way. They were afflicted by ideological bias as the Soviet government forced Marxism-Leninism on teaching and methodology. It led to censorship and dismissal of theories alternative to mainstream views. Those who were reluctant to deal with marxist cliches could easily switch to studying all things obscure, like Hittite language, which were deemed harmless by the party, but the scope of Soviet SSH output available to international scholars was very limited.

Other academic systems in the Eastern Bloc wound up very similar to the Russian model, despite their natural and cultural differences. For the most part they were copying the Soviet Academy of Sciences with its broad-spectrum approach and a huge network of research institutes. The focus on megascience and nuclear physics was, however, much less prominent.

Nowadays the remnants of Soviet academies still dominate research landscapes of many ex-USSR countries,[2] while the rest have actively pursued a more EU-oriented approach and significantly changed their disciplinary balance. Larger COMECON countries in Europe (Poland, Czech Republic, Hungary, etc.) were long-established parts of European research community prior to WWII and by the end of the Cold War era combined Soviet and European features. After the collapse of communist regimes, virtually all of them rushed into EU grant programs, which quickly shifted their focus.

Bibliometrical Data and Their Limitations

Before presenting any findings on this balance, we have to highlight their limitations. We have analyzed various countries' publication output using Scopus/SciVal database. This database offers the best combination of coverage, accuracy and scope for measuring scholarly publications across a broad range of STEM and SSH disciplines but a) its accuracy for pre-1996 is not sufficient, and b) it includes only a small share of non-English periodicals from Russia and other states under consideration (about 300 out of circa 4500 Russian journals in 2014 and much fewer for previous years). There is huge bias towards academic output aimed at international audience, which is usually not the case for ex-COMECON authors working in the fields of humanities, social sciences and — to a lesser extent — medicine.

We have used a top-level OECD Fields of Science (FoS) category scheme, as it is a widespread and the most 'official' subject classification in R&D management. Table 1 shows the shares of six major subject groups for major ex-COMECON states in terms of publication count in 2014.[3]

Country	Agricultural Sciences	Engineering & Technology	Natural Sciences	Medicine	Arts & Humanities	Social Sciences
Belarus#	2	35	88	15	1	4
Azerbaijan#	2	38	87	11	2	6
Armenia#	2	17	84	17	2	3
Russian Federation#	4	30	84	15	3	7
Ukraine#	4	42	81	11	1	10
Vietnam	14	27	80	25	1	8
Georgia#	7	14	71	29	3	7
Kazakhstan#	5	16	70	12	4	14
Czech Republic*	12	22	67	37	3	7
Poland*	10	26	67	36	3	6
Romania*	7	29	67	28	6	12
Hungary*	11	17	65	40	5	9
Latvia*#	14	30	65	28	3	10
Germany	8	20	64	44	3	10
Estonia*#	14	18	64	29	9	17
Bulgaria*	14	21	63	29	2	5
Slovenia*	9	26	62	30	8	16
Serbia	12	28	62	36	3	8
Lithuania*#	11	28	59	23	6	22
Slovakia*	12	32	59	27	5	8
USA	7	15	52	51	6	17
Croatia*	11	18	51	39	8	16
Cuba	11	11	46	61	1	7

Table 1. Shares (%) of OECD top-level FoS subject groups for major ex-COMECON countries, Germany and USA, 2014. Document types: "article" and "review". Documents can be attributed to multiple subject groups, so for each country the sum of shares of all subject groups is more than 100%. Source: SciVal. #=ex-USSR, *=EU member. Table is sorted by share of publications in Natural Sciences.

The main distinctive feature of Soviet academia, i.e., heavy investment in natural sciences (mainly physics), is still common for all countries with an average of 68% of all publications being in that area. Former Soviet republics had the highest number of publications in natural sciences (80–96% in 1996) but it has been declining everywhere except Belarus (83% to 88%) and Turkmenistan (80% to 95%).

EU member states have much lower numbers in natural sciences. Their publication rate has declined in the past decade as Eastern European countries were trying to blend into the EU academic system.

Agricultural sciences accounted for just 1–3% of articles and reviews of ex-USSR scholars, and their growth in 1996-2014 was barely noticeable, except for Estonia, Latvia, and Lithuania. Other new EU members demonstrated a similarly pronounced increase in agricultural research. By contrast, Cuba and Vietnam for some reasons have lost slightly in this area.

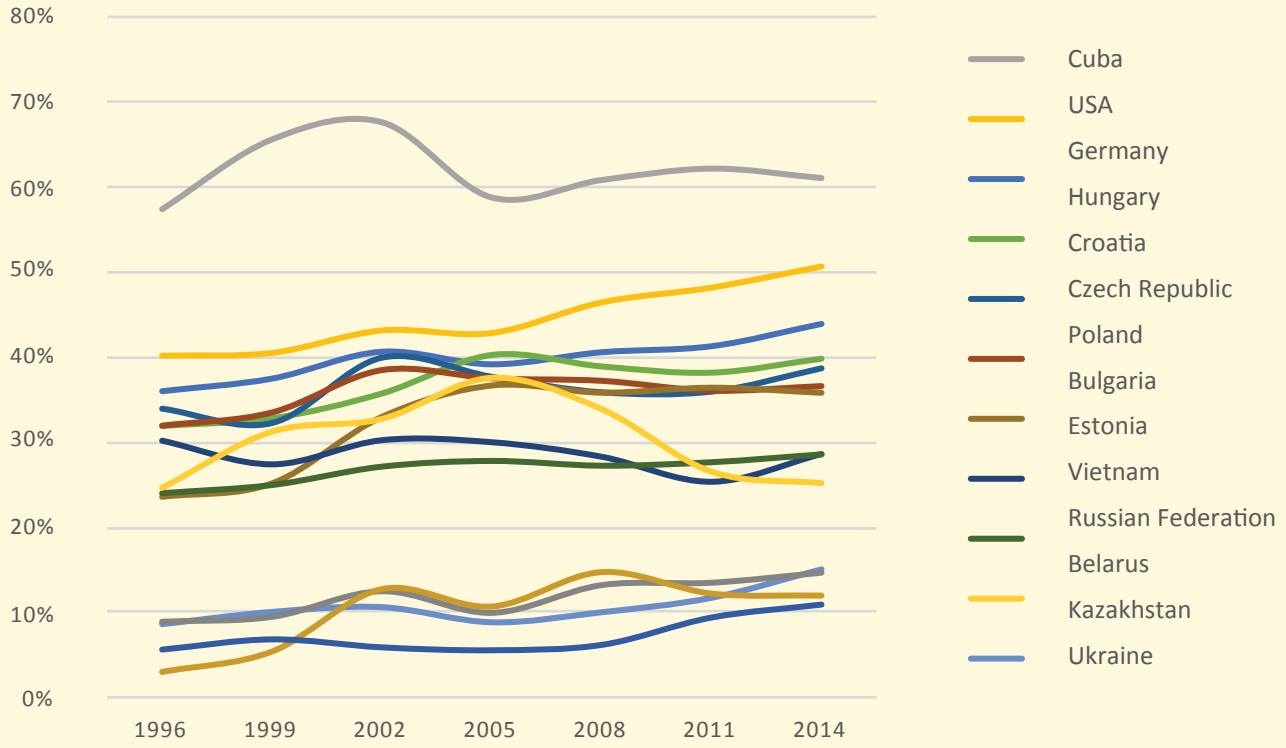

Figure 1. Shares of articles and reviews in OECD top-level FoS subject group 'Medicine' for major ex-COMECON countries, Germany, and USA, 2014. Document types: 'article' and 'review'. Source: SciVal

Cuba stands apart from all other post-communist countries, as medical sciences have always been top priority there. More than half of all Cuban research output is, according to Scopus, devoted to medical sciences. In the past few years this indicator has remained stable at circa 60%. All the other ex-COMECON countries, however, still lag behind the USA.

Nevertheless, post-Soviet medical sciences in EU-oriented states have experienced an internationalisation surge with the number of publications in Scopus-indexed journals rising across the board (with the only two exceptions being Montenegro and Slovakia). The share of medical publications was higher in EU member states and rose on average from 25% in 1996 to 31% in 2014, with the leaders being Croatia, Poland, Hungary, and Czech Republic (all over 35% in 2014).

Former Soviet republics have also shown a noticeable increase but their results remain drastically low compared to Germany or the USA. Such a modest share of medical research output in Scopus for Russia, Belarus, Ukraine ,and Kazakhstan is partly compensated by a vast Russian-language medical journal network. Sadly, these journals — more than 500 in Russia alone — remain unknown the English-dominated global research community.4 This brings us to the problem of local vs. global academic communities, which is crucial for modern ex-Soviet states. According to Russian Science Citation Database (RSCD), which covers virtually all Russian scientific journals, medicine was the second in popularity after economics in terms of Russian-language publication counts in 2014. Each of these two subject groups accounts for more than 50,000 RSCD articles per year, while Russia's total output in Scopus is less than 40,000 articles per year. The current RSCD disciplinary ranking is a reversed version of Scopus ranking for Russia — with economics, medicine, law, agriculture, and educational research occupying top levels.

These are exactly the areas of lowest output shares for Russia, according to Scopus.

In-depth analysis of such a profound contradiction is beyond the scope of this essay. We just have to mention that, while nationally-oriented academic communities in arts and humanities are typical for most non-English-speaking countries, the notion of 'national' medical research is clearly something worrying.

Social sciences in the former USSR republics, almost non-existent in Scopus in the 1990s (possibly due to a low number of indexed journals and English language bias), have experienced a moderate rise from an average of 0.6% in 1996 to 7.8% in 2014, but this number is still lower than in the majority of Eastern European EU members. Social sciences output in those countries has also risen from an average of 3.6% to 11.6% in 2014. Baltic countries are clearly the leaders here: Lithuania (from 2.9% to 21.5%), Estonia (from 2.2% to 17.2%) and Latvia (from 1.5% to 10.4%).

On the whole, our data is consistent with earlier studies. Russia, despite its recent reforms and a major move towards developing world-class universities, has exhibited only modest shift towards typical a US/EU17 research landscape, which is increasingly dominated by life sciences and medicine. The same applies to Belarus, Ukraine, and Kazakhstan. Poland, Czech Republic and other ex-COMECON EU members, on the other hand, had already by 1996 become closer to EU17, and later succeeded in pursuing this integration route.

We also highlight the problem of local vs. global academic communities in Russia, where the structures of national and international research output are partly inverted. This radical difference between Scopus and RSCD data poses further questions and suggests that all bibliometric comparisons should be drawn with due consideration for database limitations.

References

[1] Yang, L. Y., Yue, T., Ding, J. L., & Han, T. (2012). A comparison of disciplinary structure in science between the G7 and the BRIC countries by bibliometric methods. Scientometrics, 93(2), 497-516. doi:10.1007/s11192-012-0695-8

[2] Uzbek Academy of Sciences, for example, still operates 28 research centres including Institute of Ion-Plasma Technologies and Institute of Bioorganic Chemistry.

[3] We excluded all countries with fewer than 500 SciVal publications in 2014.

[4] Several of these journals are included in Scopus but for a large part are indexed so badly that Scopus has no information on author affiliations and addresses, so it is impossible to count them as 'Russian' articles.

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What Determines the Divide between Soft and Hard Sciences in Soviet and Post-Soviet Kazakhstan

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Soviet Past

The contemporary divide between hard and soft sciences in Kazakhstan originated in the pre-World War II period, when the republic's research system, embodied in the Kazakh branch of the Soviet Academy of Sciences, was originally established. The Soviet government was very practical in cultivating research capacity of the Kazakh Soviet Socialist Republic. Research priorities were set, infrastructure was developed, and funding was distributed in accordance with the needs of the military, industrial, agricultural, and public health initiatives in the region. Economically, Kazakhstan's primary role was to supply a variety of natural resources for the plants and factories at the later stages of the production process, which were geographically concentrated in the European parts of the Russian Federative Socialist Republic and its western neighbours.

Much of the research activity, conducted predominantly in Russian in collaboration with the Russian Academy of Sciences, was concentrated on the geographic mapping of mineral resource locations, on assessing the composition of the locally extracted ores and rocks. In addition to that, Soviet Kazakhstani research was concerned with the exploration of the most economically efficient approaches to extract minerals out of the ores and rocks. In military-sector-driven research agenda, three lines were particularly important: (a) research related to the exploration of space; (b) research related to nuclear weapons production and testing; and (c) research related to biological weapons production and testing. Given the strategic view of Kazakhstan as the main agricultural production region of the Soviet Union, Kazakhstan had a strong capacity in research connected with exploration of the regional biodiversity, plant and animal breeding, veterinary science, and applied research related to testing of herbicides and pesticides. Finally, as the environmental conditions and health of the local population deteriorated as a result of the implementation of biological and nuclear weapons testing, as well as heavy use of pesticides and herbicides, research in medical