中国科学院科技战略咨询研究院
Institutes of Science and Development, Chinese Academy of Sciences

Clarivate

2025

Research Fronts : Active Fields, Leading Countries/Regions

Institutes of Science and Development,
Chinese Academy of Sciences

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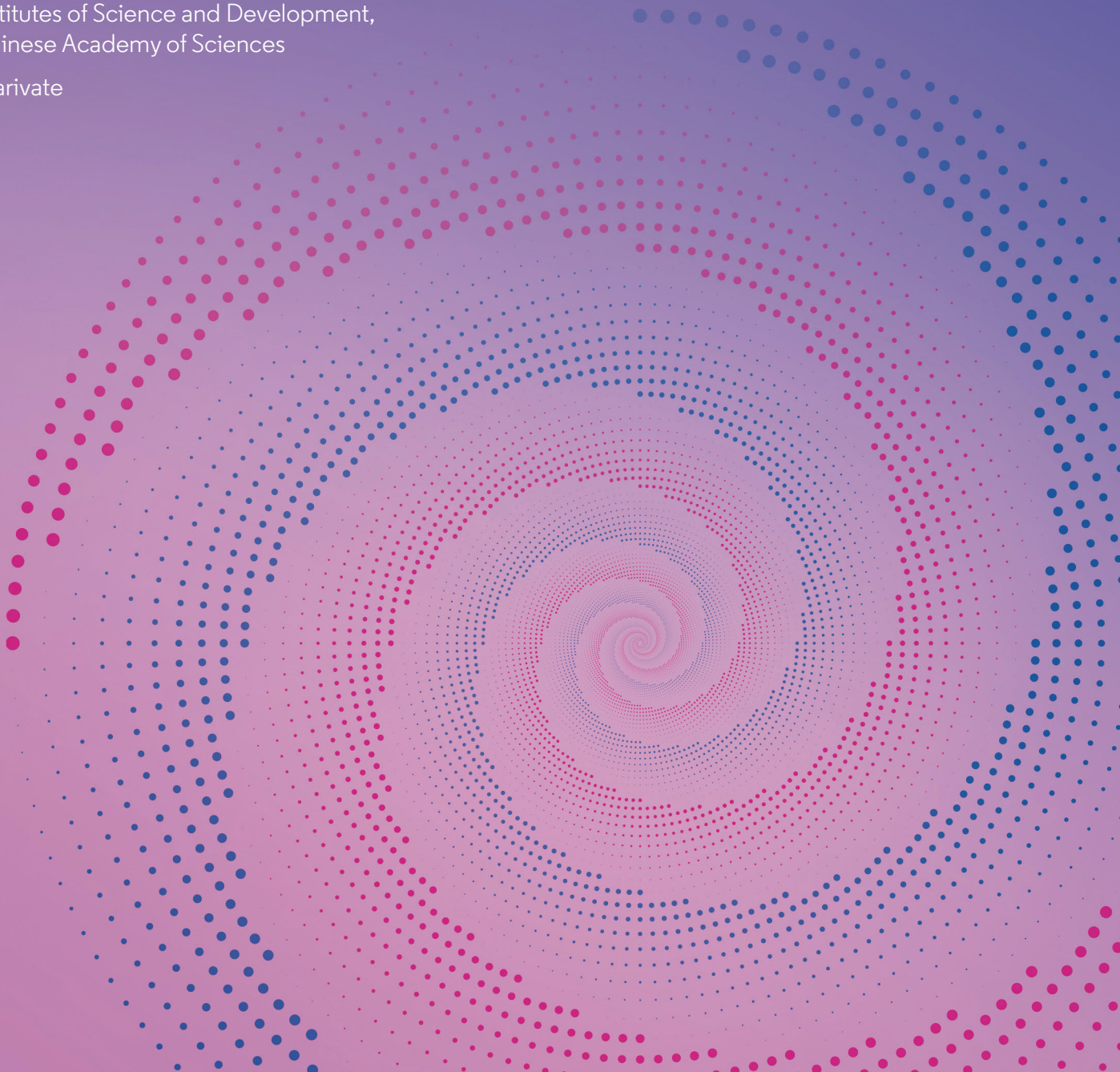

Science and technology are universal and epochal, and the development of science and technology must be viewed from a global perspective. At present, major breakthroughs and accelerated applications of technological innovation have been instrumental in reshaping the global economic structure and transforming the arena of industrial and economic competition. The “Research Fronts 2025” report is a prequel to another survey, “Research Fronts 2025: Active Fields, Leading Countries/Regions”, which selects and discusses 110 hot fronts and 18 emerging fronts in 11 broad research areas. Based on the findings of “Research Fronts 2025”, this second report uses the Research Leadership Index to assess the research activity of the world’s major countries/regions and to observe how that activity, in the face of global competition in innovation and technological advancement, is demonstrated in these Research Fronts.

110 **Hot fronts**

18 **Emerging fronts**

1 Methodology

1.1 The logic model of Research Leadership Index (RLI)

The Research Leadership Index (RLI) is a comprehensive evaluation measure to determine the degree of activity in Research Fronts. Since a Research Front itself is composed of a group of highly cited core papers along with subsequent papers that cite the core literature, the design of the Research Leadership Index considers the numbers of the core papers and citing papers, as well as their respective citations. These calculations underlie two indicators: Output Share and Citation Share. The logical model of Research Leadership Index (RLI) is shown in Figure 1.

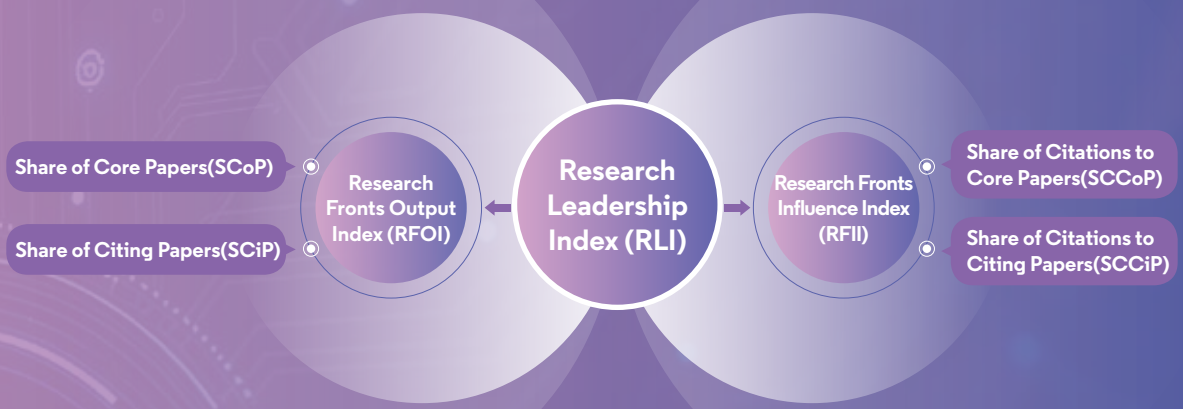

Figure 1. The logic model of Research Leadership Index (RLI)

The entities measured by the Research Leadership Index can be countries/regions, cities, institutions, laboratories, teams, and individual scientists. Each entity can be measured at three levels: Research Front level, area level, and a level within the context of 11 broad research areas.

1.2 Research Leadership Index of country/region (RLIC)

This report calculates the Research Leadership Index of main countries/regions at the Research Front level, area level, and the level of all 11 broad research areas. Based on that, the report determined the degree of activity in innovation and its pattern within the main countries/regions as reflected in Research Fronts, and revealed the sources of research vitality in various countries/regions. The methods for calculation and analysis are as follows:

1.2.1 Research Leadership Index of a country/region in a Research Front (RLI_{Cij})

The Research Leadership Index measures a country/region's degree of activity as reflected in Research Fronts, including two aspects of the output and citation influence of papers in the fronts. The equation for Research Leadership Index of country/region in a Research Front (RLI_{Cij}) is:

$$\mathrm{RLI}_{Cij} = \mathrm{RFOI}_{Cij} + \mathrm{RFII}_{Cij} = \frac{CoP_{ij}}{CoP_j} + \frac{CiP_{ij}}{CiP_j} + \frac{CoC_{ij}}{CoC_j} + \frac{CiC_{ij}}{CiC_j}$$

$RFOI_{Cij}$ is the Research Fronts Output Index of a country/region, $RFII_{Cij}$ is the Research Fronts Influence Index of a country/region, j represents the Research Front, and i represents each country/region.

(1) Research Fronts Output Index of a country/region ($RFOI_{Cij}$)

The Research Fronts Output Index of a country/region ($RFOI_{Cij}$) is the relative share of the number of papers (core papers and citing papers) contributed by a country/region to the literature that constitutes a Research Front. $RFOI_{Cij}$ equals the sum of the two indicators $SCoP_{Cij}$ and $SCiP_{Cij}$

$$\mathrm{RFOI}_{Cij} = \mathrm{SCoP}_{Cij} + \mathrm{SCiP}_{Cij} = \frac{CoP_{ij}}{CoP_j} + \frac{CiP_{ij}}{CiP_j}$$

A country/region's Share of Core Papers in a Research Front ($SCoP_{Cij}$) indicates the percentage CoP_{ij} of in CoP_j.

$$\mathrm{SCoP}_{Cij} = \frac{CoP_{ij}}{CoP_j}$$

CoP_{ij} represents the number of core papers published by country/region i in Research Front j; CoP_j represents the number of core papers in Research Front j.

A Country/region's Share of Citing Paper in a Research Front ($SCiP_{Cij}$) indicates the percentage of CiP_{ij} in CiP_j.

$$\mathrm{SCiP}_{Cij} = \frac{CiP_{ij}}{CiP_j}$$

CiP_{ij} represents the number of citing papers published by country/region i in Research Front j; CiP_j represents the number of Citing papers in Research Front j.

(2) Research Fronts Influence Index of a country/region ($RFII_{Cij}$)

The Research Fronts Influence Index of a country/region ($RFII_{Cij}$) is the relative share of the citation of papers (core and citing) that a country/region contributed in a Research Front. $RFII_{Cij}$ equals the sum of the two indicators $SCCoP_{Cij}$ and $SCCiP_{Cij}$.

$$\mathrm{RFII}_{Cij} = SCCoP_{Cij} + SCCiP_{Cij} = \frac{CoC_{ij}}{CoC_j} + \frac{CiC_{ij}}{CiC_j}$$

Country/region's Share of Core Paper Citation for a Research Front ($SCCoP_{Cij}$) indicates the percentage of CoC_{ij} in CoC_j.

$$\mathrm{SCCoP}_{Cij} = \frac{CoC_{ij}}{CoC_j}$$

CoC_{ij} represents the citation of core papers published by country/region i in Research Front j; CoC_j represents the citation of core papers in Research Front j.

The measure known as Country/region's Share of Citation to Citing Paper in a Research Front ($SCCiP_{Cij}$) indicates the percentage of CiC_{ij} in CiC_j.

$$\mathrm{SCCiP}_{Cij} = \frac{CiC_{ij}}{CiC_j}$$

CiC_{ij} represents the citation of citing papers published by

country/region *i* in Research Front *j*; CiC_j represents the citation of citing papers in Research Front *j*.

1.2.2 Research Leadership Index of a country/region in an area (RLI_{Cik})

The Research Leadership Index of country/region *i* in area *k* (RLI_{Cik}) is the summation of the Research Leadership Index of country/region *i* (RLI_{Cij}) in n Research Fronts in area *k*. *k* is the one area, n is the total number of areas.

The formula for RLI_{Cik} is as follows:

$$\mathrm{RLI}_{ik} = \mathrm{RFOI}_{Cik} + \mathrm{RFII}_{Cik} = \sum_{j=1}^{n} \frac{CoP_{ij}}{CoP_j} + \sum_{j=1}^{n} \frac{CiP_{ij}}{CiP_j} + \sum_{j=1}^{n} \frac{CoC_{ij}}{CoC_j} + \sum_{j=1}^{n} \frac{CiC_{ij}}{CiC_j}$$

RLI_{Cik} is equal to the sum of the two indicators $RFOI_{Cik}$ and $RFII_{Cik}$.

(1) Research Fronts Output Index of a country/region in an area ($RFOI_{Cik}$)

The Research Fronts Output Index of a country/region in an area ($RFOI_{Cik}$) is the relative share of the number of papers (core and citing) contributed by a country/region to an area comprising n Research Fronts. $RFOI_{Cik}$ is equal to the sum of the two indicators $SCoP_{Cik}$ and $SCiP_{Cik}$.

$$\mathrm{RFOI}_{Cik} = \mathrm{SCoP}_{Cik} + \mathrm{SCiP}_{Cik} = \sum_{j=1}^{n} \frac{CoP_{ij}}{CoP_j} + \sum_{j=1}^{n} \frac{CiP_{ij}}{CiP_j}$$

The formula for a country/region's Share of Core Papers in an area ($SCoP_{Cik}$) is below:

$$\mathrm{SCoP}_{Cik} = \sum_{j=1}^{n} \frac{CoP_{ij}}{CoP_j}$$

The formula for a country/region's Share of Citing Papers in an area ($SCiP_{Cik}$) is:

$$\mathrm{SCiP}_{Cik} = \sum_{j=1}^{n} \frac{CiP_{ij}}{CiP_j}$$

(2) Research Fronts Influence Index of a country/region in an area ($RFII_{Cik}$)

The Research Fronts Influence Index of a country/region in an area ($RFII_{Cik}$) is the relative share of the citation of papers (core and citing) contributed by a country/region to an area comprising n Research Fronts. $RFII_{Cik}$ equals the sum of the two indicators $SCCoP_{Cik}$ and $SCCiP_{Cik}$.

$$\mathrm{RFII}_{Cik} = \mathrm{SCCoP}_{Cik} + \mathrm{SCCiP}_{Cik} = \sum_{j=1}^{n} \frac{CoC_{ij}}{CoC_j} + \sum_{j=1}^{n} \frac{CiC_{ij}}{CiC_j}$$

The formula for a country/region's Share of Citations to Core Papers in an area ($SCCoP_{Cik}$) is:

$$\mathrm{SCCoP}_{Cik} = \sum_{j=1}^{n} \frac{CoC_{ij}}{CoC_j}$$

Below, the formula for a country/region's Share of Citations to Citing Papers in an area ($CiCS_{Cik}$):

$$\mathrm{SCCiP}_{Cik} = \sum_{j=1}^{n} \frac{CiC_{ij}}{CiC_j}$$

1.2.3 Research Leadership Index of a country/region in 11 broad research areas (RLI_{Ci})

The Research Leadership Index of a country/region in 11 broad research areas (RLI_{Ci}) represents the scores of RLI_{Cik} of 11 broad research areas added together. The index is a comprehensive evaluative index to measure the degree of activity of a country/region based on its contribution to 11 broad research areas comprising 128 Research Fronts.

$$\mathrm{RLI}_{Ci} = \mathrm{RFOI}_{Ci} + \mathrm{RFII}_{Ci} = \sum_{k=1}^{10} \sum_{j=1}^{n} \frac{CoP_{ij}}{CoP_j} + \sum_{k=1}^{10} \sum_{j=1}^{n} \frac{CiP_{ij}}{CiP_j} + \sum_{k=1}^{10} \sum_{j=1}^{n} \frac{CoC_{ij}}{CoC_j} + \sum_{k=1}^{10} \sum_{j=1}^{n} \frac{CiC_{ij}}{CiC_j}$$

RLI_{Ci} is equal to the sum of the two indicators $RFOI_{Ci}$ and $RFII_{Ci}$.

(1) Research Fronts Output Index of a country/region in 11 broad research areas ($RFOI_{Ci}$)

The Research Fronts Output Index of a country/region in 11 broad research areas ($RFOI_{Ci}$) is the sum of the relative share of the number of papers (core and citing) contributed by a country/region to 11 broad research areas comprising 128 Research Fronts. $RFOI_{Ci}$ is equal to the sum of the two indicators $SCoP_{Ci}$ and $SCiP_{Ci}$.

$$\mathrm{RFOI}_{Ci} = \mathrm{SCoP}_{Ci} + \mathrm{SCiP}_{Ci} = \sum_{k=1}^{10} \sum_{j=1}^{n} \frac{CoP_{ij}}{CoP_j} + \sum_{k=1}^{10} \sum_{j=1}^{n} \frac{CiP_{ij}}{CiP_j}$$

The formula for a country/region's Share of Core Papers in 11 broad research areas ($SCoP_{Ci}$) is as follows:

$$\mathrm{SCoP}_{Ci} = \sum_{k=1}^{10}\sum_{j=1}^{n}\frac{CoP_{ij}}{CoP_{j}}$$

The formula for a country/region's Share of Citing Papers in 11 broad research areas (SCiP_{Ci}) is:

$$\mathrm{SCiP}_{Ci} = \sum_{k=1}^{10}\sum_{j=1}^{n}\frac{CiP_{ij}}{CiP_{j}}$$

(2)Research Fronts Influence Index of a country/region in 11 broad research areas (RFII_{Ci})

The Research Fronts Influence Index of a country/region in 11 broad research areas (RFII_{Ci}) is the sum of the relative share of the citation of papers (core and citing) contributed by a country/region to 11 broad research areas comprising 128 Research Fronts. RFII_{Ci} is equal to the sum of the two indicators SCCoP_{Ci} and SCCiP_{Ci}.

$$\mathrm{RFII}_{Ci} = \mathrm{SCCoP}_{Ci} + \mathrm{SCCiP}_{Ci} = \sum_{k=1}^{10}\sum_{j=1}^{n}\frac{CoC_{ij}}{CoC_{j}} + \sum_{k=1}^{10}\sum_{j=1}^{n}\frac{CiC_{ij}}{CiC_{j}}$$

The formula for a country/region's Share of Citations to Core Papers in 11 broad research areas (SCCoP_{Ci}) is as follows:

$$\mathrm{SCCoP}_{Ci} = \sum_{k=1}^{10}\sum_{j=1}^{n}\frac{CoC_{ij}}{CoC_{j}}$$

The formula for a country/region's Share of Citations to Citing Papers in 11 broad research areas (SCCiP_{Ci}) is:

$$\mathrm{SCCiP}_{Ci} = \sum_{k=1}^{10}\sum_{j=1}^{n}\frac{CiC_{ij}}{CiC_{j}}$$

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2. Analysis of the RLI_{Ci} of Top Countries/Regions

We measured the RLIci of main countries/regions for overall performance in 11 broad research areas to examine their level of activity, thereby identifying the development trends and relative performance of each country/region in basic research.

The following highlights are noted.

2.1 The USA ranks 1st in RLI_{Ci}, while China ranks 2nd by a narrow margin, and the UK and Germany are in the second tier

Based on 11 broad research areas and each country/region's respective performance in the 128 constituent Research Fronts, the USA is the most active, with an RLI_{Ci} score of 193.03, ranking 1st (Figure 2). China ranks 2nd with a score of 182.37, about 94.5% of the USA. Taken together with the previous reports, the trend of China and the USA advancing side by side has become increasingly solidified. The UK and Germany score 73.93 and 72.43, respectively, ranking 3rd and 4th, in the second tier. Although the two still trail behind the top two, their relative advantage remains clear when compared with fifth-ranked Canada (41.81).

Other countries/regions ranked in the Top 20 of the RLI_{Ci} can be placed in the third tier, and some neighboring countries have only very small score differences. The RLI_{Ci} scores for Australia, France, Italy, Japan, and Spain rank from 6th to 10th. The 11th to 20th places are occupied by the Netherlands, Switzerland, South Korea, Sweden, India, Belgium, Austria, Israel, Denmark, and Singapore (Figure 2).

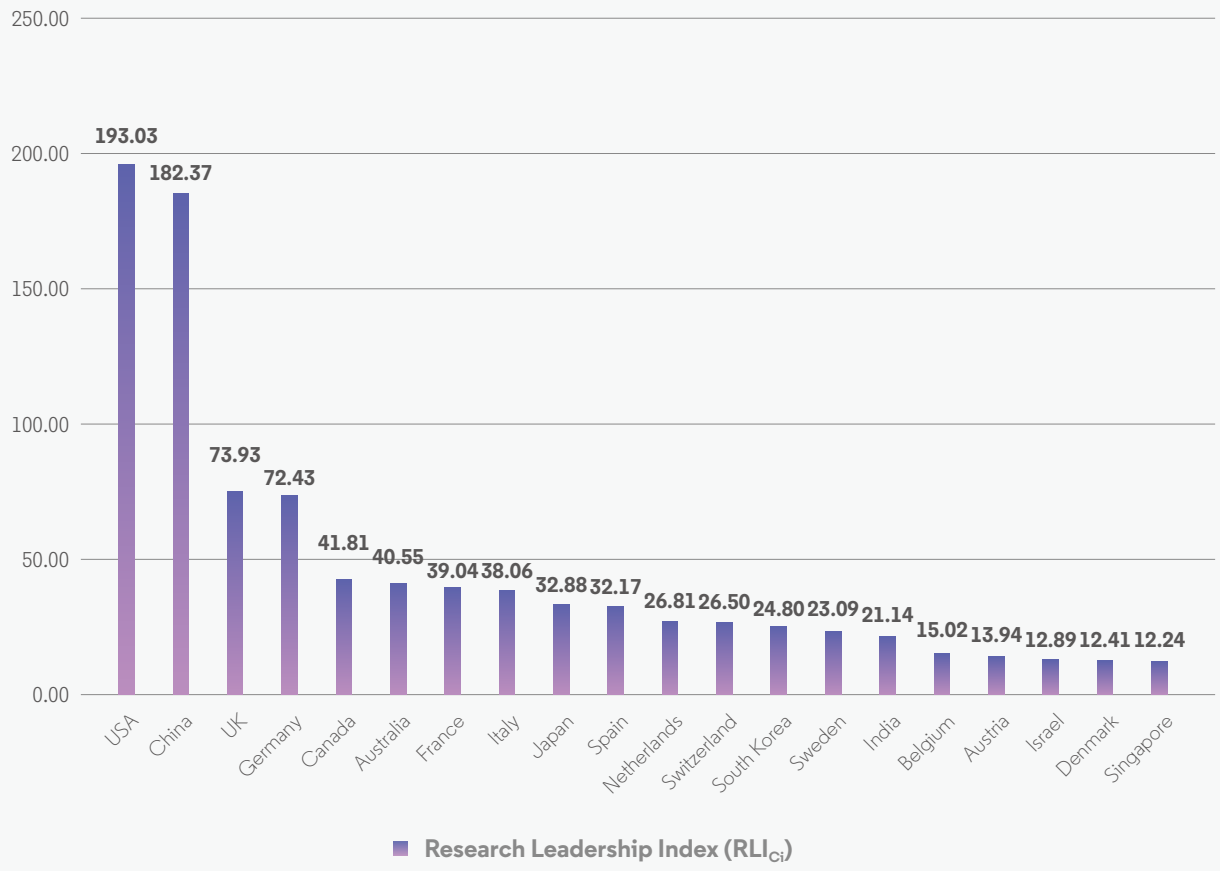


Figure 2. Research Leadership Index (RLI_{Ci}) of Top 20 Countries/Regions in 11 broad research areas comprising 128 Research Fronts

Table 1 shows the three indicators RLI_{Ci}, $RFOI_{Ci}$, and $RFII_{Ci}$ for the Top 20 countries/regions. China's indicators $RFOI_{Ci}$ score is 8.03 points (or 8.3%) higher than that of the USA and has relatively strong research output capacity. The $RFII_{Ci}$ score of the USA is 18.70 points (or 23.9%) higher than that of China, showing a significant advantage, and its lead in the global impact of research outputs is even greater. The UK and Germany are nearly indistinguishable across all three indicators.

Table 1. The Research Leadership Index (RLI_{Ci}) of Top 20 Countries/regions in 11 broad research areas comprising 128 Research Fronts

	RLI_{Ci}		$RFOI_{Ci}$		$RFII_{Ci}$	
	Score	Rank	Score	Rank	Score	Rank
USA	193.03	1	96.02	2	97.02	1
China	182.37	2	104.05	1	78.32	2
UK	73.93	3	34.68	4	39.26	3
Germany	72.43	4	34.97	3	37.45	4
Canada	41.81	5	18.57	6	23.24	5
Australia	40.55	6	18.43	7	22.12	6
France	39.04	7	18.57	5	20.47	7
Italy	38.06	8	18.08	8	19.98	8
Japan	32.88	9	16.40	9	16.48	9
Spain	32.17	10	15.74	10	16.42	10
Netherlands	26.81	11	12.03	13	14.78	11
Switzerland	26.50	12	12.66	11	13.84	12
South Korea	24.80	13	12.59	12	12.22	13
Sweden	23.09	14	11.11	14	11.98	14
India	21.14	15	11.00	15	10.14	15
Belgium	15.02	16	6.41	17	8.61	16
Austria	13.94	17	7.18	16	6.76	20
Israel	12.89	18	5.75	18	7.14	17
Denmark	12.41	19	5.55	19	6.86	18
Singapore	12.24	20	5.53	20	6.70	21

2.2 The gap between China and the USA continues to narrow

From 2017 to 2025, the relative ratio of RLI_{Ci} between China and the USA showed an overall trend of fluctuating upward growth. China was equivalent to 42.3% of the USA in 2017, rose to 52.1% in 2018, and further increased to 68.2% in 2019, achieving steady growth for three consecutive years; after a slight decline in 2020, it rose to 91.5% in 2021; this was followed by three years of rapid adjustment, with the lowest point (in 2023) falling back to a level comparable to that of 2020. However, beginning in 2024, it re-entered an upward trajectory, reaching a new peak of 94.5% in 2025, effectively doubling compared with 2017.

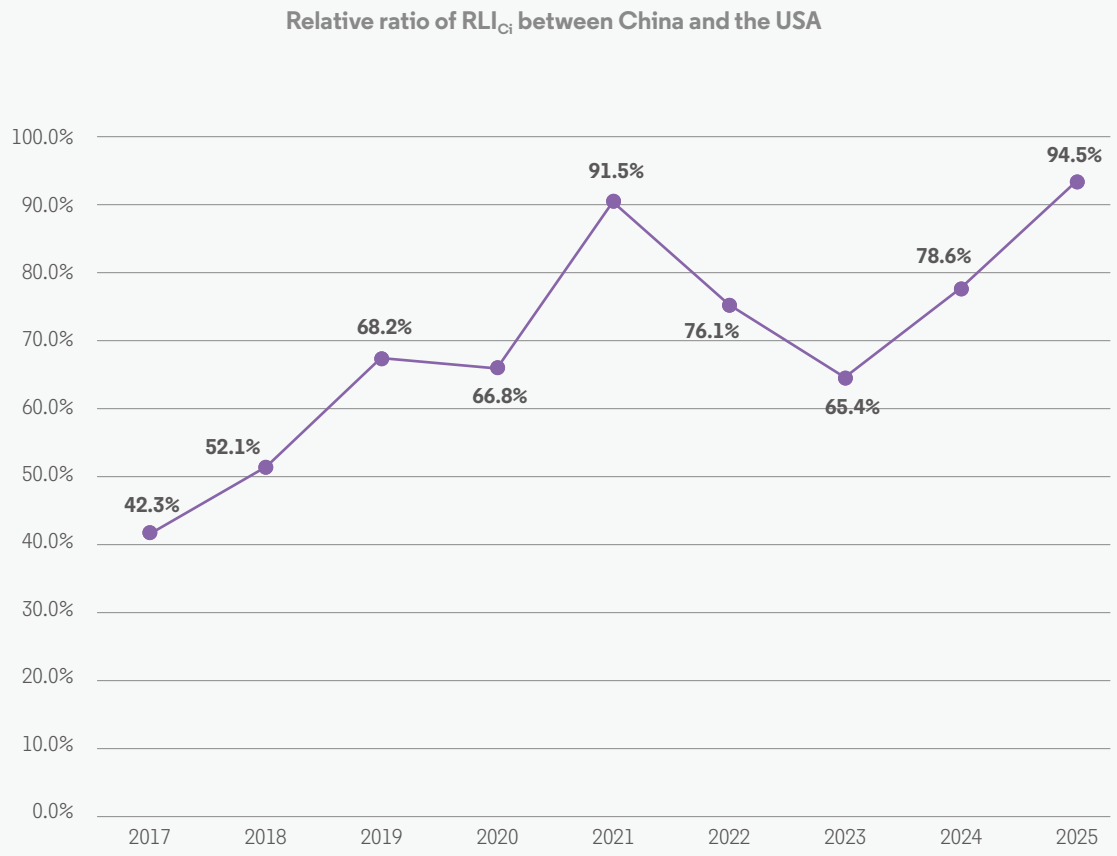


Figure 3. Relative ratio of RLI_{Ci} between China and the USA in 11 broad research areas comprising 128 Research Fronts

2.3 China and the USA perform on par, with the USA achieving the highest score in five areas, and China leads in six areas

In all 11 areas, China scored the highest in six, and the USA in five, with the two countries jointly taking the highest scores in each area. By research area, the USA's RLI_{Ci} scores rank 1st in five of the main areas: "Geosciences", "Clinical medicine", "Biological sciences", "Astronomy and astrophysics", and "Mathematics", and 2nd in the other six areas. This showing demonstrates that the overall activity level of the USA in basic research remains the strongest.

China's RLI_{Ci} scores rank 1st in six areas: "Agricultural, plant and animal sciences", "Ecology and environmental science", "Chemistry and materials science", "Physics", "Information science", and "Economics, psychology and other social sciences", and ranks 2nd in three areas: "Geosciences", "Biological sciences", and "Mathematics", while ranking 4th and 5th, respectively, in "Clinical medicine" and "Astronomy and astrophysics".

"Clinical medicine" and "Astronomy and astrophysics" have always been relatively weak areas for China. However, the overall situation in these two fields still shows an upward trend. For this study, we compared the changes of RLI_{Ci} in these two areas in the last nine years. From 2017 to 2025, in "Clinical Medicine", China ranked 10th, 13th, 9th, 12th, 1st, 4th, 9th, 6th, and 4th in terms of RLI_{Ci}. Among them, in the first four years 2017-2020, the ranking of China's RLI_{Ci} generally hovered around 10th place. In 2021 and 2022, due to the large share of the Research Fronts related to COVID-19, China's ranking in "Clinical medicine" surged temporarily, reaching 1st and 4th place, respectively. In 2023, it returned to the level of 2019 (9th place), but in the following years, China's ranking improved by three places in 2024 and two places in 2025 compared with the previous year, showing a clear upward trend. Meanwhile, China respectively ranked 11th, 19th, 11th, 8th, 8th, 7th, 8th, 6th, and 5th in "Astronomy and astrophysics" for the last nine years, shows a stable and upward trend.

Table 2. The score and rank of RLI_{Ci} and RLI_{Cik} of Top20 Countries/Regions

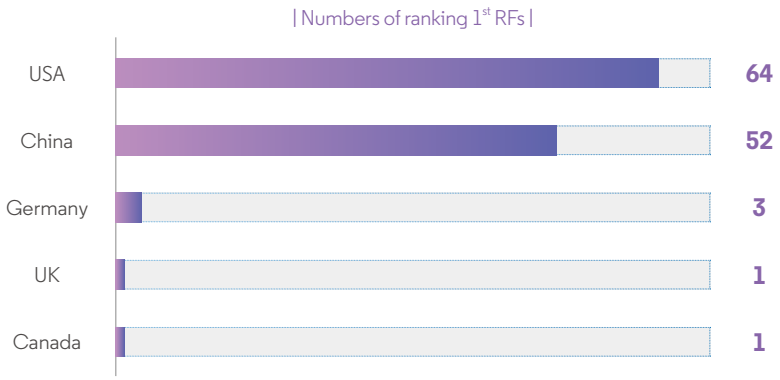
	11 broad research areas		Agricultural, plant and animal sciences		Ecology and environmental science		Geosciences		Clinical medicine		Biological science		Chemistry and materials science		Physics		Astronomy and astrophysics.		Mathematics		Information science		Economics, psychology and other social sciences	
Countries/ regions	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
USA	193.0	1	7.6	2	10.2	2	16.9	1	34.0	1	25.3	1	10.7	2	14.0	2	21.6	1	25.7	1	14.4	2	12.5	2
China	**182.4**	**2**	**18.6**	**1**	**23.1**	**1**	**15.6**	**2**	**10.6**	**4**	**18.8**	**2**	**22.4**	**1**	**16.6**	**1**	**9.7**	**5**	**12.3**	**2**	**19.6**	**1**	**15.2**	**1**
UK	73.9	3	4.0	5	4.6	5	8.7	4	11.4	3	10.6	3	3.4	4	4.4	5	10.4	3	1.4	6	7.3	3	7.7	3
Germany	72.4	4	4.8	3	5.1	3	9.1	3	11.8	2	10.2	4	3.4	5	5.7	4	11.4	2	2.3	4	5.3	4	3.4	5
Canada	41.8	5	3.3	10	4.3	6	3.0	11	8.9	7	5.1	5	3.4	3	1.0	17	6.9	10	2.3	5	1.7	9	1.7	9
Australia	40.5	6	3.6	8	4.7	4	5.2	6	6.4	10	3.3	9	1.4	8	0.9	19	7.4	8	0.4	16	1.8	8	5.3	4
France	39.0	7	2.0	12	2.0	11	7.1	5	8.7	8	2.6	14	0.9	13	2.2	9	8.9	6	0.9	9	1.5	10	2.3	8
Italy	38.1	8	1.5	16	2.4	10	3.9	9	9.9	5	3.2	10	0.3	20	3.3	6	9.9	4	0.9	8	1.1	12	1.6	10
Japan	32.9	9	1.2	20	1.9	13	4.5	7	7.1	9	2.5	15	1.5	7	5.9	3	6.9	11	0.3	19	0.7	17	0.4	35
Spain	32.2	10	1.7	14	1.7	17	3.2	10	9.6	6	2.6	13	1.1	9	2.0	10	7.5	7	0.7	11	0.7	14	1.3	16
Netherlands	26.8	11	1.1	24	2.5	9	2.6	12	6.0	12	3.9	7	1.0	10	0.7	22	4.7	13	0.6	12	0.7	15	3.0	6
Switzerland	26.5	12	1.8	13	3.0	8	4.1	8	2.8	16	1.9	19	0.9	14	1.4	12	5.4	12	2.4	3	2.0	7	0.9	26
South Korea	24.8	13	2.0	11	0.8	22	1.8	18	3.9	13	3.9	6	2.7	6	3.0	7	2.8	19	0.4	15	2.2	6	1.3	15
Sweden	23.1	14	1.1	23	3.5	7	2.2	15	2.1	19	3.9	8	0.2	23	1.2	15	7.1	9	0.2	22	0.7	16	0.9	23
India	21.1	15	3.9	7	1.9	15	2.2	14	1.6	23	1.2	24	1.0	11	1.4	13	4.1	14	0.4	17	0.9	13	2.6	7
Belgium	15.0	16	0.7	32	0.9	20	1.1	21	6.2	11	2.2	17	0.4	15	1.0	18	1.1	33	1.0	7	0.2	25	0.3	40
Austria	13.9	17	0.5	35	1.8	16	1.7	20	1.2	28	1.6	22	0.2	24	1.7	11	2.7	20	0.9	10	0.3	23	1.4	13
Israel	12.9	18	1.5	15	0.1	61	0.4	30	2.5	17	3.0	11	0.1	36	1.2	16	2.1	27	0.6	13	1.1	11	0.2	45
Denmark	12.4	19	0.8	29	2.0	12	2.0	16	1.1	30	3.0	12	0.4	16	0.7	23	1.1	34	0.2	23	0.4	19	0.9	25
Singapore	12.2	20	1.2	21	0.4	32	0.4	37	2.5	18	1.7	21	0.9	12	0.8	20	0.0	87	0.6	14	2.6	5	1.2	18

The USA and China dominate the global Research Fronts, while other countries reach the top only in select areas or specific fronts. Among the 110 hot Research Fronts and 18 emerging Research Fronts in 11 broad research areas, China and the USA combine to account for the #1 ranking in 90.6% of the 128 fronts. The USA ranks 1st in 64, accounting for 50.0% of the 128 Research Fronts. China earns the top spot in 52 fronts, or 40.6%. Germany is tops in three Research Fronts, the UK and Canada each rank 1st in one. Australia, Egypt, India, Italy, Japan, Pakistan, and South Korea also rank 1st in one.

Of the 11 broad research areas, in the areas of "Agricultural, plant and animal sciences", "Ecology and environmental sciences", "Chemistry and materials science", and "Information science", the number of fronts in which China ranks 1st far exceeds that of the USA. In the area of "Physics", and "Economics, psychology and other social sciences", the number of fronts in which China ranks 1st is almost equal to that of the USA. In the five areas of "Geosciences", "Clinical medicine", "Biological sciences", "Astronomy and astrophysics", and "Mathematics", the number of fronts where China ranks 1st is all significantly fewer than that of the USA (Table 3).

Table 3. The numbers and ratios of the Research Fronts in which the respective Top 5 countries/regions rank first, out of 128 fronts in 11 broad research areas (based on RLI_{Ci})

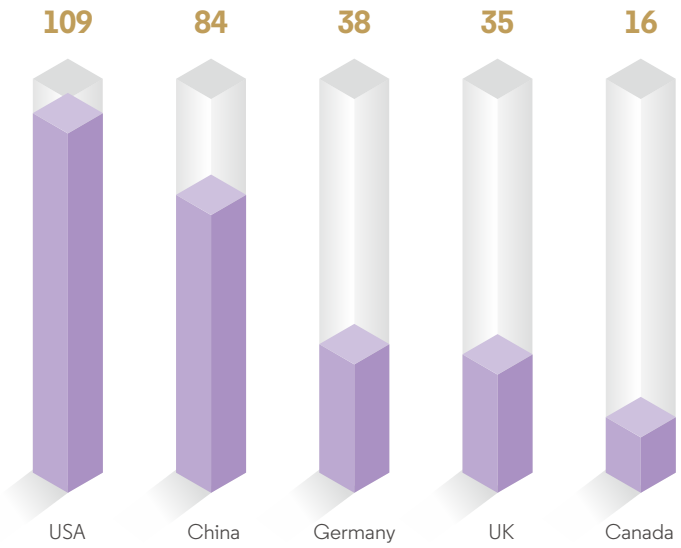
Areas	Numbers of RFs	Numbers of ranking 1st RFs					Ratios (%)				
		USA	China	Germany	UK	Canada	USA	China	Germany	UK	Canada
11 broad research areas total	128	64	52	3	1	1	50.0	40.6	2.3	0.8	0.8
Agricultural, plant and animal sciences	11	2	6	0	0	0	18.2	54.5	0.0	0.0	0.0
Ecology and environmental sciences	11	2	8	0	0	1	18.2	72.7	0.0	0.0	9.1
Geosciences	11	6	3	1	0	0	54.5	27.3	9.1	0.0	0.0
Clinical medicine	17	15	1	0	0	0	88.2	5.9	0.0	0.0	0.0
Biological sciences	14	9	4	1	0	0	64.3	28.6	7.1	0.0	0.0
Chemistry and materials science	11	2	9	0	0	0	18.2	81.8	0.0	0.0	0.0
Physics	11	4	6	0	0	0	36.4	54.5	0.0	0.0	0.0
Astronomy and astrophysics	10	8	2	0	0	0	80.0	20.0	0.0	0.0	0.0
Mathematics	10	8	1	1	0	0	80.0	10.0	10.0	0.0	0.0
Information science	11	3	8	0	0	0	27.3	72.7	0.0	0.0	0.0
Economics, psychology and other social sciences	11	5	4	0	1	0	45.5	36.4	0.0	9.1	0.0



Among countries/regions ranking among the top three performers in the 128 Research Fronts, the USA earns that distinction in 109 fronts, or 85.2%, China in 84 Research Fronts (65.6%), Germany in 38, the UK in 35, and Canada in 16, with the latter three countries/regions able to boast the achievement in 29.7%, 27.3% and 12.5% of the total number of Research Fronts (Table 4).

Table 4. The numbers and ratios of countries/regions ranking among the top three performers in Research Fronts, among the Top 5 countries/regions in 11 broad research areas comprising 128 Research Fronts (based on RLI_{Ci})

Areas	Numbers of RFs	Numbers of ranking Top three RFs					Ratios (%)				
		USA	China	Germany	UK	Canada	USA	China	Germany	UK	Canada
11 broad research areas total	128	109	84	38	35	16	85.2	65.6	29.7	27.3	12.5
Agricultural, plant and animal sciences	11	6	10	2	1	0	54.5	90.9	18.2	9.1	0.0
Ecology and environmental sciences	11	8	8	1	1	3	72.7	72.7	9.1	9.1	27.3
Geosciences	11	10	6	2	4	0	90.9	54.5	18.2	36.4	0.0
Clinical medicine	17	16	5	5	5	5	94.1	29.4	29.4	29.4	29.4
Biological sciences	14	12	9	5	5	1	85.7	64.3	35.7	35.7	7.1
Chemistry and materials science	11	10	11	2	3	3	90.9	100.0	18.2	27.3	27.3
Physics	11	11	7	4	2	0	100.0	63.6	36.4	18.2	0.0
Astronomy and astrophysics	10	9	2	6	4	2	90.0	20.0	60.0	40.0	20.0
Mathematics	10	10	9	3	1	2	100.0	90.0	30.0	10.0	20.0
Information science	11	10	11	5	4	0	90.9	100.0	45.5	36.4	0.0
Economics, psychology and other social sciences	11	7	6	3	5	0	63.6	54.5	27.3	45.5	0.0



| Numbers of ranking Top three RFs |

The USA makes the top three in more than 50% of the respective Research Fronts associated with each of the 11 broad research areas. In "Physics" and "Mathematics", the USA ranks among the top three performers in 100% of the pertinent Research Fronts. This notably superior performance also carries over into "Geosciences", "Clinical medicine", "Chemistry and materials science", "Astronomy and astrophysics", and "Information science", in which the USA ranks among the top three reaching or exceeding 90%. In "Ecology and environmental sciences" and "Biological Sciences", the USA ranks among the top three performers in 72.7% and 85.7% of the pertinent Research Fronts. Meanwhile, in the two main fields of "Agricultural, plant and animal sciences" and "Economics, psychology and other social sciences", the USA's proportions of top-three placements tally at 54.5% and 63.6%, respectively.

China's proportion of top three placements ratio reaches 100% in "Chemistry and material science" and "Information science". China registers among the top three reaching 90.9% and 90% in "Agricultural, plant and animal sciences" and "Mathematics". In the area of "Ecology and environmental sciences", China ranks among the top three performers in 72.7% of the pertinent Research Fronts. The nation's ratio of top-three showings in the fronts constituting "Biological Sciences" and "Physics" is 64.3% and 63.6% respectively, while the proportion in "Geosciences" and "Economics, psychology and other social sciences" are both 54.5%. However, in the two areas of "Clinical medicine" and "Astronomy and astrophysics", China's top-three placements account for only 29.4% and 20%, respectively (Figure 4).

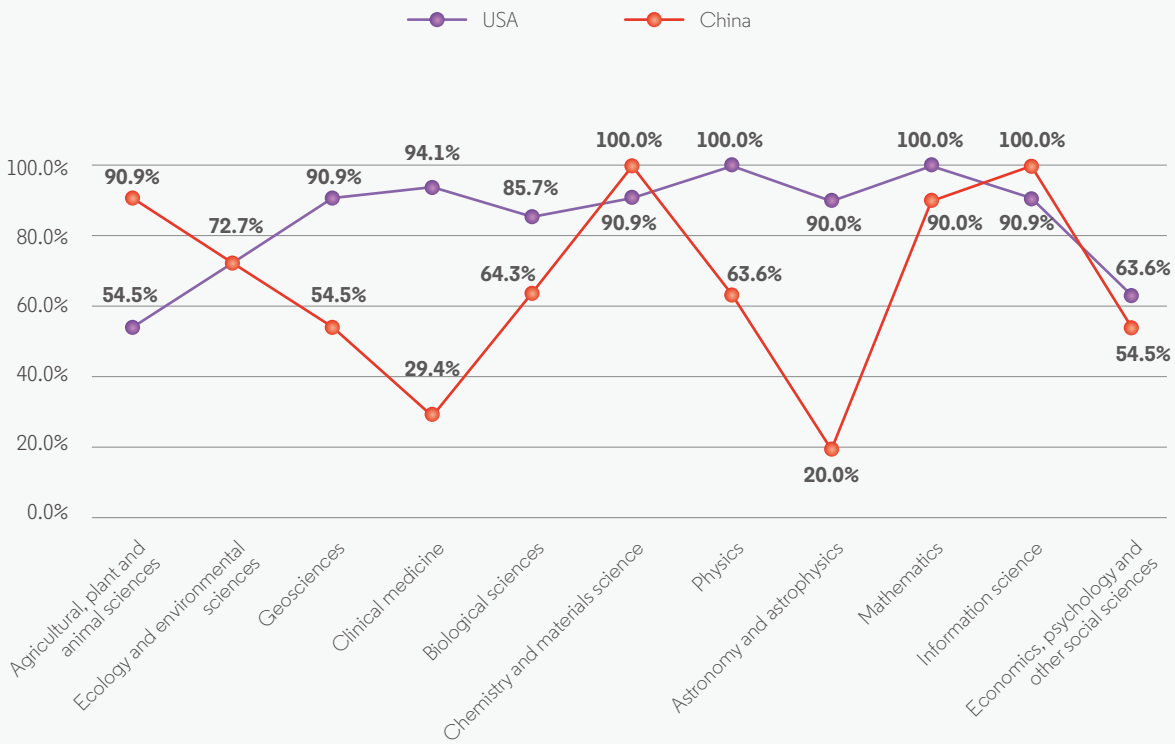


Figure 4. The ratios top-three performances in Research Fronts for China and the USA in 11 broad research areas comprising 128 Research Fronts (based on RLI_{Ci})

Germany has the highest proportion of top-three placements in Research Fronts within "Astronomy and astrophysics", accounting for 60%, followed by "Information science" at 45.5%. In "Physics" and "Mathematics", the proportions are 36.4% and 30%, respectively.

The UK's ratio of top-three placements in "Economics, psychology and other social sciences" accounts for the highest proportion, at 45.5%; in "Astronomy and astrophysics", the percentage of top three appearances is 40%; and in the three areas of "Information science", "Geosciences", and "Biological Sciences", the UK's presence in the top three ranges all exceed 35%.

Canada's proportions of top three placements in the five areas, including "Clinical medicine", reach or exceed 20%, while accounting, in "Biological Sciences", for 7.1%. However, in the other five areas, Canada has no fronts in which it is ranked in the top three (Figure 5).

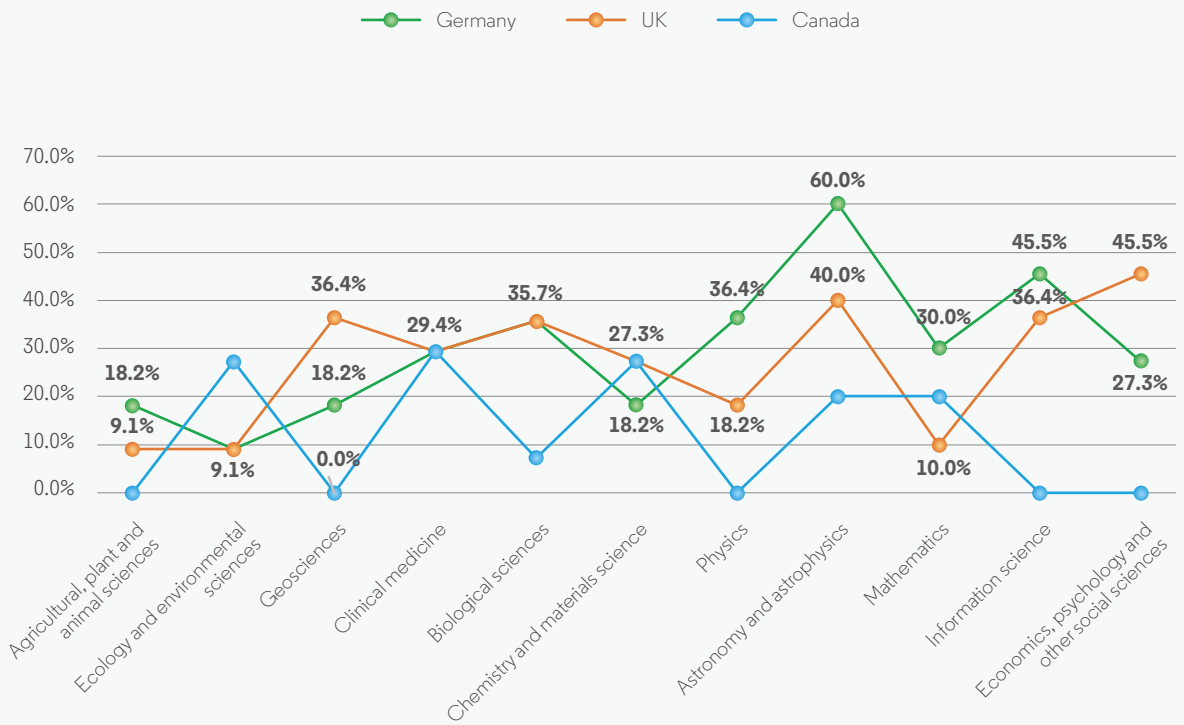


Figure 5. The ratios of Research Fronts in which the UK, Germany, and France rank among the top three performers, in 11 broad research areas comprising 128 Research Fronts (based on RLI_{Ci})

3. Analysis of the Research Leadership Index (RLI_{Cik}) of countries/regions in different areas

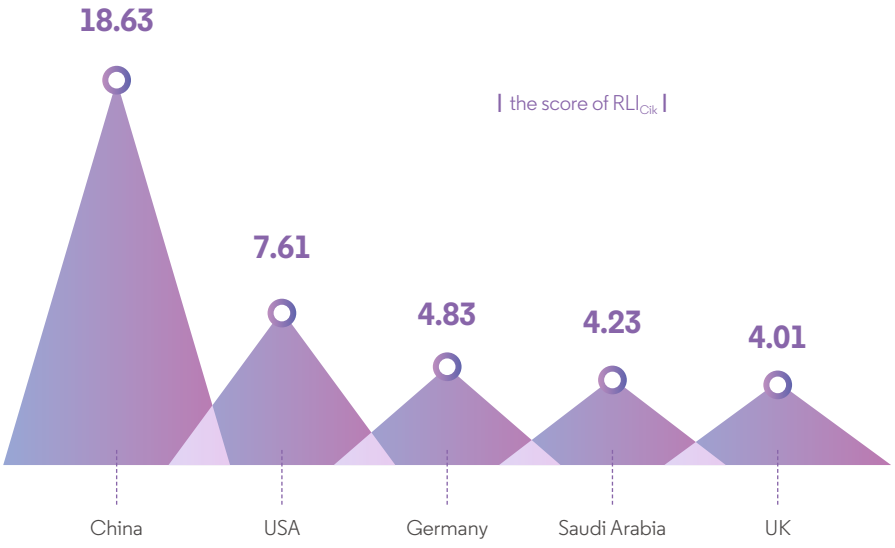
This section highlights the scores and rankings obtained via the RLI_{Cik} measurement, exploring the Research Front activity and influence of various countries/regions in specific areas, and analyzing the respective sources of national vitality in scientific and technical innovation.

3.1 AGRICULTURAL, PLANT AND ANIMAL SCIENCES: China's performance is the most eye-catching; the USA is 2nd; Germany, Saudi Arabia, and the UK are the 3rd to 5th

In the area of "Agricultural, plant and animal sciences", China demonstrates outstanding advantages, according to its RLI_{Cik} score of 18.63, ranking 1st and 2.45 times that of the second-ranked USA (7.61). Germany, Saudi Arabia, and the UK post scores close to each other, ranking 3rd, 4th, and 5th, respectively. As can be seen from Table 5, the ranking according to $RFII_{Cik}$ and $RFOI_{Cik}$ is the same as RLI_{Cik} for China and the USA (Table 5).

Table 5. The score and rank of the Top 5 countries/regions based on RLI_{Cik}, $RFOI_{Cik}$ and $RFII_{Cik}$ in "Agricultural, plant and animal sciences"

Indicators	Score					Rank				
	China	USA	Germany	Saudi Arabia	UK	China	USA	Germany	Saudi Arabia	UK
RLI_{Cik}	18.63	7.61	4.83	4.23	4.01	1	2	3	4	5
$RFOI_{Cik}$	10.23	3.73	1.98	2.32	1.66	1	2	6	3	8
$RFII_{Cik}$	8.40	3.88	2.85	1.91	2.34	1	2	3	6	4

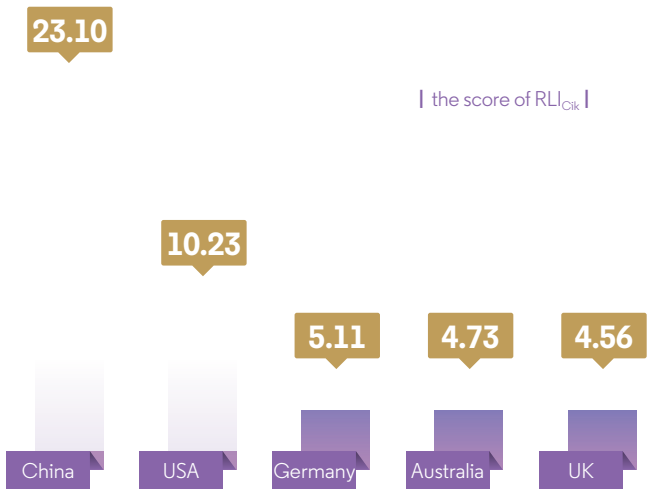


3.2 ECOLOGY AND ENVIRONMENTAL SCIENCES: China far exceeds other countries/regions; the USA is 2nd; Germany, Australia, and the UK rank 3rd to 5th

In "Ecology and environmental sciences" (Table 6), China scores 23.10 in RLI_{Cik}, ranking 1st, which is approximately 2.26 times higher than the second-ranked USA, and far ahead of other countries/regions. Germany, Australia, and the UK are in 3rd, 4th, and 5th place, with respective scores of 5.11, 4.73, and 4.56. The rank order of the Top 3 countries/regions remains the same for all three indicators: RLI_{Cik}, $RFOI_{Cik}$ and $RFII_{Cik}$.

Table 6. The score and rank of the Top 5 countries/regions based on RLI_{Cik}, $RFOI_{Cik}$ and $RFII_{Cik}$ in "Ecology and environmental sciences"

Indicators	Score					Rank				
	China	USA	Germany	Australia	UK	China	USA	Germany	Australia	UK
RLI_{Cik}	23.10	10.23	5.11	4.73	4.56	1	2	3	4	5
$RFOI_{Cik}$	12.95	5.22	2.62	2.33	2.30	1	2	3	4	5
$RFII_{Cik}$	10.15	5.01	2.50	2.39	2.26	1	2	3	5	6



3.3 Geosciences: The USA and China jointly lead, while Germany, the UK, and France are comparable

In "Geosciences", the RLI_{Cik} for the USA is 16.95 ranking 1st, while China scores at 15.62, ranking 2nd. China's performance across the indicators is very close to that of the USA, with China's score reaching 92% of the USA mark, exceeding that of the 3rd ranked Germany by more than 70%. The USA and China occupy first and second place across the indicators, together forming the world's top tier. Germany, the UK, and France register at 9.09, 8.71 and 7.08, ranking 3rd, 4th, and 5th, respectively. As can be seen in Table 7, those three countries are solid and important forces in global research in this field, but the gap with the top-ranked countries has already widened significantly.

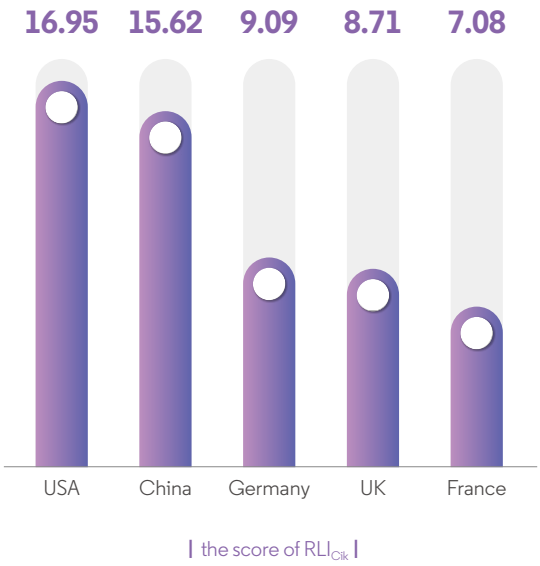


Table 7. The score and rank of the Top 5 countries/regions based on RLI_{Cik}, $RFOI_{Cik}$ and $RFII_{Cik}$ in "Geosciences"

Indicators	Score					Rank				
	USA	China	Germany	UK	France	USA	China	Germany	UK	France
RLI_{Cik}	16.95	15.62	9.09	8.71	7.08	1	2	3	4	5
$RFOI_{Cik}$	8.49	8.40	4.31	4.15	3.16	1	2	3	4	5
$RFII_{Cik}$	8.46	7.22	4.77	4.57	3.92	1	2	3	4	5

3.4 CLINICAL MEDICINE: The USA far exceeds other countries/regions, Germany, the UK, China, and Italy have close scores, and China has risen to 4th place

In "Clinical medicine", the USA scores 34.04 in RLI_{Cik}, ranking 1st, which is approximately 2.9 times higher than the 2nd ranked Germany, far ahead of other countries/regions. Germany, the UK, China, and Italy score close to one another, ranking 2nd to 5th. China scores at 10.55, ranking 4th, two places higher than its 6th place position in 2024. As can be seen in Table 8, The USA ranks 1st among all the indicators. China shows large variations in its rankings across the indicators. It ranks 2nd in terms of Research Fronts Output Index but 8th in Research Fronts Influence Index, indicating that its strength lies much more in quantity than in impact.

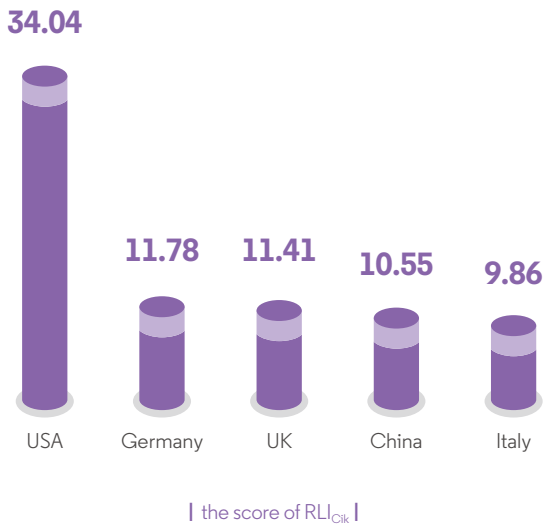


Table 8. The score and rank of the Top 5 countries/regions based on RLI_{Cik}, $RFOI_{Cik}$ and $RFII_{Cik}$ in "Clinical medicine"

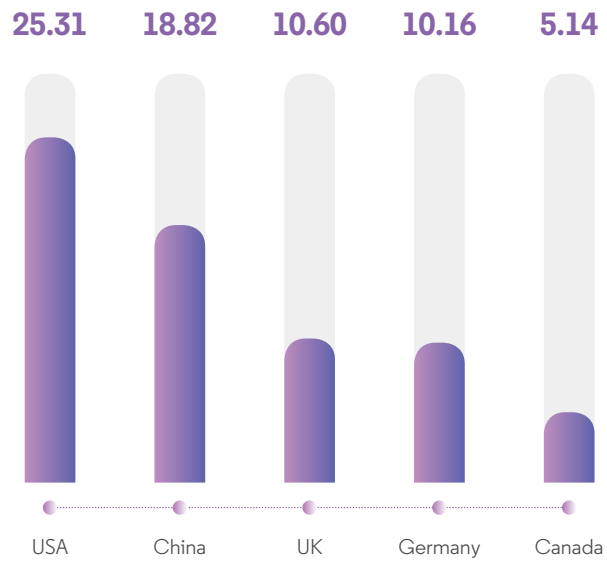
Indicators	Score					Rank				
	USA	Germany	UK	China	Italy	USA	Germany	UK	China	Italy
RLI_{Cik}	34.04	11.78	11.41	10.55	9.86	1	2	3	4	5
$RFOI_{Cik}$	17.40	5.43	5.57	6.17	4.86	1	4	3	2	5
$RFII_{Cik}$	16.64	6.35	5.84	4.38	5.00	1	2	3	8	6

3.5 BIOLOGICAL SCIENCES: The USA continues to lead, China remains 2nd place, and the UK, Germany have similar scores

In "Biological sciences", the USA and China register at 25.31 and 18.82 in RLI_{Cik}, placing 1st and 2nd. The UK and Germany post scores close to each other, ranking 3rd and 4th. Canada scores 5.14, ranking 5th. As can be seen in Table 9, the respective rankings of the USA, China, and Canada in RLI_{Cik} are identical to those in $RFOI_{Cik}$ and $RFII_{Cik}$. The UK and Germany's rankings differ slightly according to the three indicators.

Table 9. The score and rank of the Top 5 countries/regions based on RLI_{Cik}, $RFOI_{Cik}$ and $RFII_{Cik}$ in "Biological sciences"

Indicators	Score					Rank				
	USA	China	UK	Germany	Canada	USA	China	UK	Germany	Canada
RLI_{Cik}	25.31	18.82	10.60	10.16	5.14	1	2	3	4	5
$RFOI_{Cik}$	11.99	10.83	4.49	4.90	2.24	1	2	4	3	5
$RFII_{Cik}$	13.32	7.98	6.11	5.27	2.90	1	2	3	4	5



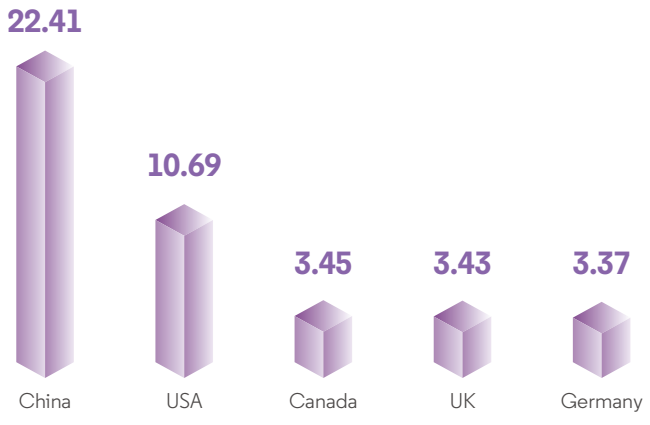
| the score of RLI_{Cik} |

3.6 CHEMISTRY AND MATERIALS SCIENCE: China's RLI_{Cik} demonstrates outstanding advantages; the USA is 2nd, Canada, the UK, and Germany are roughly on par

In "Chemistry and materials science", China's RLI_{Cik} score is 22.41, earning China 1st place, 2.1 times that of 2nd-placed the USA (10.69), demonstrating a clear overall advantage. Although the USA lags China by a large margin, it still far exceeds other countries/regions. Canada, the UK, and Germany post marks of 3.45, 3.43, and 3.37 respectively, ranking 3rd to 5th. The level of these three countries is basically the same. The rankings based on the indicators RLI_{Cik}, $RFOI_{Cik}$, and $RFII_{Cik}$ for China and the USA are the same, while the rankings of Canada, the UK, and Germany vary slightly among the three indicators (Table 10).

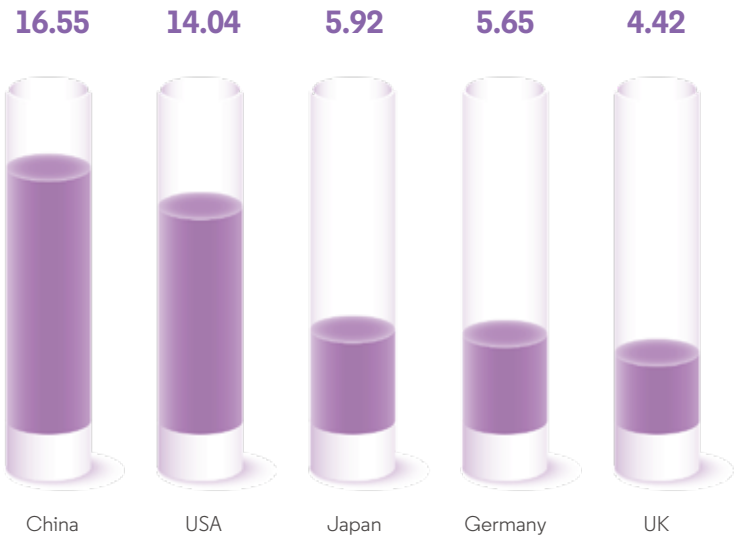
Table 10. The score and rank of Top 5 countries/regions based on RLI_{Cik}, $RFOI_{Cik}$ and $RFII_{Cik}$ in "Chemistry and materials science"

Indicators	Score					Rank				
	China	USA	Canada	UK	Germany	China	USA	Canada	UK	Germany
RLI_{Cik}	22.41	10.69	3.45	3.43	3.37	1	2	3	4	5
$RFOI_{Cik}$	13.34	5.20	1.52	1.49	1.84	1	2	4	5	3
$RFII_{Cik}$	9.07	5.49	1.92	1.93	1.53	1	2	4	3	5



3.7 PHYSICS: China and the USA run neck and neck; Japan, Germany, and the UK are 3rd to 5th

In the area of "Physics", China posts the highest degree of activity with an RLI_{Cik} of 16.55. The USA scores 14.04, ranking 2nd. China and the USA show an overall leading trend, while Japan and Germany score close together at 5.92 and 5.65, respectively. The UK scores 4.42, ranking 5th. China ranks 1st in two of the three indicators and 2nd in one. Specifically, it ranks 1st by the measure of output contribution and 2nd in terms of research impact, while the USA ranks 1st in national impact.



| the score of RLI_{Cik} |

Table 11. The score and rank of the Top 5 countries/regions based on RLI_{Cik}, $RFOI_{Cik}$ and $RFII_{Cik}$ in "Physics"

Indicators	Score					Rank				
	China	USA	Japan	Germany	UK	China	USA	Japan	Germany	UK
RLI_{Cik}	16.55	14.04	5.92	5.65	4.42	1	2	3	4	5
$RFOI_{Cik}$	10.02	7.42	2.93	2.77	2.31	1	2	3	4	5
$RFII_{Cik}$	6.54	6.62	2.99	2.89	2.11	2	1	3	4	5

3.8 ASTRONOMY AND ASTROPHYSICS: The USA continues to maintain a significant leading advantage; European powers such as Germany, the UK, and Italy hold stable positions, and China ranks 5th

In "Astronomy and astrophysics" (Table 12), the USA ranks 1st, with an RLI_{Cik} score of 21.59, nearly twice that of 2nd-ranked Germany (11.43). Germany, the UK (10.40), and Italy (9.95) have similar scores. These European research powers have consistently played a very important and active role in global cutting-edge research in this field. China places 5th with a score of 9.67, moving up one place compared to 2024. The USA, Germany, and Italy rank in the same order on the three indicators, while the UK and China's placements vary according to the different measures.

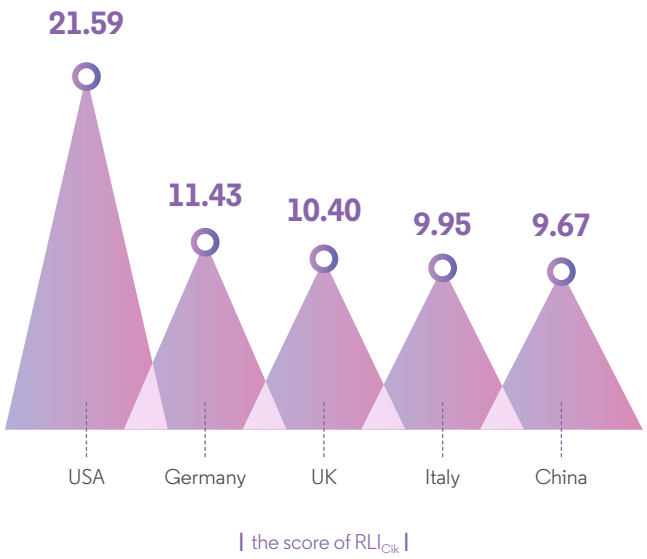


Table 12. The score and rank of the Top 5 countries/regions based on RLI_{Cik}, $RFOI_{Cik}$ and $RFII_{Cik}$ in "Astronomy and astrophysics"

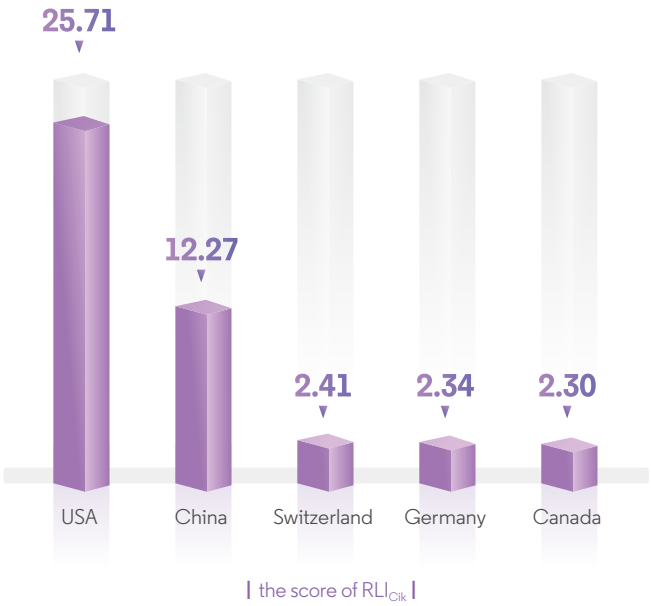
Indicators	Score					Rank				
	USA	Germany	UK	Italy	China	USA	Germany	UK	Italy	China
RLI_{Cik}	21.59	11.43	10.40	9.95	9.67	1	2	3	4	5
$RFOI_{Cik}$	11.24	5.86	5.01	5.03	5.05	1	2	5	4	3
$RFII_{Cik}$	10.35	5.56	5.39	4.92	4.62	1	2	3	4	5

3.9 MATHEMATICS: The USA far outperforms other countries, while China ranks 2nd by a significant gap; Switzerland, Germany, and Canada are 3rd to 5th

In the area of "Mathematics", the USA scores 25.71, leading other countries by a considerable margin, and being 2.1 times that of 2nd-ranked China (12.27). Switzerland, Germany, and Canada record similar scores of 2.41, 2.34, and 2.30, ranking 3rd to 5th, but there is still a considerable gap compared with 2nd-ranked China. The rankings of the USA and China according to the three indicators are completely consistent, while the rankings of Switzerland, Germany, and Canada vary slightly among the three indicators.

Table 13. The score and rank of the Top 5 countries/regions based on RLI_{Cik}, $RFOI_{Cik}$ and $RFII_{Cik}$ in "Mathematics"

Indicators	Score					Rank				
	USA	China	Switzerland	Germany	Canada	USA	China	Switzerland	Germany	Canada
RLI_{Cik}	25.71	12.27	2.41	2.34	2.30	1	2	3	4	5
$RFOI_{Cik}$	12.44	6.42	1.15	1.28	0.96	1	2	4	3	5
$RFII_{Cik}$	13.27	5.85	1.26	1.06	1.34	1	2	4	5	3



3.10 INFORMATION SCIENCE: China ranks 1st, and the USA 2nd; the UK, Germany, and Singapore rank 3rd to 5th

In "Information science", China ranks 1st, and the USA 2nd, with respective RLI_{Cik} scores of 19.58 and 14.36. The UK scores 7.32, ranking 3rd. Germany and Singapore score 5.25 and 2.57, ranking 4th and 5th, respectively. The rankings based on the three indicators RLI_{Cik}, $RFOI_{Cik}$, and $RFII_{Cik}$ are the same across the board for the top five countries/regions.

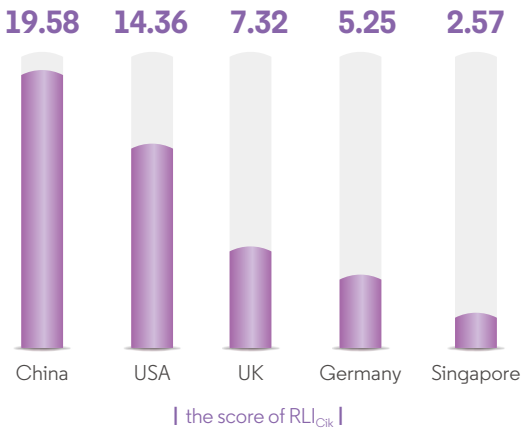


Table 14. The score and rank of the Top 5 countries/regions based on RLI_{Cik}, $RFOI_{Cik}$ and $RFII_{Cik}$ in "Information science"

Indicators	Score					Rank				
	China	USA	UK	Germany	Singapore	China	USA	UK	Germany	Singapore
RLI_{Cik}	19.58	14.36	7.32	5.25	2.57	1	2	3	4	5
$RFOI_{Cik}$	11.78	6.95	3.18	2.28	1.35	1	2	3	4	5
$RFII_{Cik}$	7.80	7.41	4.14	2.97	1.22	1	2	3	4	5

3.11 ECONOMICS, PSYCHOLOGY AND OTHER SOCIAL SCIENCES: China holds the top spot; The USA ranks 2nd; The UK, Australia, and Germany rank 3rd to 5th

In "Economics, psychology and other social sciences", China ranks 1st, with an RLI_{Cik} score of 15.16. The USA follows closely at 12.51, ranking 2nd, and the UK scores 7.69, ranking 3rd. Australia and Germany rank 4th and 5th with 5.27 and 3.42, respectively. China and the USA occupy first and second place across the three indicators. Among them, China ranks second in national research impact, and first in other two indicators; the USA ranks conversely (Table 15). For the UK, Australia, and Germany, the rankings based on the indicators RLI_{Cik}, $RFOI_{Cik}$, and $RFII_{Cik}$ are the same across the board.

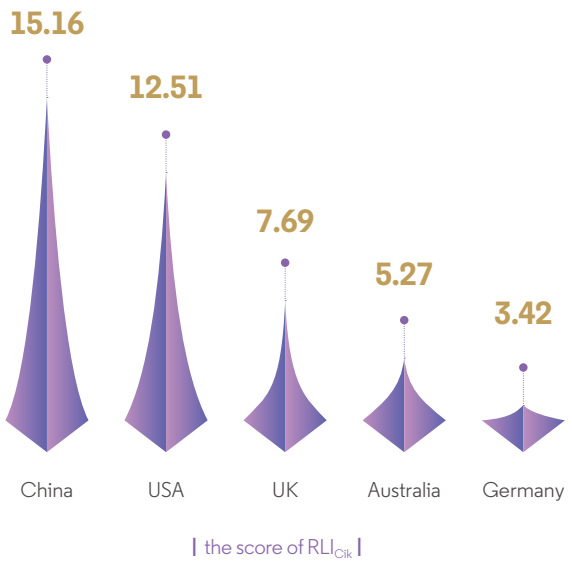


Table 15. The score and rank of the Top 5 countries/regions based on RLI_{Cik}, $RFOI_{Cik}$ and $RFII_{Cik}$ in "Economics, psychology and other social sciences"

Indicators	Score					Rank				
	China	USA	UK	Australia	Germany	China	USA	UK	Australia	Germany
RLI_{Cik}	15.16	12.51	7.69	5.27	3.42	1	2	3	4	5
$RFOI_{Cik}$	8.86	5.95	3.81	2.29	1.71	1	2	3	4	5
$RFII_{Cik}$	6.30	6.56	3.88	2.98	1.71	2	1	3	4	5

Planner: Jiaofeng PAN, Institutes of Science and Development, Chinese Academy of Sciences
Indicator designer: Fuhai LENG, Institutes of Science and Development, Chinese Academy of Sciences
Data analyst and Report writer: Qiuju ZHOU, Institutes of Science and Development, Chinese Academy of Sciences
English reviewer: Weiping YUE, Christopher M. KING Clarivate
Gate-keeper: Fan YANG Institutes of Science and Development, Chinese Academy of Sciences
Weiping YUE, Na WANG Clarivate
Consultant: Feng ZHANG Institutes of Science and Development, Chinese Academy of Sciences
Li WANG Clarivate

Institutes of Science and Development, Chinese Academy of Sciences
No.15 ZhongGuanCunBeiYiTiao Alley, Haidian District, Beijing P. R. China 100190
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