Germany as a Science Nation

Current Status

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Contents

Summary

Germany's status as a science nation is characterised by its broad-based research excellence. The research landscape spans all disciplines, and the impact of that research informs policy making and translates into industrial innovation.

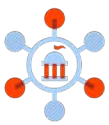
This report analyses Germany's status as a science nation by examining its research landscape, strengths, and the influence of its scientific output on innovation and policymaking.

University Rankings:
German universities are increasingly recognized on the global stage, with institutions like the Technical University of Munich being the top-ranking institution within EU27. The Times Higher Education rankings show Germany as the highest-ranked non-English speaking country, reflecting its commitment to academic quality and research excellence.

European Research Council (ERC) Impact:
The ERC has had a significantly effect on German science, particularly following Brexit. After 2020, Germany became the country with the highest number of publications funded by the ERC, enhancing its position as a leader in the European research area.

Complementary research sectors:
A unique aspect of Germany is the strength and diversity of its non-university research sector. Each of the 274 institutes and research centers that comprise the Helmholtz Association, the Max Planck Society, the Leibniz Association and the Fraunhofer Society focuses on a specific area of research. And while each institute is a separate entity, they often work closely with universities locally, nationally and internationally, ensuring that there is a strong link between sectors.

Industry Collaboration:
Collaboration between academia and industry is essential for advancing research and driving innovation in Germany and the country has one of the highest rates of academic-industry co-publication globally.



Knowledge Sovereignty:
Despite its strong research foundation, Germany faces challenges in translating academic research into industrial application, in key technology areas such as quantum computing and AI.

Germany remains a vital player in the international science arena, with a robust research ecosystem that continues to evolve. To maintain its competitive edge, Germany must address challenges in translating academic research into practical applications, in emerging technological fields. By fostering collaborative efforts between academia and industry, and investing strategically in research, Germany can reinforce its leadership in the global scientific community and ensure continued contributions to innovation and societal advancement.

Introduction

Germany has a long and outstanding tradition as a science nation, setting global standards in chemistry, physics, engineering, and medicine.

At the beginning of the 20th century, the country was a leader in these disciplines, producing prominent figures such as Albert Einstein, Max Planck, and Robert Koch. However, this golden age was abruptly interrupted by the Nazi era. With the end of World War II, a comprehensive reconstruction began, marked by the establishment of significant scientific organisations such as the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG), the Max Planck Society, the Fraunhofer Society, and the Helmholtz Association. The 1960s saw a wave of university foundations, and after reunification, the research landscape was reshaped again by integrating many former East German institutions into the Leibniz Association. With the rise of global powerhouses such as the United States and China, Germany never regained the global leadership position it held before the war. Nevertheless, the 49 Nobel Prizes awarded to German or German-born scientists since 1945 testify to the continued high quality of the research system and the country continues to play a central role in the international scientific landscape.

This study analyses Germany's current role as a science nation in the international context using a bibliometric methodology. It identifies strengths and weaknesses and looks at the factors that have led to excellence in science. Special attention is given to the influence of German research on the global stage, its significance for innovation and policy, and its contribution to knowledge sovereignty.

This report is part of a series of research landscape reports released by Elsevier over the years, covering topics such as Artificial Intelligence, Net Zero, Biodiversity, Gender Gap in Science, and country or region-focused reports. The goal of these reports is to stimulate discussions and support evidence-based policymaking.

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German Research Excellence

The landscape of scientific research in Germany is characterized by broad-based excellence that spans a diverse array of institutions.

This diversity is crucial as it fosters innovation and collaboration across many disciplines. Germany's research ecosystem includes a broad non-university research sector with specialised research institutes, technical universities, and comprehensive universities, each contributing to the advancement of knowledge. The interplay between these different types of institutions not only enhances the quality of research output but also promotes interdisciplinary approaches that are essential in addressing complex scientific challenges in today's rapidly evolving environment.

Breadth and Depth in the Academic Landscape

There are notable distinctions between the non-university and university research sectors in Germany, as well as between technical and comprehensive universities (Fig. 1). Non-university research institutions, such as the Leibniz Association and the Fraunhofer Society, often focus on specialised knowledge, applied research or technological advancements, while universities typically emphasise broad fundamental research and education. Figure 1 shows that the various research institutions differ significantly in terms of their share of annual publications ("scholarly output") and the impact of their work, as indicated by the Field Weighted Citation Index (FWCI[1]).

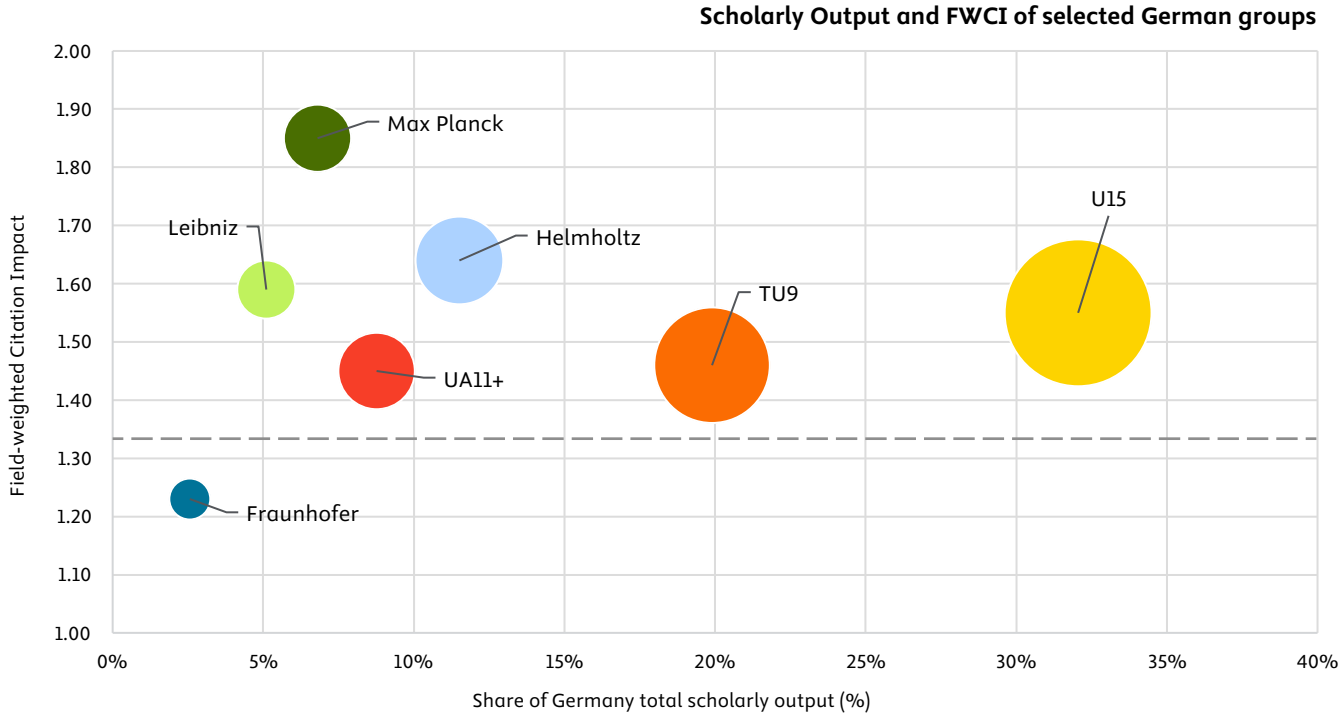

Figure 1: Publication output (as a % of country total) and the scientific impact (in FWCI[1]) for the three largest university groupings (U15, TU9, UA11+) and the four main non-university research organisations. The size of the bubble represents volume of research at the respective institution. The dotted line represents the country average Field-Weighted Citation Impact. *Source: Elsevier Scopus.*

Within the university sector, technical universities, like the Technical University Munich (TUM), are geared towards engineering and technology disciplines, fostering a strong connection between theoretical knowledge and practical application. In contrast, comprehensive universities, such as Heidelberg University, provide a broader disciplinary framework that includes medical faculties, integrating many disciplines and encouraging a more transdisciplinary approach to research (Fig. 2). Understanding these differences is vital for policymakers and stakeholders aiming to enhance the effectiveness and impact of research initiatives across Germany's scientific community.

1 For this analysis, we employ the **Field Weighted Citation Impact** (FWCI), which is normalized to a world average of 1.0 and takes into account differences in research behavior across disciplines. An FWCI of 1.2 indicates a performance that is 20% above the global average, while an FWCI of 3.0 signifies a performance three times better than average.

The Germany University Sector

Among German universities, TUM stands out as the leader in research productivity, having published nearly 52,000 research articles between 2019 and 2023 (Fig. 2). Following closely is the Ludwig-Maximilian University Munich, which recorded just over 47,000 publications during the same five-year period. The Ruprecht-Karls-University Heidelberg ranks third, with almost 41,000 publications, while Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen occupies the fourth position with more than 35,000 articles. The University of Hamburg has contributed 34,000 publications, and both the Technical University Dresden, the Charité – Universitätsmedizin Berlin, and Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU) each published around 30,000 articles in the same timeframe.

Notably, the Charité, which is the joint medical faculty of the Humboldt University Berlin and the Free University Berlin, boasts the highest Field-weighted Citation Impact at 2.17, followed closely by Heidelberg with an FWCI of 2.06. All these institutions have citation levels that well exceed the national average of 1.36, highlighting their significant impact within the global scientific community.

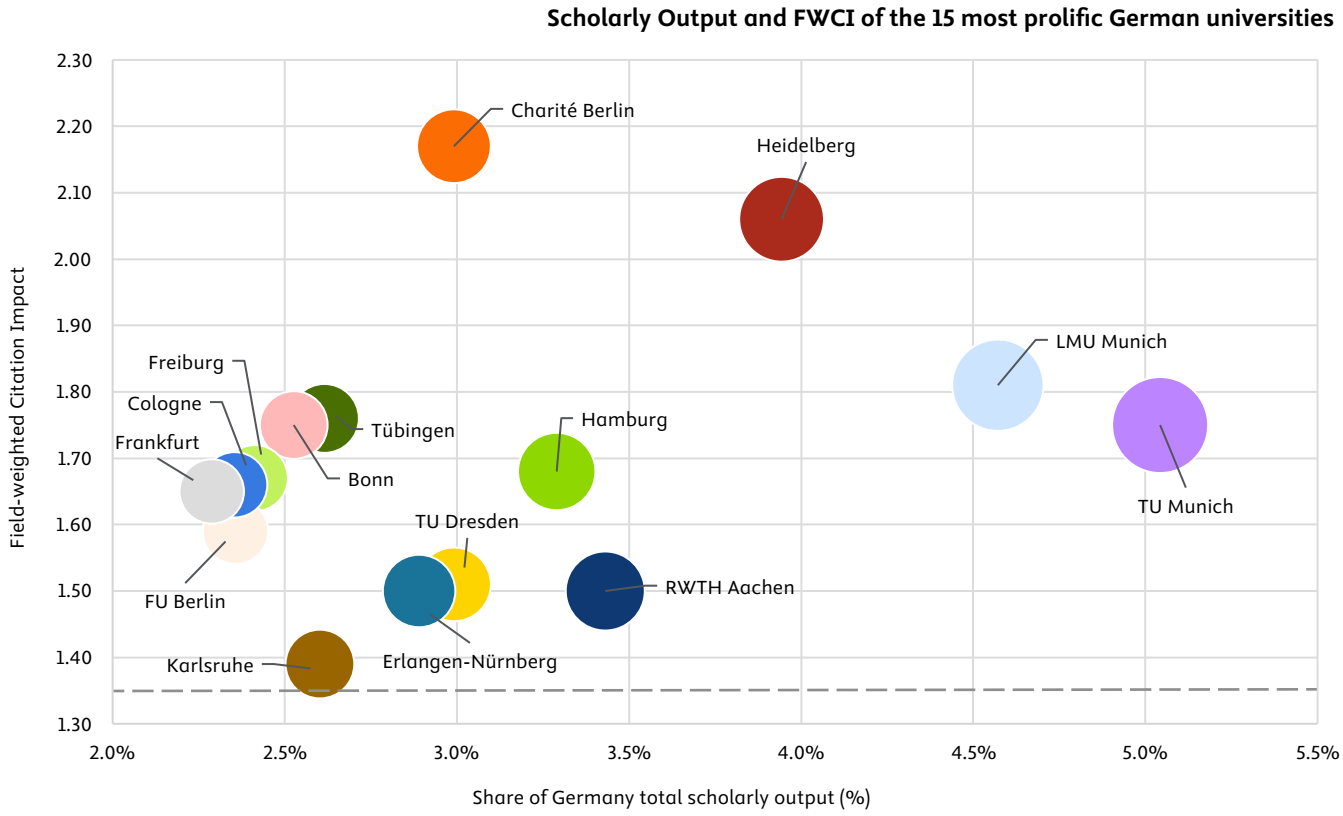

Figure 2: 15 most prolific German universities, output (as a % of country total) and the scientific impact (in FWCI). The size of the bubble represents volume of research at the universities. The dotted line represents the country average Field-Weighted Citation Impact. 2019-2023.

The European Research Council and Germany

The European Research Council (ERC) was established by the European Commission in 2007 to support pioneering scientific and technological research within the European Union. The ERC is renowned for its competitive grant schemes that prioritize excellence, allowing top researchers from any field to pursue groundbreaking projects. It plays a crucial role in enhancing the European Research Area (ERA), which aims to create a single, borderless ecosystem for research, innovation, and technology across the EU. The ERC is highly regarded for its ability to enable institutions to attract and retain top talent, foster innovative research, and contribute significantly to Europe's scientific competitiveness on the global stage.

The impact of Brexit has significantly influenced the landscape of research funding and publication in the United Kingdom, resulting in a plateau in the number of papers funded by the European Research Council from the UK (Fig. 3). This stagnation has not only affected the UK but has also led to a slowdown in research output across other European countries. In contrast, Germany has emerged as a leader in this context, developing into the country with the highest number of papers supported by ERC funding. This shift underscores Germany's growing prominence in the European research area, as it capitalizes on the opportunities presented by ERC grants to enhance its scientific output and maintain a competitive edge in global research initiatives.

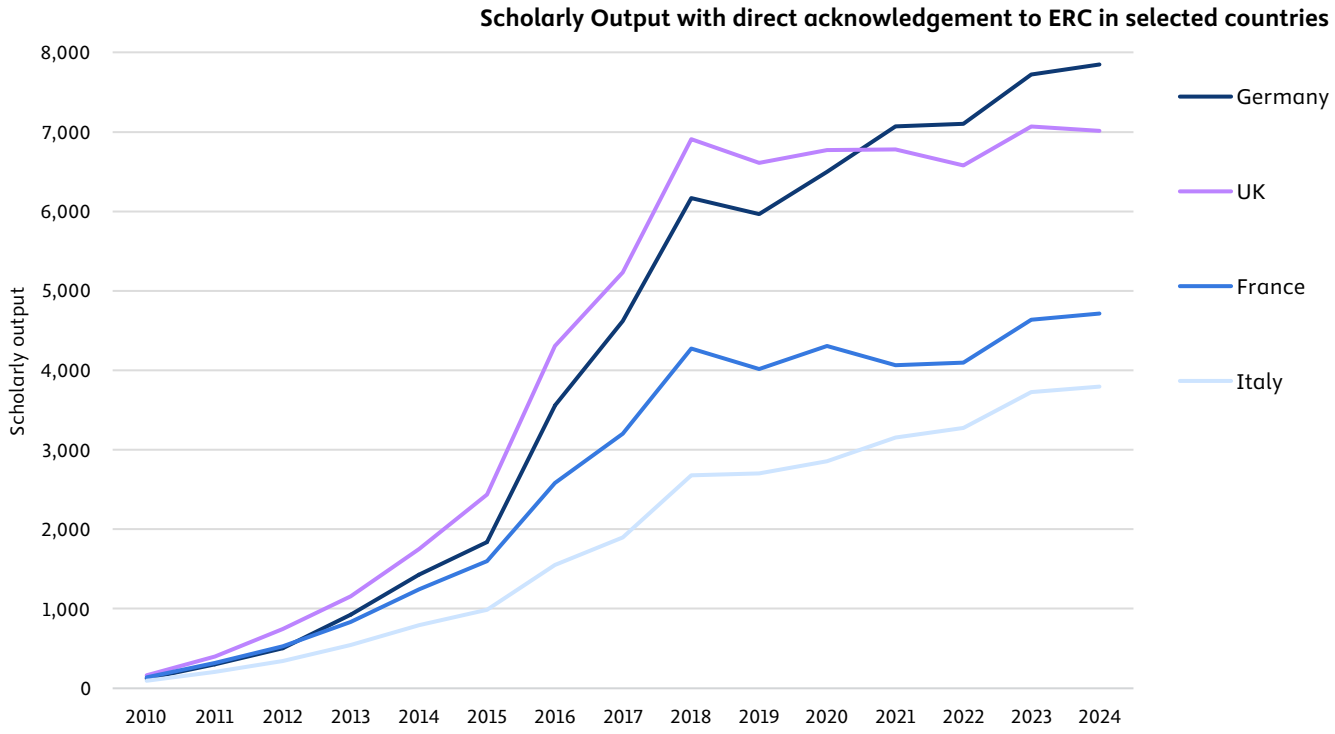

Figure 3: Publications by Country funded by the European Research Council (ERC), 2010-2024, based on acknowledgements data in Scopus.

Germany and the Times Higher Education Rankings

The Times Higher Education (THE) World University Rankings are a comprehensive evaluation of university performance globally, assessing institutions across key areas such as teaching, research, industry engagement, and international outlook.

Established in 2004, these rankings use 18 carefully calibrated performance indicators to provide a balanced comparison of universities worldwide (Table 1).

Rank	University
26	Technical University of Munich (TUM)
38	Ludwig Maximilian University of Munich (LMU)
47	Heidelberg University
84	Humboldt University of Berlin
89	University of Bonn

Table 1: Top five ranked German universities in the THE World University Ranking 2025.

Over the past decade, German institutions have consistently improved their positions in the THE rankings, with TUM leading the way. As a result, Germany has emerged as the highest-ranked non-English speaking country in terms of the number of institutions within the top 200 (Fig. 4). This achievement underscores the breadth of excellence present in the German higher education system, reflecting a strong commitment to research, innovation, and academic quality across a diverse array of disciplines.

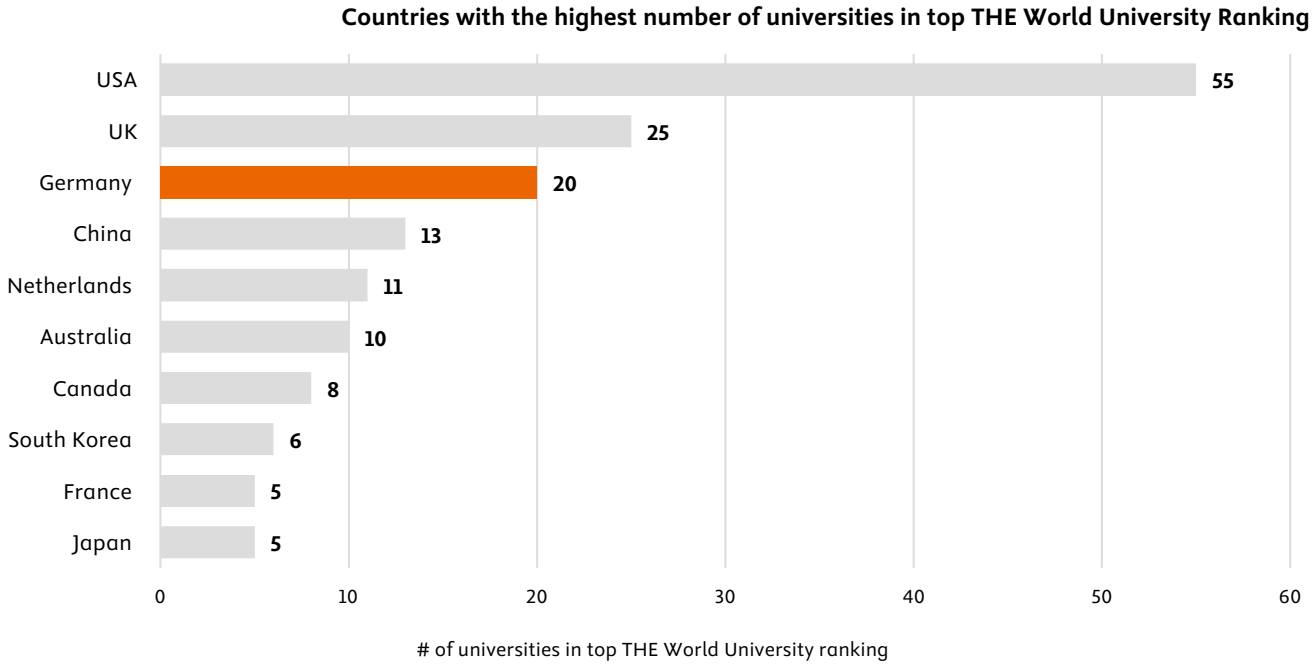

Figure 4: Top 10 countries ranked by number of universities in the THE World University Ranking 2025.

Comprehensive Excellence in German Research

German research institutions demonstrate a remarkable diversity of strengths. Using the most current impact measurement methodologies, we can demonstrate the different ways that the research done at universities and at non-university research institutes contributes to science and society. Such recognition can play a critical role in shaping science policy and creating an environment that nurtures sustained scientific advancement.

The University Alliances

The German U15, TU9, and UA11+ are three distinct university alliances in Germany, each with its unique focus and strengths. The U15 comprises fifteen major research-intensive universities known for their strong emphasis on medical and scientific research. In contrast, the TU9 is an alliance of nine leading technical universities specializing in engineering and natural sciences, renowned for their technological innovation and industry collaboration. A third, more recent university alliance, the UA11+ consists of fifteen medium-sized universities that excel in interdisciplinary research and knowledge transfer, often playing a central role in their respective regional contexts. All three alliances produce a large degree of highly cited research: the U15 lead the pack with 2.2% of their output among the top 1% of highly cited publications, followed by the TU9 with 2% and UA11+ with 1.9%. Taken together, these alliances highlight the diverse and robust landscape that is higher education and research in Germany.

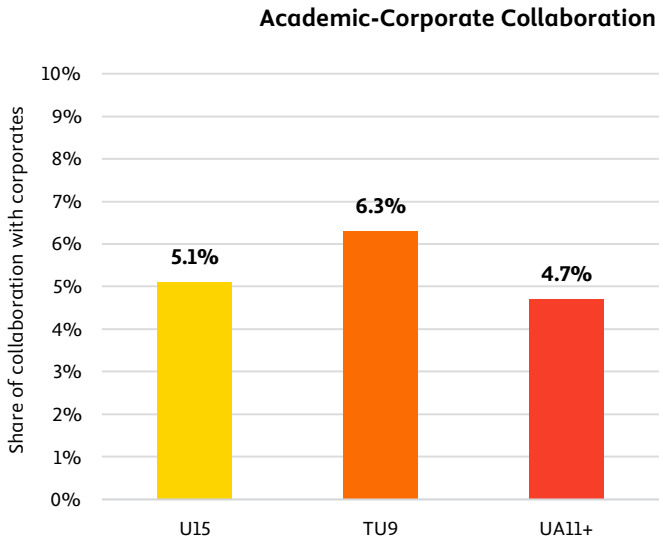

Figure 5: Percentage of total output TU9, U15 and U11 in collaboration with corporates, 2019-2023.

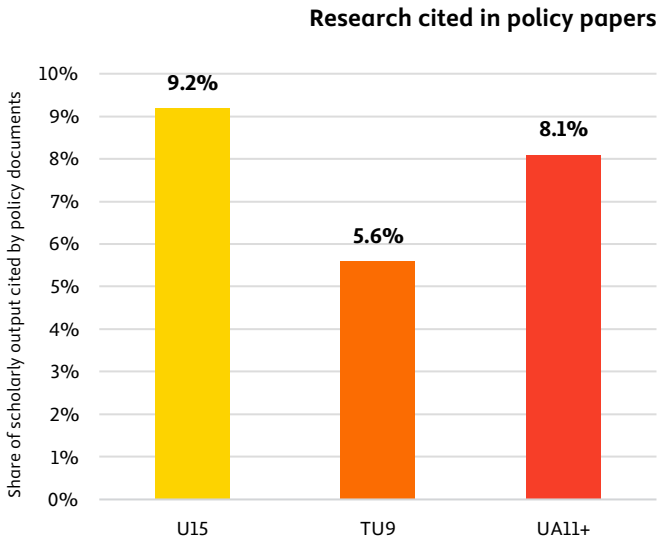

Figure 6: Percentage of total output quoted in policy papers, 2019-2023.

Perhaps unsurprisingly, technical universities in Germany demonstrate a higher frequency of academic collaboration with industry, as evidenced by the significant number of co-publications generated through these partnerships (Fig. 5). This trend underscores their commitment to applied research and innovation in practical settings. In contrast, the U15 and U11+ university associations focus on producing research that is particularly relevant to broader policy debates, highlighting their role in shaping informed decision-making and public discourse (Fig. 6). Together, these dynamics illustrate the complementary strengths of different university types in contributing to both industrial advancement and policy development within the German research landscape.

The Non-University Research Sector

The publicly funded non-university sector in Germany is a key to its overall research excellence. Each non-university research organisation possesses distinct strengths that contribute to the overall excellence of the research landscape. The Helmholtz Association, for instance, stands out as the largest organisation in terms of scientific output, reflecting its extensive resources and collaborative efforts across a large variety of research fields. In contrast, the Max Planck Society and its 84 institutes excel in research excellence, producing a significant number of top-ranked papers, with a remarkable proportion of its research falling within the top 1% of the most cited globally (Fig. 7). This distinction highlights the society's commitment to academic excellence in basic research and its wide reach in the international scientific community.

Meanwhile, the 76 institutes within the Fraunhofer Association are recognized for their close collaboration with industry partners, as evidenced by the high number of patent citations generated from their work (Fig. 8). This focus on innovation and technology transfer underscores the association's role in bridging the gap between basic research and practical applications. And finally, the research conducted within the 96 Leibniz Institutes is frequently cited in policy documents (Fig. 9), emphasizing its relevance to policymakers globally and locally, and the impact that researchers working at Leibniz institutes have on addressing current policy debates and broad societal challenges.

Together, these organisations illustrate the comprehensive approach that the German research system takes in enabling impact across multiple dimensions, with each non-university research association playing a vital role in advancing knowledge and addressing pressing issues in a broad range of domains.

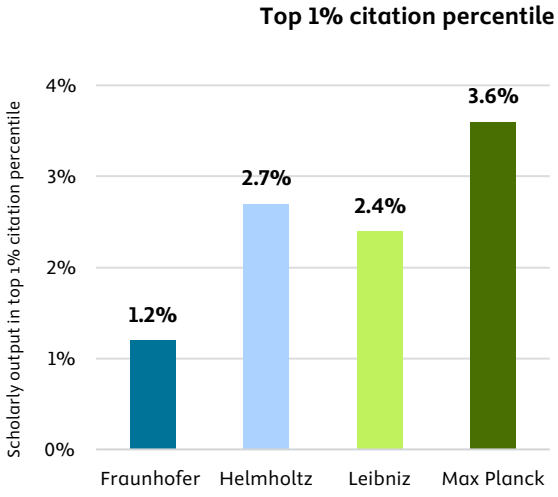

Figure 7: Percentage of total output in the top 1% cited percentile, 2019-2023 publications.

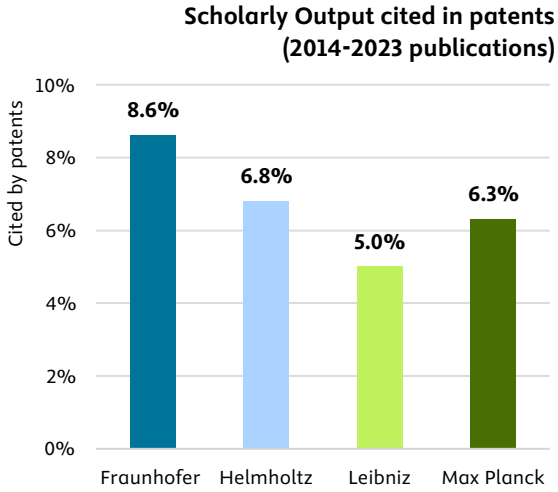

Figure 8: Percentage of total output quoted in patents; 2014-2023.

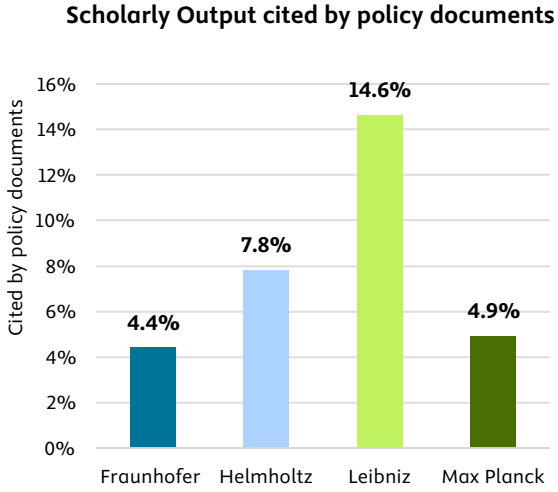

Figure 9: Percentage of total output quoted in policy papers, 2014-2023 publications.

The Relevance of German Research to Industry

Germany's broad research ecosystem fosters innovation and technological advancements that drive industrial growth and competitiveness on a global scale and in new sectors, such as quantum technologies or battery research. Moreover, German research addresses pressing societal challenges, such as climate change, healthcare, and digital transformation, providing evidence-based solutions that enhance the quality of life. In the political arena, research informs policy making, ensuring that decisions are grounded in scientific evidence. And the transfer of knowledge from German research into broader societal and economic fields underscores its central role in shaping a progressive and resilient future.

The collaboration between academia and industry in research as seen through the lens of co-publications is a valid marker for assessing how academia and industry collaborate. Japan leads the way with the highest levels of collaboration, reflecting a robust integration of academic expertise and industrial capabilities (Fig. 10). Following closely is Germany, which has also established strong partnerships between its research institutions and various sectors of industry.

This partnership is vital as it merges a wide range of skills, knowledge, and resources to create opportunities and address challenges faced by industry. In an environment in which researchers and industry professionals collaborate, both sectors can capitalise on their respective strengths. Academic institutions offer cutting-edge research and theoretical frameworks, while industries provide the means for implementation. This synergy improves the quality and relevance of research outcomes as can be measured comparing the FWCI of academic-corporate publications with those produce solely within academia (Fig. 11).

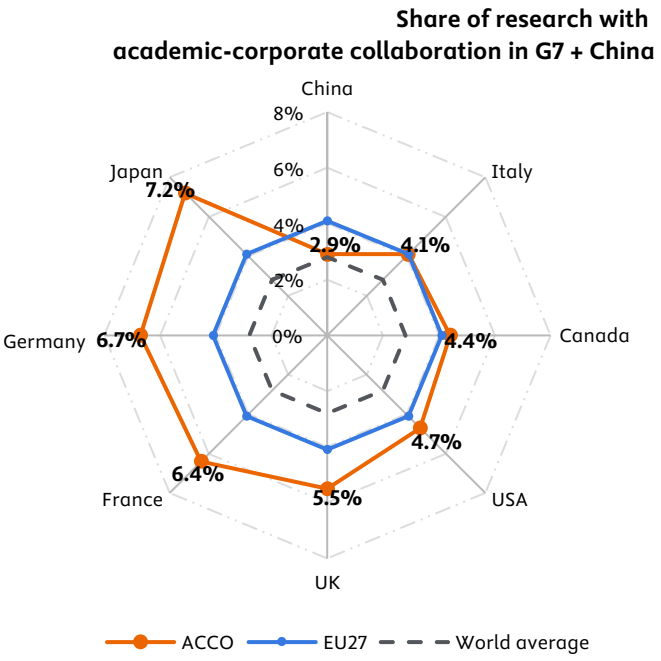

Figure 10: Percentage of total output of co-publications of academia with industry, 2019-2023.

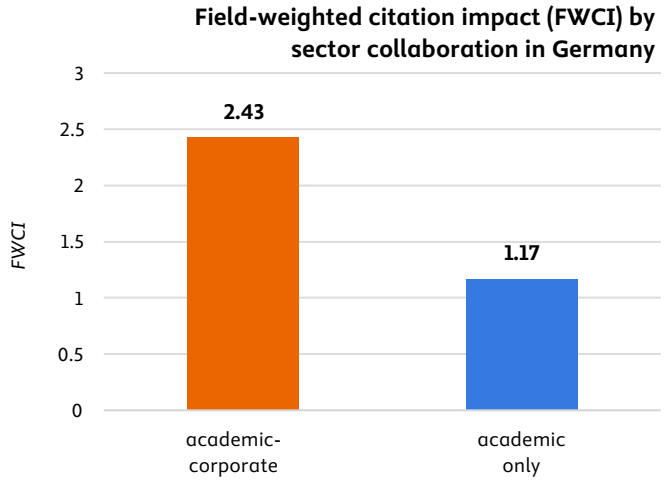

Figure 11: Average FWCI for academia-corporate co-publications and for academia-only papers, 2019-2023.

Universities and Industry

We now turn to the collaboration between German universities and industry, focusing on the differences between TU9 and U15. Comparing the two groups, technical universities within the TU9 alliance tend to publish more frequently with German companies than with international ones (Fig. 12). In contrast, comprehensive universities within the U15 group show a higher number of co-publications with companies based outside of Germany. Over the past two decades, this trend has remained constant for the TU9 universities, but for the U15 group, the growth in joint publications with German industry partners slowed after 2006, while the rate of growth for co-publications with industry abroad has increased since that time.

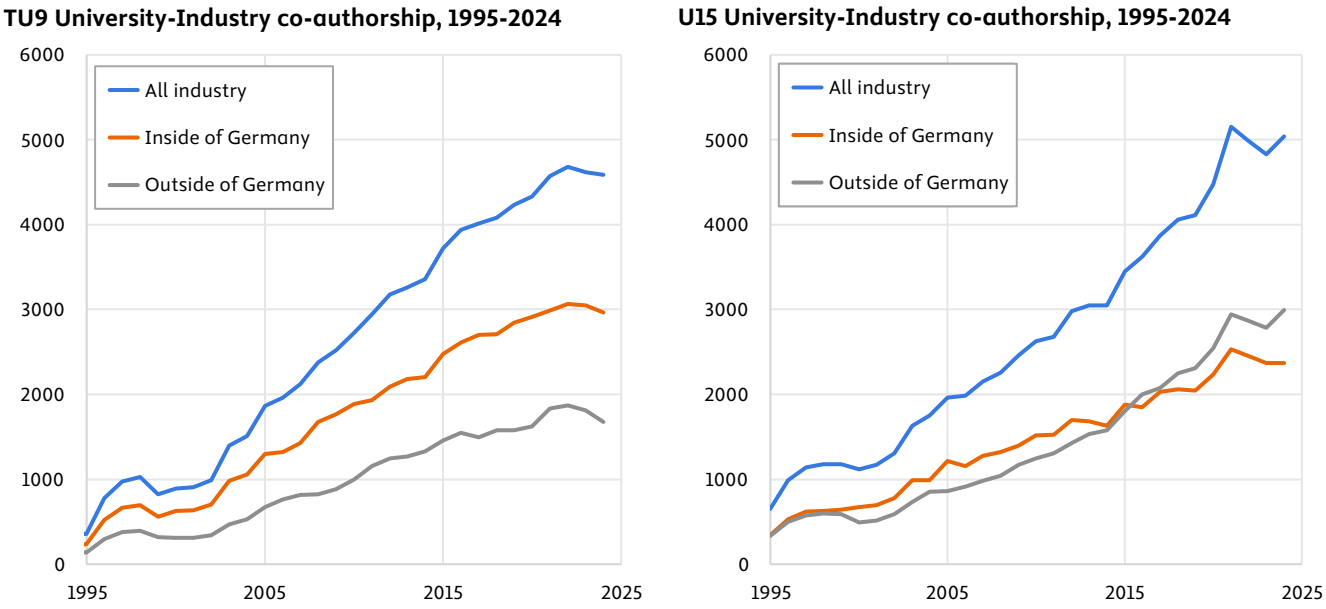

Figure 12: Universities of Technology in Germany tend to have more co-authorships with national corporate partners, while in research-intensive and leading medical universities the co-authorship is evenly distributed among national and international corporate partners.

Patents and Publications in Europe and in Germany

Within Europe, Germany is by far the country with the largest number of patentable inventions. The map below shows the number of patents invented in Europe, based on Portfolio Size (Fig. 13).

Invented in	# Active patents
Germany	577,494
France	219,021
Russia	164,700
UK	162,114
Italy	107,172
Switzerland	76,519
Netherlands	75,585
Sweden	61,330
Poland	48,526
Austria	46,219
Spain	39,227

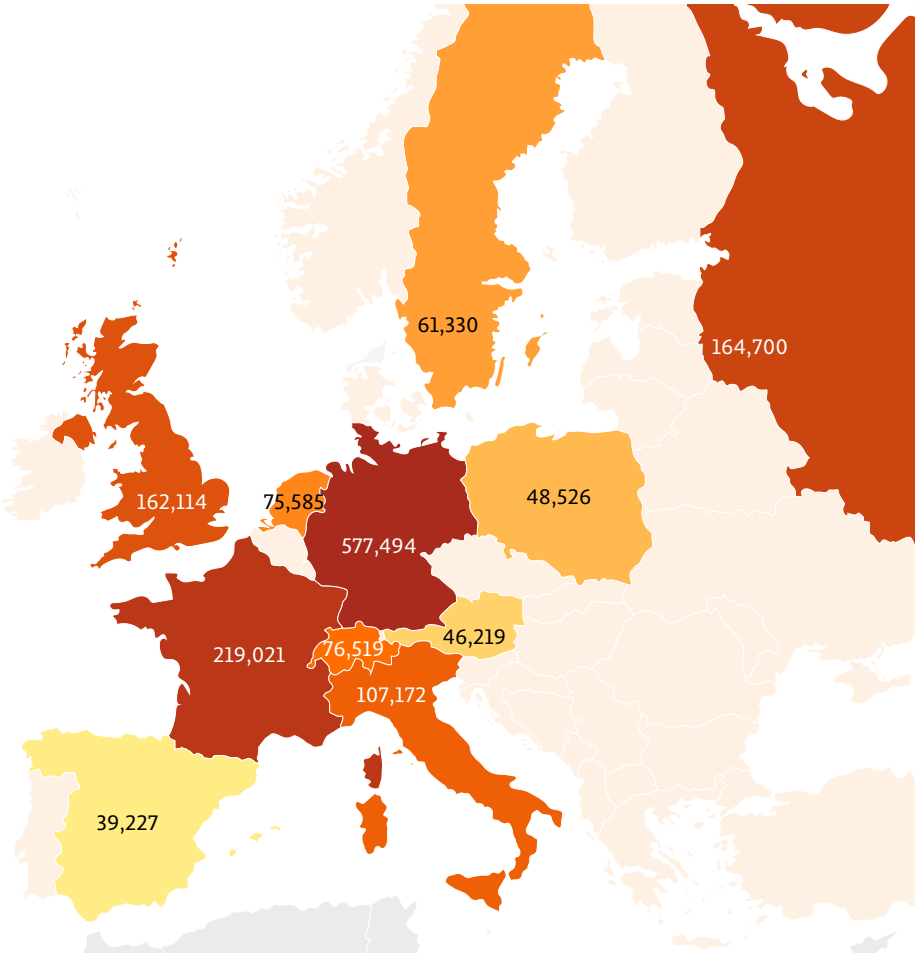

Figure 13: Patents (all fields) invented in Europe, based on Portfolio size. The relative size of output (0 to 400.000 papers p.a.) for each country is correlated with the intensity of the shading. *Source: PatentSight.*

Collaborative partnerships between academia and industry are known to attract a higher level of citations, but the question remains: do these collaborations translate into economic advantages? One effective approach to understanding the impact of research on economic growth is to examine the relationship between research outputs and patents. By analyzing patents that cite academic research, we can gain insights into how these collaborations contribute to innovation and economic development (Fig. 14). This assessment not only highlights the practical applications of research but also underscores the potential for translating scientific advancements into tangible economic benefits.

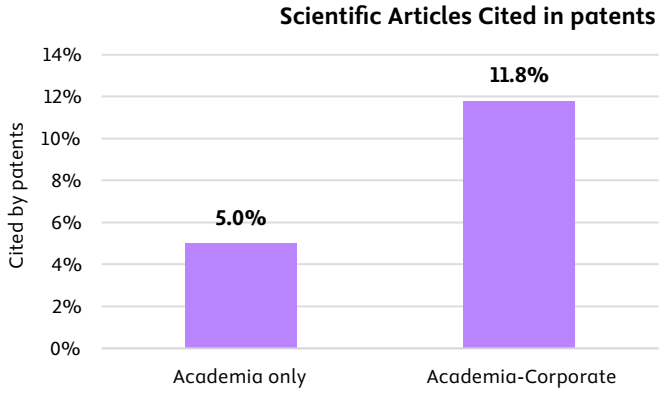

Figure 14. Percentage of total German research output cited in patents for academia only (left) and for academia-corporate collaborations (right), 2014-2023.

Technological Sovereignty in Key Technology Areas

Another way to look at Germany's ability to produce excellent research in a broad array of fields is to assess how well it provides knowledge capacity that is necessary for maintaining technological sovereignty in key areas.

Another way to look at Germany's ability to produce excellent research in a broad array of fields is to assess how well it provides knowledge capacity that is necessary for maintaining technological sovereignty in key areas. In January 2025, Germany's Federal Ministry of Education and Research (BMBF) published *"Research and Innovation for Technological Sovereignty 2030 (FITS2030)"*[2] , a framework aimed at bolstering Germany and Europe's technological sovereignty and leadership. It focuses on monitoring the development of key digital and industrial technologies, such as artificial intelligence, quantum technologies, and robotics, to reduce reliance on foreign expertise and imports. The report thus sets a framework for assessing the country's resilience, competitiveness, and ability to set global standards.

Publications serve as a key indicator of knowledge capacity within a research system, reflecting the generation and dissemination of knowledge among scholars and institutions. They signify that the academic community has developed expertise in various fields. Conversely, patents represent the translation of this knowledge into practical applications by industry, demonstrating the commercialisation of research findings. In Germany, notable strengths are observed in publications related to quantum technologies, photonics, battery technologies, Industry 4.0, and high-performance computing (Fig. 15).

In certain domains, such as robotics, photonics, and Industry 4.0, there is a complementary relationship between publications and patents, indicating a robust cycle of innovation. However, in other areas, including quantum technologies, high-performance computing, and battery technologies, a gap exists between the volume of publications and the number of patents filed. This discrepancy suggests potential barriers to translating academic research into industrial applications, highlighting an area for further investigation and policy attention to enhance the impact of research on technological advancement.

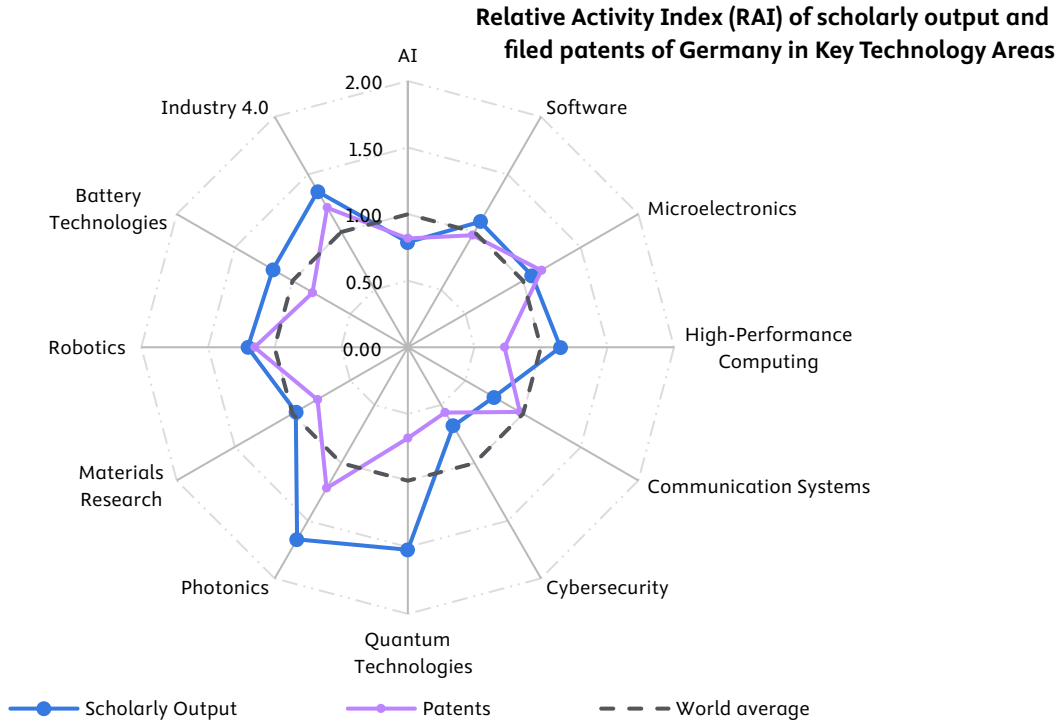

Figure 15: Relative Activity Index (RAI) of Scholarly output (blue) and filed patent (purple) of Germany, normalized for the world average (1.0, black). The above graph is based on approximations using key words and is not a detailed analysis. Publications are based on the period 2019-2023, while patents are based on currently active patents invented in Germany.

2 Bundesministerium für Bildung und Forschung (2025, January 24) Technologisch souverän in Deutschland und Europa. Retrieved from https://www.bmbf.de/SharedDocs/Publikationen/DE/5/1079492_Rahmenprogramm_FITS2030.html

Germany, Europe and the World

Given the vast size and influence of the United States and China in the global research landscape, we present the European Union as a collective entity comprising 27 member states.

This approach allows for a clearer visual representation of significant contributors to contemporary science. Additionally, we have grouped several emerging countries into regions, providing a comprehensive overview of the global research environment and highlighting the diverse range of nations that are making impactful contributions to scientific advancement.

To assess productivity and output, we utilise the number of publications as a key metric. These publications are subsequently cited by other researchers, serving as a strong indicator of scientific impact. In terms of overall productivity, the United States accounts for approximately 20% of global publications, while China and the EU, as a bloc, collectively represent around 24%.

As depicted in Figure 16, China and the EU block are almost identical in term of volume and very similar in citation levels, measured by the Field-weighted Citation Impact (FWCI). The USA has still higher citation levels than China and EU average, despite a decisive declining trend in recent years. Within the EU there are significant differences in FWCI for various countries, and Germany is above average.

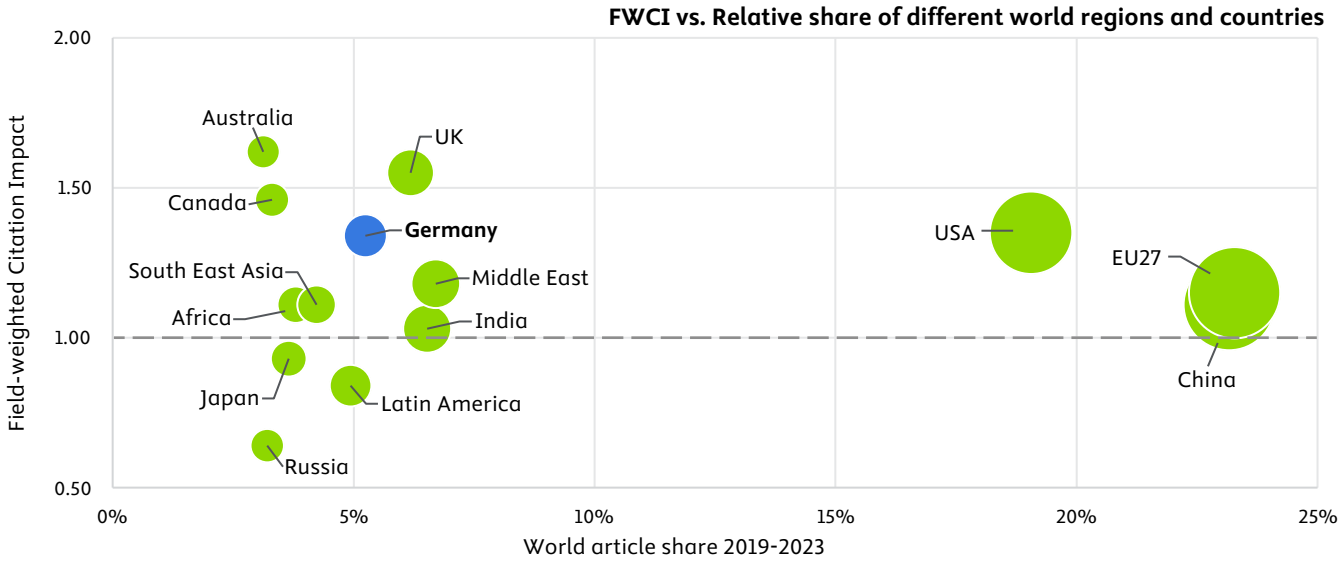

Figure 16: FWCI vs. relative article share of China, Germany, USA and different world regions and countries. The dotted line at FWCI 1.00 indicates the world average.

When comparing key parameters such as FWCI, total output of scientific papers, and the number of authors for the 10 largest scientific producers worldwide, Germany ranks in the middle. In terms of FWCI, it is significantly behind the three anglophone countries, especially the UK and Canada, which occupy the top positions, but ahead of France and Japan (Table 2). Even in terms of growth rates for total output or the author cohort, Germany does not surpass a middle position. Nevertheless, being in the middle among the big players means that Germany is the world's fifth-largest scientific nation.

2019-2023 publications	FWCI	Scholarly Output	Scholarly Output (growth %)	Authors	Authors (growth %) *2019-2023*
EU27	1.15	4,596,327	8%	3,287,914	14%
China	1.12	4,589,434	48%	5,374,387	63%
USA	1.35	3,768,465	0.3%	2,860,930	10%
India	1.01	1,288,239	55%	1,113,933	56%
UK	1.55	1,219,017	6%	709,379	9%
Germany	1.33	1,029,892	5%	678,885	10%
Italy	1.38	770,529	19%	445,576	22%
Japan	0.93	720,239	-0.7%	646,944	2.5%
Canada	1.46	652,635	7%	397,957	13%
France	1.29	650,326	-0.6%	446,320	5%
Russia	0.63	634,296	-11%	452,240	-4%

Table 2: Data on academic research published in EU27 and in the 10 most prolific countries worldwide, 2019-2023.

If we look at the majority of European nations, it is clear that, in addition to the large nations such as the UK, Germany, France and Italy, smaller nations such as Denmark, Switzerland, the Netherlands, Sweden and Norway, as well as Belgium and Austria, cannot keep up in terms of total output, but are consistently ahead of Germany in terms of FWCI (Fig. 17).

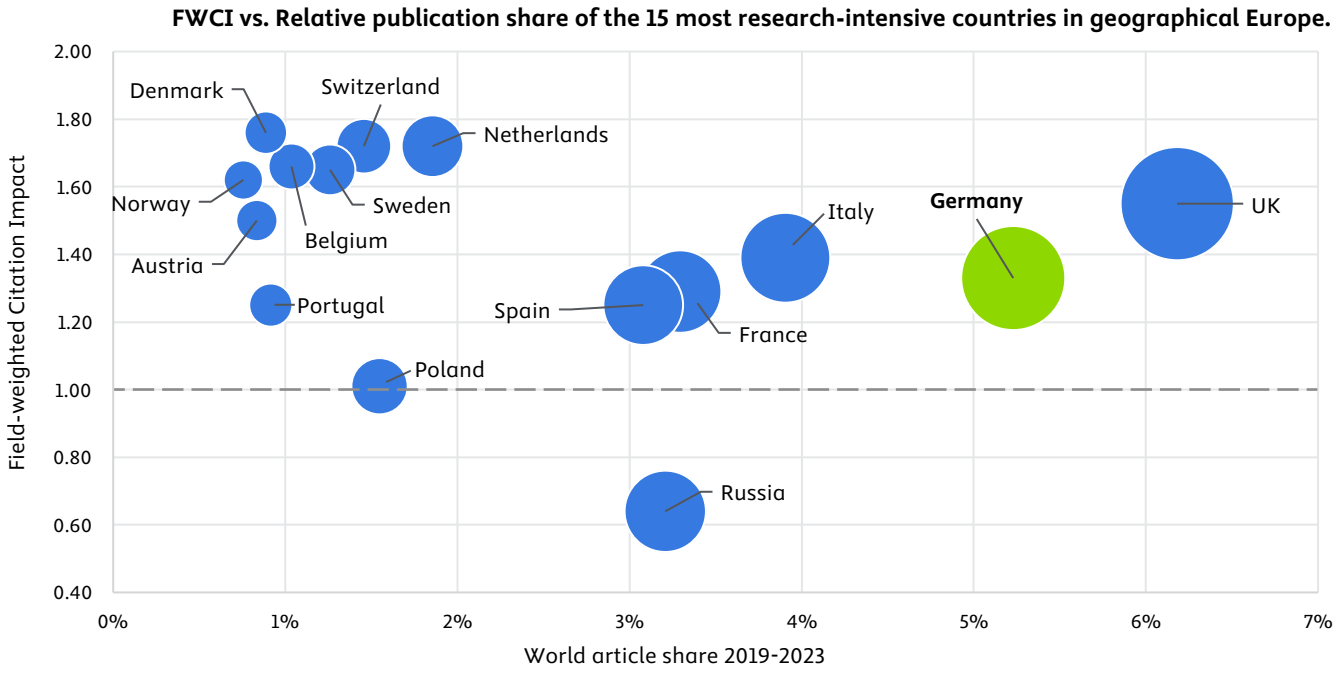

Figure 17: FWCI vs. relative publication share of 15 most research-intensive European countries, 2019-2023.

If we look at the trends in scholarly output over more than two decades (2000-2023), two parameters stand out (Fig. 18). Firstly, output more than doubled for most countries during this period, and more than tripled for Spain and Italy. Secondly, the surge in publications in 2021 is striking, which can be seen in all countries and reflects the times of lockdown during the coronavirus pandemic. France decline seems more systemic, and its output have not returned to pre-pandemic levels. Data for 2024 is still incomplete so it's not yet clear if the lines will flatten or continue downward for most countries.

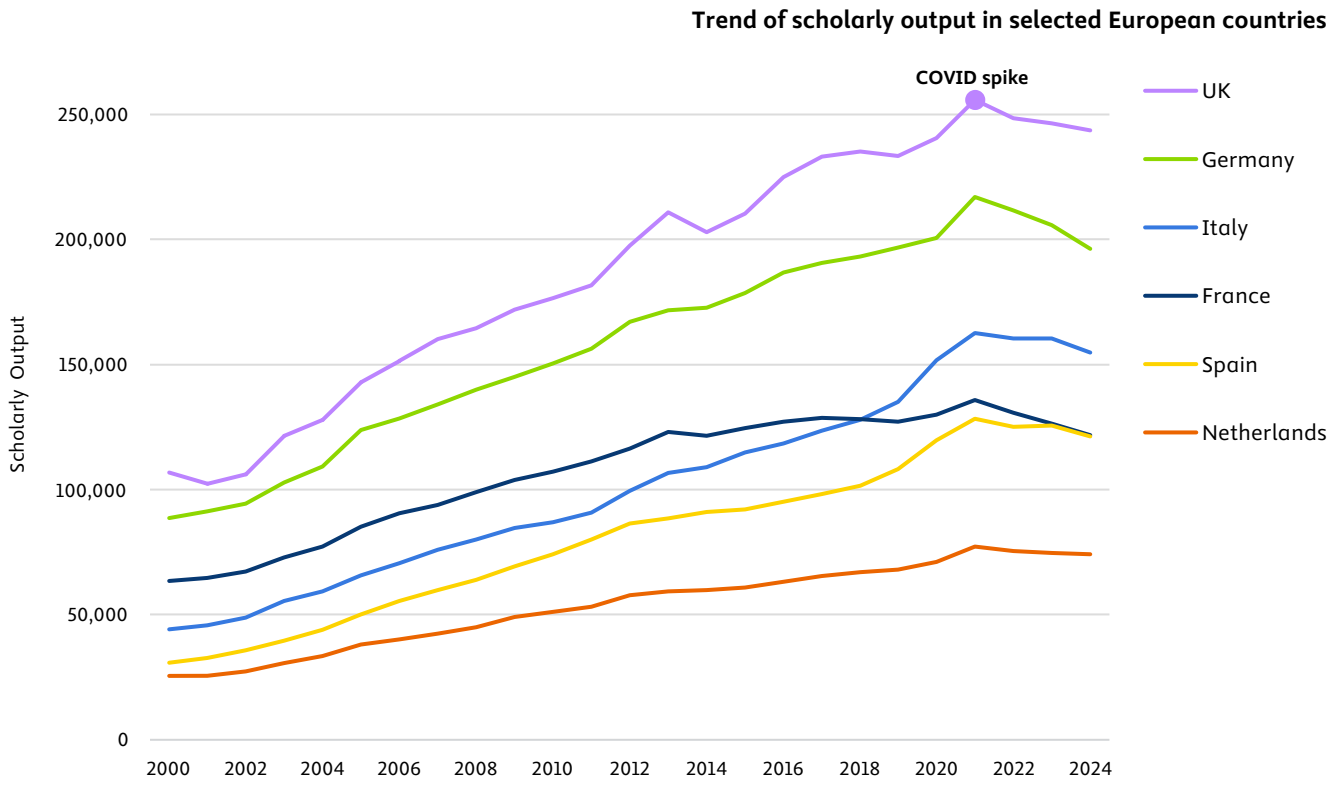

Figure 18: Trends of scholarly output in the 6 largest European countries since the start of the millennium.

Conclusions and Perspectives

This report analysed Germany as a science nation both on a national scale and in an international comparison.

It is primarily based on quantitative parameters, while qualitative factors such as reputation and prestige were largely disregarded. Germany's legacy as a science nation is underpinned by a robust and diverse research ecosystem that continues to evolve in response to global challenges and opportunities. The country's historical significance in fields such as chemistry, physics, and engineering has shaped a landscape rich in interdisciplinary collaboration, ensuring that both university and non-university research institutions contribute effectively to the advancement of knowledge. Despite the competitive pressures from emerging global powers, Germany remains a pivotal player in international science, as evidenced by its high number of publications, impactful research, and significant contributions to innovation and policy development. The ongoing ability of German institutions to attract funding from the European Research Council further demonstrates Germany's position leading position within the European Research Area, attracting top talent and fostering groundbreaking projects.

Looking ahead, it is crucial for Germany to address existing gaps in translating academic research into practical applications, especially in key technological domains such as quantum technologies and artificial intelligence. As outlined in the BMBF report *"Research and Innovation for Technological Sovereignty 2030"*, enhancing the synergy between academia and industry will be critical to bolstering the country's technological leadership and securing its competitive edge on the global stage. By targeting investments and fostering better collaboration to ensure interdisciplinary collaboration among all stakeholders, Germany can build on its strengths and reinforce its status as a leading science nation in an increasingly interconnected and dynamic world.

Definitions

This report is primarily based on Scopus data. Scopus is a large abstract and citation database launched in 2004 by Elsevier. It's one of the most prominent tools for researchers to find relevant academic publications, track citations, and analyse research trends. It covers 36,377 titles from 11,678 publishers. For more information see www.scopus.com.

Scholarly Output
Scholarly Output describes the products of scholarly activity, such as journal articles, books, book chapters, conference papers, and other forms of research dissemination. Throughout the report, when looking at collaborations, we use whole counting, meaning that collaborating entities on a scholarly publication all get a full count in terms of contribution.

Citation
A citation is a formal reference to earlier work made in document, frequently to other scholarly papers, but also to policy documents or patents. A citation is used to credit the originator of an idea or finding and is typically used to indicate that the earlier work supports the claims of the work citing it. The number of citations received by a paper from subsequently published papers and/or policy documents as well as patents, can be used as a proxy of the quality, importance, societal impact or economic translational value of the reported research.

FWCI (Field-Weighted Citation Impact)
Field-weighted citation impact (FWCI) is an indicator of mean citation impact and compares the actual number of citations received by a paper with the expected number of citations for papers of the same document type (article, review, or conference proceeding), publication year, and subject area. When the paper is classified in two or more subject areas, the harmonic mean of the actual and expected citation rates is used. The indicator is therefore always defined with reference to a global baseline of 1.0 and intrinsically accounts for differences in citation accrual over time, differences in citation rates for different document types (e.g., reviews typically attract more citations than research articles), as well as subject specific differences in citation frequencies overall and over time and document types. It is one of the most sophisticated indicators in the modern bibliometric toolkit.

Subject Area Classification
The subject area classification used in this report is based on the Journal Classification (ASJC) used in Scopus database, further condensed using the classification by Times Higher Education for their subject rankings. Scopus uses a hierarchical structure with 27 main subject areas. Times Higher Education THE agglomerate these 27 areas into 11 broader subject areas which makes comparison more manageable. Each publication can be linked to multiple ASJCs and this means that when you look at the breakdown by subject area a publication will be counted twice if it appears in a Scopus Source mapped to two categories, as SciVal doesn't use fractionalization. Therefore, for most entities in SciVal, if you add up the percentage values in the pie or donut charts, they will equal more than 100%. The percentages represent the relative publication share per subject area.

International Collaboration
International collaboration in this report is indicated by papers with at least two different countries listed in the authorship byline.

Academic-Corporate Collaboration
Academic-Corporate collaboration in this report is indicated by papers with at least one author from an academic institution and one author from a corporate institution listed in the authorship byline.

RAI (Relative Activity Index)
Relative Activity Index is defined as the share of an entity's publications in a subject relative to the global share of publications in the same subject. A value of 1.0 indicates that an entity's research activity in a field corresponds exactly with the global activity in that field; higher than 1.0 implies a greater emphasis while lower than 1.0 suggests a lesser focus.

Data sources

Scopus
Scopus is a comprehensive, source-neutral abstract and citation database curated by independent subject matter experts who are recognized leaders in their fields. 91+ million items include data from 7,000+ publishers, 94,000+ affiliation profiles and 17+ million authors. Scopus puts powerful discovery and analytics tools in the hands of researchers, librarians, research managers and funders to promote ideas, people and institutions Delivering a comprehensive overview of the world's research output in the fields of science, technology, medicine, social sciences, and arts and humanities, our state-of-the-art search tools and filters help uncover relevant information, monitor research trends, track newly published research and identify subject experts. Worldwide, Scopus is used by more than 3,000 academic, government and corporate institutions and is the main data source that supports the Elsevier Research Intelligence portfolio.

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SciVal is a web-based analytics solution with unparalleled flexibility that provides access to the research performance of over 20,000 academic, industry and government research institutions and their associated researchers, output and metrics. SciVal allows users to visualize research performance, benchmark relative to peers, develop strategic partnerships, identify and analyse emerging research trends, and create uniquely tailored reports.

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Overton is the world's largest searchable index of policy documents, guidelines, think-tank publications and working papers. Its database consists of more than 1.65 million policy documents, with data collected from 182 countries and over a thousand sources worldwide. These policy documents include white papers from international multilateral organisations, as well as guidelines from city councils, parliamentary transcripts and other classes of the so-called "gray literature." Around half of these documents make citations to academic or scholarly publications. More than 2 million distinct journal-based publications are cited by at least one policy document in the database.

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