



Global Research Report

U.S. research trends: The impact of globalization and collaboration

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April 2023



Global Research Report

- Examines the trajectory of recent United States research
- Focuses on the balance of domestic and collaborative research and its policy implications
- Looks at the redistributive effects of EPSCoR
- Raises questions as to how well past investment has prepared the U.S. to achieve its scientific goals

The U.S. remains a leading research power but needs to acknowledge shrinking domestic research capacity, particularly in engineering. It will need to work pragmatically with competitors such as Mainland China.

Capacity: U.S. investment, research student numbers and output of research articles and reviews have not grown as fast as other parts of the world

Portfolio: U.S. 'footprint' in research remains extensive but research subject diversity has declined because the science budget expanded much faster in biomedicine than in technology areas

Impact: The U.S. no longer dominates the research landscape, sharing this on an increasingly equal basis with other G7 nations and at eye level with Mainland China. More U.S. papers are now of world average citation impact while competitors are producing relatively more papers of the highest citation impact

Collaboration: International research collaboration has expanded and delivers most U.S. growth, doubling for major traditional partners such as the United Kingdom and Germany and quadrupling with Mainland China. Citation impact of collaborative papers is greater than domestic research

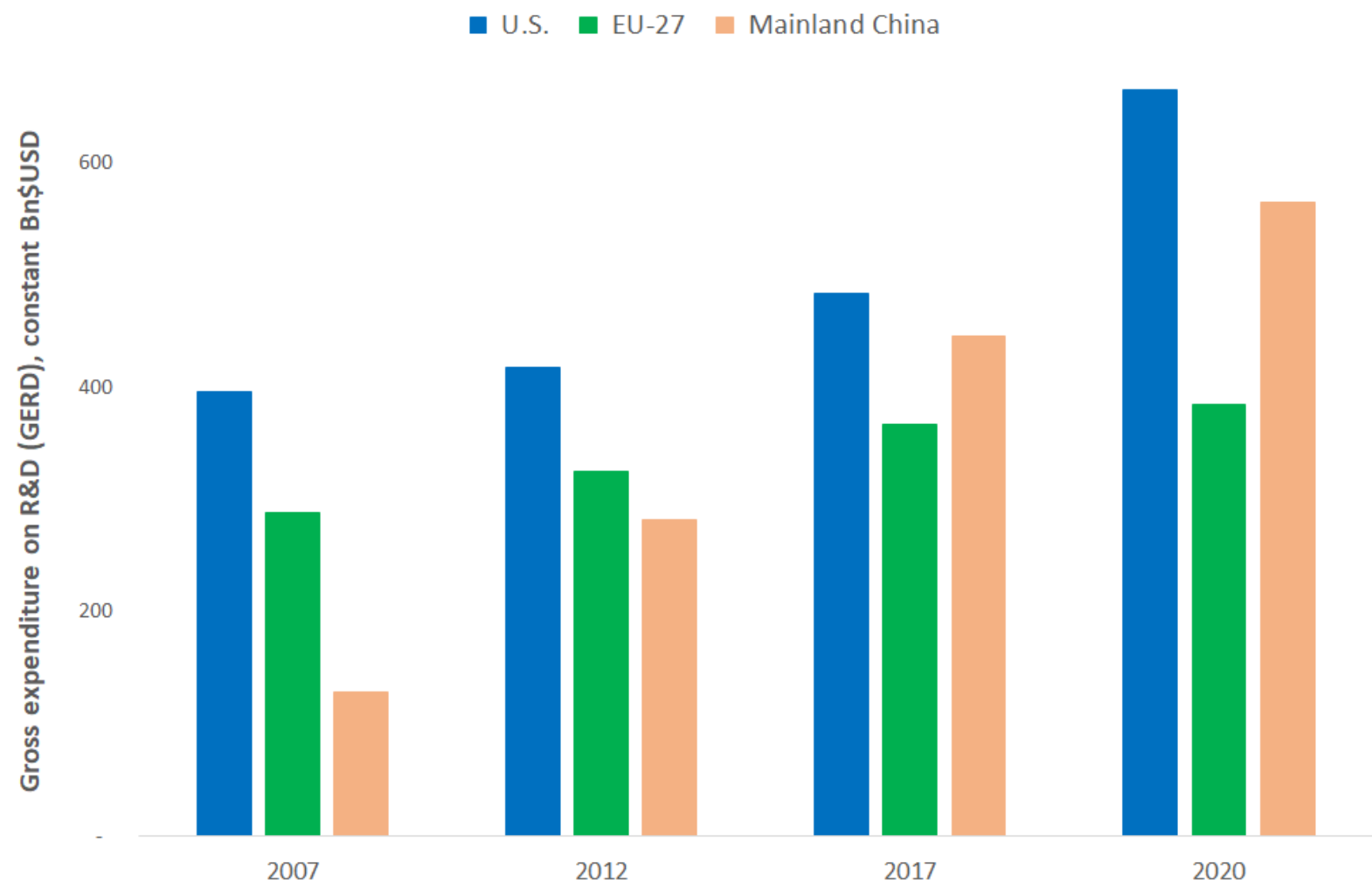
Balance: U.S. collaboration accounts for over 50% of output in most science/engineering areas and includes a diverse network of partners. Mainland China is the most frequent partner in technology research and is as frequent as the U.K. and Germany in physical sciences

Distribution: U.S. has sought to address over-concentration by structured funding directed to relatively weak areas. Data show greater equity in the distribution of excellence through rising impact in U.S. states of historically low research output.

R&D investment

U.S. investment has risen and is still greater than comparators

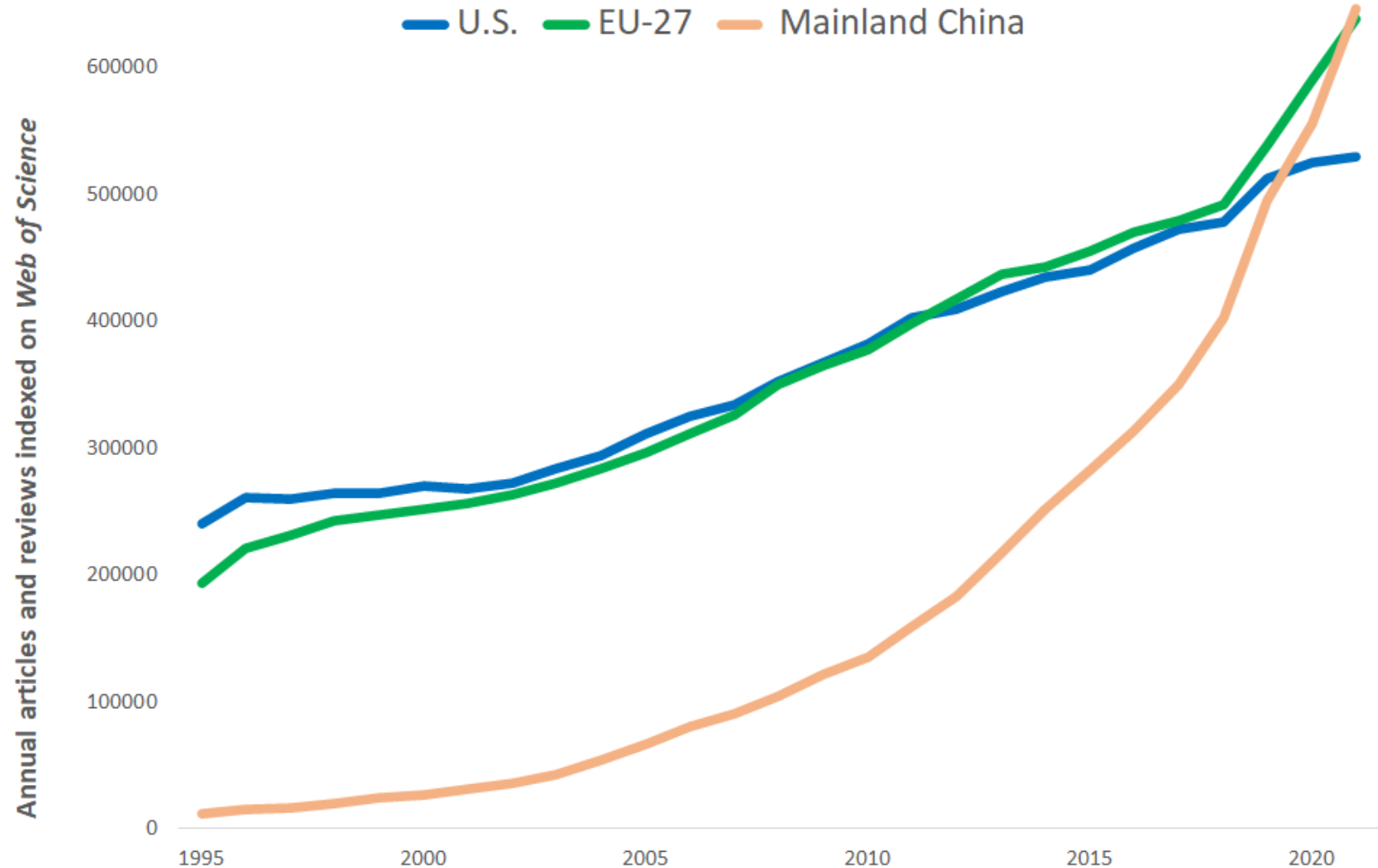
Mainland China investment is rising faster and is likely to match U.S. within a few years



Publication output

Mainland China is now publishing more articles and reviews in journals indexed in the Web of Science than either the U.S. or the EU

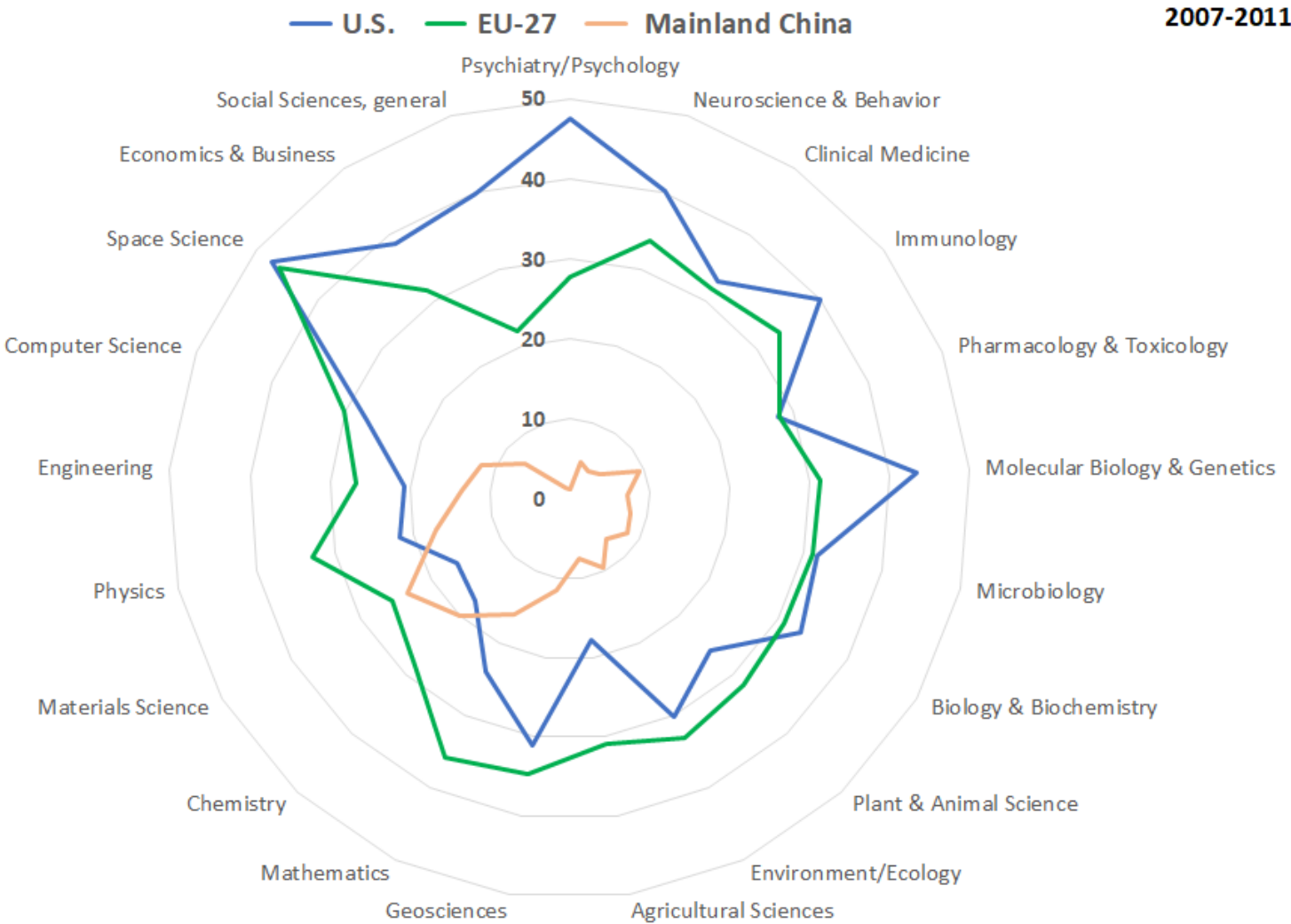
Its increase had been slowing but is now evidently back on its steep upwards track



Research Footprint

U.S. capacity and diversity was high but note that it is tilted towards biomedical areas compared to the EU

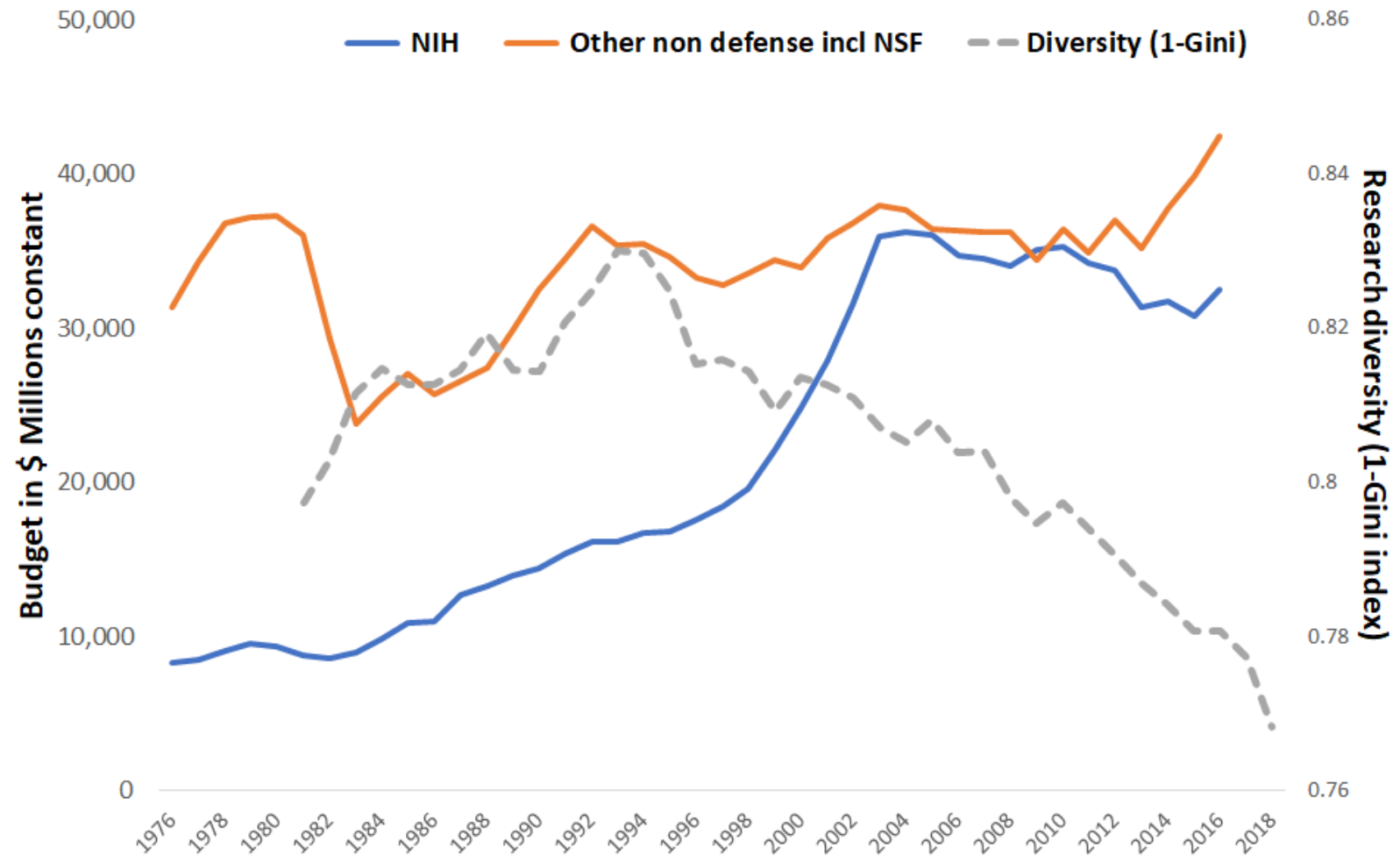
Ten years ago, China output was strong only in physical sciences



Unbalanced investment

U.S. expenditure on health and medicine rose much more steeply than on other sciences, especially after the late 1990s.

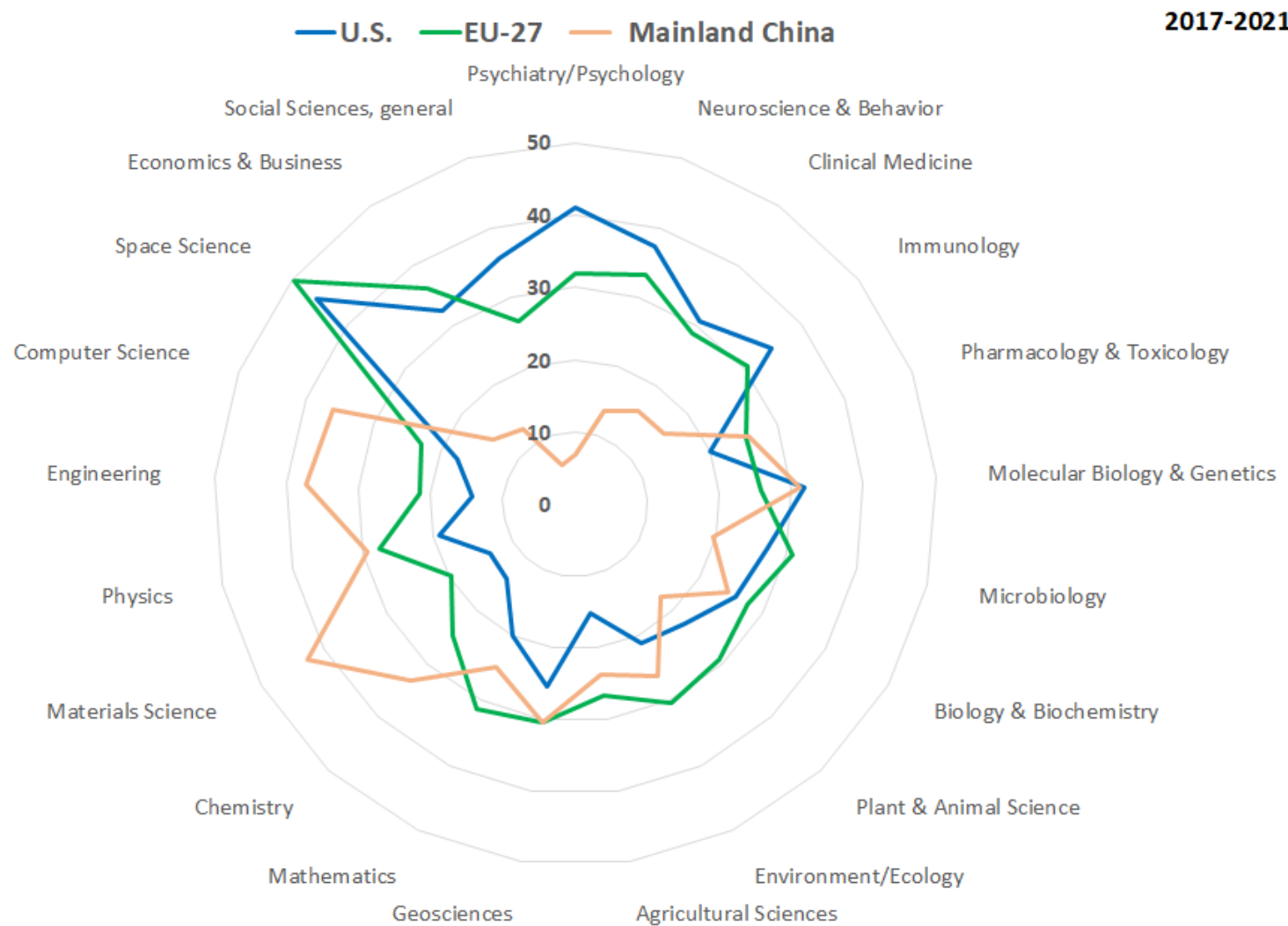
The consequence was that U.S. dominance in technology areas was not sustained.



Research Footprint

China's output now dominates technology and physical sciences globally

Note that China is publishing as many papers in molecular biology as the U.S.

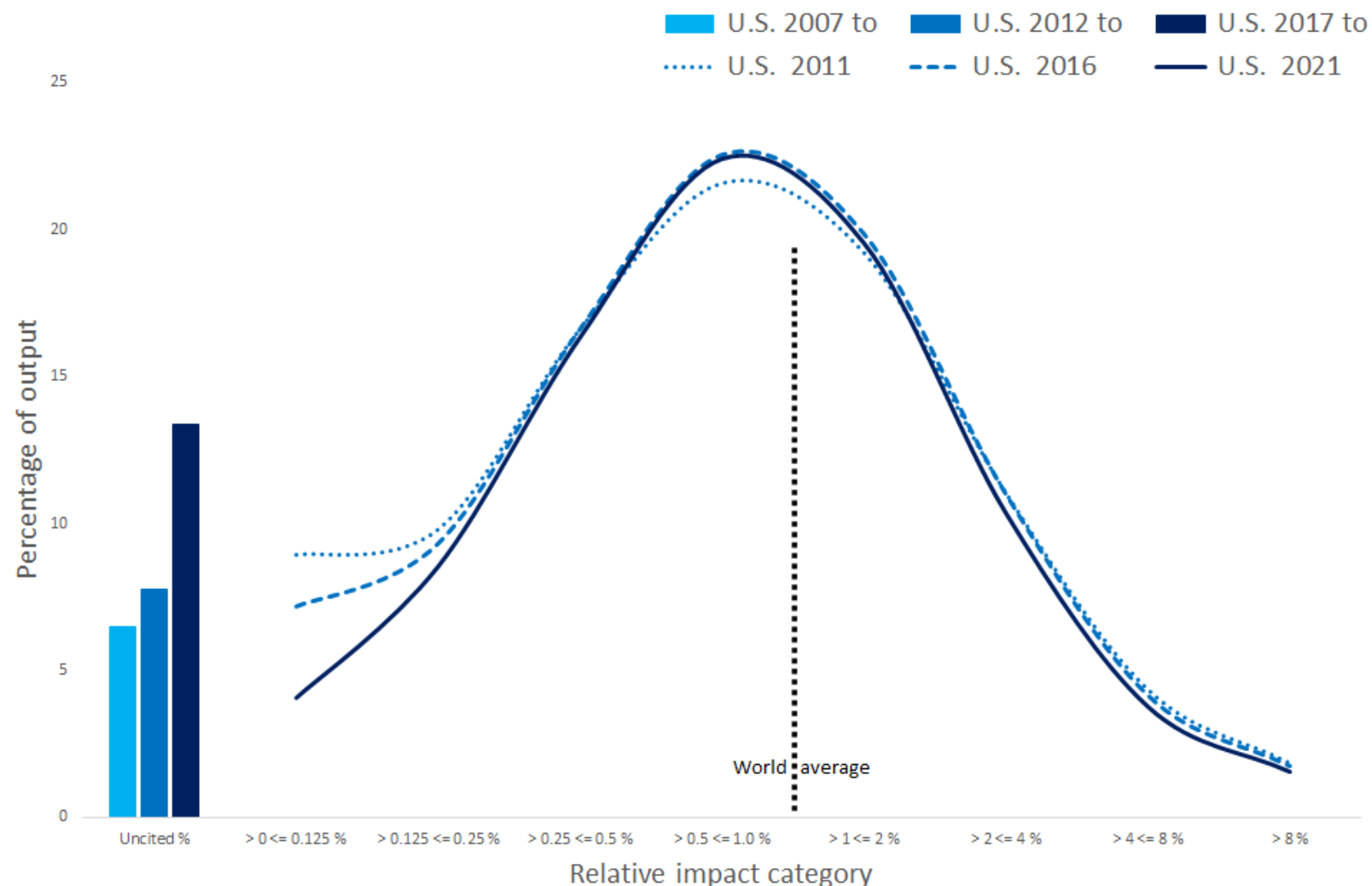


Impact Profile

An Impact Profile enables us to unpack 'average' Category Normalized Citation Impact (CNCI) and see how that impact is distributed across low and high cited categories

Early = 2007-2011
Mid = 2012-2016
Late = 2017-2021

Relatively little change BUT that little is a marginal decrease in U.S. papers in the most highly cited categories > 2.0



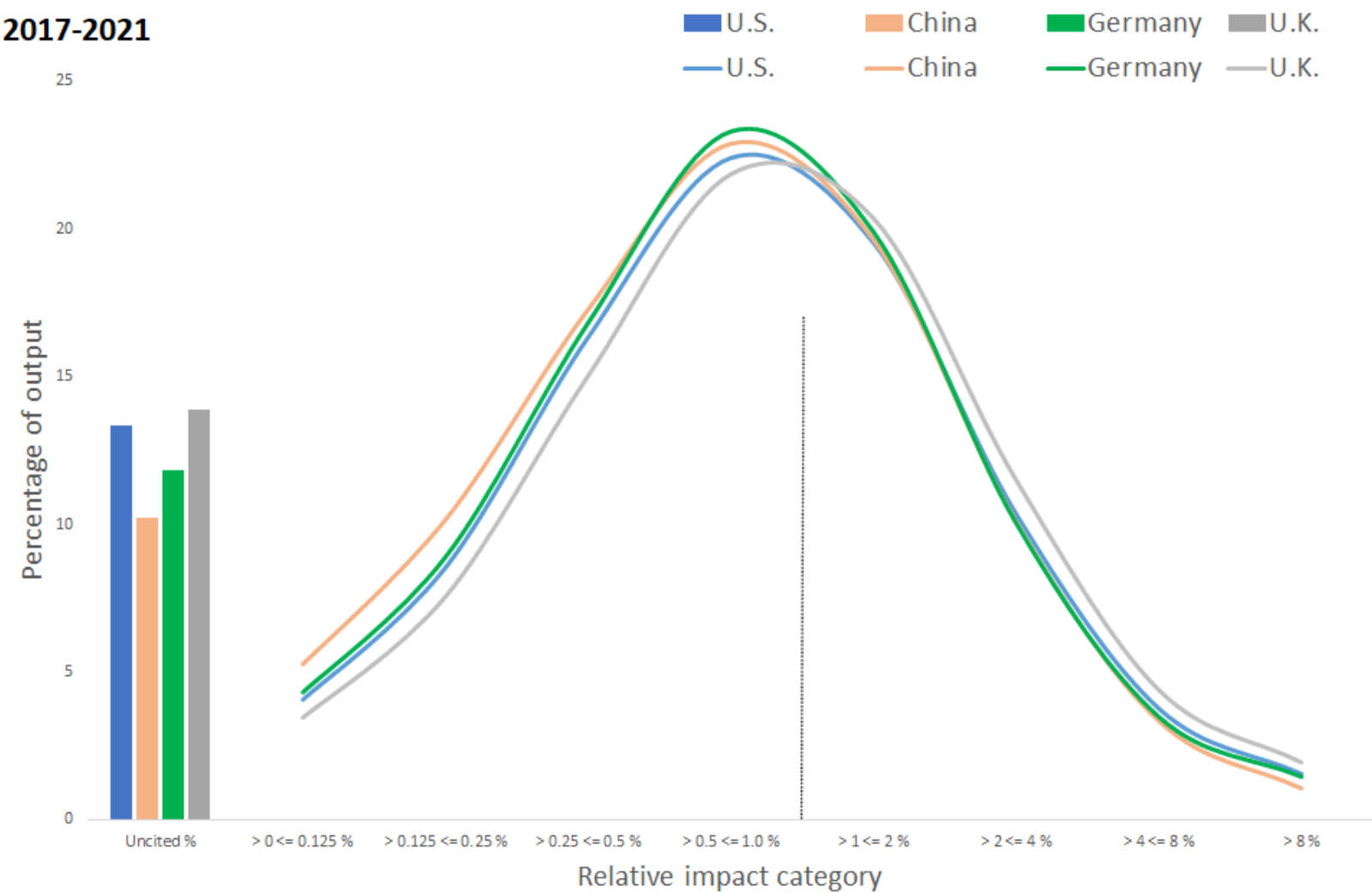
Impact Profile

Comparator Impact Profiles for the U.K., Germany and Mainland China show us how research impact in these countries has changed over recent periods and put the U.S. data in context

It is evident that China is not just productive but also producing quality that meets the U.S. in the highly cited categories

- Early = 2007-2011
- Mid = 2012-2016
- Late = 2017-2021

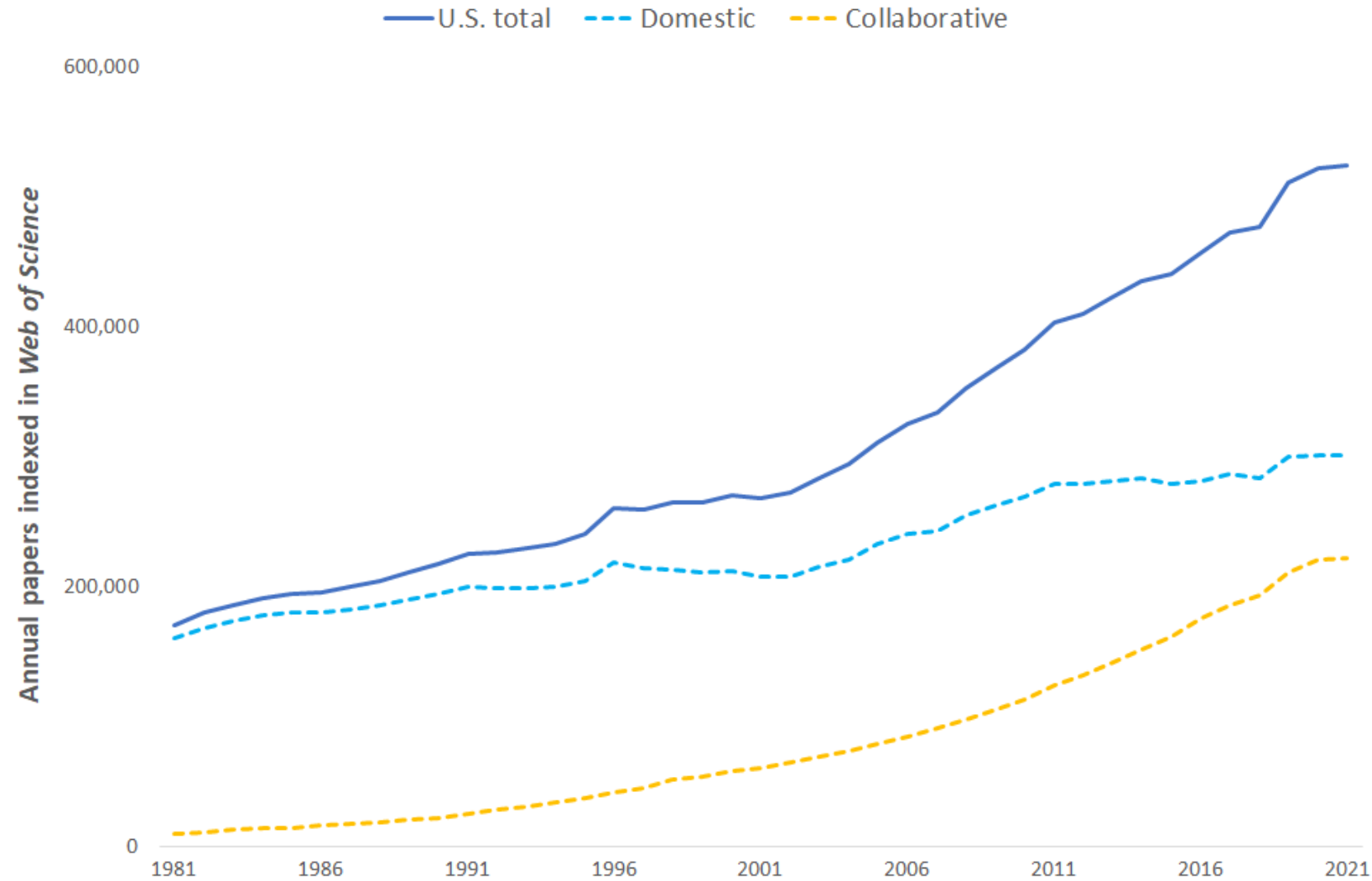
2017-2021



International collaboration and output

U.S. output has grown and that growth has been driven almost entirely by international collaboration

U.S. collaboration is still a smaller fraction of total output than that of many other countries

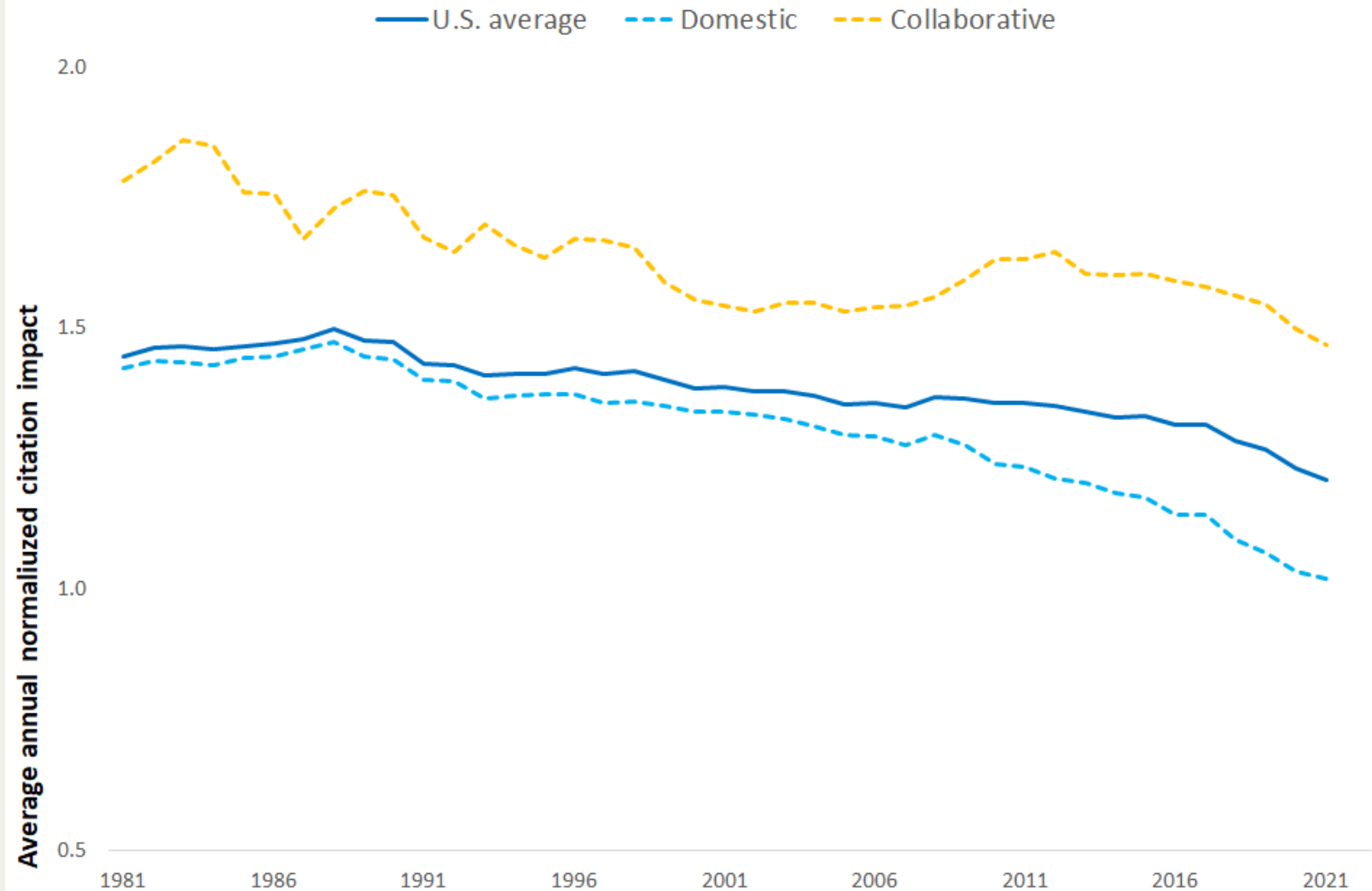


International collaboration and impact

Papers that have international co-authors are on average more highly cited than purely domestic papers

The dark blue line is the 'headline' track of average national CNCI

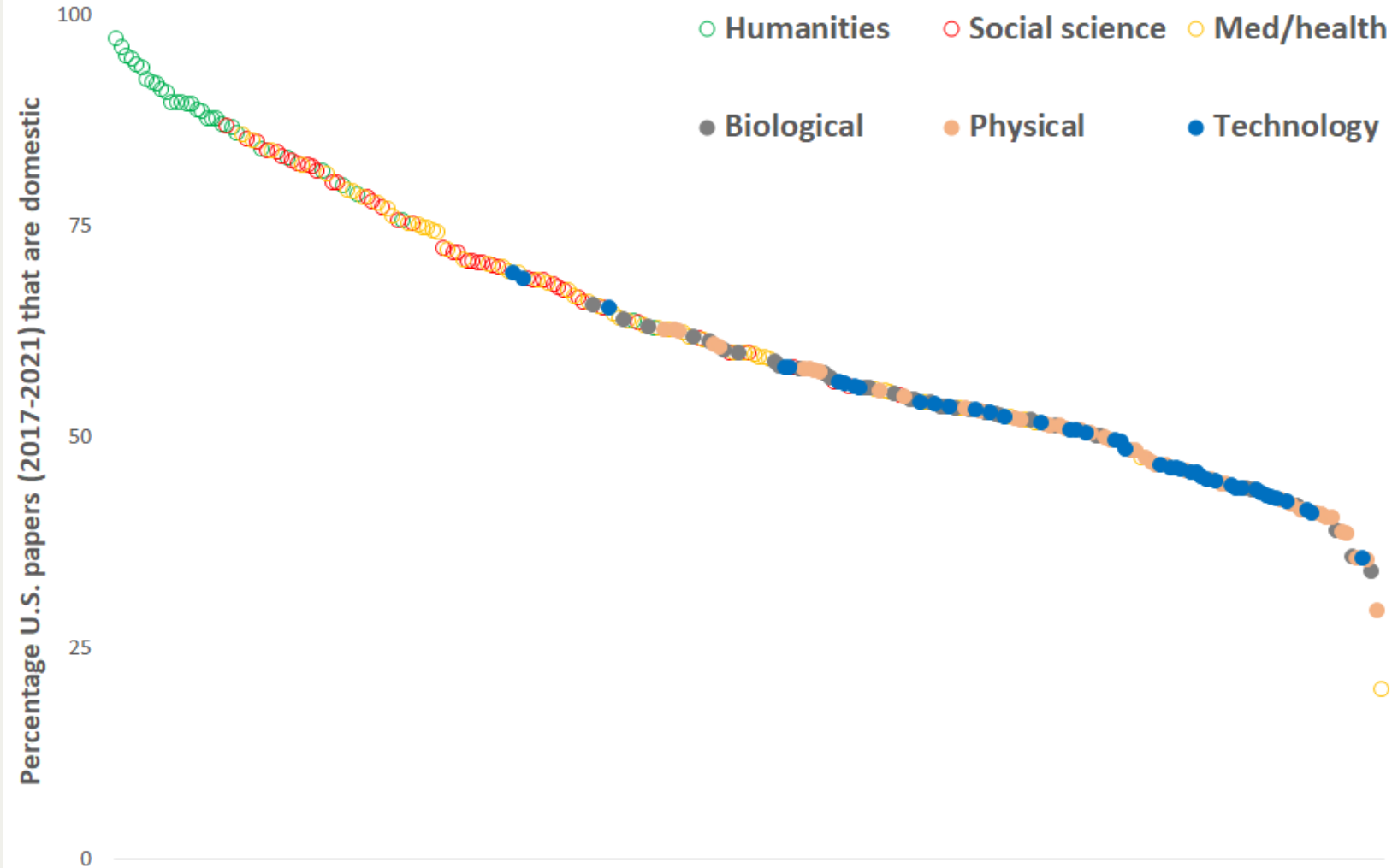
U.S. CNCI would have declined further had it not been for the increasing volume of international collaboration, because the impact of domestic research is barely above world average



International collaboration by subject

Domestic research continues to dominate the humanities and social sciences

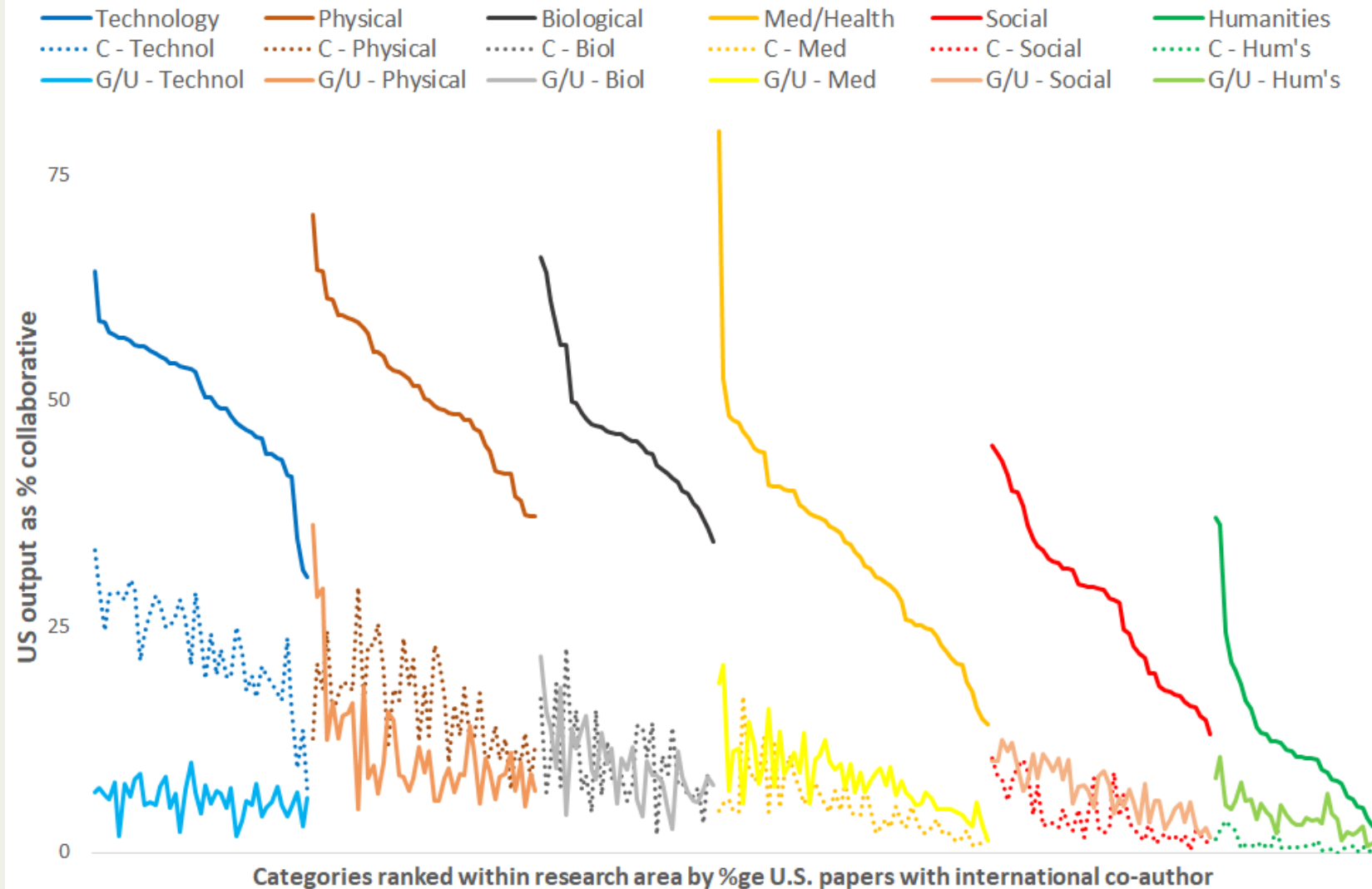
Technology and physical sciences have as much as 50% international collaboration



International collaboration partners

China is the most frequent partner in technological sciences, co-authoring more than 25% of 2017-2021 U.S. papers in many areas highlighted as U.S. strategic priorities

China is also a frequent partner in physical sciences but the U.K. and Germany remain key partners in bio-medical areas



International collaboration

The policy implications of the global international research network are profound

Guidance through analysis of the available data is essential for proper understanding of current status and proper planning for investment

Data accessible in *Web of Science* give a clear picture of the international growth of collaborative research over forty years

There has been a shift from bilateral to multilateral research in the last twenty years

Collaborative research has higher impact, involves leading research institutions and delivers the cutting edge of innovation

The benefits of shared costs, ideas and outcomes are considerable

Not collaborating means not dining at the table where these rewards are available

The emergent separation between domestic and international research needs further consideration

Is domestic research the necessary groundwork that enables international partnerships, or the residual activity of those not engaged internationally?

Is there a risk of divergence between the international network and the domestic base?

Regional research strengths

Knowledge capacity and innovation are constrained by a lack of historical investment in higher education and research

This is a problem in other G7 countries as well

The U.S. EPSCoR program seeks to push investment to 'level up' these regions, and the data suggest that this has been successful





Thank you.

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