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Knowledge Distribution in the Science and Technology Space (Case of the Eurasian Economic Union)

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Abstract

Purpose: The article aims to assess the possibilities and contribution of countries to the creation and distribution of knowledge circulating in the scientific and technological space of the EAEU. **Research design, data, and methodology:** To understand the conditions and possibilities for the distribution of knowledge, the methodology of the quality of economic space used. The space is considered through density, placement, connectedness, and asymmetry. Used bibliometric analysis, balance of payments analysis, and integration indicators. **Results:** The study showed that low barriers, including language, created visible advantages in the mutual distribution of knowledge. However, the geo-technological space of the EAEU is polarised and has differences in the density and distribution of scientific resources. Asymmetries are shown in the distance between countries in multidirectional trends. Cooperation between countries has a different level of interaction. **Conclusions:** The internal resources of the geo-technological space of the EAEU are limited, and most of the needs are covered by external sources. Some mechanisms of the scientific policy of countries in scientific careers act as «demotivates» for distributing knowledge within the EAEU. Countries need to improve the quality of services and trade data to better understand technology distribution processes through bilateral channels.

Keywords: Knowledge Distribution, Science and Technology Space, Geo-Technological Space, EAEU, Cross-Country Knowledge Flows, Distribution Science

JEL Classification Code: F15, O33, O14, D33, R12

1. Introduction

The emergence, distribution and diffusion of knowledge and new technologies increasingly go beyond national borders and often occur within the framework of growing integration and global innovation and technological processes. Kazakhstan has joined the Eurasian integration project in the last decade - the EAEU. One of the essential tasks of the EAEU is joint modernisation. This cannot get real inspiration without conditions for the creation and distribution of knowledge, diffusion of innovations, and multidirectional cross-country flows of knowledge and technologies in the science and technology space of the EAEU.

Each of the EAEU members has a long history of bilateral, more or less intensive economic relations with

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partners in the union. At the same time, the integration issues in science and technology are new for the union. Scientific and technical cooperation is fragmented and does not bring visible advantages. Integration in science and technology has been actively discussed only in recent years. It is believed that cooperation in science and technology makes achieving a fundamentally new level of technological capabilities possible. The intensive cross-country flow of knowledge and technology provides mutual benefits to both beneficiary and donor countries by developing the science and technology space. Therefore, it is advisable to consider the possibilities of embedding the integration benefits in the structure of the national science and technology policy, using various channels for acquiring new knowledge and technologies.

Therefore, questions arise about the availability of contact points, common scientific and technological interests, channels for knowledge and technology distribution, the real power of strengthening countries' science and technology capacity, and the expansion of scientific and technological competencies because of integration.

The article aims to assess the possibilities and contribution of countries to the creation and distribution of knowledge circulating in the scientific and technological space of the EAEU. Therefore, the article studies the factors that shape the configuration of the scientific and technological space, the potential of the technological space of the EAEU countries, and cross-country flows of goods, services, human resources, and knowledge.

2. Literature Review

The starting point and the primary theoretical basis of this study is the theory of economic space. This theory is a reasonable basis for studying the scientific and technical space and the cross-country flow of knowledge and technology, including integration unions.

Perroux (1950) singled out two types of spaces: economic and geonomic. The geonomic space contains “objects and subjects (material resources and people)". The economic relations that exist between economic elements identify the economic space. Perroux defines three types of economic space: “economic space defined by the plan; economic space as a field of forces; economic space as a homogeneous aggregate”.

Hagerstrand (1953) has developed spatial models for the diffusion of innovations. He paid attention to the dialectical relationship of spatial characteristics and time in the diffusion of innovations. He also drew attention to geographic distance, physical, social, cultural, informational, and economic factors and "barriers" to knowledge and innovation distribution in space.

The works of Granberg (2003), Minakir and Demyanenko (2010) contributed significantly to understanding the economic space. These studies consider the science and technology space quality characteristics as density, placement, connectedness, and asymmetry and explore the territorial, resource, institutional, and informational context. These characteristics of integration unions make it possible to describe the economic space not just as a "container" of objects and subjects but also as a field of forces in their complex interaction.

The knowledge growth determined the shifts in the technological base of various fields. Kovalev (2001) considers the essence of world science geography to be the study of all the emerging sectorial and spatial structures of R&D in individual countries and regions, the territorial differentiation of science, spatial diffusion of knowledge, ideas, and technical innovations, involvement of nations in science, internationalisation, and globalisation of science.

The scale and intensity of the international exchange of knowledge and technology have increased so much that this phenomenon is called “techno globalism”. Globalisation is driven by transnational corporations (TNCs), which act as a “conveyor of external knowledge”, connecting different regions and facilitating the transfer of knowledge between countries (Subramaniam, 2006; Li & Bathelt, 2018; Bathelt & Li, 2020). They are interested and engaged in R&D collaboration, technology discovery and technology transfer, the three most commonly known sources of knowledge transfer (De Rassenfosse & Seliger, 2020).

Despite progress in the field of communications, the issue of geographical distance remains essential. By studying institutional factors, scientists have found that geographic distance hurts trust between department employees in different countries (Haas & Cummings, 2015). However, a study of the impact of geographic distance on the acquisition of new technologies found that, for example, remoteness does not impede Chinese companies from acquiring intellectual property rights for inventions from remote countries (Nepelski & De Prato, 2014).

Montresor (2001) notes that "techno-globalism and techno-nationalism have emerged as two key issues in the economics of technological change". This dilemma is based on the literature analysis and the taxonomy of technological systems and their characteristics, such as "techno-territoriality", "techno-sovereignty", "techno-citizenship", and "techno-nationality".

The mobility of scientists facilitates the rapid distribution of new scientific knowledge (Spankulova et al., 2020). In particular, firms with a more substantial presence of inventors from technologically advanced countries benefit disproportionately from R&D (Chen & Dauchy, 2018). Therefore, the professional mobility of scientists and highly qualified specialists is the most apparent policy direction that promotes the flow of knowledge and diffusion of innovations (Spankulova et al., 2020).

Tolstik (2016) notes that the country's ability to create information resources on the Internet indicates the technical and technological level of development of new communications but also the actual sovereign capabilities of the national economy. A single information space is the basis of successful integration; the integrated information system of the EAEU should form unified markets for a product of manufacturing, medicines, and circulation of medical products.

Information channels are an essential source of knowledge. It has been revealed that the development of information technologies influences the strengthening of the geographical diffusion of knowledge (Abramo et al., 2020).

Access to knowledge sources is provided by creating information sources or networks with entities in other regions that enable cross-regional knowledge flows (Owen-Smith & Powell, 2004; Bathelt et al., 2004). It is necessary to consider the factors that may weaken the benefits of interregional cooperation. One such factor is the cost of creating and maintaining information sources (Esposito & Rigby, 2019).

Forming any integration association in general, especially in specific geopolitical and socio-economic conditions, carries advantages and risks for countries and associations. They manifest themselves in different directions and areas, including in countries' scientific and technological development. Therefore, tools for analysing the functioning of regional integration associations have a scientific and practical interest. The EU countries proposed the world's first integration measurement index - the European Economic Integration Index (EU-Index) (König & Ohr, 2013). This index is formed based on four indicators: single market, homogeneity (homogeneity), symmetry, and institutional consistency (harmony). There are other approaches to measuring integration (De Lombaerde et al., 2011, 2017; Prakash & Hart, 2000; Dennis & Yusof, 2003). Studies of trade, investment, and economic problems of integration associations are widely developed globally and in the EAEU countries. The research subject of this paper (spatial aspects of scientific and technological integration) has not yet been sufficiently developed.

Various aspects of the EAEU science and technology space development were noted in the studies. Shugurov (2020) notes the low scientific and technical cooperation level within the EAEU. The reasons for this are the insufficient development of national innovation systems and the innovation climate in the EAEU countries. The share of the EAEU countries in the world's high-tech exports is less than 1%. A low level of R&D funding (less than 1% of GDP), low industrial involvement and a high share of government in the structure of R&D funding (more than 60%) characterise the countries. The science and technology potential and space of the EAEU are polarised, and scientific and technical cooperation between countries has different levels of interaction. Thus, most countries interact more actively with Russia and less with other EAEU countries (Sargsyan et al., 2019).

Some aspects of the Eurasian integration influence the technological development of the EAEU countries. One is the spatial aspect, usually considered through characteristics such as quality, differentiation, heterogeneity, asymmetries, and inequality. Peculiarities of non-equilibrium both between the subjects (Russia's dominance) and within the subjects of Eurasian integration (regional inequality, confinement of benefits of mutual trade and migration to large cities) are pointed out by (Khusainov et al., 2017; Vardomskiy, 2021; Pakholkin, 2018). Since the beginning of the Russian-Ukrainian war, discussions about the prospects and benefits for the countries as part of the Eurasian integration have reached a new level. In the EAEU, the risks of transferring sanctions to other participants and technological isolation have increased, narrowing the corridors for the distribution of knowledge and technologies after the exit of high-tech companies from the EAEU, and there has been a change in the flow of migration from Russia.

Thus, the scientific literature review revealed some factors that, to a greater or lesser extent, affect the spread of knowledge and technology flows: spatial characteristics and geographical remoteness, mobility of human resources and recognition of scientific achievements, the focus of countries' policies on creating channels for disseminating knowledge and creating joint knowledge.

3. Research Methods and Materials

The article considers the scientific and technical space in two aspects. Firstly, it is a "geo-technological" space in which a quantitatively measured scientific and technical potential (people, capital, organisations and enterprises, technologies) is distributed. Secondly, as an environment in which relations ensure the formation, development, dissemination and circulation of scientific knowledge and their multidirectional flows, embodied and incorporeal technologies (institutions, networks, culture, education, information channels).

Based on the theory and methodology of spatial economics (Perroux, 1950; Hagerstrand, 1953; Granberg, 2003; Minakir & Demyanenko, 2010), we propose the following framework for the study of the quality of cross-country knowledge and technology flows (Figure 1).

By the framework (Figure 1), the article aimed to consider the main characteristics of science and technology capacity and analyse the cross-country flow of knowledge and technologies.

Bibliometric analysis of joint publications in the Science Citation Index Expanded database (Knyazeva & Slashcheva, 2008) was used to analyse the development of scientific and technical cooperation.

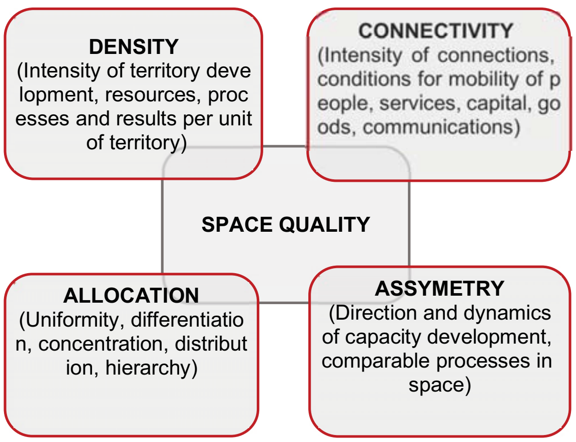

Figure 1: Framework for the Study of the Space Quality and the Knowledge and Technology Flow

This approach allows for evaluating cooperation's current state and dynamics, identifying research areas of mutual interest and progress achieved, and determining priorities for joint scientific activities.

Analysing the balance of payments helps understand the process of knowledge and technology distribution (Teixeira & Barros, 2020). This method lets us understand the cross-country flow of goods, technologies and services, including mutual flows within a union.

Analysis of the policy in the field of scientific staff evaluation and publication of research projects and dissertations' findings provides essential information to understand the incentives for the distribution of knowledge in partner countries.

The Eurasian Development Bank methodology (Table 1) was taken as a primary methodology for the regional integration analysis. It presents three indicators: integration of pairs (dyads) of countries, integration of a country with a group of countries, and integration within a group of countries (Balter et al., 2014). This methodology is adapted for the analysis of scientific and technological integration.

Table 1: Integration of Knowledge Distribution Channels in Eurasian Science and Technology Space

Indicator	Countries dyad	Country-region	Region
Market's integration channels			
Mutual trade	The share of trade of the dyad countries in the total foreign trade turnover of these countries	The share of the country's trade with the countries of the region in the total foreign trade turnover of the country	The share of trade between the countries of the region in the total foreign trade turnover of the countries of the region
Human resources channels			
Labour Migration	The share of migrants from each of the countries of the pair working in the other country in the total population of these countries	The share of labour migrants of the country working in the countries of the region in the total population of the country	Share of labour migrants from all countries of the region working in other countries of the region in the total population of the region
Academic mobility	Share of students from dyad countries studying in another dyad country in the total dyad population	Share of students from the country studying in the region in the total population of the country	Share of students from the countries of the region studying in other countries of the region in the total population of the region
Information distribution channels			
Publications	Share of joint publications of each pair of EAEU countries in the total publications of these countries	Share of publications of the country in publications of the region	Share of joint publications of all countries of the region in total publications region

4. Results and Discussion

4.1. Quality Science Space and Capacity of the EAEU Countries

To describe the quality of the geo-technological space, the most accessible data that countries publish by regions selected. Based on the assumption that scientific resources are often distributed unevenly and scientific and technical activity proceeds with different intensities, comparisons in the distribution of scientific potential in the EAEU countries were made. These comparisons showed significant differences between and within countries (Table 2).

So, between Kazakhstan and Belarus, such a gap is more than 15 times; within Kazakhstan, the gap reaches 30,000 times. In Kazakhstan, scientific resources are concentrated mainly in the two largest cities, while in other regions, there is space that confirms the high values of the Herfindal-Hirshman Index.

Table 2: Quality Science and Technology Space

	Armenia	Belarus	Kazakhstan	Kyrgyzstan	Russia
DENSITY					
R&D expenditures in USD per 1 sq. km	973	1541	94	35	1043
Difference between areas within countries with the highest and lowest levels of density, times	-	4000	30000	-	26.50
ALLOCATION					
Growth of the number of R&D organisations from 2012 to 2021, times, times	1.30	0.84	1.3	-	1.17
The highest rate of growth in the domestic regions of the country, times	-	1.29	3.00	-	-
The lowest rate of growth in the domestic regions of the country, times	-	0.73	0.60	-	-
Concentration R&D organisations, (Herfindal-Hirshman Index)	-	3734	2127	-	-
ASYMMETRY					
Growth R&D personnel from 2012 to 2021, times	0.87	0.84	1.06	1.36	0.91
The highest rate of growth in the domestic regions of the country, times	-	2.10	2.13	-	1.10
The lowest rate of growth in the domestic regions of the country, times	-	0.64	0.48	-	0.87
Share of countries in R&D spending, %	0.2	1.8	1.4	0.0	96.6
Distance between countries and the EAEU in 2012 (R&D expenditures and Researchers in R&D per 1 million population)	2563	1192	3199	3832	658
Distance between countries and the EAEU in 2021 (R&D expenditures and Researchers in R&D per 1 million population)	2263	1156	2775	3250	630

Note: '–' no data

Within the countries and in the EAEU space itself, the dynamics of the most mobile part of Science resources, R&D specialists, is unstable. A slight increase in scientific personnel in Kazakhstan and Kyrgyzstan cannot compensate for their decline. The reduction in R&D spending in the EAEU is precisely due to the decline in state funding in Russia. Although the distance between countries within the space has somewhat decreased, this rapprochement is because there has been a decrease in the main elements of the scientific potential of the EAEU. We can say that the scientific and technological space of the EAEU is shrinking.

The science and technology capacity of the EAEU countries has significant asymmetry: a big part of the scientific and technical resources of the EAEU countries is concentrated in Russia (92% of scientific personnel, 80% of scientific organisations, 96% of R&D spending). From 2012 to 2021, the highest spending was noted in 2013 - 24.5 billion US dollars (Figure 2).

Unfortunately, the decline continued in all components of the scientific capacity in the EAEU, which indicates the weakness of initiatives in modernisation (Table 3).

In absolute terms, the EAEU countries lost about 70 thousand scientific personnel, including Russia, more than 60 thousand. In all countries, there is a decrease in the share of domestic spending on R&D in GDP.

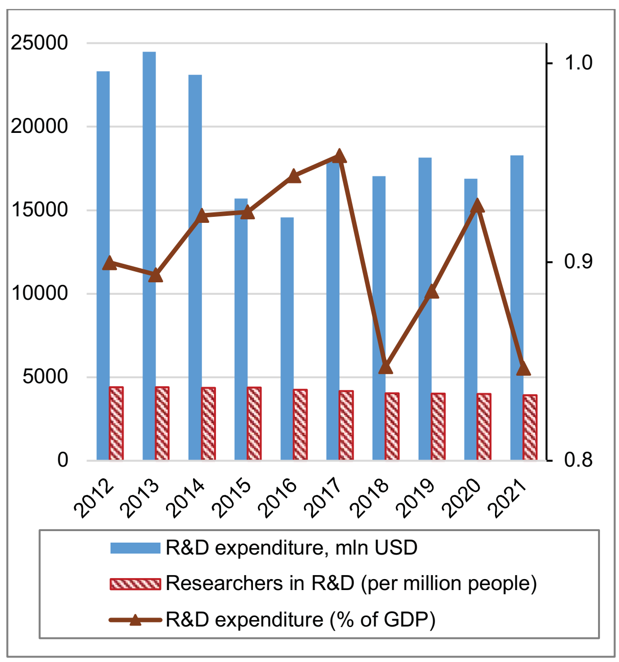

Figure 2: R&D Expenditures in the EAEU Countries.

Only Kyrgyzstan could retain human resources during this period despite the critically low level of R&D spending.

Table 3: Science Capacity of the EAEU Countries, 2012-2021

	Year	EAEU	Armenia	Belarus	Kazakhstan	Kyrgyzstan	Russia
Researchers in R&D, people	2012	786 021	5 598	30 437	20 404	3 264	726 318
	2021	719 287	4 889	25 644	21 617	4 435	662 702
Researchers in R&D, per million people	2012	4414	1851	3222	1215	582	5072
	2021	3913	1650	2757	1138	663	4543
Share of R&D personnel in employed population, %	2012	0.90	0.48	0.65	0.24	0.14	1.01
	2021	0.81	0.49	0.53	0.24	0.18	0.92
R&D expenditure, % of GDP	2012	0.94	0.23	0.65	0.17	0.17	1.03
	2021	0.89	0.21	0.47	0.13	0.08	0.99

Source: www.eurasiancommission.org

4.2. Scientific Publications as a Channel for the Distribution of Knowledge

Trends in the development of scientific fields and scientific collaboration of the EAEU Member States are considered through bibliometric analysis. According to the Scimago Journal & Country Rank, the EAEU countries published 1,722,925 publications from 1996-2022, with a steady increase in joint publications. The EAEU countries cover only 3.07% of publications indexed in the Web of Science, with 90% provided by Russia. Publication profiles of the EAEU countries are characterised by the following data (Table 4). The most popular scientific fields for all EAEU countries are physics, astronomy, and engineering, a share of publications in which is at least 10.0%. The average level falls on chemistry, medicine and mathematics.

Considering the volume, content and structure of the publications, the areas most ready for joint initiatives in science are physics and astronomy, engineering, and materials science due to accumulated significant potential there.

Table 4: Bibliometric and Publications Profile of the EAEU Countries

	Armenia	Belarus	Kazakhstan	Kyrgyzstan	Russia
	Bibliometric profile,1996-2022				
H-index	228	226	154	116	728
Share in the world publications, %	0.04	0.07	0.16	0.02	2.78
Citations per document	20.2	12.0	7.3	28.9	8.7
Total documents, (2012)	1161	1803	856	124	45653
Total documents (2021)	1290	2939	6043	676	130728
Total documents, (2022)	1411	2787	6257	659	108464
Documents with International Collaboration, % (2022)	63.64	59.17	56.57	76.63	24.43
	Share of publications by fields of science, %				
Physics and astronomy	29.5	23.4	10.8	10	14.2
Engineering	13.2	16	12.4	9.2	10.2
Material sciences	8.7	14.4	8	5.6	12.1
Chemistry	5.9	10.3	5.6	6.7	10
Medicine	5.5	4.4	7.5	7.7	11.1
Mathematics	7.8	7	5.9	6.0	4.9
Biochemistry, genetics and molecular biology	5.6	4.7	4.4	6.3	6.1
Computer sciences	7.1	5.1	6.1	4.5	3.9
Earth sciences	2.7	1.8	5.1	11.2	3.8
Social sciences	2.7	1.3	7.5	8	4.3
Agriculture	2.1	4.5	5.9	6.8	4
Environmental Sciences	1.9	2.3	4.5	7.5	4.5
Chemical engineering	2.1	5	6.3	1.9	3.6

Source: Scimago Journal & Country Rank

At the same time, broad scientific areas need intensive development. Expanding interactions between countries for developing networks is advisable to fully develop the scientific and technological space. Other fields make up a low share of the total volume of publications. Computer science, biotechnology, chemical engineering, and environmental sciences are among them. These fields form the core of the world economy's modern technical and economic paradigm.

International cooperation plays a vital role in the distribution of knowledge. Joint publications characterise the established structure of scientific and technical cooperation between countries within the EAEU and give an idea of the potential for integration and contribution to the global science and technology space. There is a different level of interaction between countries if considering joint publications. Kyrgyzstan and Armenia have a high share of publications with international collaboration - more than 60%.

In the EAEU, the most significant clusters of publications were created with the participation of Russia, while the level of interaction between them is much weaker (Table 5). Thus, distributing knowledge through collaborative publications is more of a sunburst or hierarchical configuration than an integration network for creating and distributing scientific knowledge. However, this growth cannot be explained by the increased integration of science and technology in the EAEU but rather by the desire to integrate into the global scientific space. Moreover, the scientific journals of the EAEU countries become less attractive because they play a weak role in developing a scientific career until they begin to be indexed in Web of Science and Scopus.

Table 5: Joint Publications of the EAEU in 2020

	Joint publications
Russia - Kazakhstan	245
Russia - Belarus	181
Belarus - Armenia	135
Kazakhstan - Belarus	68
Russia - Kyrgyzstan	59
Russia - Armenia	29
Kazakhstan - Kyrgyzstan	31
Kazakhstan - Armenia	12
Kyrgyzstan - Belarus	5
Kyrgyzstan - Armenia	1

Source: www.scimagojr.com

Due to historical, political, and sociocultural factors, the prevalence of the Russian language in the post-Soviet space and low language barriers have developed, which generally facilitates the distribution of knowledge. In developing the newly independent states, the national language environment, the state languages, became necessary. Today, most local scientific journals publish a significant amount of information in two languages, one of which is Russian. In recent years, there have been many publications in English. In the EAEU countries, there are similar rules for state attestation of scientific personnel. Within these rules, there are requirements for local and foreign journals for the publication of articles. Such rules were developed in many ways to incentivise the distribution of scientific results abroad. Until 2021, Kazakhstan included journals from the CIS and EAEU countries in the list of recommended ones, while in other countries, there were no journals from partner countries. This means the EAEU countries have created demotivates for disseminating knowledge within the integration space. This situation is somewhat paradoxical, given the scale of the declared integration tasks. For these reasons, scientists are changing their publication preferences, focusing on other external channels for disseminating knowledge.

4.3. Development and Distribution of Knowledge-Intensive Industries in EAEU Countries

An analysis of the economic capacity of the EAEU countries shows that Kyrgyzstan is a leading country in terms of the share of agriculture in the economy. This reflects the high share of publications in the field of agriculture (Table 6). The agricultural sector of the Kyrgyz Republic employs about 40% of the labour force. Although it accounts for almost 15% of GDP - the second most significant component of GDP (after industry) - it is unorganised and undercapitalised, and Kyrgyzstan's food industry continues to be underdeveloped.

Kazakhstan takes a leading position by the share of industry – 35%. Its share in the country's economy accounts for 29.6% of GDP. The largest share falls on the manufacturing industry - 62.9%, and the mining sector - 34.0%. In the manufacturing industry, the leaders are metallurgy - 42.9%; food production - 14.8%; and mechanical engineering - 12.7%. The structure of publications in Kazakhstan reflects the structure of the manufacturing industry very clearly: physics, engineering and materials science are the basis for developing these industries.

Belarus leads in value-added production (22.9% - in 2021, 24% - in 2022) and value-added in medium and high-tech production (41.2%). The most developed industries are the production of food and beverages, mechanical engineering, light industry, woodworking, petrochemical and pharmaceutical industries. At the same time, it is also evident that the structure of publications reflects the structure of production in Belarus - physics, engineering, materials science, and chemistry form the scientific and technological basis for developing these industries. According to the Global Innovation Index (GII), from 2017 to 2021, the Republic of Belarus significantly increased its position. Belarus also leads in terms of employment in knowledge-intensive industries.

The development of high-tech industries and the growth of priority sectors of the science and technology space of the EAEU countries is reflected in the Eurasian space countries' cooperation and foreign trade turnover in high-tech goods and services. Thus, high-tech goods in the cooperation of the EAEU member countries are import and export goods related to the aerospace industry, ICT, electronics and telecommunications, the pharmaceutical industry, chemical products, equipment and weapons. Industrial manufacturers depend highly on foreign components and parts, primarily in the machine-building complex (Bordachev et al., 2019). Data on the volume of high-tech exports in EAEU mutual trade in 2019 and 2020 indicate it decreased in all countries of the Union, which is most likely caused by the pandemic crisis.

Table 6: Industry in the EAEU end EU in 2021 Years

	Armenia	Belarus	Kazakhstan	Kyrgyzstan	Russia	European Union
Agriculture, forestry, and fishing, value added (% of GDP)	11.1	6.8	5.1	14.7	3.7	1.8
Agriculture, forestry, and fishing, value added per worker (constant 2015 thousand US$)	6.1	7.2	7.6	2.2	14.2	25.5
Industry (including construction), value added (% of GDP)	26.6	32.2	35.3	26.7	33.2	22.8
Industry (including construction), value added per worker (constant 2015 thousand US$)	13.3	13.4	37.8	3.7	23.6	66.4
Manufacturing, value added (% of GDP)	11.4	22.9	13.6	13.5	14.4	14.7
Manufactures exports (% of merchandise exports),	22.7	38.4	16.1	38.9	22.1	77.1
Medium and high-tech manufacturing value added (% manufacturing value added) (2020 y)	8.2	41.2	16.9	2.2	25.8	..
Medium and high-tech exports (% manufactured exports) (2020 y)	15.2	41.5	37.8	17.6	27.5	..
Mutual export of high-tech goods, billion USD dollars	0.17	7.8	1.18	0.21	15.4	
Share in mutual export of high-tech goods, %	0.7	31.7	4.8	0.8	62	
Economic Complexity Index (ECI)	-0.24	0.83	-0.33	0.16	0.2	..

Source: 1) World Development Indicators. 2) www.eurasiancommission.org

At the same time, the share of exports remained virtually unchanged. Undoubtedly, the production and export of high-tech products are a factor in the innovative development of the economy. To enhance the potential of the cross-country flow of knowledge and technology, in 2017, the EAEU member states agreed to develop and create the Eurasian technology transfer network, the Eurasian network of industrial cooperation and subcontracting, the Eurasian innovative industrial clusters, interstate programs and projects, business innovation infrastructure (Gussarova et al., 2017). Along with the Eurasian technology platforms, they support the main stages of the innovation process. The implementation of these initiatives requires acceleration and science and technology integration.

4.4. Distribution of Knowledge and Technology in EAEU

Countries' capacity cannot reflect the features of the countries' interaction in science and technology. There is a different intensity of interactions and connectivity between member countries.

Thus, the countries of the association have different levels of integration into the region, as well as the region with the countries of the region (Table 7). Since the EAEU's establishment, the cross-country flow of knowledge and technology within the EAEU countries has remained passive and acted more as concomitants in mutual trade. According to the methodology outlined, the integration indicators were calculated for the dyads of countries, indicators of the integration of countries into the region and the region. Analysis by dyads of countries confirmed that countries have different levels of integration by dyads. The table shows only the maximum values in the most intensive integration ties in the dyads of countries formed with Russia.

In the field of labour migration, the closest ties are with Kyrgyzstan. For many years, Russia has been an attractive market for labour migrants from Central Asia. In the field of academic mobility, channels with Kazakhstan are the most developed. This is due primarily to the ethno-demographic features of Kazakhstan, where many ethical Russians live. The largest migration flows from Kazakhstan are directed to Russia. The situation has changed; Kazakhstan has received a significant flow of migrants from Russia. In the dyad, Belarus-Armenia has the highest index for publications, even though the number of joint publications is the largest in Russia and Kazakhstan. This is explained by the fact that Russia and Kazakhstan have a large volume of publications in general. The EAEU countries have different levels of integration into the region. Russia had the lowest indicators of integration into the region, being the largest economy of the integration association.

Table 7: Indicators of Eurasian Integration in the Distribution of Knowledge and Technologies

	Armenia	Belarus	Kazakhstan	Kyrgyzstan	Russia
	Market's integration channels				
Countries dyad (max) Russia- Belarus					0.0472
Country-Region	2.3267	0.4984	0.2423	0.4574	0.1162
Region	0.0226	0.0421	0.0286	0.0035	0.0906
	Human resources channels (Labour migration)				
Countries dyad (max) Russia- Kyrgyzstan					0.0013
Country-Region	2.3267	0.4984	0.2423	0.4574	0.1162
Region	0.0226	0.0421	0.0286	0.0035	0.0906
	Human resources channels (Academic mobility)				
Countries dyad (max) Russia- Kazakhstan					0.0004
Country-Region	0.0015	0.0014	0.0038	0.0015	0.0001
Region	0.0000	0.0000	0.0000	0.0000	0.0005
	Information distribution channels (Publications)				
Countries dyad (max) Armenia - Belarus		0.0339			0.0340
Country-Region	0.1400	0.1436	0.0626	0.1661	0.0040
Region	0.0013	0.0018	0.0025	0.0007	0.0035

The analysis shows that the EAEU region has low integration indicators in the region-country direction. This also confirms that stable multilateral channels for knowledge distribution and technologies have not been formed within the EAEU. The region's countries are highly dependent on external channels and sources of knowledge and technology; the internal potential of the countries cannot provide the current and future tasks of modernising the region's economies.

5. Conclusion and Limitation

Thus, the analysis showed that there are problems in developing sources and channels for disseminating knowledge and technologies in the EAEU countries, which form the modern structure of the scientific and technical space of the EAEU countries.

Firstly, the quality of the space is highly differentiated both in the EAEU as a whole and within the countries. More than 90% of the scientific potential of the EAEU is concentrated in Russia; therefore, the processes that take place here form trends in the development of the scientific space and potential of the EAEU. Therefore, the closure of channels of external sources of knowledge and technology for Russia under sanctions will impact all countries in the region. In all countries, there is a decrease in the share of domestic R&D expenditures in GDP, scientific personnel, and knowledge-intensive employment. Moreover, the study shows signs of compression of the scientific and technological space of the EAEU.

Secondly, publications play an essential role in the dissemination of knowledge. There are no language barriers to translating knowledge in the region's countries. Despite the initiatives promoted in the field of scientific cooperation in the EAEU, the knowledge dissemination channels through scientific publications remain ignored. In the region's countries, there are no incentives to publish articles in journals of partner countries; however, incentives have been created for the publication of scientific research in journals indexed by the Web of Science and SCOPUS.

Thirdly, an indicator of the effectiveness of the channels of dissemination and assimilation of knowledge is the level of development of knowledge-intensive industries and the level of economic complexity of exports. This is because a particular set of competencies is required to produce any product, and exports reflect the industrial knowledge accumulated in the country. The region's countries demonstrate low and even negative values of the economic complexity index, which allows us to conclude that the complexity of collective knowledge is low.

Fourth, the integration of countries implies obtaining benefits from such cooperation, including creating and supporting knowledge transfer channels.

The analysis of integration indicators shows that such channels within the framework of the EAEU integration project do not have a developed multilateral character.

A significant limitation in the study of knowledge dissemination processes within and between countries is the limitations in the methodology of national statistical offices. It seems appropriate to use the experience of Belarus, where individual indicators of the European Innovation

Scoreboard are being collected, and the development of a methodology for collecting data on mutual services with a detailed breakdown by types of knowledge-intensive services.

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