








“Sanctions against russian science: Pros and cons”

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SANCTIONS AGAINST RUSSIAN SCIENCE: PROS AND CONS

Abstract

This paper examines the advantages and disadvantages of imposing sanctions on Russian science, along with the measures enacted to penalize or restrict it. Proponents of sanctions argue that accountability is essential, and a tangible cost must be imposed for Russia's actions. Sanctions can serve as a signal to end war and aggression, weaken Russia's economic foundation, and exacerbate brain drain, potentially hindering the development of military technologies and reducing Russia's capacity to sustain its aggression. Furthermore, some Russian academics openly support the war and should be held accountable for their stance. However, significant opposition to sanctions exists. A prevailing argument, often mirrored in fields like sports and culture, is that science should remain apolitical. Critics contend that sanctions disrupt the free exchange of ideas, penalize innocent individuals, and may harm global scientific progress and human development, given Russia's integral role in international research. Additionally, sanctions are often criticized as costly and inefficient. Despite these debates, a variety of restrictive measures targeting Russian science have been implemented. These include funding cuts, suspension of collaborations, termination of joint projects, and exclusion of academics linked to the Russian regime. Other measures involve companies closing R&D facilities in Russia, restrictions on scientific equipment and reagents, boycotts of Russian-organized conferences, and the suspension of international research partnerships. This study synthesizes the arguments for and against sanctions on Russian science and provides an analytical discussion to shape a nuanced perspective on this complex issue.

Keywords

sanctions, restrictions, science, research, academics,
Russia, Ukraine, war, politics, propaganda

JEL Classification

F51, H56, P16

INTRODUCTION

On February 24, 2022, the Russian Federation launched a military invasion of Ukraine. The invasion is ongoing, and after 2 years, fighting is getting even more bitter. Since the start of the war, the UN Human Rights Office, OHCHR, has verified 29,579 civilian casualties – 10,242 people killed, including 575 children, and more than 19,300 injured, including 1,264 children (according to the 2024 data) (UN, 2024).

Millions of Ukrainian citizens have been forced to leave Ukraine; a lot have lost their homes and workplaces. The United Nations recorded eight million refugees across Europe (20% of the Ukrainian population), with a further five million internally displaced (Naujokaitytė, 2023).

Ukraine's GDP fell 29.1% in 2022 (Matters, 2023). Significant damage was done to civil infrastructure, residential buildings, hospitals, and educational and scientific institutions (Nazarovets & Teixeira Da Silva, 2022). 3,145 education institutions have suffered bombing and shelling (415 of them have been annihilated), over 50 research institutions have been damaged or destroyed, and around 40% of the country's research workforce has been affected by the

war (International Science Council, 2023). About 5% of scientific employees and 8% of scientific and pedagogical employees who work in higher education institutions left the territory of Ukraine and went to other countries (Naujokaitytė, 2023).

To punish russia for its unprovoked and non-motivated aggression, a lot of different sanctions were adopted: against the russian federation, against russian companies, against russian individuals in different spheres from military and economy to culture, sports, and science. Overall, more than 22,000 different sanctions are currently active against russia. This is the highest number ever in human history. russia is 3+ times more sanctioned than Iran, 5+ times more than Syria or North Korea (Castellum, 2024).

1. LITERATURE REVIEW

Analysis of the current state of publication in academia on sanctions against russia with in-built Scopus instruments shows a lack of relevant academic literature on this topic. Exploratory search string (TITLE-ABS-KEY (sanctions) AND TITLE-ABS-KEY (russia OR russian AND federation) gives 734 documents from 1985 to 2024 with the growing number of publications after 2014 (Crimea occupation, start of the ATO) and peak in 2023 (Figure 1).

To identify the places of specific sanctions against russian science, bibliometric maps were created in VoS Viewer (Figures 2 and 3).

The most influential clusters of the papers are the ones combining the economy-related sanctions in

the context of food security, food chain disruption and flows (yellow) and international trade (green cluster). The purple cluster presents the energy market consequences of sanction, red – sustainability consequences, and light blue – social implications.

Science and scientific community nodes are part of the last cluster of papers, but they are relatively small, supporting the idea that sanctions against russian science are an emerging topic in academia. Moreover, they are the newest nodes in the cluster from the point of chronology (in yellow, Figure 3).

Discussion of arguments and opinions in favour and against the sanction is the main idea of such a few papers representing that node.

Plackett (2022) focuses on the change of the collaboration vector in russian science from West to

Source: Elaborated by the authors (in-built Scopus instruments).

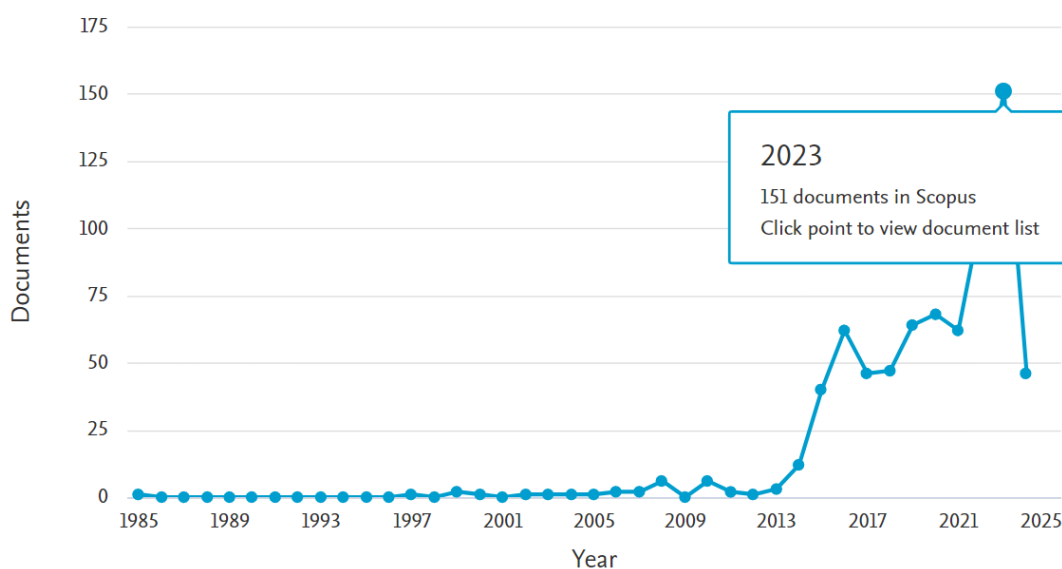


Figure 1. Publication activity on sanctions against russia in 1985–2024, papers

Source: Elaborated by the authors (VOSViewer).

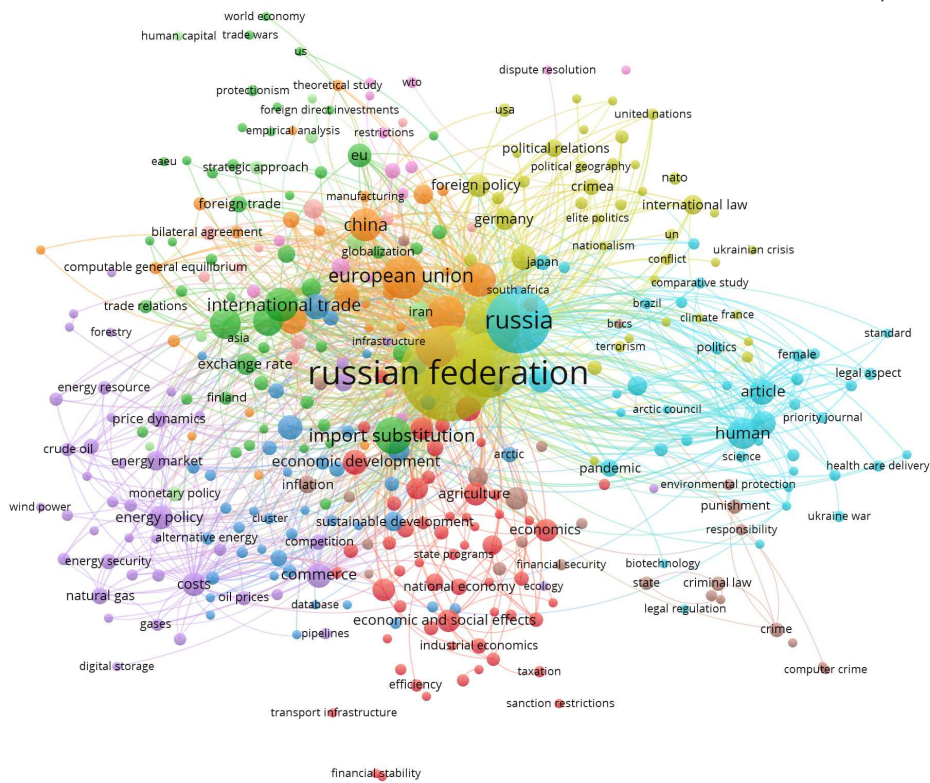


Figure 2. Keyword bibliometric map on publications in sanctions against Russia in 1985–2024 (co-occurrences mode)

Source: Elaborated by the authors (VOSViewer).

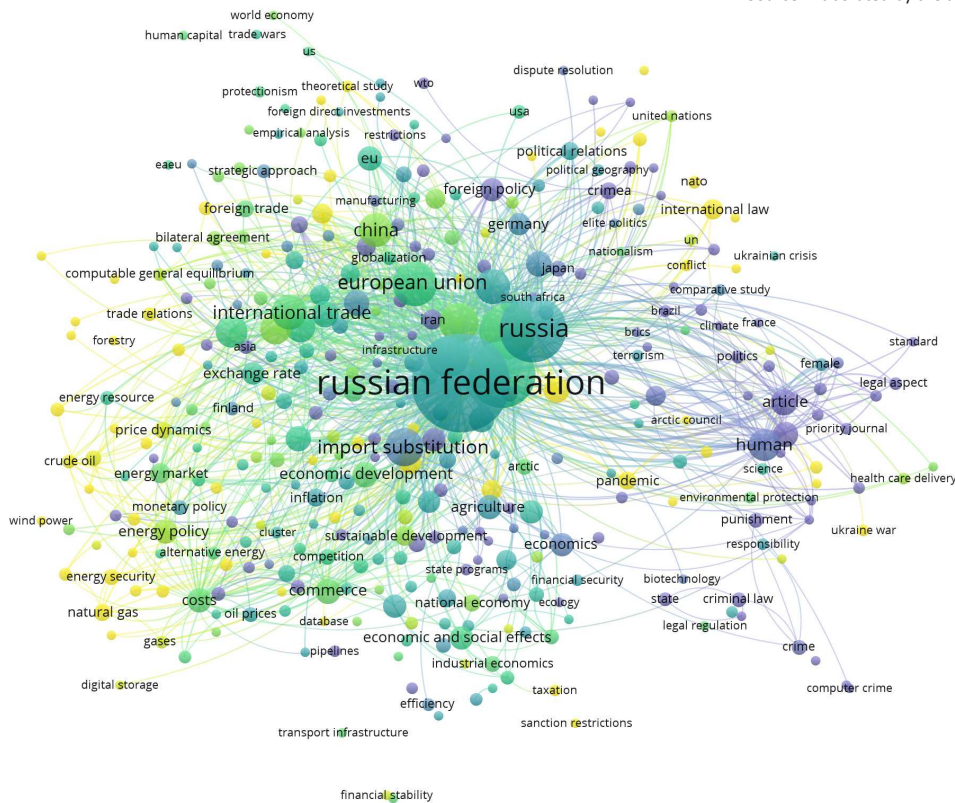


Figure 3. Keyword bibliometric map on publications in sanctions against Russia in 1985–2024 (chronology mode)

East (while the main collaborator is China now). Nazarovets and Teixeira Da Silva (2022) prove the fact that banning publication in international journals of russian-affiliated authors remains controversial. Otherwise, Koonin (2022) highlighted the need to balance moral stances with practical support for individual russian-affiliated authors. Pulverer (2022) focused on balancing immediate actions to support Ukraine with long-term strategies to foster international scientific cooperation and resilience. Nielsen and Kaisto (2024) foster ongoing dialogue about the implementation and effectiveness of sanctions in the context of russian sanctions, demonstrating their ethical and practical dilemmas.

All the above mentioned papers have a qualitative focus. Makkonen and Mitze (2023), applying quantitative tools with time-dynamic regressions reveal that the impact of sanctions on scientific collaboration intensifies over time. This highlights the vulnerability of global knowledge exchange to geopolitical conflicts.

But still, there is no consensus and clear argumentation in favor or against sanctions on russian science. In order to sum up existing discussion about sanctions against russian science, this paper explores pros and cons in sanctioning against russian science as well as a final discussion to justify their necessity.

2. RESULTS

2.1. Arguments in favor of sanctions against russian science

2.1.1. A price to pay

russian aggression against Ukraine has created huge losses in different spheres: killed and wounded Ukrainians, millions of broken lives, hundreds of billions of USD in material losses.

After less than one year after the full-scale invasion, 361 educational institutions were destroyed, and another 2,556 were damaged (Ostapenko et al., 2023).

Ukraine lost a fifth of its research capacity after the russian invasion. Research time has fallen among

Ukrainian scientists while 17% have left the field altogether (Dixon, 2023).

The idea for sanctions in this case is quite simple: there should be responsibility for actions, a price to be paid.

2.1.2. A signal to stop the war

Anne Borg, Rector of Norwegian University of Science and Technology, thinks that freezing cooperation is a peaceful weapon, but history has shown that it can have a significant effect. Sanctions would be a signal to stop the war (Moe, 2022).

Sanctions are among the most important and influential ways to use nonmilitary means to pressure russian citizens to end the war (Else, 2022; Sher et al., 2022).

2.1.3. Eroding russia's economic base

Commission president Ursula von der Leyen said that one of the goals of sanctions is to erode russia's economic base sharply and slash any prospect of modernizing it. To achieve this, russia should be cut off from global science (Matthews, 2023).

2.1.4. A brain drain

Sanctions are a good stimulus for adequate academicians to leave russia and continue their academic activity elsewhere.

Just weeks into russia's war on Ukraine, academics are leaving the country (Lem, 2022c).

2.1.5. russian academic sphere as the source of propaganda

russian universities are a weapon of the state – they pose a danger both inside and outside the country by spreading toxic propaganda messages. They are part of an apparatus that means that almost 90% of russians support not only war in Ukraine but also the invasion of other European countries (Chumachenko et al., 2022).

Kremlin leverages state-controlled institutions to aid in its disinformation campaign against Ukraine (The White House, 2022).

Institute of Russian History RAS of the Russian Academy of Sciences has developed a propaganda textbook on Russian history with justification for war (RBC, 2023).

2.1.6. Russian academicians as supporters of war

The soundest case is the famous Rector's letter. Right after the start of full-scale invasion, the Russian Union of Rectors, which represents more than 700 university rectors and presidents, issued a statement to support the invasion of Ukraine by the Russian Federation.

"It is very important in these days to support our country, our army, which defends our security, to support our president, who, perhaps, made the most difficult, hard-won but necessary decision in his life," they state (Lem, 2022a).

Statements in support of war were also issued by the Russian Academy of Sciences Presidium (2022), Academic Council of Lomonosov Moscow State University (2022) as well as individual academics, including those from Saint Petersburg State University (n.d.), and many others (Moskovsky Komsomolets, 2022).

President of the Russian Academy of Sciences (RAN) Gennady Krasnikov became a member of the Security Council of Russia (a principal military authority directly responsible for the start of the Russian invasion of Ukraine) (RBC, 2024a).

The appropriation of the Zaporizhzhia nuclear power plant and the importation of Russian scientists and engineers to its territory is not only a direct violation of international laws but a security threat to the whole world (Chumachenko et al., 2022).

2.1.7. Sanctions might prevent the research and development of military and military-related equipment

Scientific results can be misused for military purposes, exposing the ambivalence of science.

According to Albrecht et al. (2023), scientists make wars possible through their research. Natural and technical sciences research leads to the develop-

ment and use of armed drones and automated weapon systems. Findings from mass psychology, media, and opinion research are central components of military strategy – propaganda is the best-known example.

The U.S. Department of the Treasury's Office of Foreign Assets Control (OFAC) taking actions against the Russian Academy of Science branches provide the following motivations:

- being owned or controlled by, or for having acted or purported to act for or on behalf of, directly or indirectly, the Government of the Russian Federation;
- acquiring and attempting to acquire U.S.-origin items in support of the Russian military;
- responsible for achieving results in the implementation of technological priorities in Russia, particularly in areas of strategic importance (U.S. Department of Treasury, 2023).

President of the Russian Academy of Sciences Krasnikov said that during the war, Russian scientists quickly developed new materials from which they created body armor for military personnel with unique protective properties (RBC, 2024b; Korshunova, 2024).

2.2. Arguments against sanctions on Russian science

Despite these and other arguments "in favor" of sanctions, there are many voices against. That is why it would also be fair to discuss the other side.

A Science4Peace Forum provides a collection of such arguments (Albrecht et al., 2023). Existing statements and positions were summarized and that created the following list of arguments against the sanctions.

2.2.1. Science is out of politics

One of the key arguments against science (often seen in other spheres like sports or culture) is that science is out of politics. War is a continuation of politics (Esposito, 1954), that is why war should not be reason for sanctions in academic

sphere. However, neutrality is inapplicable in this situation. Russia's unjustifiable military invasion of Ukraine is unprecedented; it requires unprecedented reactions from the world scientific community (Chumachenko et al., 2022).

The argument that “science is out of politics” is extremely strong. On the contrary, in many cases, Russian science works on the Russian military, providing new technologies, new equipment, new ammo, new medicine methods to help soldiers, etc.

In addition, Russian science often acts as a window for Russian propaganda. Many papers are published in international journals in which the annexed territories of Ukraine (Crimea and Donetsk, Luhansk, Zaporizhzhia, and Kherson regions) are mentioned as Russian. There are cases of justification of Russian aggression in academic papers, as well as pure propaganda of Russian narratives.

2.2.2. Sanction might disrupt the free flow of thoughts

Sanctions (like banning Russian academicians in international journals) violate academic freedom. The rectors' conferences of Belgium's Dutch- and French-speaking regions issued a joint statement asking all governments to “make sure that academic cooperation can continue as much as possible, as it allows the free flow of thoughts even during the darkest hours of armed conflict” (Upton, 2022b).

Yuko Harayama, co-chair of the Japanese Association for the Advancement of Science, believes science must remain open (Naujokaitytė, 2022).

Relocation and change of affiliation can be effective tools to fix the problem of sanction in individual level. However, if one stays in Russia and is affiliated with the Russian regime, it is one's choice, with possible consequences known in advance.

Anonymous German researcher in Science | Business survey: “Free research needs free people and a free mindset! No collaboration with dictators, autocrats, and nations not respecting humanity!” (Science | Business, 2022).

2.2.3. Sanction might punish innocents

Sanctions act as a mass-destruction weapon. This means some sanctions are individual, but some are sectoral. In the case of sanction against Russian science, the criterion might be as simple as it could be: nationality. This seems unfair. As a result, sanctions might punish even those students and academics who have spoken out against the war or those who do not support Russian aggression but are silent (Ross, 2022).

There are evidence that the thousands of Russians (including academicians) have risked arrest protesting against the war (Upton, 2022b).

On 2 March, just days after the full-scale war started, the National Research Foundation sent off 49,000 emails to Russian researchers with an appeal to condemn the invasion and not be silent. Only 12% of the foundation's responses were supportive or neutral. The rest showed clear support for their country's aggression (Naujokaitytė, 2022).

Or another example. Nazarovets and Teixeira da Silva (2022), based on the letter ‘against the war,’ concluded that only about 2% of all Russian scientists had shown their negative stance on this war.

2.2.4. Too big to fail

Russian science is a crucial element of global science. Any sanctions against it will hurt the international academic community. Several global projects risk being called into question since, without Russian participation will not be easy (if not impossible) to implement them (Voronin, 2022).

Global challenges (climate change, biodiversity, poverty, and other SDGs) can hardly be solved without Russian territory and the expertise of Russian scientists. This might be hurt with further consequences for the world (Naujokaitytė, 2022; Reuters, 2022).

The importance of Russian science is one of the myths surrounding Russia and its importance to the world. This myth can be easily busted with different metrics: share of Russian publications in the world, share of citations on Russian publications in the world, number of journals, and positions in various academic rankings.

Table 1. Nobel Prize laureates from russia

Source: Elaborated by the authors based on the Nobel Prize (n.d.) data.

Field	1990–2023		
	Overall	russian federation	Share of the russian federation
Physics	87	3	3%
Chemistry	80	1	1%
Physiology or Medicine	78	0	0%
Literature	35	0	0%
Peace	51	2	4%
Economic Sciences	66	0	0%
Overall	397	6	2%

The most sound and easy-to-understand criterion is the number of Nobel Prize laureates (see Table 1).

Without the “Peace” category (in current conditions, “Peace” in the context of russia looks quite strange), the share of russian science is 1%. Therefore, the argument about the global importance of russian science is not undisputed. Additional evidence in this favor is a share of publications in the top 25% quartile. According to Scopus, only 20% of russia-affiliated publications were published in Q1 (overall, 60% of russian publications were published in low-quality Q3-Q4 journals).

Finally, the last argument regarding this. In 2023, the list of highly cited scientists included 6,835 researchers from 64 countries. Of these, 2,542 indicated organizations located in the United States as their primary affiliation, 1,350 in China, 562 in the United Kingdom, 333 in Germany, and another 298 in Australia. russia has 8 (yes, simply, eight) highly cited researchers: 318 times less than in the USA or 0.1% from the overall number (Foresight Center, 2024).

2.2.5. Sanctions are not a solution

Mass-sanctioning russia will not solve the problem. This argument claims that sanctions against russian academicians will not stop the war (Osipian, 2022). Sanctions will not help to achieve a ceasefire or resolve the conflict and will do nothing to help bring about change in russia.

Kurt Deketelaere, secretary general of the League of European Research Universities, contrasted the modest funding russia has won for European Union research with the hundreds of millions

paid to Gazprom, the state-owned energy company (Upton, 2022a).

Joint projects with russia can be done for the benefit of all the world, and cutting out russian scientists might be counter-productive (Reuters, 2022).

Jan Palmowski, secretary general of the Guild of European Research-intensive Universities, claims, “current actions mean in terms of future consistencies and what are the limits, because ultimately, we will have to collaborate with systems we do not agree with” (Upton, 2022a).

2.2.6. Sanctions are not working

There are doubts about the efficiency of sanctions (Baker, 2022).

On May 1, 2022, Science4Peace initiative launched a petition stating that the sanctions imposed on scientists are counterproductive; they do not put pressure on the russian government (Mottaz, 2022). Sanctions are not working which is why they are useless. The analysis provided in this paper shows that sanctions are working: fewer papers are published, fewer citations are generated, fewer conferences are held, fewer funding is obtained, fewer projects are realized.

These examples are evidence that sanctions are targeting the dominating majority.

To conclude, arguments against sanctions seems less powerful than those in favor. No wonder many sanctions against russian science since the 2022 invasion were adopted. Below is a brief discussion of the most important ones.

2.3. Sanctions against russian science: A brief overview

Despite a discussion and opposition (silent or active) against sanctions, a lot of sanctions against the russian science were adopted.

Science|Business online survey showed that nearly 70% of the 240 individuals who identified themselves as researchers said they agree that “scientific relations with russia should be sanctioned in some manner.” Another 21% disagreed, and the remaining 9% were not sure (Figure 4).

As a result, a lot of measures to punish/restrict russian science were adopted. The rationale for sanctions includes cutting off russia’s access to new technologies, scientific research, and information support.

These measures include funding restrictions, halting collaboration with russia, closure of common projects or removal of academicians associated with the russian regime, companies closing their R&D departments in russia, restrictions and limitations in equipment and reagents, academicians refusing to participate in scientific conferences and international events organized by russia, as well as joint research projects with russia, etc.

Some examples of sanctions adopted by countries are presented in Appendix A, Table A1.

Moreover, there were sanctions initiatives at the individual universities/organizations. For example, the Massachusetts Institute of Technology has ended a decade-long partnership to establish an industrial-academic development on Moscow’s western outskirts (Basken, 2022). Australian

National University has cut ties with russia (Ross, 2022). The German Research Foundation Deutsche Forschungsgemeinschaft (DFG) has close research ties with russia (Matthews et al., 2022).

A number of research projects were frozen or excluded russia from participation (Table A2). A bunch of international organizations suspended russian membership:

- International Union of Speleology (Union Internationale de Spéléologie – UIS);
- European Association of Urology (EAU);
- The International Geographical Union (IGU);
- European federation of Psychologists Associations (EFPA);
- All European Academies (ALLEA);
- the European Association for Quality Assurance in Higher Education (ENQA);
- The European Foundation for Management Development (EFMD);
- the Association of MBAs (AMBA);
- Business Graduates Association (BGA);
- And many others.

Another interesting and important moment is the closure of R&D departments in russia by international companies (Table A3).

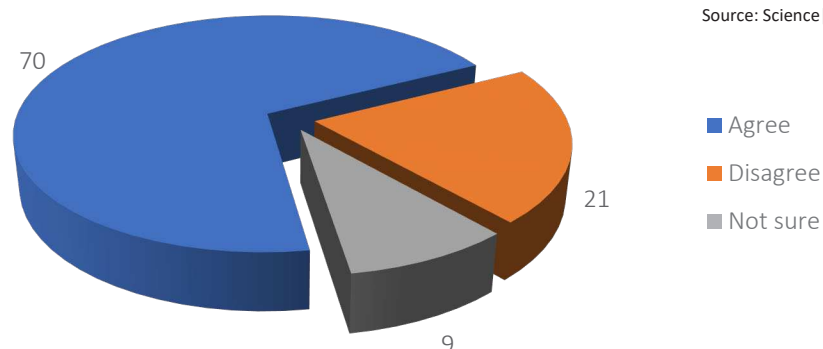


Figure 4. Science|Business online survey results on the European researcher support of the sanctions against russia

2.3.1. Equipment, reagents, and materials restriction

The EU has banned the export of technical equipment of various kinds. Companies like Zeiss, Nikon, or Thermo Fisher Scientific stopped or paused sales and manufacturing operations in Russia.

At the start of 2022, up to 80% of tenders for the supply of equipment to Russian universities and research institutes were won by foreign companies (Voronin, 2022). According to Head of the Laboratory of Epigenetics, Institute of General Genetics, named after N.I. Vavilov RAS Sergei Kiselev, the dependence of the “life sciences” on Western reagents is, if not 100, then 90% (Vedeneeva, 2022).

Some specific equipment like spectrometers, X-ray equipment, and electron microscopes are produced mainly by the USA and Japan. According to Director of the Institute of General and Inorganic Chemistry named after N. S. Kurnakova RAS Vladimir Ivanov, it would be hard or impossible for Russia to buy such things under sanctions conditions (Vedeneeva, 2022).

In addition, a lot of equipment is located in European or US laboratories. As a result, Russian academicians lose access to vital elements of research (Lenchuk, 2022).

According to COMTRADE, in 2020, the volume of imports of research equipment to Russia amounted to USD 2.8 billion, of which 13.8% came from Germany and 6.1% from the United States (Balatsky et al., 2022).

2.3.2. Academician PR

PR is an important aspect of the academic sphere as well.

Quacquarelli Symonds, the agency responsible for QS World University Rankings, stopped cooperation with Russia and Belarus. This means that Russian universities (48 in ranking before the full-scale invasion in 2022) are not presented in this list since 2022 (QS, 2023; Kazakov, 2022).

2.3.3. Indirect sanctions

Sanctions against Russia are highly diverse, including visa restrictions, flight limitations (European skies are closed for Russian aircraft, so additional hubs like Turkey or UAE should be used to reach the destination for Russian academicians), problems with payments (Visa and Mastercard have left Russia and most of the Russian banks are sanctioned), the fall of the Ruble (as a result increased costs), etc.

For example, because of economic sanctions against Russia, publishers cannot charge APCs for publishing (Matthews, 2022b).

2.3.4. Countersanctions and self-sanctions

Russian Government decided not to take into account the indexation of publications in international bases (like Scopus or WoS) when assessing the results of academicians or organizations (Lenchuk, 2022).

Russian institutes typically prevent from continuing their work those scientists who had left Russia because of the mobilization or anti-war position (Maksimova & Pietari, 2023). Russian Federation has started a campaign against its academicians, especially those involved in research projects with secret information. Their publications in international journals or presentations in international conferences as well as participation in international projects were treated as passing secrets.

Charges have been filed against physicists involved in Russia's hypersonic missile program, Anatoly Maslov, a hypersonics expert Dmitry Kolker, physicist Aleksandr Kuranov, Aleksandr Shipyuk, Valery Zvegintsev, Vladislav Galkin, Anatoly Gubanov, Valery Golubkin, Vladimir Kudryavtsev, Roman Kovalev, Sergey Mereshchakov, etc.

As a result, some cases of state treason were initiated with real prison sentences. Anatoly Gubanov and Valery Golubkin were sentenced to 12 years in a maximum security colony. Dmitry Kolker died two days after his arrest (Radio Svoboda, 2024).

This witch-hunting is still in progress. In April 2024, the trial of Novosibirsk physicist Oleg Kabov (head of the laboratory of the Kutateladze Institute

of Thermophysics, Siberian Branch of the Russian Academy of Sciences) has begun (Voronov, 2024).

On May 24, the Russian Minister of Science and Higher Education Valery Falkov announced Russia's withdrawal from the Bologna system (Kazakov, 2022).

At the start of full-scale invasion, Dmytro Chumachenko in Open Letter from Scientists of Ukraine regarding Russian military intervention proposed the following list of sanctions against Russian science:

- to block access to all scientometric databases and materials of scientific publishers for citizens and institutions of the Russian Federation;
- to make it impossible for researchers affiliated with institutions and scientific institutions of the Russian Federation to participate in international grant programs funded by the European Union and other partners;
- to suspend the participation of researchers, students and institutions from the Russian Federation in current international academic mobility programs;
- to boycott attempts at holding scientific events on the territory of the Russian Federation (in particular, scientific conferences, symposiums, etc.);
- to suspend indexing of scientific materials published in the Russian Federation in all scientometric databases;
- to prohibit citizens of the Russian Federation from being editors/co-editors/reviewers of international publications (Chumachenko, 2022).

As can be seen, after 2+ years of full-scale war, Chumachenko's list is covered by existing sanctions only partially; still, the damage was done.

2.4. Consequences and discussion

Consequences from the sanctions are very diverse, ranging from isolation and lack of financing to problems with equipment, reagents, and brain drain.

To be unbiased and to show the potential and actual consequences of sanctions on Russian science, the results of a Russian poll by PCR.NEWS of Russian academicians (Markina & Leskova, 2022) and text of the open letter of Russian academicians after the start of full-scale invasion (T-invariant, 2022) were used. A summary is presented in Table B1.

Based on a poll of 1967 Russian scientists, the following critical consequences of sanctions could be mentioned. Three-quarters of highly productive Russian scientists (76.2%) faced at least one of the sanctions restrictions. They include reduced access to digital resources and libraries (57.5%), reagents and materials (51.6%), foreign software, equipment and databases (48.1%). Every third person (32.3%) was denied acceptance of articles in international journals, and/or their foreign internship was canceled (31.5%). Every fifth person faced a refusal from foreign colleagues to co-author a publication (20.7%), and almost the same number (18.8%) received a refusal to apply for participation in foreign scientific events. 15.2% of respondents were excluded from joint research projects with foreign colleagues, and another 6% lost membership in the editorial board/professional association/expert group (Dezhina & Nefedova, 2024).

As can be seen, sanctions are indeed working. Moreover, there are some additional facts related to the consequences of sanctions on Russian science.

Moscow lost 13 positions and fell back to 60th in Nature's "Leading 200 Science Cities" ranking. Compared to 2022, the number of publications by Moscow scientists in leading scientific publications taken into account by Nature decreased by 217 (almost 23%). This was the lowest number of publications ever (Nature, 2023).

The number of Ph.D. students in the Russian Federation in 2022 decreased by 30% compared to 2010, and the number of new Ph.D. degrees in 2022 fell almost three times compared to 2010: from 33,700 to 11,400 (Sadovnychyj, 2023). In 2023, the situation got significantly worse: the number of new Ph.D. degrees decreased by almost a quarter compared to 2022 (RBC, 2024c).

One of the reasons for such failure was a lack of financing. On the one hand, russian scientists will have to say goodbye to the already familiar grants allocated for international scientific research from abroad. On the other hand, war is highly costly and is priority in the russian budget. As a result, in 2022, there was a 6-year record “sequestration” of the budget for scientific development, cutting it from 626.6 to 569 billion rubles. The situation is only worsening because sanctions against the russian economy are increasing, and budget gaps are increasing.

The budget for 2023–2025 plans to allocate 492 billion rubles (USD 6.33 billion) to civilian science in 2023, 490 billion rubles (USD 6.3 billion) in 2024, and 473 billion rubles (USD 6.09 billion) in 2025. The tendency is clear. An obvious result would be a decline in equipment quality and resources available to research institutes and centers, such as the inability to replace or repair old equipment. Additionally, scientists’ salaries, which are already relatively low except for a few areas such as physics and bioinformatics, may also be impacted (Maksimova & Pietari, 2023).

In 2024, expenses for the federal project “Development of infrastructure for scientific research” will be cut in half. The federal project, within which it was planned to purchase instruments and equipment for universities and research centers throughout russia, will spend 47.8 billion rubles instead of the 97 billion included in the budget law adopted a year ago.

The authorities plan to slash the state program “Scientific and technological development of russia” (within this program, academic research projects are financed) by 150 billion rubles during 2024–2026.

Similar processes are observed on the micro level. russian Foundation for Basic Research is expecting for Rb1.15 billion decrease, while Moscow State University said to slash its budget by 10% in 2022 (Lem, 2022b).

Another necessary consequence is that many russian scientists have physically fled the country. Novaya Gazeta Europe, a russian newspaper-in-exile, in August 2022 (before mobilization in russia), counted more than 270 russian academics who had left the country since the war started. Borissova Saleh (a russian science journalist) estimates that thousands of scientists have left, “if not dozens of thousands” (Matthews, 2023). The russian Academy of Sciences has calculated that over the past 5 years russia has lost 50 thousand researchers who left science or left the country altogether (Parmon, 2023).

Scientific equipment shortages present another hurdle to russian science caused by sanctions. Sanctions on logistics, software, computing, banking and technology imports caused big problems in russian labs, in form of shortages of reagents and seeds, equipment and materials (Matthews, 2022a). For example, the EU has banned the export of a huge range of technical equipment to russia, including mass spectrometers and oscilloscopes. The US has banned exporting semiconductors, computers, lasers, and sensors to russia.

The same is true for the micro level. Thermo Fisher Scientific (regularly ranked as the biggest in the world) had paused sales and manufacturing operations in russia and Belarus (ThermoFisher Scientific, n.d.). Nikon, a key producer of microscopes, has suspended shipments to russia (KSE Institute, 2024d). Deficit of everything caused significant price growth and costs for the scientific activity have risen sharply.

CONCLUSION

This study summarizes the existing discussion about the pros and cons of sanctioning russian science and provides evidence both supporting and questioning their efficiency.

Proponents of sanctions emphasize their importance, arguing that they represent accountability and the price a country must pay for its crimes. Sanctions also serve as a clear signal from the global community to halt or deter aggression. Advocates claim that sanctions weaken russia economically, leading

to consequences such as a brain drain – an essential resource not only for sustaining physical warfare but also for undermining scientific research that supports military efforts. Moreover, there is concrete evidence that russian universities and their academics actively or passively spread propaganda and support the war in Ukraine, making them personally accountable.

However, the study also highlights existing counterarguments against the implementation of sanctions. Critics frequently stress in various sources that science should remain apolitical and that sanctions risk disrupting the free exchange of knowledge, academic freedom, and punishing innocent individuals. They warn that, given the current global interdependence of scientific efforts, restricting russian science could harm international research initiatives and slow humanity's progress. Additionally, the overall effectiveness and cost of sanctions remain uncertain, with concerns that such measures may fail to achieve the desired political outcomes.

Despite these debates, a range of restrictive measures has been implemented, including cuts in funding for educational institutions and scientific projects, the freezing of academic collaboration, the closure of projects involving russian institutions, and the exclusion of russia from several international educational and scientific organizations and global rankings. Numerous restrictions on the supply of equipment, reagents, and materials for scientific research have also been introduced. These actions represent an unprecedented attempt to isolate russian science from the global research ecosystem. The investigation also identifies the role of Scopus/Elsevier in facilitating or easing sanctions, offering new insights into how academic platforms contribute to the enforcement of international policies.

This study makes a significant contribution to the ongoing discussion about sanctioning russian science, providing the first comprehensive evaluation of the effectiveness and consequences of sanctions on russian science.

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APPENDIX A. Examples of sanctions against russian science

Table A1. Sanction against the russian science: The case of countries

Source: Elaborated by the authors.

Country	Sanctions description	Source
The USA	In June 2022, the US issued Guidance On Scientific and Technological Cooperation with the russian federation for U.S. Government and U.S. Government Affiliated Organizations. The US will “wind down” research collaborations with russia. The policy applies to federally funded projects involving research institutions and individuals affiliated with the russian government.	Ambrose (2022), The White House (2022)
The G7	Science ministers from the G7 countries declared their commitment to restricting government-funded research projects involving participation by the russian government.	G7 (2022)
The EU	The European Commission has said it will not sign any new contracts or agreements with russian organizations for EU programs. Officials would also review all current projects under Horizon 2020* and Horizon Europe and that in the meantime it would make no payments to russian entities.	Upton (2022b)
Germany	All collaboration with russia on education and research is being “halted immediately.”	Havergal (2022a)
The UK	It halts funding to all research programs found to have links to russian state and institutional collaborators and stops all ongoing projects where they provide a direct benefit to the russian regime. In addition, the UK will not fund any new collaborative projects with russia.	Havergal (2022b)
The Netherlands	All Dutch research and education partnerships with russia and belarus should be frozen, including the exchange of money, data and knowledge. No new collaborations can be started and researchers affiliated with a russian or belarusian institution will not be invited to review research proposals.	Upton (2022c)
Denmark	The country suspends any research and innovation cooperation with institutions in russia and belarus and refrains from any new academic exchanges.	Upton (2022b)
Latvia	Latvian institutions have been “strongly urged” to end all relationships with russia.	Upton (2022b)
Lithuania	Ministry asked universities to cut ties with russia.	Upton (2022b)
Finland	The country freezes higher education and research cooperation with russia. New projects should not be initiated and existing cooperation between organizations should be suspended for the time being. The processing of new initiatives related to cooperation between the authorities of Finland and russia or belarus will also be frozen.	Ministry of Education and Culture (2022)
Norway	The country freezes research and education cooperation with russia. The Research Council of Norway’s joint call for proposals with russia will be stopped.	Moe (2022)
Poland	The Ministry of Education and Science of Poland ceases cooperation with scientists, scientific institutes, universities and research centers in russia.	PolskieRadio (2022)
Canada	Government announced a halt to federal science cooperation with russia, and urged many grant-holders to avoid collaboration with russian industry.	Hudson (2022)

Note: * In Horizon 2020, russian researchers took part in 138 projects, picking up around €14 million in EU funding.

Table A2. Sanctions against russian science within international research projects

Source: Elaborated by the authors.

Project	Sanctions description	Source
CERN	CERN’s Council passed a resolution “to terminate the International Cooperation Agreement between CERN and the russian federation, together with all related protocols and addenda, with effect from 30 November 2024; To terminate... all other agreements and experiment memoranda of understanding allowing the participation of the russian federation and its national institutes in the CERN scientific program.”	WNN (2024)
ExoMars	In July 2022, the ESA Council cancelled the ESA-Roscosmos cooperation for ExoMars Rover and Surface Platform mission.	The Universe Space Tech (2022)
Luna-25, -26, -27	ESA will discontinue cooperative activities with russia on Luna-25, -26 and -27.	ESA (2022)
CREMLINplus	A voluminous project with a budget of 25 million euros and a consortium comprising 35 partners, 10 from russia and 25 from the EU and associated countries. The collaboration with russian institutions in CREMLINplus has been terminated.	CREMLINplus (2022)
eROSITA	The German eROSITA black hole telescope aboard the russia-built Spetr-RG satellite was switched off.	Pultarova (2022)

Table A3. Closure of R&D centers in russia (selected cases)

Source: Elaborated by the authors.

Company	Company Description	Sanctions description	Source
Intel	Intel owned an R&D office in Nizhny Novgorod and R&D office in Moscow (with 850 employees overall)	Intel Corporation has sold its office in Nizhny Novgorod. At the end 2023, two people worked at russian Intel. Before the invasion, the corporation employed 1,200 people.	Mind (2024)
Dell	Dell Development Center in St. Petersburg Big Data Technology Center in Moscow	In August 2022 Dell Technologies says it had ended all operations in russia after shutting its offices.	RFE/RL (2022)
Nvidia	The Moscow laboratory of the company was one of the 4 largest data centers of the company, and it accounted for up to 70% of all games tested by the company	Nvidia has officially left russia, follows from its reporting for the third quarter of 2022.	KSE Institute (2024a)
Siemens	Siemens Research Center Moscow	In May 2022, Siemens made the decision to cease its operations in russia after 170 years and disassociate itself from any involvement with the russian government.	KSE Institute (2024b)
Nokia	Nokia laboratory at Skolkovo The Nokia Technology Development Center (R&D) in St. Petersburg	Nokia to exit the russian market.	KSE Institute (2024c)
IBM	IBM RSTL (russian Systems and Technology Laboratory)	After freezing operations in russia in 2022, IBM has told employees it is ending all work in the country and has begun laying off staff.	KSE Institute (2024e), Vigliarolo (2022)
SAP	SAP Labs	The company stopped all sales in russia. The average headcount of SAP Labs in 2021 was 300 employees at the end of 2022, it was 41 people.	Tadviser (2024)

APPENDIX B

Table B1. Potential and actual consequences of sanctions to russian science

Source: Elaborated by the authors.

Source of opinion	Consequences of sanctions
Letter of russian academicians	russia has doomed itself to international isolation. It has devolved into a pariah country. This means that we, russian scientists and journalists, will no longer be able to do our job in a normal way because conducting scientific research is unthinkable without cooperation and trust with colleagues from other countries. The isolation of russia from the world means cultural and technological degradation of our country with a complete lack of positive prospects.
Chumakov, P. M., Engelhardt Institute of Molecular Biology, russian Academy of Sciences	The main concern is about materials that are unlikely to be purchased in the near future, and they are melting before our eyes. Work may stop.
Kudryavtsev, A. M., Vavilov Institute of General Genetics, russian Academy of Sciences	The imported equipment that we purchased has at least doubled in price even in our market. We understand that in the near future there will be difficulties with the purchase of plastic and reagents. We see that many scientific journals reject our articles simply on the basis that they are from russia, regardless of the quality of these articles.
Makeev, V. J., Vavilov Institute of General Genetics, russian Academy of Sciences	Reagents have quadrupled in price. Many people, with whom I worked, are leaving.
Mugue, N. S., Research Center of Neurology	Our science cannot live without reagents, consumables, spare parts for instruments, etc. We have practically no russian devices. Talented youth are leaving en masse.
Dmitriev, S. E., Lomonosov Moscow State University	In my laboratory, shortly after the events began, several people packed up and went abroad, while others were packing their bags. With the rest, we spend all our free time searching for high-quality reagents and consumables that companies still have, although their prices have already tripled.
Bazykin, G. A., Skolkovo Institute of Science and Technology	Any scientific work is built on international cooperation, which will now be severely limited. It is built on a priori trust, which will now be reduced in russia in all its manifestations, including in russian science. It is built on material and technical resources that will be radically limited.
Chugunov, A. O., Moscow Institute of Physics and Technology	from the very first days it became obvious that a blow to salaries would not be long in coming; that it will become more and more difficult to buy new powerful computers; that there will be an end to international cooperation; Foreign business trips will be impossible for a long time.