2. China Surpasses Us in Research Spending - Economy

Organisation for Economic Co-operation and Development (OECD) released report on global R&D spending patterns. China has overtaken the United States in research and development spending in Purchasing Power Parity (PPP) terms. Both countries have crossed the historic $1 trillion research spending mark

This represents a fundamental shift in global scientific and technological leadership

1.Recent Development

1. China's rise from one of the lowest R&D spenders in 1980 to global leader demonstrates state-driven systematic investment
2. US dominance built over decades through public investment and open scientific culture is now challenged

2.Major Highlights of the Report

R&D Spending Parity Achieved

1. China's R&D spending has matched and surpassed the United States in PPP terms
2. Both nations investing over $1 trillion annually in research and development
3. China's achievement particularly remarkable given its low base in 1980
4. Represents sustained growth over four decades through systematic state policy
5. PPP adjustment accounts for differences in cost of living and research expenses

Legacy of US Scientific Leadership

1. United States produced groundbreaking innovations including the internet and World Wide Web
2. Development of mRNA vaccines during COVID-19 pandemic demonstrated US biotech capabilities
3. Semiconductor and microprocessor technologies revolutionized computing globally
4. Global Positioning System (GPS) technology transformed navigation and logistics
5. This scientific dominance built on strong public investment in basic research
6. Open scientific culture encouraged international collaboration and talent attraction
7. Scientific research contributed over 20% of US productivity growth since World War II
8. Direct linkage established between innovation investment and economic strength

China's Trajectory - From Low Base to Global Leader

1. In 1980, China ranked among the lowest R&D spenders globally
2. Pursued systematic, state-driven investment strategy in science and technology
3. Made R&D spending a national priority aligned with economic development goals
4. Massive expansion of universities and research institutions
5. Created incentives for research output and patent filings
6. Integrated R&D with industrial policy and manufacturing capabilities

China's Research Output Dominance

1. Surpassed US in top 1% highly cited papers by 2019
2. Became global leader in total cited papers by 2022
3. Overtook US in total scientific publications by 2024
4. In 2024, China filed approximately 1.8 million patents
5. US filed around 603,000 patents in same period
6. Nearly three times more patent applications than United States
7. Indicates strong innovation ecosystem and commercialization push
8. Reflects integration of research with industrial applications

3.Reasons for US Declining Share

Declining Public Investment in R&D

1. US federal R&D spending fallen from 1.86% of GDP in 1964 to approximately 0.66% in 2021
2. Represents two-thirds reduction in government commitment to research
3. Shift from public to private funding has reduced support for basic, open science

4. Private sector focuses on near-term commercial applications rather than fundamental research
5. Basic science requires long-term investment without immediate returns
6. Government historically funded high-risk, high-reward research
7. Declining public investment threatens foundation of future innovation

Shift from Research to Development

1. Private sector now dominates US R&D spending at approximately 78%
2. Corporate R&D focuses on commercial development and product refinement
3. Less emphasis on fundamental research and basic science
4. Creates shrinking pool of openly shared scientific knowledge
5. Proprietary research limits broader scientific community access
6. Reduces spillover effects that benefit entire economy
7. Short-term profit motives conflict with long-term knowledge creation

Policy-Induced Constraints on Scientific Openness

1. Increasing restrictions on international collaboration in research
2. Visa constraints limiting foreign researchers and students
3. Access restrictions to research facilities and data
4. Security-driven policies implemented to protect strategic technologies
5. These measures undermine open exchange system that fuelled US leadership
6. Historical US advantage was attracting global talent
7. Restrictions create disadvantages in competitive global research environment

Talent Drain and Long-Term Risks

1. Immigrants contributed approximately 40% of US Nobel Prizes since 2000
2. Foreign-born researchers critical to US scientific achievements
3. Inflow of international talent declining due to restrictive policies
4. Cuts in research funding reducing available grants and positions
5. Reduced openness causing scientist exodus to other countries
6. Brain drains effects difficult to reverse once established
7. Loss of talent creates long-term competitive disadvantage

4.R&D Expenditure Situation in India

Current Investment Levels

1. India's Gross Expenditure on Research and Development (GERD) remains between 0.6% to 0.7% of GDP
2. Below global average of approximately 2.3% of GDP
3. Significantly lower than China (2.4%), South Korea (4.8%), and United States (3.5%)
4. Investment levels insufficient for emerging economy with innovation ambitions
5. Gap between current spending and requirements for global competitiveness

Private Sector Participation

1. India's private sector contributes only around 36% of total R&D expenditure
2. In comparison, private sector in China, South Korea, and US contributes over 70%
3. Low private sector participation indicates limited industry-research linkages
4. Corporate India focuses more on technology adoption than original research
5. Need for incentives to encourage private R&D investment

Government Contribution

1. Central Government contributes 43.7% of total R&D expenditure
2. State governments and higher education sector contribute remaining share
3. Heavy reliance on public funding limits total resources available
4. Government funding subject to fiscal constraints and competing priorities

5.Need for Funding in R&D

Economic Growth Driver

1. R&D drives creation of new industries and economic sectors
2. Improves productivity across existing industries through innovation
3. Enhances global competitiveness of domestic companies
4. Creates high-value jobs and increases income levels
5. Contributes to GDP growth through technological advancement

Technological Advancement

1. Facilitates breakthroughs in artificial intelligence and machine learning
2. Advances biotechnology for health and agriculture applications
3. Develops renewable energy technologies for sustainable growth
4. Creates cutting-edge manufacturing processes and materials
5. Positions country at forefront of fourth industrial revolution

Addressing Social Challenges

1. Research helps address poverty through innovative solutions
2. Healthcare R&D improves disease prevention and treatment
3. Education technology enhances learning outcomes
4. Environmental sustainability research combats climate change
5. Agricultural research ensures food security

Employment and Entrepreneurship

1. Innovation generates direct employment in research institutions
2. Creates indirect employment through new industries and startups
3. Stimulates entrepreneurship based on research outcomes
4. Develops high-skilled workforce with advanced capabilities
5. Attracts global talent and investment

Global Positioning

1. Positions India as global leader in science and technology
2. Enhances international reputation and soft power
3. Creates opportunities for technology exports and licensing
4. Strengthens bargaining position in international collaborations

6.Government Initiatives to Boost R&D

Research, Development and Innovation (RDI) Scheme

1. Approved with ₹1 lakh crore corpus for energizing private-sector R&D
2. Targets deep-tech startups and innovative companies
3. Offers long-term, low-interest or zero-interest loans
4. Provides equity investments for high-potential ventures
5. Funds new Deep-Tech Fund of Funds via Anusandhan National Research Foundation

Anusandhan National Research Foundation (ANRF)

1. Established in 2023 to provide strategic direction for research and innovation
2. Mobilizes funds amounting to ₹50,000 crore during 2023-28
3. Multiple funding streams including ANRF Fund and Innovation Fund
4. Science and Engineering Research Fund for fundamental research
5. Special Purpose Funds for targeted initiatives

National Geospatial Policy, 2022

1. Positions India as global leader in geospatial sector by 2035
2. Liberalizes access to geospatial data for research and commercial use
3. Encourages use in governance, business applications, and research
4. Creates opportunities for geospatial technology startups
5. Integrates with Digital India initiatives

Indian Space Policy, 2023

1. Builds on space reforms introduced in 2020

2. Opens space domain to non-governmental entities
3. Allows end-to-end participation by private sector
4. Aims to enhance India's space capabilities
5. Promotes flourishing commercial space industry
6. Fosters public-private collaboration in space research

National Quantum Mission

1. Allocated ₹6,003.65 crore for period 2023-31
2. Advances quantum computing, communication, and sensing technologies
3. Supports scientific and industrial R&D in quantum technologies
4. Positions India among global quantum technology leaders

BioE3 Policy, 2024

1. Encourages creation of Biomanufacturing and Bio-AI hubs
2. Establishes national Biofoundry network
3. Accelerates biotechnology development and commercialization
4. Integrates biological sciences with engineering and AI

National Supercomputing Mission

1. Launched in 2015 to build supercomputing infrastructure
2. Empowers universities and research institutions with advanced computing
3. Connects facilities through National Knowledge Network
4. Enables complex simulations and data-intensive research

India Semiconductor Mission

1. Established in 2021 for semiconductor ecosystem development
2. Approved 10 semiconductor projects across six states
3. Includes first commercial Silicon Carbide fabrication facility in Odisha
4. Reduces dependence on semiconductor imports

India AI Mission

1. Embodies vision of "Making AI in India and Making AI Work for India"
2. Increased computing capacity from 10,000 GPUs to 38,000 GPUs
3. Ensures accessible AI infrastructure for startups and researchers
4. Supports industries in AI adoption and innovation

Atal Innovation Mission

1. Fosters innovation at grassroots level
2. Provides support to students, startups, and entrepreneurs
3. Establishes Atal Tinkering Labs in schools
4. Creates innovation ecosystem across country

7.Conclusion

China's R&D supremacy challenges US leadership built over decades. India must significantly increase investment, enhance private participation, and create robust innovation ecosystem to compete globally in science and technology.

Source - https -//www.downtoearth.org.in/science-technology/china-surpasses-us-in-research-spending-the-consequences-extend-far-beyond-scientific-ranking-and-clout