Review

Cyberspace: A systematic review of 30 years of social and economic research

Anna A. Mikhaylova[1], Andrey S. Mikhaylov[2,3,*]

[1] Institute of Geopolitical and Regional Studies, Immanuel Kant Baltic Federal University, Kaliningrad, 236029, Russia

[2] Center for Geopolitical Studies, Institute of Geography RAS, Moscow 119017, Russia

[3] Higher School of Business, Southern Federal University, Rostov-on-Don 344019, Russia

* Corresponding author: Andrey S. Mikhaylov, mikhailov.andrey@yahoo.com

Abstract: The study is focusing on cyberspace—a new type of space mastered by humans with the help of digital technologies. This systematic review uses SPAR-4-SLR protocol to analyze over 30 years of scholarly research indexed in Scopus database, highlighting five time periods: before 1995, 1996–2008, 2009–2012, 2013–2019, and after 2020. A final sample of 6645 publications in social sciences, Business, management and accounting (BMA), and Economics, econometrics and finance (EEF) was analyzed across multiple parameters, including: chronology, types of documents, sources, countries, institutions, authors, topics, and most cited publications. The review has systematized information about the most influential organizations and individuals involved in cyberspace research. First of all, these are researchers from the United States, the United Kingdom, and China. Key journals that publish research on the topic have been identified, and a ranked list of funding organizations supporting research on the social and economic aspects of cyberspace are identified. The study provides insights into the achievements of the social and economic sciences in cyberspace over the past 30 years. The results will be useful to scholars who seek for a general overview on the topic of cyberspace, as well as experts and policymakers developing mechanisms and tools for regulating cyberspace as a mixture of the virtual and real worlds.

Keywords: digitalization; digital infrastructure; cyberspace; cybersecurity; geopolitics; information technology; regulation; information policy

1. Introduction

The development of the Internet infrastructure has led to the formation of another type of space where people conduct their activities—the cyberspace. It can be described as a "new frontier" for humanity (Sardar, 1995). It exists simultaneously with physical space, is closely connected with it, but has its own characteristics. The physical elements that define the skeleton of cyberspace are global and local information networks that have a territorial reference (Batty and Barr, 1994). The widespread introduction of digital technologies leads to a gradual merger of geo- and cyber-spaces and the need to model such a merger (Papadimitrou, 2023). On the one hand, cyberspace has long transcended geographic boundaries (Johnson and Post, 1996), providing the opportunity for high-speed cross-border data movement. On the other hand, the location of the main institutions, organizations and network platforms is territorially determined (Zhao, 2022). The uneven distribution of information and communications infrastructure, technologies and digital skills is typically driven by socio-economic factors and leads to uneven cyberspace adoption across countries (Mikhaylova and Hvaley, 2023). States themselves are increasingly interested in establishing their sovereignty in relation to cyberspace and ensuring their

cybersecurity. Thus, although cyberspace is different from geospace, it is at the same time inseparable from it, which forces a person to exist in two worlds at once—virtual and physical. This makes cyberspace a relevant object of study for social and economic sciences.

In the Scopus database, we found relatively few scientometric reviews devoted directly to the study of the developments of cyberspace. In 2017, a bibliometric study of Chinese scientists from the National University of Defense Technology (Changsha) was published (Li, 2017). It is one of the few that aims to form an idea of the scientific landscape and trends in the study of cyberspace. The authors analyzed over 2000 articles indexed in the Web of Science database for 1989–2016. This made it possible to highlight new trends in the development of the topic of cyberspace based on keywords such as law, intellectual property, the Internet, cyberwar, computer communications. Another relevant review that deserves attention was published in 2024 by scholars from Peking University (Beijing). It presents the results of a comparative analysis of international and Chinese human geography perspectives on cyberspace (Feng and Zhang, 2024). The authors, having summarized the progress of socio-geographical research from the two databases—Web of Science and CNKI, propose to view cyberspace as a virtual-real hybrid space. As a result of the deep penetration of ICTs into human life, cyberspace is increasingly becoming a new public space where the technological and the human collide. A separate phenomenon that arose during the transfer of social life to cyberspace was called cyberculture. It is studied by the social sciences, the achievements of which are analyzed in a scientometric review based on the Web of Science (de Mesquita et al., 2018).

Other scientometric reviews on cyberspace that we discovered and analyzed are more focused on security issues, dealing with the issues of cybersecurity and cyberthreats (Chang, 2016; Guo et al., 2019). Scholars from the Indian Banaras Hindu University, having reviewed Scopus-indexed publications for 2001–2018 (Rai et al., 2019), concluded that the leaders in shaping the scientific agenda on cybersecurity are the USA, UK, China, and India, and also noted a growing trend of cooperation in this area. The importance of international cooperation in cybersecurity research is confirmed by another study held by scientists from the CSIR-National Institute of Science, Technology and Development Studies (New Delhi) (Dhawan et al., 2021). The authors note the leadership of the United States in scholarly output, and Canada in the relative citation index. Another study presents the contribution of Indian researchers as one of the leaders in the development of the topic of cybersecurity (Elango et al., 2023). A trend is observed of a gradual shift of interest in issues of specific digital technologies, rather than general questions related to big data and the processes of their movement in cyberspace. The accumulation of a large number of studies on this topic allowed a team of researchers from China to conduct a more focused scientometric study and show progress in studying the connection between big data and virtual space (He et al., 2019).

After analyzing the available scientometric studies, we came to the conclusion that modern reviews directly devoted to achievements in cyberspace research are not enough. This article closes the gap in the field of social sciences and economics and focuses on the issues of human development of cyberspace from the initial stage, when digital technologies just began to actively expand into our lives, to the present. This

study is a systematic scientometric review, the purpose of which is to provide an assessment of current achievements and future directions of research devoted to the study of socio-economic aspects of the formation and development of cyberspace.

The study procedure is transparent and described in detail in the relevant sections so that the results can be reproduced (e.g., using other databases). In comparison with earlier review studies on this topic, this article presents extensive results of the analysis of cyberspace, obtained specifically in the social sciences and economics over a period of more than 30 years. This study includes four levels of measurement: international (worldwide), national (at the country level), institutional (at the level of organizations that fund and carry out research), and individual (at the author level). Thus, our article provides information about the spatiotemporal and structural patterns of distribution of scientific literature in cyberspace, as well as trends in socio-economic research across time periods.

This article is structured as follows: The section Materials and Methods describes in detail the process of collecting bibliometric and statistical data, as well as the bibliometric analysis protocol used by the authors. Here, information about the analytical tools that were used to conduct the quantitative analysis and create the graphical material is described. The Results and Discussion section presents an analysis of international social and economic research in the field of cybersecurity, conducted using descriptive and evaluative bibliometrics procedures. The leading scientific centers for cyberspace research are identified, and the dynamics of research interest in this topic are shown. Data on the state of development of this thematic area are presented. The study concludes with the main findings and future directions for cyberspace research.

2. Materials and methods

With the growing volume of scientific information, scholarly literature reviews have become a truly useful tool and a relevant methodological approach. The development of digital technologies has made it possible to conduct high-quality and objective literature reviews based on large datasets. This was facilitated by the accumulation and digitization of large bibliometric data, increased access to international databases of scientific and technical information, and the emergence of specialized tools of bibliometric analysis.

Reviews can be used to build a strong theoretical ground for a broader study (Tsiotsou et al., 2022), as well as a stand-alone specific study to generate original scientific findings (Paul and Criado, 2020). The reviews are based on the systematization of earlier scientific works in order to revise the results already obtained, as well as identify trends and determine future directions of research on the topic.

In general, a literature review includes highlighting current contributions, identifying bottlenecks and research gaps, and identifying future directions for development. In scientific practice (Paul and Criado, 2020; Paul et al., 2021; Snyder, 2019; Weng et al., 2022) there is a variety of approaches to constructing literature reviews, depending on the goals and methods of research. There are five types of scientific reviews worth mentioning: substantive, theoretical, methodological, meta-

analytic and meta-systematic. Each of these types focuses on a different object of study, be it a topic, method, theory, concept, or methodological framework. Combinations of approaches to constructing scientific literature reviews are also possible. In this article we present the results of a substantive literature review devoted to the development of the topic of cyberspace geography.

Depending on the method used, systematic, semi-systematic and integrative reviews are distinguished (Snyder, 2019). Systematic reviews are fundamentally quantitative and focused on addressing a specific question. Typically, they are intended to show the influence of a topic or subject on a research field, as well as used to communicate advances in the field and their practical applications. This article presents a systematic review designed to provide a comprehensive understanding of the research frontiers in the study of cyberspace.

The scientific community has proposed a number of protocols for constructing systematic literature reviews. The most common are the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA and its updated versions; Moher et al., 2009; Page et al., 2020) and the Scientific Procedures and Rational Reviews of Systematic Literature Reviews (SPAR-4-SLR; Paul et al., 2021). In this study, the SPAR-4-SLR approach was used. The design of the systematic review conducted is presented in **Table 1**.

Table 1. Design of a systematic review of cyberspace research using the SPAR-4-SLR protocol.

Stage	Criteria	Description
1. Assembling		
1.1 Identifying sources	Object of study	Cyberspace
	Topic	Cyberspace in the mirror of social sciences and Economics
	Key questions	1) Scholarly output on the topic by time periods. 2) Leading research centers—organizations and locations. 3) Most prolific and influential authors. 4) Organizations funding research on Cyberspace. 5) Actively growing topics by number of publications.
	Publication types	Article, book, book chapter, conference paper, conference review, editorial, letter, note, review, short survey
	Quality of sources	Indexed in Scopus
1.2 Acquiring documents	Search mechanism	Advanced search for Scopus-indexed documents using keywords present in either title, abstract or keywords.
	Search period	1991–April 2024
	Search date	11 April 2024
	Keywords	"cyber space" OR "cyberspace"
	Primary sample	14,009 documents
2. Arranging		
2.1 Organizing the sample	Sampling filters	Subject area filters: • Social sciences, • Business, Management and Accounting (BMA), • Economics, Econometrics and Finance (EEF). Multiple subject areas are possible.
	Query string	(TITLE-ABS-KEY ("cyber space" OR "cyberspace")) AND (LIMIT-TO (SUBJAREA, "SOCI") OR LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA, "ECON"))
2.2 Purifying the sample	Final sample	6645 documents

Table 1. (*Continued*).

Stage	Criteria	Description
3. Assessing		
3.1 Evaluating the sample	Analysis methods	Performance analysis based on descriptive and evaluative bibliometrics procedures; qualitative and quantitative analysis.
	Future research agenda	Growing topics identified
3.2 Interpreting and reporting results	Visualization of results	Tables and graphs prepared using MS Excel, SciVal analytical tool
	Limitations	Articles by authors indexed in other databases (except Scopus) are not presented.

Source: Developed based on the approach by Paul et al. (2021).

In the process of research, bibliometric analysis of publications on the topic "Cyberspace" was supplemented by a comparative assessment of the worldwide distribution of information and communication technologies. Data from the International Telecommunication Union (ITU) for 2005–2023 on the individuals using the internet, the fixed-broadband subscriptions, and the mobile-cellular telephone subscriptions was used. The correlation coefficients between these three indicators and the number of Scopus-indexed documents on cyberspace over the same period were calculated.

3. Results and discussion

3.1. Scientific landscape of cyberspace research

A total of 14,009 documents were found in Scopus dedicated to the study of cyberspace. The first publication on the topic was published in 1990 and was presented at the conference "SPIE—The International Society for Optical Engineering" (Walser, 1990). The author of the article is Randal Walser, at the time a specialist at Autodesk Inc.—the largest software supplier, and later the founder of the startup Spacetime Arts for the development of virtual worlds. Walser R., having been involved in the Cyberspace project for many years, was involved in the design of cyberspace himself. As an expert practitioner, he wrote: "Cyberspace is a new computer-based medium that enables groups of people to play the roles of characters in simulations of three dimensional worlds." (p. 147). He proposed to consider the designer/creator of cyberspace not as a passive observer, but as a direct participant in developing virtual world, thereby creating a connecting bridge between physical and digital reality.

Since 1991, social sciences and economics have been involved in the study of cyberspace. The change in the annual number of cyberspace-related articles published over the past 33 years has been on an increasing trend. The publication growth curve can be divided into five stages.

Until 1995, the annual volume of publications on the topic of cyberspace did not exceed 100 documents. In 1996, there was over a two-fold increase in the number of publications compared to 1995. This occurred against the backdrop of a number of technological and institutional advances. Firstly, there have been breakthroughs in information retrieval. The first search engines were created (Yahoo in 1995 and Rambler in 1996), which made it possible to search for information not in a catalog

but throughout the Internet. The browsers Internet Explorer (1995) from Microsoft and Opera (1996) from Opera Software were introduced. Secondly, in 1994, a specialized international organization was established aimed at the long-term development of the Internet: the World Wide Web Consortium (www.w3.org). And the WWW itself has become the main source of information. Thirdly, during the same period, the development of the first virtual worlds began (e.g., Alpha World in 1995) (Kaplan and Haenlein, 2009).

After 1996, the scientific community became actively involved in the study of various aspects of cyberspace, contributing to 200–300 publications annually during 1996–2008. And since 2013, a threshold of 500 publications annually was passed. In the past five years, the highest rates of scholarly output have been achieved (over 1000 docs per year), as a result, 33% of all publications on cyberspace were published in 2020–2024.

The interest of the world academic community in the topic of cyberspace unfolded as information and communication technologies (ICTs) developed. **Figure 1** shows similar dynamics between the number of publications and Internet use in the world. The generality of trends in the development of science and technology is confirmed by the values of correlation coefficients between the number of publications and indicators: (1) Individuals using the Internet—0.990, (2) Fixed-broadband subscriptions—0.980, and (3) Mobile-cellular telephone subscriptions—0.886.
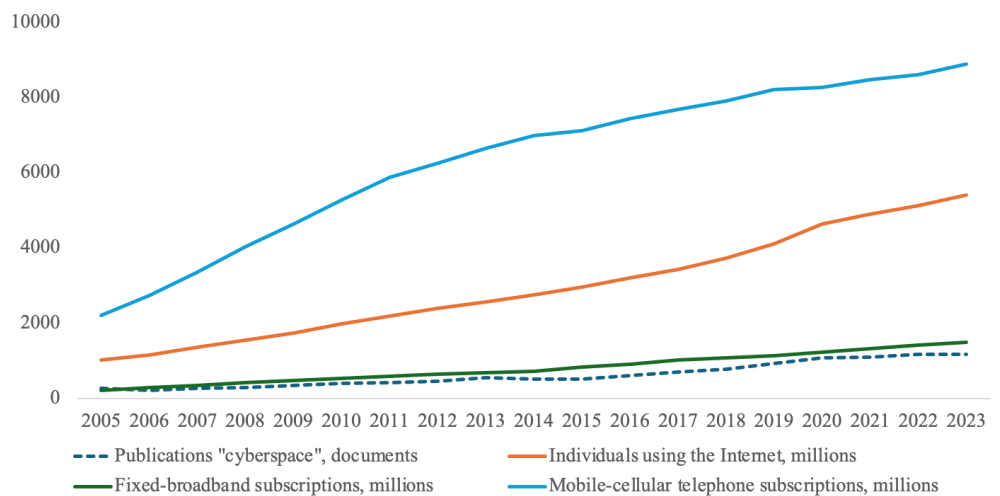

Figure 1. Relationship between global distribution of publications on cyberspace (*n* = 14,009) and internet usage indicators, 2005–2023.
Source: ITU, Scopus database.

Most documents are published in Computer science (26.3%), Social sciences (24.3%) and Engineering (14.0%). For focusing on social aspects of the cyberspace we limit our search to the following subject areas: Social sciences, Business, management and accounting (BMA), and Economics, Econometrics and Finance (EEF), leaving us with 6645 documents. There has been a significant, steady growth in the volume of publications over the years. Given the search filters applied to the subject area, nearly half (49.7%) of the documents in the sample are published in social sciences. Such disciplines as Computer science, Arts and humanities, Engineering and others are visible as being listed as additional subject areas of journals—**Figure 2**.
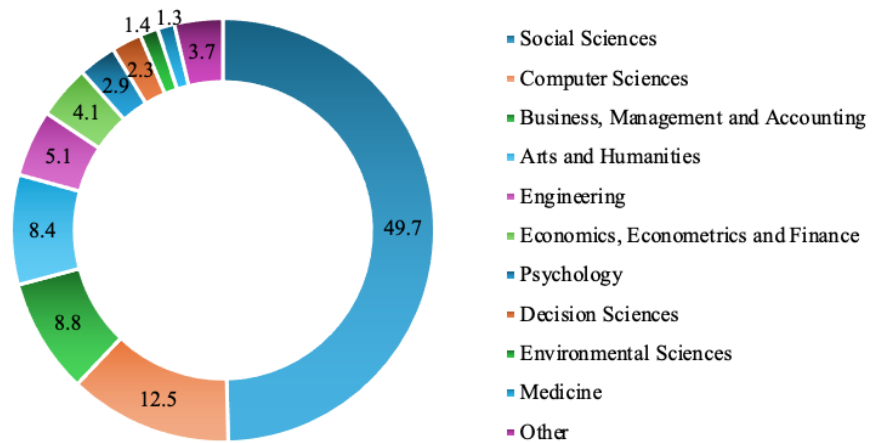
Figure 2. Documents (*n* = 6645 documents) by subject area.
Source: Scopus, 1991–2024.

Table 2 presents a general overview of Scopus-indexed publications on cyberspace produced in the social, BMA and EEF in 1991–2024 (April).

Table 2. Overview of publications (*n* = 6645 documents) on cyberspace, 1991–2024.

Categories	1991–1995		1996–2008		2009–2012		2013–2019		2020–2024		Total	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Document Types	72	100	1623	100	782	100	2182	100	1986	100	6645	100
Article	61	84.7	1091	67.2	419	53.6	1123	51.5	1252	63.0	3946	59.4
Book	0	0.0	44	2.7	51	6.5	130	6.0	64	3.2	289	4.3
Book chapter	0	0.0	136	8.4	190	24.3	569	26.1	449	22.6	1344	20.2
Conference paper	5	6.9	93	5.7	58	7.4	201	9.2	131	6.6	488	7.3
Conference review	0	0.0	7	0.4	1	0.1	8	0.4	5	0.3	21	0.3
Editorial	1	1.4	18	1.1	10	1.3	22	1.0	13	0.7	64	1.0
Letter	0	0.0	1	0.1	0	0.0	3	0.1	2	0.1	6	0.1
Note	1	1.4	22	1.4	8	1.0	13	0.6	9	0.5	53	0.8
Review	4	5.6	201	12.4	45	5.8	107	4.9	55	2.8	412	6.2
Short survey	0	0.0	9	0.6	0	0.0	4	0.2	2	0.1	15	0.2
Research Areas	72	-	1623	-	782	-	2182	-	1986	-	6645	-
Social Sciences	63	87.5	1414	87.1	721	92.2	1981	90.8	1804	90.8	5983	90.0
BMA	24	33.3	339	20.9	103	13.2	332	15.2	257	12.9	1055	15.9
EEF	3	4.2	79	4.9	40	5.1	198	9.1	170	8.6	490	7.4
Top-10* Countries	72	-	1623	-	782	-	2182	-	1986	-	6645	-
United States	34	47.2	660	40.7	288	36.8	575	26.4	336	16.9	1893	28.5
United Kingdom	11	15.3	238	14.7	108	13.8	247	11.3	166	8.4	770	11.6
China	0	0.0	12	0.7	20	2.6	101	4.6	222	11.2	355	5.3
Australia	1	1.4	61	3.8	28	3.6	91	4.2	70	3.5	251	3.8
Canada	3	4.2	71	4.4	43	5.5	73	3.3	39	2.0	229	3.4
Spain	0	0.0	13	0.8	19	2.4	86	3.9	72	3.6	190	2.9
India	0	0.0	9	0.6	15	1.9	50	2.3	93	4.7	167	2.5
Germany	0	0.0	28	1.7	13	1.7	67	3.1	53	2.7	161	2.4

Table 2. (*Continued*).

Categories	1991–1995		1996–2008		2009–2012		2013–2019		2020–2024		Total	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Russian Federation	0	0.0	2	0.1	1	0.1	63	2.9	82	4.1	148	2.2
Italy	1	1.4	21	1.3	10	1.3	47	2.2	50	2.5	129	1.9
Top-10* Organizations	72	-	1623	-	782	-	2182	-	1986	-	6645	-
University of Oxford	0	0.0	7	0.4	5	0.6	13	0.6	16	0.8	41	0.6
University of Toronto	0	0.0	11	0.7	9	1.2	14	0.6	3	0.2	37	0.6
Chinese Academy of Sciences	0	0.0	2	0.1	2	0.3	6	0.3	20	1.0	30	0.5
King's College London	0	0.0	1	0.1	5	0.6	15	0.7	8	0.4	29	0.4
University of Maryland	0	0.0	7	0.4	5	0.6	8	0.4	8	0.4	28	0.4
University of Warwick	1	1.4	3	0.2	3	0.4	15	0.7	6	0.3	28	0.4
The University of Sheffield	0	0.0	7	0.4	2	0.3	11	0.5	5	0.3	25	0.4
The Ohio State University	0	0.0	9	0.6	6	0.8	6	0.3	4	0.2	25	0.4
University of Leeds	0	0.0	6	0.4	4	0.5	9	0.4	5	0.3	24	0.4
University of Haifa	1	1.4	9	0.6	1	0.1	5	0.2	8	0.4	24	0.4
Top-5* Source Titles	72	-	1623	-	782	-	2182	-	1986	-	6645	-
Business Lawyer	0	0.0	21	1.3	11	1.4	15	0.7	2	0.1	49	0.7
Cyberpsychology and Behavior	0	0.0	45	2.8	1	0.1	0	0.0	0	0.0	46	0.7
Advanced Sciences and Technologies for Security Applications	0	0.0	0	0.0	0	0.0	20	0.9	25	1.3	45	0.7
Computers and Security	0	0.0	13	0.8	3	0.4	9	0.4	16	0.8	41	0.6
New Media and Society	0	0.0	21	1.3	6	0.8	3	0.1	3	0.2	33	0.5
Top-7* Funders	72	-	1623	-	782	-	2182	-	1986	-	6645	-
National Science Foundation	2	2.8	12	0.7	2	0.3	20	0.9	10	0.5	46	0.7
National Natural Science Foundation of China	0	0.0	1	0.1	1	0.1	12	0.5	32	1.6	46	0.7
European Commission	0	0.0	0	0.0	3	0.4	7	0.3	10	0.5	20	0.3
National Office for Philosophy and Social Sciences	0	0.0	0	0.0	0	0.0	1	0.0	18	0.9	19	0.3
National Key Research and Development Program of China	0	0.0	0	0.0	0	0.0	2	0.1	14	0.7	16	0.2
Horizon 2020	0	0.0	0	0.0	0	0.0	2	0.1	11	0.6	13	0.2
Social Sciences and Humanities Research Council of Canada	0	0.0	0	0.0	3	0.4	3	0.1	5	0.3	11	0.2

Note: * for the entire period, BMA—Business, Management and Accounting; EEF—Economics, Econometrics and Finance.

The largest share of publication types are journal articles. However, their share among other types of publications decreases over time. While before 1995 this was almost 85% of all publications, by 2013–2019 their share dropped to 51.5% (the lowest value for the sample). The change in the structure of document types is associated with an increase in the proportion of fundamental and encyclopedic publications—books and book chapters—as science develops. Their share increased by 2.5 times over the entire study period. The average share of conference papers, as a source of the most

recent ideas and developments, is quite stable in all periods identified—at the level of 7.3% (fluctuating from 5.7% to 9.2%).

Table 3. Scholarly output in cyberspace by social sciences subcategory (*n* = 1804), 2020–2024.

Subject area & Subcategory	Scholarly Output%	Citations %	Authors %	Citations per Publication	Field-weighted Citation Impact
Social Sciences, total	1804	5188	3394	2.9	1.2
With a publication share of over 20%					
General	24.2	16.0	19.9	1.9	**1.2**
Law	22.1	22.4	21.1	**2.9**	1.1
With a share of publications from 10% to 20%					
Political Science and International Relations	18.8	20.0	13.8	**3.1**	**1.6**
Sociology and Political Science	13.7	15.2	12.8	**3.2**	**1.9**
With a share of publications from 5% to 10%					
Education	9.5	11.3	14.6	**3.4**	0.9
Communication	8.6	10.2	9.3	**3.4**	1.1
Cultural Studies	7.0	4.5	6.5	1.8	0.8
Safety Research	6.7	4.5	7.1	2.0	**1.5**
Geography, Planning and Development	5.9	13.6	7.6	**6.6**	1.0
Miscellaneous	5.6	4.6	7.1	2.3	1.0
With a share of publications from 1% to 5%					
Library and Information Sciences	4.3	4.7	5.6	**3.1**	0.8
Linguistics and Language	3.5	2.5	3.5	2.0	0.9
Public Administration	3.5	3.4	3.3	2.8	0.9
Development	2.2	2.8	2.7	**3.6**	**2.0**
Anthropology	2.0	1.5	1.8	2.2	0.9
Urban Studies	1.9	3.5	2.0	**5.2**	**1.5**
Gender Studies	1.7	1.9	1.4	**3.3**	1.1
Health (social science)	1.6	2.0	3.0	**3.6**	0.6
Transportation	1.4	5.1	2.8	**10.1**	1.0
With a publication share of under 1%					
Human Factors and Ergonomics	0.3	0.9	0.6	**7.5**	**1.2**
Archeology	0.3	0.1	0.2	1.0	**1.3**
Life-span and Life-course Studies	0.2	0.1	0.1	1.7	0.2
Demography	0.1	0.0	0.1	0.0	0.0

Note: Values equal to or higher than the average for subject area are highlighted in bold.

The distribution of publications across the three subject areas selected is uneven. The vast majority of research is carried out in Social Sciences—**Table 3**. The share of publications in these sciences in the studied sample grew until 2012 and then remained at a level of at least 90%. In second place is Business, Management and Accounting (BMA)—**Table 4**. However, interest in cyberspace as an object of study is declining in this research area. While before 1995, the BMA accounted for a third of all publications, in 2020–2024—less than 13%. To a lesser extent, cyberspace is studied

in Economics, econometrics and finance (EEF)—**Table 4**. In none of the periods under review did the share of publications in this research area rise above 10%. Although it should be noted that there was a small surge in publication activity in 2013–2019.

Table 4. Scholarly output in cyberspace by subcategories business, management and accounting—BMA (*n* = 257) and economics, econometrics and finance—EEF (*n* = 170), 2020–2024.

Subject area & Subcategory	Scholarly Output, %	Citations, %	Authors, %	Citations per Publication	Field-weighted Citation Impact
Business, Management and Accounting (BMA)					
Total	257	1519	685	6	1.5
With a publication share of over 20%					
General	31.1	14.9	27.4	2.8	**1.8**
Management of Technology and Innovation	23.0	17.2	25.8	4.4	1.1
Strategy and Management	21.8	23.7	24.5	**6.4**	1.3
With a share of publications from 10% to 20%					
Management Information Systems	14.8	22.8	15.9	**9.1**	1.0
Business and International Management	11.3	19.9	10.7	**10.4**	**2.1**
With a share of publications from 5% to 10%					
Miscellaneous	7.4	4.7	10.2	3.7	0.6
Marketing	6.2	8.8	7.4	**8.4**	0.8
Tourism, Leisure and Hospitality Management	6.2	13.5	4.4	**12.8**	**2.7**
With a publication share of under 5%					
Organizational Behavior and Human Resource Management	4.7	3.7	3.8	4.7	**1.8**
Accounting	3.5	0.5	5.3	0.8	0.3
Industrial Relations	0.8	0.5	1.0	4.0	0.9
Economics, Econometrics and Finance (EEF)					
Total	170	416	388	2.5	1.3
With a publication share of over 50%					
General	51.8	57.7	51.8	**2.7**	**2.0**
With a share of publications from 20% to 50%					
Economics and Econometrics	28.2	26.7	26.5	2.3	0.8
Miscellaneous	20.0	15.6	22.4	1.9	0.4
With a share of publications from 5% to 10%					
Finance	6.5	4.8	10.8	1.8	0.7

Note: Values equal to or higher than the average for subject area are highlighted in bold.

The Social Sciences subject area has two main subcategories: General and Law, each accounting for over 20% of publications. Also, these subcategories represent the majority of authors who deal with cyberspace research. For the BMA subject area, the most productive in terms of the share of publications and authors involved are three subcategories: General; Management of Technology and Innovation; Strategy and Management. For the EEF subject area, more than half of all publications, authors, and citations fall into the General subcategory.

In terms of relative citation rates, the following subcategories of Social Sciences should be distinguished: Transportation; Human Factors and Ergonomics; Geography, Planning and Development; Urban Studies. It was publications from these subcategories that collected the largest number of citations per paper (CPP): from 5 to 10, with the average for the subject area being 2.9. For the BMA subject area, the average citation level is twice above the average for the Social Sciences, and is equal to 6 citations per paper. Among the most highly cited subcategories are Tourism, Leisure and Hospitality Management (12.8 CPP); Business and International Management (10.4 CPP); Management Information Systems (9.1 CPP); Marketing (8.4 CPP). This indicates the demand for publications about cyberspace in these areas. For Economics, Econometrics and Finance (EEF), only 1 subcategory can be identified with a citation level of publications above the average for the subject area (2.5 CPP)—this is the General subcategory with 2.7 citations per paper.

A comparative analysis of all subcategories across the three subject areas according to the Field-Weighted Citation Impact (FWCI), which demonstrates the level of global research influence, made it possible to identify the five most attractive and popular areas for the study of cyberspace by social and economic sciences, namely: (1) Tourism, Leisure and Hospitality Management; (2) Business and International Management; (3) Development; (4) Sociology and Political Science; (5) Organizational Behavior and Human Resource Management.

3.2. Leading research centers and researcher groups

One of the objectives of this study is to determine the geographical centers of research into the socio-economic aspects of cyberspace. Our research has enabled us to identify two countries with the greatest contribution throughout the entire study period—the United States (28.5% of publications) and the United Kingdom (11.6% of publications). The United Kingdom, occupying 2nd place for a long time, is 2.5 times inferior to the United States in terms of the total volume of publications for 1991–2024.

In the initial development period of the cyberspace topic, almost half of the publications were affiliated with the United States. This is largely because the technologies that underlie the creation of the architecture of cyberspace have received active commercial implementation in the US. In the following periods, other countries also joined in the exploration of cyberspace. Over the past ten years, the topic of cyberspace has received active study in China. In 2020–2024, the country managed to double the number of publications compared to 2013–2019. As a result, during this period, China displaced the UK and ranked second. Also, in 2020–2024, two more countries—India and Russia—managed to overcome the threshold of 4% of publications and take 4th and 5th places, respectively. Thus, the modern geography of scientific centers for the study of cyberspace in the social and economic dimensions is formed around five countries: the USA, China, the United Kingdom, India, and Russia (**Figure 3a**). At the same time, based on the current dynamics, we can predict a further increase in the share of Chinese and Indian research in the structure of publications.

Another five countries from the top-10 by publication output on cyberspace in the social and economic sciences—Australia, Canada, Spain, Germany, Italy—may

have unstable publication dynamics, as shown by sharp peaks and drops throughout the considered time period (**Figure 3b**).
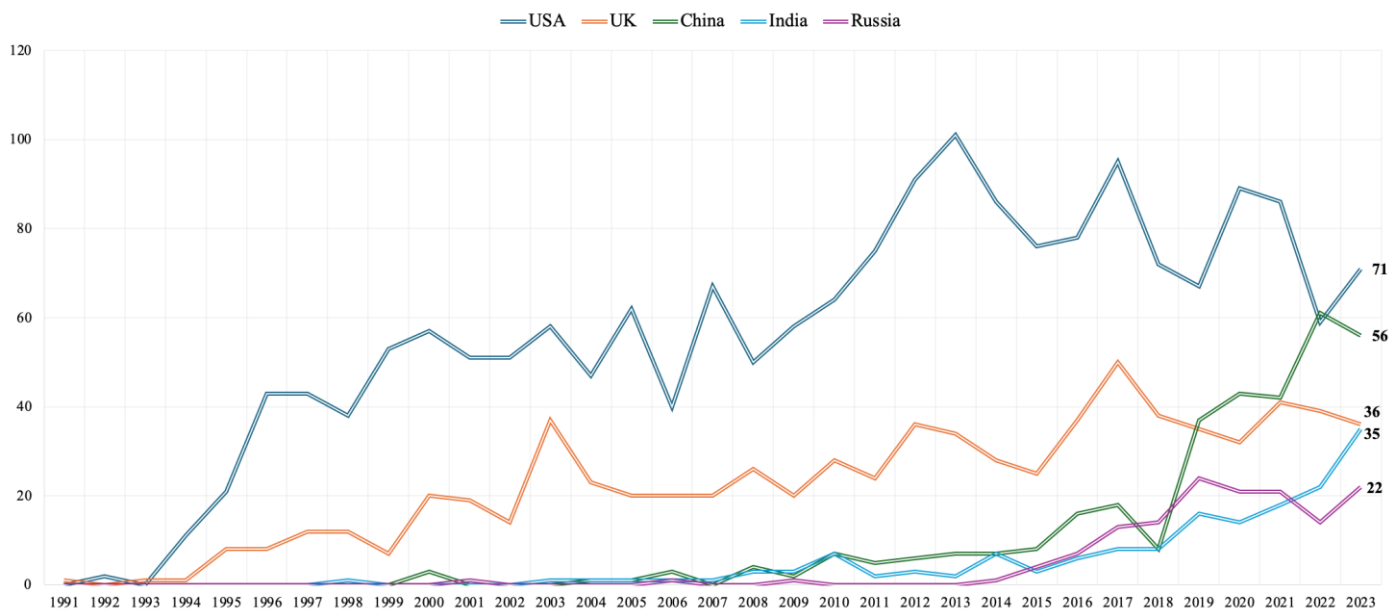
(a) USA, UK, China, India, Russia.
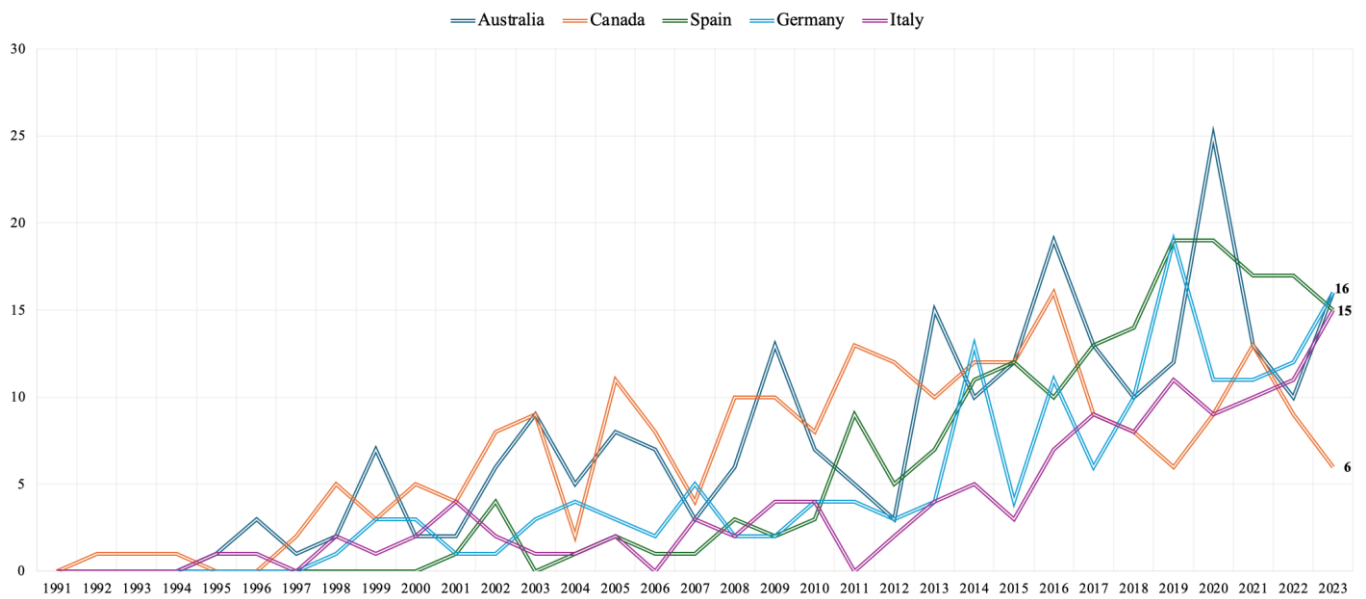
(b) Australia, Canada, Spain, Germany, Italy.

Figure 3. Research output of countries in cyberspace (number of publications), 1991–2023.

Additionally, we considered the question of research funding on the topic of cyberspace. In total, 546 cyberspace publications reported funding, which was provided by 159 institutions. For other publications, the source of funding was not available or not indicated. Most funder institutions (133) supported studies that resulted in five or fewer publications. The largest contribution to the support of cyberspace research was made by 26 funding institutions, acknowledged the support of 264 articles published during 1994–2024, including 55% in 2020–2024 (or 144 documents affiliated with 160 research organizations). By 2024, the most influential

sponsoring institutions supporting cyberspace research were from China (top 3: National Natural Science Foundation of China (NSFC)—22.2%, National Planning Office for Philosophy and Social Sciences (NPOPSS)—12.5%, National Key Research and Development Program of China (NKP)—9.7%), the EU (top 2: Horizon 2020—14.6%, European Commission—6.9%), and the USA (National Science Foundation—6.9%). Other noteworthy sponsors are the Social Sciences and Humanities Research Council of Canada (SSHRC), the Russian Foundation for Basic Research (RFBR), the Japan Society for the Promotion of Science (JSPS), the Spain Ministry of Science, Innovation and Universities (MICIU), and the Portuguese Foundation for Science and Technology (FCT), each contributing to 3.5%.

Considering the organizations affiliated with publications, a more even distribution of documents between them is notable (without singling out a prominent leader). Among the organizations with the largest cumulative volume of publications are three universities from the United Kingdom (University of Oxford, King's College London, and University of Warwick) and one each from Canada (University of Toronto), the United States (University of Maryland) and China (Chinese Academy of Sciences, although featuring multiple institutes). After 2010, these organizations published quite steadily on the topic of cyberspace (with drops in certain periods)—**Figure 4**.
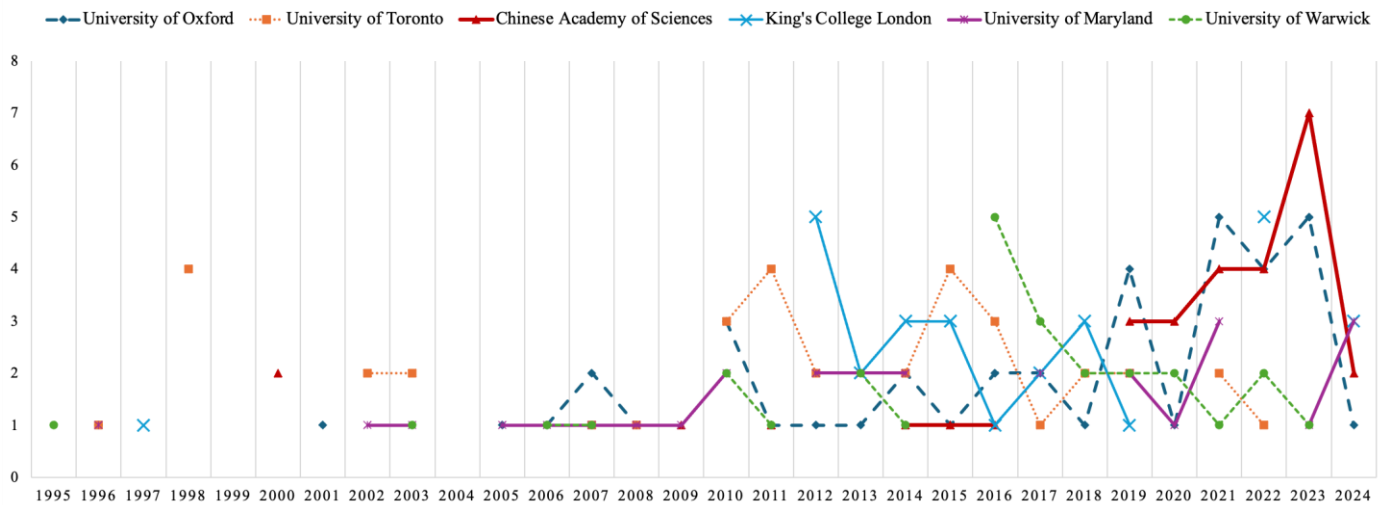

Figure 4. Dynamics of publications on cyberspace by leading organizations, 1995–2024.

In addition to the leading organizations – scientific centers for the study of cyberspace, we identified individual researchers who were affiliated with these organizations and had the largest number of dedicated publications (at least 3, maximum 7). These data are presented in **Table 5**. We compared the obtained data with the list of the top-five world authors who have made the greatest contribution to the study of cyberspace without taking into account their affiliations (**Table 5**). The most productive researcher, Warf Barney from the University of Kansas (United States), published 25 publications (incl. 17 articles) on cyberspace over the entire period under study: the first in 1997, and the latest one in 2021. It is noteworthy that not a single author from the top-five leading organizations was included in the list of world leading authors on the topic. This means that the success of organizations is

based on the work of research teams, and not individual authors.

Table 5. Research output of the leading authors on cyberspace, 1991–2024.

Country	Organization	Author	No of papers	Scopus ID
Top-five authors worldwide with the largest number of publications on cyberspace				
United States	University of Kansas	Warf Barney	25	55172120700
France	Universite Paris 8 Vincennes-St Denis	Douzet Frédérick	13	29067585100
South Korea	Yeungnam University	Park Han Woo	11	10043514200
United States	Widener University	Moringiello Juliet M.	10	6506762981
Greece	International Hellenic University	Zekos Georgios I.	10	6506079167
Top authors from the organizations identified as having the largest number of publications on cyberspace				
Canada	University of Toronto	Deibert Ronald J.	7	6602230897
		Rohozinski Rafal	6	35812292300
		Virkar Shefali	3	56110668000
		Crete-Nishihata Masashi	3	35145218500
		Lindsay Jon Randall	3	55584201400
China	Chinese Academy of Sciences (Institute of Automation; Institute of Geographic Sciences and Nature Resources Research; Laboratory of Cyberspace Geography)	Wang Feiyue	6	57211758869
		Wang Xiao	4	57005000100
		Gao Chundong	3	57211714190
		Guo Qiquan	3	57211712113
		Hao Mengmeng	3	56134804700
		Jiang Dong	3	35787361300
United States	University of Maryland	Moringiello Juliet M.	5	6506762981
		Reynolds William L.	5	7202109681
		Khamis Sahar	3	35761475400
		Smith Margaret W.	3	58873381800
United Kingdom	University of Warwick	Christou George	7	14819141500
		Paliwala Abdul	3	6506689024
	King's College London	Kavanagh Camino	3	55531743200
	University of Oxford	Virkar Shefali	3	56110668000

3.3. Leading sources for cyberspace research

The number of sources presenting studies on cyberspace is growing. While during the initial period of the emergence of the topic (1991–1995) there were 52 titles, during the period of active interest (2020–2024) the number of titles reached 1426—**Figure 5**. It is natural that older publications (1996–2008) collected the largest number of citations—46.3 thousand. In relative terms, the period 1996–2008 is also in the lead—28.5 citations per article. In second place by citation per paper (CPP) is the period 2009–2012 with 17.4 citations per article. Almost the same CPP is found for the very first publications of 1991–1995—15.3 CPP. The papers from 2013–2019 are least in demand by the scientific community to date, with only 9.3 citations per paper.
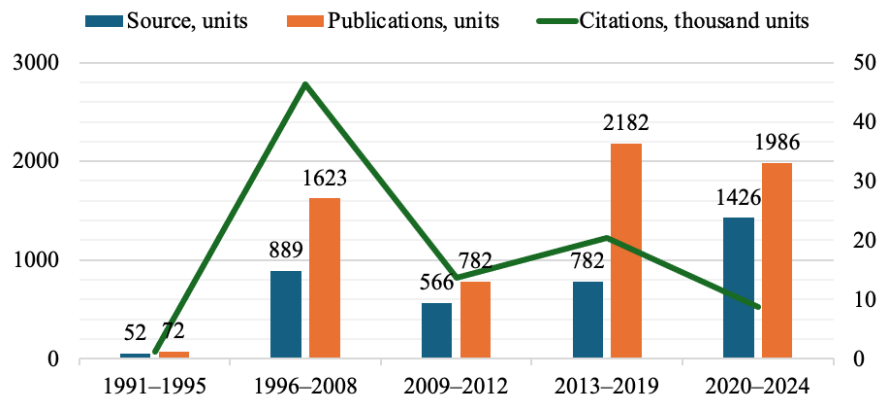
Figure 5. Distribution of sources, publications and citations on the topic of cyberspace, 1991–2024.

Table 6 reflects the change in the ranking of sources where social and economic research on cyberspace was published by periods.

Table 6. Leading titles by the volume of publications and citations on the topic of cyberspace, 1991–2024.

Source	Top by Publications	Source	Top by Citations
1991–1995			
Futures	6	Futures	190
Computer Law and Security Report	3	Journal of Contemporary Ethnography	184
Computers and Composition	3	Interactive Learning Environments	94
Information Society	3	Body & Society	92
Internet Research	3	Internet Research	67
1996–2008			
Cyberpsychology and Behavior	45	New Media and Society	3253
Information Society	25	Cyberpsychology and Behavior	2787
Social Science Computer Review	22	Information Society	1126
Business Lawyer	21	Progress in Human Geography	693
New Media and Society	21	Harvard Business Review	651
2009–2012			
Business Lawyer	14	Delete: The Virtue of Forgetting in the Digital Age	598
At the Interface Probing the Boundaries	13	Computers and Education	387
Computer Law and Security Review	13	Geographical Journal	363
Cyberpsychology	9	Criminal Justice and Behavior	293
IEEE Security and Privacy	9	Computers, Environment and Urban Systems	288
2013–2019			
Advanced Sciences and Technologies for Security Applications	20	Cyberpsychology	508
Herodote	19	International Security	364
International Journal of Cyber Criminology	17	Computers and Security	336
Business Lawyer	15	International Journal of Cyber Criminology	220
Cyberpsychology	14	Internet Culture	189

Table 6. (*Continued*).

Source	Top by Publications	Source	Top by Citations
2020–2024			
Advanced Sciences and Technologies for Security Applications	27	Computers and Security	297
Computers and Security	18	Knowledge-Based Systems	227
Journal of Cybersecurity	17	Journal of Cybersecurity	167
Sustainability Switzerland	17	Sustainable Cities and Society	167
International Journal of Cyber Criminology	15	International Journal of Information Management	160

Note: Sources that repeat as both top-ranked by publication and citations are marked in color.

None of the presented titles was able to maintain leadership in the number of publications and/or citations per article on cyberspace during the entire study period. Only four journals were in the top-five by the number of publications on the topic in two time periods at once: from 2009 to 2019—"Cyberpsychology", "Business Lawyer" and from 2013 to 2024—"International Journal of Cyber Criminology", "Advanced Sciences and Technologies for Security Applications". Another journal, "Computers and Security", was able to secure high positions in cited articles on cyberspace from 2013 to 2024.

In recent years (2020–2024), two significant sources should be highlighted, which lead not only in the number of documents, but also in citations—"Computers and Security" and "Journal of Cybersecurity". The first journal, "Computers and Security" (e-ISSN:1872-6208; ISSN: 0167-4048, Elsevier), specializes in cutting-edge research and evidence-based practice recommendations for IT security management. It is intended for both academic theorists and practitioners involved in computer security in various sectors. Its CiteScore is 11.1 and Impact Factor—5.6. The editor of the journal is Professor Eugene Spafford, one of the leading scientists in the fields of computing and cybersecurity. Eugene Spafford—Executive Director Emeritus of Purdue University CERIAS (United States). In addition to Scopus, the journal is indexed in Engineering Index, Computer Science Index, INSPEC, Science Citation Index Expanded. The journal also maintains links with Heliyon, an open access journal from Cell Press (Elsevier).

The second "Journal of Cybersecurity" (e-ISSN 2057-2093; ISSN 2057-2085; Oxford University Press) aims to build an interdisciplinary cybersecurity community and publishes articles in various scientific fields on cyber topics. Impact Factor—3.9. The journal has two Editors-in-Chief. The first is Tyler Moore, the Professor of Cyber Security and Information Assurance in the Tandy School of Computer Science at the University of Tulsa (United States). The second is David Pym, Professor of Information, Logic, and Security at University College London (United Kingdom). The Journal of Cybersecurity is widely indexed in various abstract databases, including Scopus, Emerging Sources Citation Index, EBSCOhost, and others.

3.4. Key research topics on cyberspace in social sciences, business and economics

All Scopus-indexed publications are divided into topics and topic clusters. Our

publication set on cyberspace research accounts for 243 topic clusters and 727 topics. The top-20 topic clusters by the volume of scholarly output are presented in **Table 7**. Most publications are attributed to the TC.363—"International Law; Human Rights; Responsibility". By looking into the list of individual topics, we see that most publications are within the topic T.13961—"Cybercrime; Cyberattack; Warfare", accounting for 350 documents or 15.7% of the total sample. Second most popular topic cluster is TC.218—"Computer Crime; Network Security; Intrusion Detection", which includes such topics as: T.3303—"Information Security; Protocol Compliance; Computer Security" (31 publications), T.10243—"Phishing; Websites; Cybercrime" (17 documents), and T.510—"Intrusion Detection System; Network Security; Denial-Of-Service Attack" (16 documents).

Table 7. Top-20 topic clusters on cyberspace by the volume of scholarly output, 2020–2024.

Topic Cluster (TC)	TC Number	Scholarly Output	Publication share (%)	Field-Weighted Citation Impact	Prominence percentile
International Law; Human Rights; Responsibility	TC.363	365	2.81	1.39	44.55
Computer Crime; Network Security; Intrusion Detection	TC.218	123	0.23	1.97	96.19
Media; News; Journalism	TC.279	91	0.31	1.12	90.44
Terrorism; Organized Crime; Radicalism	TC.945	73	1.12	0.87	44.48
Gambling; Internet; Students	TC.555	61	0.26	0.93	93.11
Child; Adolescent; Schools	TC.99	50	0.11	1.11	96.25
Offense; Police; Offender	TC.207	47	0.22	1.28	80.60
Models; Social Networking (Online); Algorithms	TC.358	30	0.08	1.16	92.58
Industry; Research; Marketing	TC.36	29	0.04	0.87	99.39
Cryptography; Authentication; Data Privacy	TC.84	26	0.03	0.81	98.53
China; Asia; Chinese	TC.495	26	0.27	0.74	46.62
European Union (EU); Europe; Governance	TC.505	26	0.22	1.71	48.56
Law; Court; Human Rights	TC.757	23	0.47	0.44	20.94
Students; Education; Teaching	TC.542	22	0.14	1.01	81.27
Semantics; Models; Recommender Systems	TC.37	21	0.02	1.11	98.19
Child; Geography; Research	TC.596	21	0.11	0.44	68.83
International Relations; Security; Politics	TC.548	19	0.2	1.41	45.35
Patents; Copyright; Intellectual Property	TC.586	19	0.33	0.59	32.04
Industry; Innovation; Entrepreneurship	TC.24	17	0.02	2.0	99.19
Students; Teacher; Learning	TC.337	17	0.11	1.44	84.01

The most prominent topic cluster with prominence percentile score of 100 is TC.1500—"COVID-19; SARS-CoV-2; Coronavirus", featuring 12 publications related to digitalization during COVID-19. As for topics, the higher prominence score of 99,999 has T.4338—"Object Detection; Deep Learning; IOU" with 4 attributed publications. The keyword map visualizes the hottest research topics in cyberspace—**Figure 6**.

Figure 6. Cyberspace keyword map, 2020–2024.

Note: Green color keywords have an ascending usage trend, while blue color keywords are descending. The keywords size reflects the usage volume across the publication sample.

First of all, the cyberspace research is associated with the Internet, as the basis for the existence of cyberspace itself. This may also include keywords related to various digital technologies and digital processes, such as digitalization, online, blockchain, virtual, Internet of things, etc.

The second major body of research on cyberspace is associated with such concepts as cybersecurity, cybercrime and cyberattacks, as well as their various derivatives, for example, conflict, defense, national security, terrorism, politics, military conflict, sovereignty.

The third direction of cyberspace research is closely related to the second and is devoted to legal regulation, norms, and international laws, as well as the practices of individual countries in this area.

In 2020–2024, the topic of coronavirus was also relevant, which was also reflected in the research agenda for the study of cyberspace.

4. Conclusions

This article presents the results of an extensive scientometric study on the development of the concept of cyberspace over a period of more than 30 years in the fields of social sciences, business, and economics. Although some reviews have previously summarized the developments of security issues in the cybersphere—cybersecurity, only a few studies have been devoted to the study of cyberspace. The article addresses this research gap by presenting a scientometric analysis of relevant literature from Scopus and identifying key trends and topics. This should help researchers in choosing further vectors for expanding ideas about cyberspace as a new space for humans, being actively concurred, and simultaneously connecting the virtual and physical realms.

4.1. Contribution to theoretical research

The number of publications on cyberspace in three fields of science: Social sciences; Business, Management and Accounting (BMA); Economics, Econometrics and Finance (EEF) shows steady growth throughout the period from 1991 to April 2024. It is shown that the intensity of the study of cyberspace corresponds to the dynamics of the spread of key information and communication technologies (ICT) in

the world—the Internet, fixed broadband, and mobile communications. The higher the penetration of technology, the more publications were published on the topic of cyberspace. This is justified by the fact that the more people involved in the development of cyberspace, the more social problems, risks, and benefits this creates and the wider the object of research.

The initial stage of cyberspace studies (1991–1995) had few publications and citations. During these years, the first studies were published, mainly journal articles, setting the general framework for the study of cyberspace, its characteristics, boundaries, and elements. It is symbolic that the main source of new knowledge on the topic during this period was a journal called "Futures".

The second period (1996–2008), when the annual number of publications exceeded 200 and reached 300, is defined by a sharp increase in the number of publications and citations, including in relative terms (Citations per Paper), and the variety of sources presenting the results of research on cyberspace increased significantly. The first fundamental works began to appear—monographs on the topic, summarizing the work of scholars dealing with issues of cyberspace and security.

By the end of the period 2009–2012, the annual number of publications on cyberspace had approached the threshold of 500 documents, partially due to the active growth of the publication activity of scientists from the United States. The trend towards increasing the share of major reference works continued (i.e., books). During this period, the largest proportion of studies in Social Sciences was noted in comparison with other periods.

In 2013–2019, there was another surge in interest in the topic of cyberspace and an increase in the diversity of sources. The annual replenishment of the research database occurred on average with 650 documents. During this period, China actively became involved in the development of this research topic.

The most recent studies on cyberspace cover the period 2020–April 2024. During this period, more than 1000 studies were published annually. Studies covered the diverse aspects of cyberspace, strongly facilitated by the coronavirus pandemic (stimulating an increase in the use of digital technologies) and the increase in general geopolitical tensions, which were accompanied by cyber conflicts between countries.

This review study identifies the leading scientific centers for cyberspace research. Firstly, countries are identified with an expected growth of interest in the topic of cyberspace. These are likely to be the countries that were in the lead throughout the entire time (1991–2024)—the United States and the United Kingdom, but also those that have shown active growth in recent years—China, India, and Russia. The funding programs implemented in these countries played a significant role in supporting these studies.

Secondly, among scientific organizations, those with visible research groups are highlighted—these are: the University of Toronto, the Chinese Academy of Sciences (Institute of Automation; Institute of Geographic Sciences and Nature Resources Research; Laboratory of Cyberspace Geography), University of Maryland, University of Warwick, King's College London, and the University of Oxford. Also, some of the most productive authors who were not affiliated with these organizations are identified, representing the following universities—University of Kansas, Universite Paris 8 Vincennes-St Denis, Yeungnam University, Widener University, International

Hellenic University.

Thirdly, we identified key sources that published leading research on cyberspace in different time periods. Only a limited number of journals fell into two time periods at once, and each period had its own leaders. The lack of structural unity in the sources suggests that in different time periods, different aspects of cyberspace were studied, which is interesting to the audiences of different journals. In general, the topic of cyberspace is multidisciplinary.

4.2. Contribution to practice and application

The results of this study will be of interest to practitioners who are involved in building an architecture for managing cyberspace and ensuring its security for humans, including developing laws to regulate digital relationships.

The concept of cyberspace is closely related to the concepts of cybersecurity and sovereignty, as shown by the keyword map created. The current level of technological development has created new threats to state and personal security. Our research has shown that the problem of protecting cyberspace and developing international legislation is a key trend in the development of the concept of cyberspace. Threats to the safe functioning of cyberspace are associated with the use of digital instruments influencing the economy, public administration, politics, international relations, etc. It is of practical value to study possible mechanisms for reducing risks arising in the process of digitalization, as well as data protection, digital infrastructure, human rights, and national interests.

This article also gives an idea of the geography of cyberspace studies and the concentration of leading research teams, which can help in the formation of collaboration networks to continue research on the topic. Clustering topics and keywords can help adjust the research agenda at the individual or group level and prioritize cyberspace research.

4.3. Trends and future research directions

Since cyberspace is already an integral part of human life, where people carry out a significant part of their daily activities, it can be expected that future research in the social sciences will focus on the problems of ensuring security and achieving the effectiveness of such activities at both the individual and state levels.

An individual agenda in the international scientific literature that is gaining interest in the social sciences is digital sovereignty (otherwise cyber sovereignty, technological sovereignty, data sovereignty, digital strategic autonomy, etc.) as the ability of the state to establish control over various elements of digital technologies (digital data, software, equipment, technologies, infrastructure, standards and protocols, digital platforms, processes, and services), thereby delineating the boundaries of national cyberspace and ensuring its cybersecurity. The state's loss of digital sovereignty leads to digital colonization by more technologically advanced countries.

We can predict the growth of political science and legal areas studying the regulation of cyberspace. The experience of individual countries in managing their cyberspace will be of interest. First of all, these are China, the European Union, Russia,

the USA, and others, which differ in their vision of delimiting the boundaries of national cyberspace and governing it. The topic of cybercrime, information, and cybersecurity will also continue to be of interest, especially as new threats and technologies emerge.

Among the most important technologies that will further influence the development of cyberspace, as shown by the clustering of key research topics, are blockchain, the Internet of things, artificial intelligence, and social networks. We might expect that the influence of these technologies will continue to rise, creating an even stronger interrelation between the virtual and real worlds, while the role of physical infrastructure—the ICTs, will continue to grow and become vital in introducing the Tactile Internet.

Conflict of interest: The authors declare no conflict of interest.

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