Strengths and Weaknesses of the U.S. National Innovation System

Researching National Innovation Ecosystems: Institutions, Infrastructure, and Firms

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2022 Academy of Management Annual Conference
August 6, 2022

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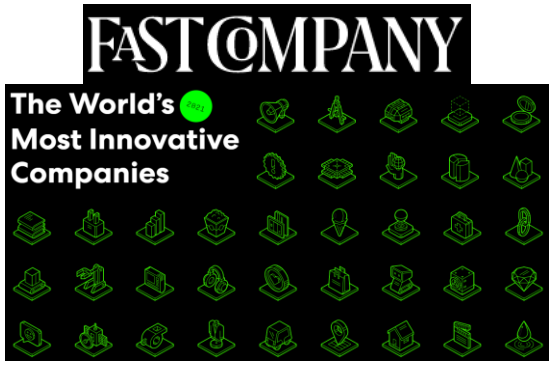
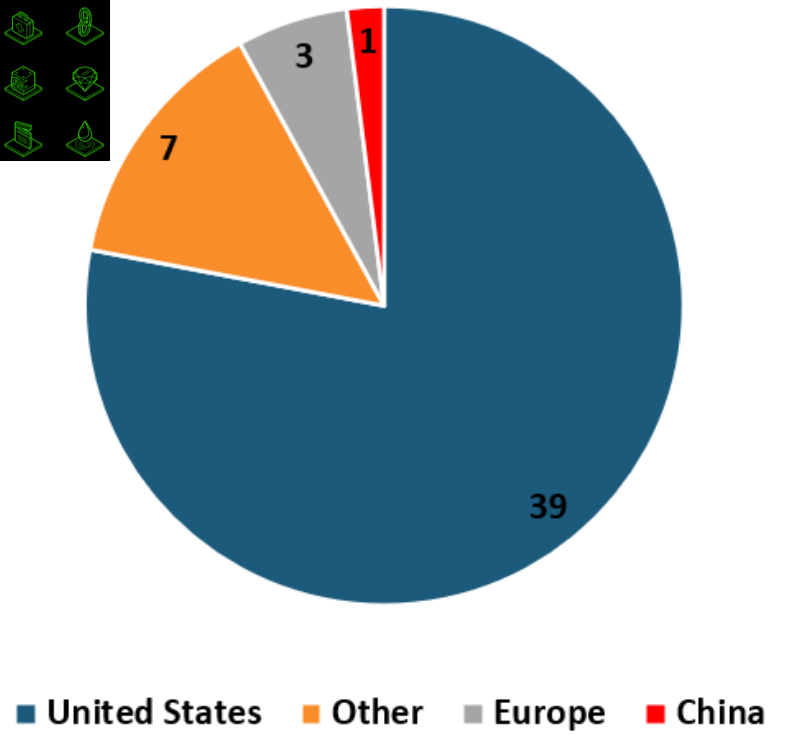
About ITIF

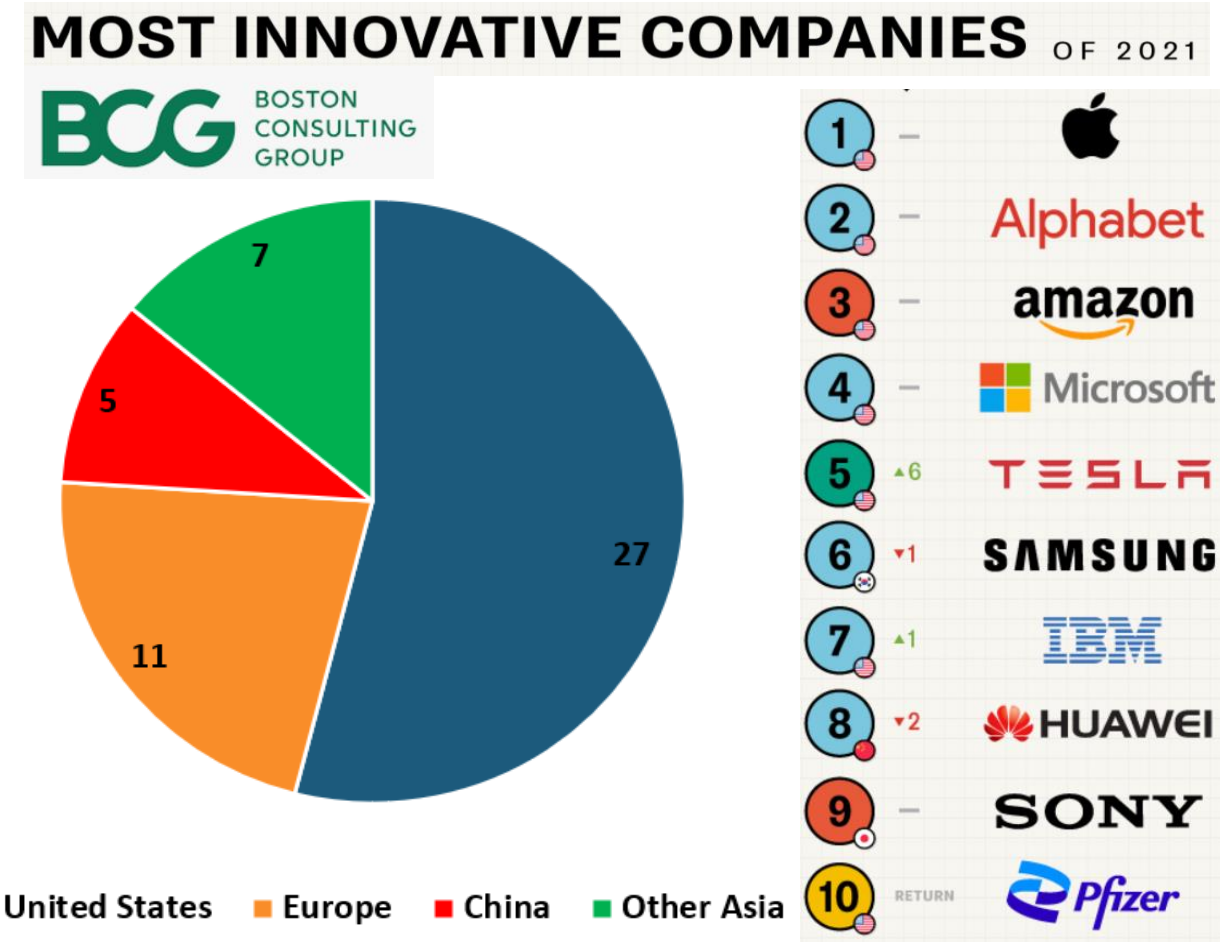
- The world's leading science and technology policy think tank.
- Supports policies driving global, innovation-based economic growth.
- Focuses on a host of issues at the intersection of technology innovation and public policy across several sectors:
  - Innovation and competitiveness
  - IT and data
  - Telecommunications
  - Trade and globalization
  - Manufacturing, life sciences, agricultural biotech, and energy



Where Does the United States Rank in Innovation?







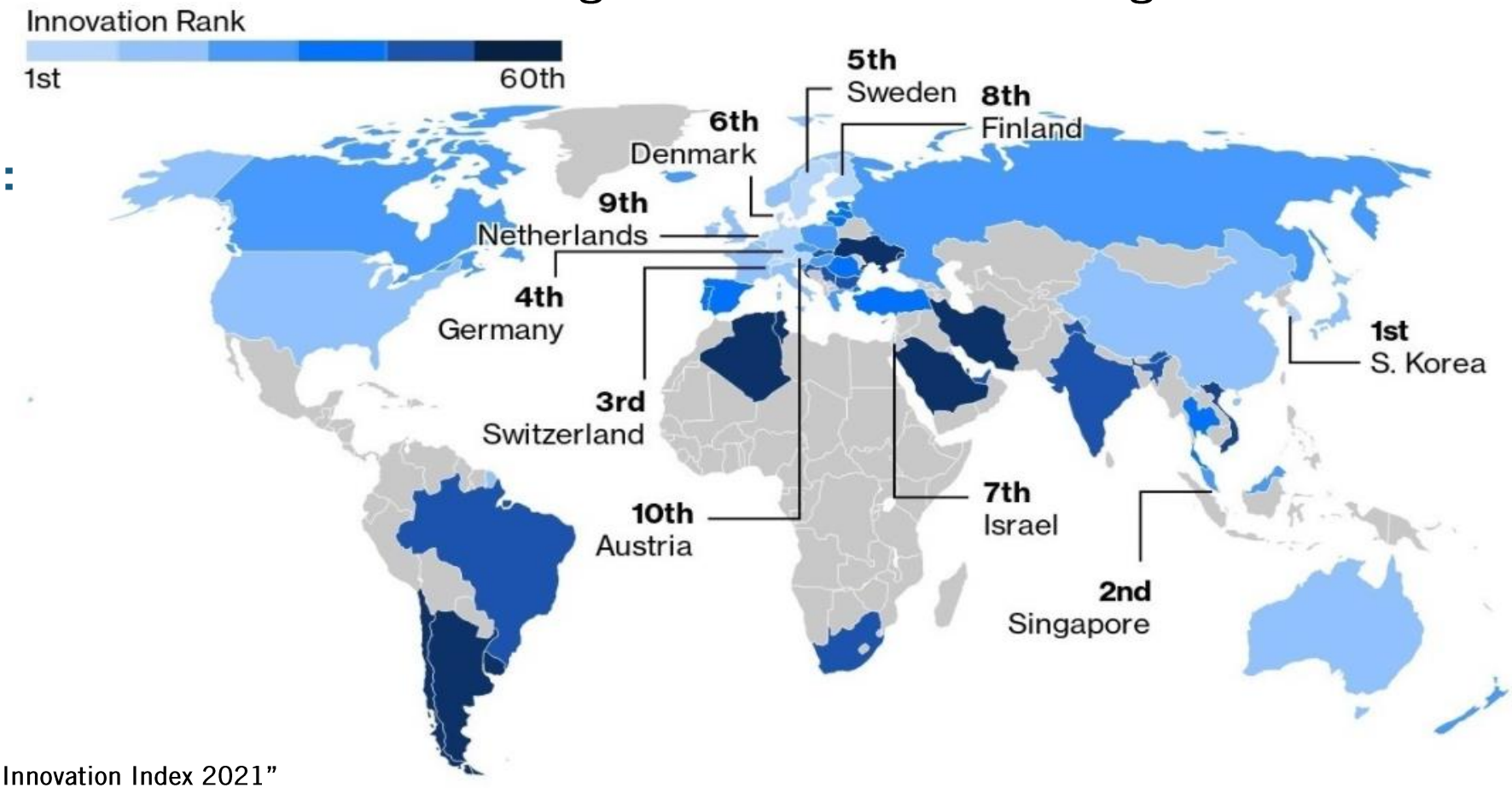
Sources: *Fast Company* "The World's Most Innovative Companies 2021"; Boston Consulting Group "The Most Innovative Companies of 2021"

Where Does the United States Rank in Innovation?

United States:

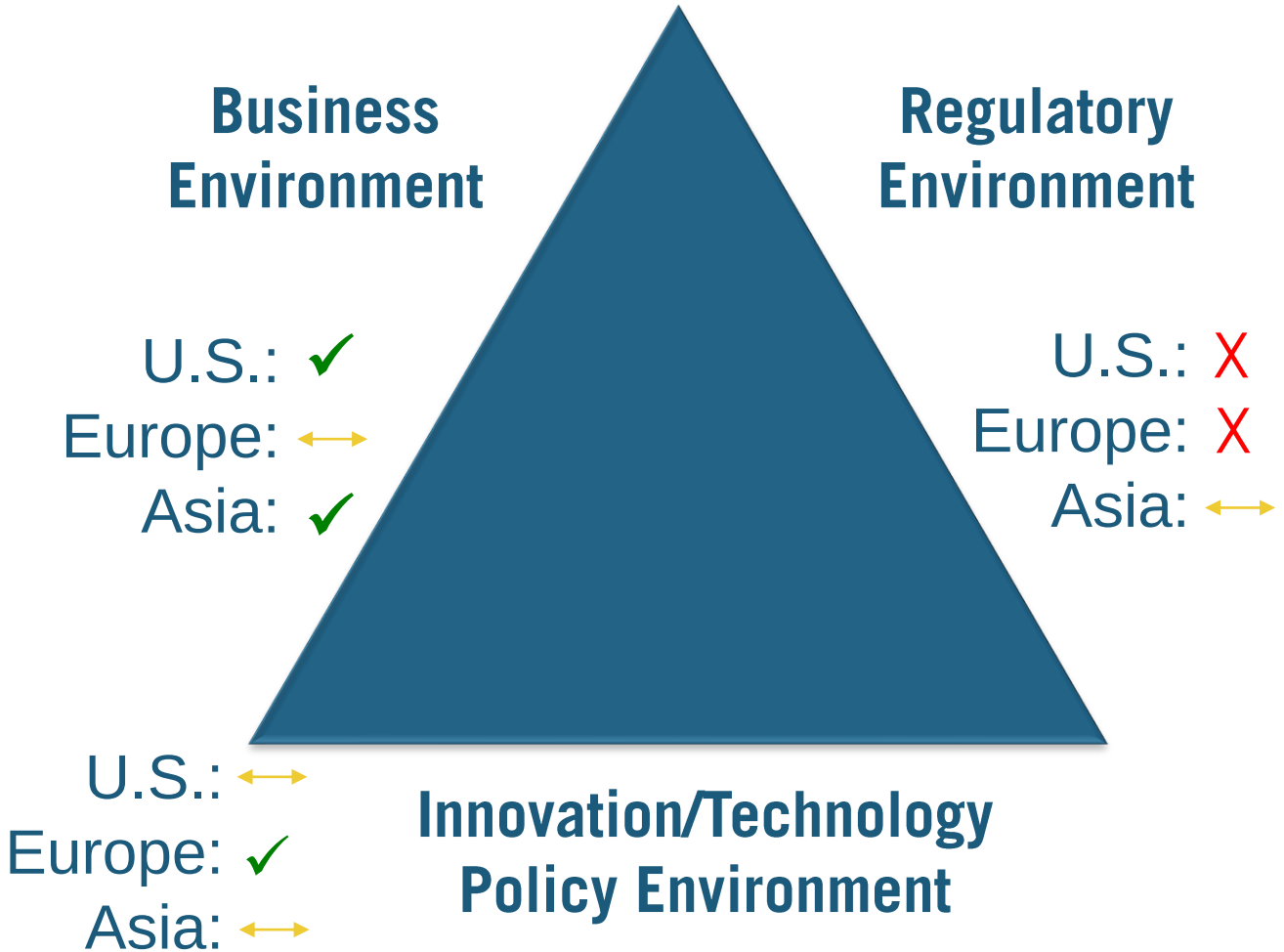
2013: #1
2021: #11

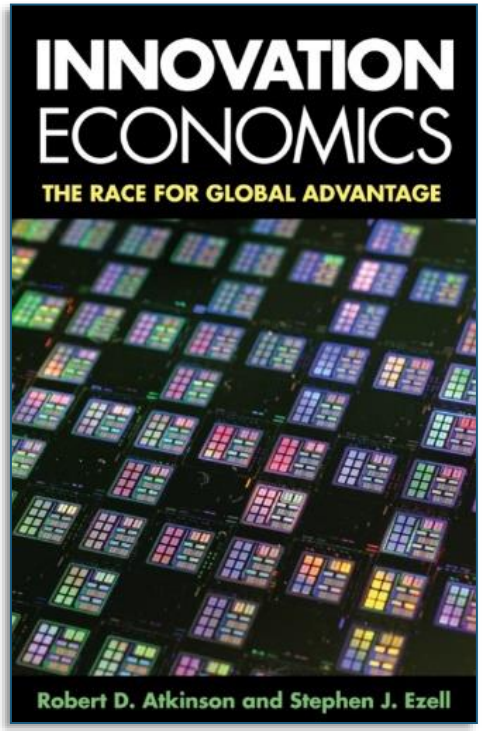
2021 Bloomberg Innovation Index Rankings



Source: Bloomberg, "Innovation Index 2021"

Maximizing Innovation: Get the "Innovation Triangle" Right





Yale University Press



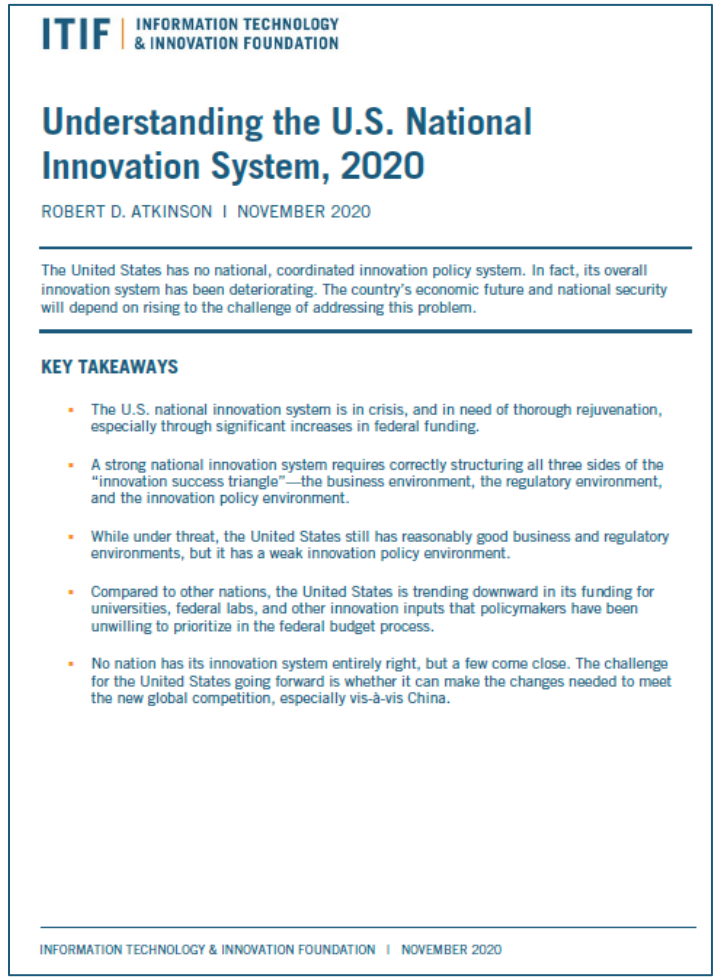
Rob Atkinson



Stephen Ezell

The U.S. National Innovation System

- The U.S. has no coordinated innovation policy system: bottom-up vs. top-down approach.
- Fragmented/disjointed/not interconnected/politicized.
- Lacking institutional home and analytical capability to assess industrial/innovation competitiveness.
- However, there is a deep "hidden developmental state" that includes a wide range of programs and institutions at the federal and state levels.



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Understanding the U.S. National Innovation System, 2020

ROBERT D. ATKINSON I NOVEMBER 2020

The United States has no national, coordinated innovation policy system. In fact, its overall innovation system has been deteriorating. The country's economic future and national security will depend on rising to the challenge of addressing this problem.

KEY TAKEAWAYS

- The U.S. national innovation system is in crisis, and in need of thorough rejuvenation, especially through significant increases in federal funding.
- A strong national innovation system requires correctly structuring all three sides of the "innovation success triangle"—the business environment, the regulatory environment, and the innovation policy environment.
- While under threat, the United States still has reasonably good business and regulatory environments, but it has a weak innovation policy environment.
- Compared to other nations, the United States is trending downward in its funding for universities, federal labs, and other innovation inputs that policymakers have been unwilling to prioritize in the federal budget process.
- No nation has its innovation system entirely right, but a few come close. The challenge for the United States going forward is whether it can make the changes needed to meet the new global competition, especially vis-à-vis China.

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Source: Robert D. Atkinson, ITIF, "Understanding the U.S. National Innovation System, 2020"

Federal Programs and Institutions Supporting Innovation

Science/Technology Commercialization-Focused Programs

- Small Business Innovation Research (SBIR)/Small Business Tech Transfer (STTR)
- I-Corps Programs at National Science Foundation/Other Federal Agencies
- Industry University-Cooperative Research Partnerships (I-UCRCs) & ERCs

Agency/Mission-Driven Innovation Initiatives/Programs

- DARPA; ARPA-E; I-ARPA
- National Laboratories/Federally Funded Research Development Centers (FFRDCs)

Manufacturing/Industrial Competitiveness-Driven Programs

- NIST Manufacturing USA Network of “Manufacturing Innovation Institutes”
- NIST Manufacturing Extension Partnership (MEP)

SBIR: “America’s Seed Fund”

SBIR accounts for only 3% of extramural research funding, but generates large returns:

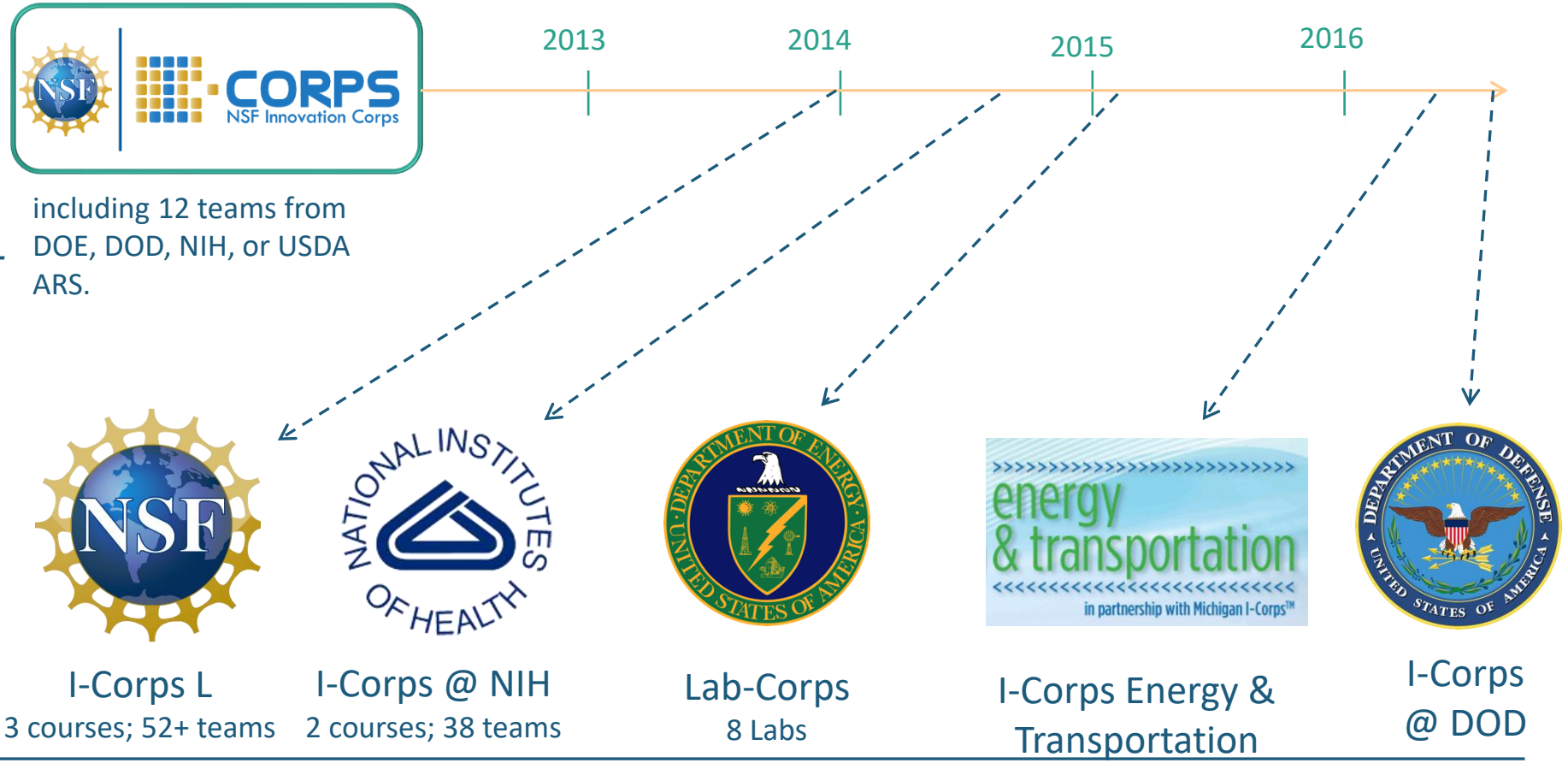
- 22% of America’s top innovations from companies receiving SBIR funds.
- 43% of innovative start-up firms with fewer than 25 employees have received an SBIR grant.



NSF I-Corps Program

- Provides experiential education helping researchers gain entrepreneurship skills.

Has trained 1,000+ teams, leading to over 500 start-ups.



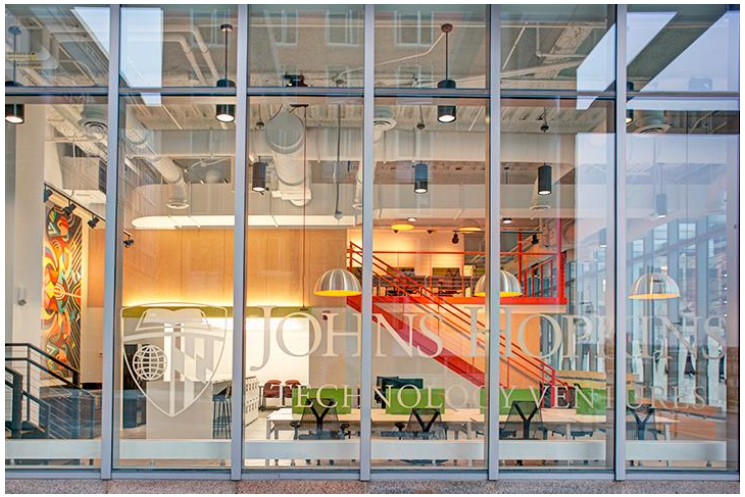
NIST Manufacturing USA Network

- 16 Institutes focused on U.S. leadership in advanced manufacturing product/process technologies.



Well-Conceived Technology Transfer Policies

- Bayh-Dole Act gave universities rights to IP from federally funded research.
  - Named one of the 15 “highest-quality” acts of legislation in U.S. history.
- Stevenson-Wydler Technology Innovation Act facilitated the transfer of technology from federal laboratories for commercial use.
- About two-fifths of U.S. universities now have on-campus incubators or accelerators.



Federal R&D Paid Off in These Innovations…

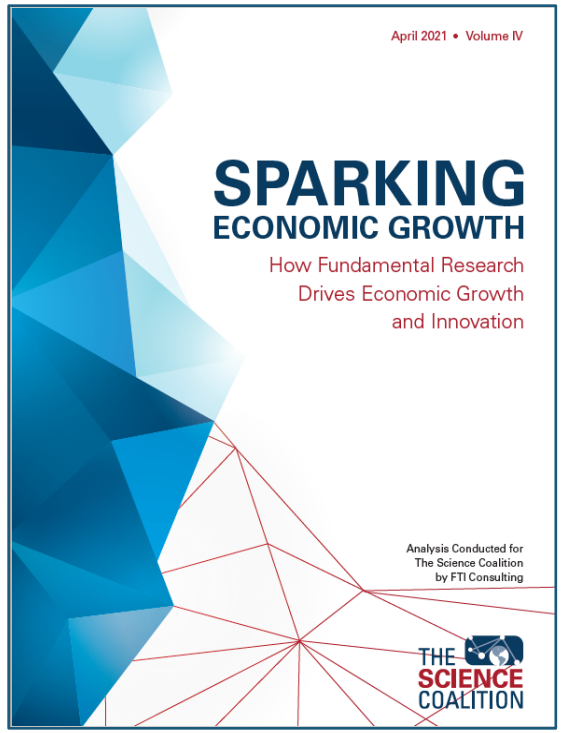
- ARPANET: (Internet's Foundation)
- GPS
- Google Search Engine
- Supercomputers
- Artificial Intelligence
- Closed Captioning
- Smartphone Technologies
- The Shale Gas Revolution
- Seismic Imaging
- Visible LED Lighting Technology
- Magnetic Resonance Imaging (MRI)
- Advanced Prosthetics
- The Human Genome Project
- HIV/AIDS
- Reverse Auctions
- Kidney Matching Program
- Fast Mulitipole Method
- Learning Science Advances
- Civilian Aviation
- Hybrid Corn
- Lactose-Free Milk
- Speech Recognition



Source: Peter Singer, ITIF, "Federally Supported Innovations: 22 Examples of Major Technology Advances That Stem From Federal Research Support"

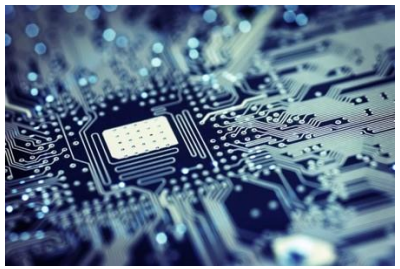
And These Companies

1. Google
2. Cisco Systems
3. Genentech
4. Sun Microsystems
5. SAS
6. iRobot
7. Orbital Sciences
8. Akamai
9. CREE
10. Praxis Biologics
11. Cell Biologics
12. Xenogen
13. Momenta Pharma.
14. A123 Systems
15. Big Stage Entertain.
16. Chromatic, Inc.
17. Cognex, Inc.
18. Aursos, Inc.
19. FAST Diagnostics
20. FluGen, Inc.
21. Kionex, Inc.
22. Response Gen.
23. Protea Biosciences
24. ONY Inc.
25. Solamer Energy
26. Spin Transfer Tech.
27. Vaccinex Inc.
28. MicronMRI Inc.
29. Maroon Biotech
30. ImagiSonix
31. Immuneworks
32. Pacific Biosciences
33. Triangle Pharma
34. Sinmat
35. ALEKS Corp.
36. Banyan Biomarkers
37. Lehigh Nanotech
38. CS-Keys
39. Universal Display Corp.



Biggest Strengths of the U.S. Innovation System

- Highly innovative private sector.
- World-leading access to risk/venture capital.
- World-leading universities (16 of the world's top 20).
- Incredible bench strength/install base of innovation assets.
- Will be able to compete in every single emerging-tech field.





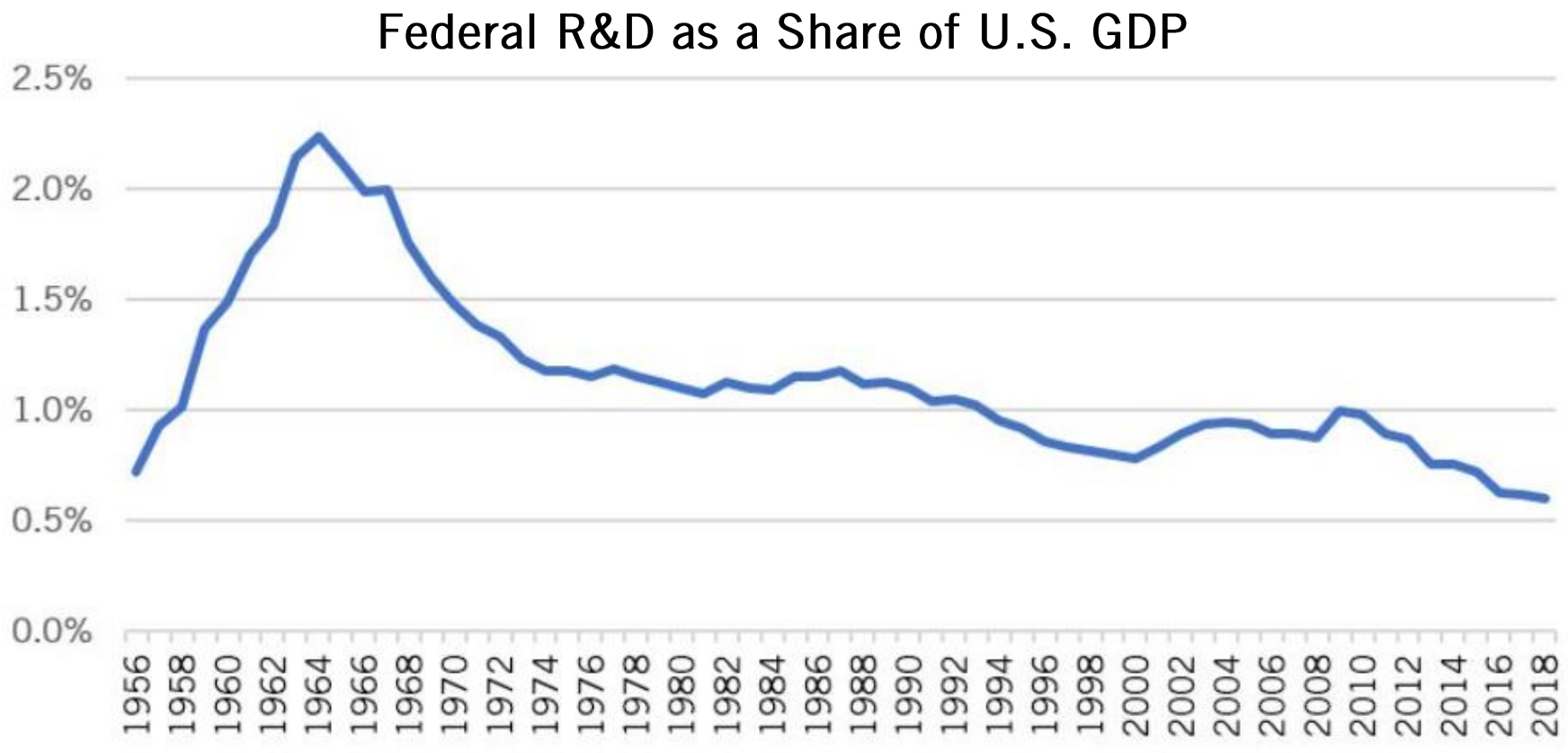


Most-Significant Weaknesses of the U.S. Innovation System

- Faltering federal R&D investment in scientific research.
- Increasing regional innovation inequality.
- Losing competitiveness in advanced technology industries.
- Failure to manufacture products originally innovated in the U.S.
- Productivity faltering.
- Extremely weak domestic STEM talent pipeline.



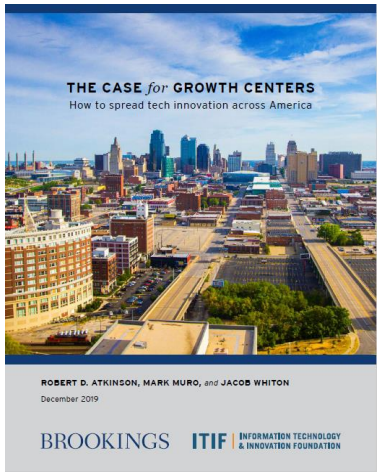
Faltering Federal R&D Investments in Scientific Research

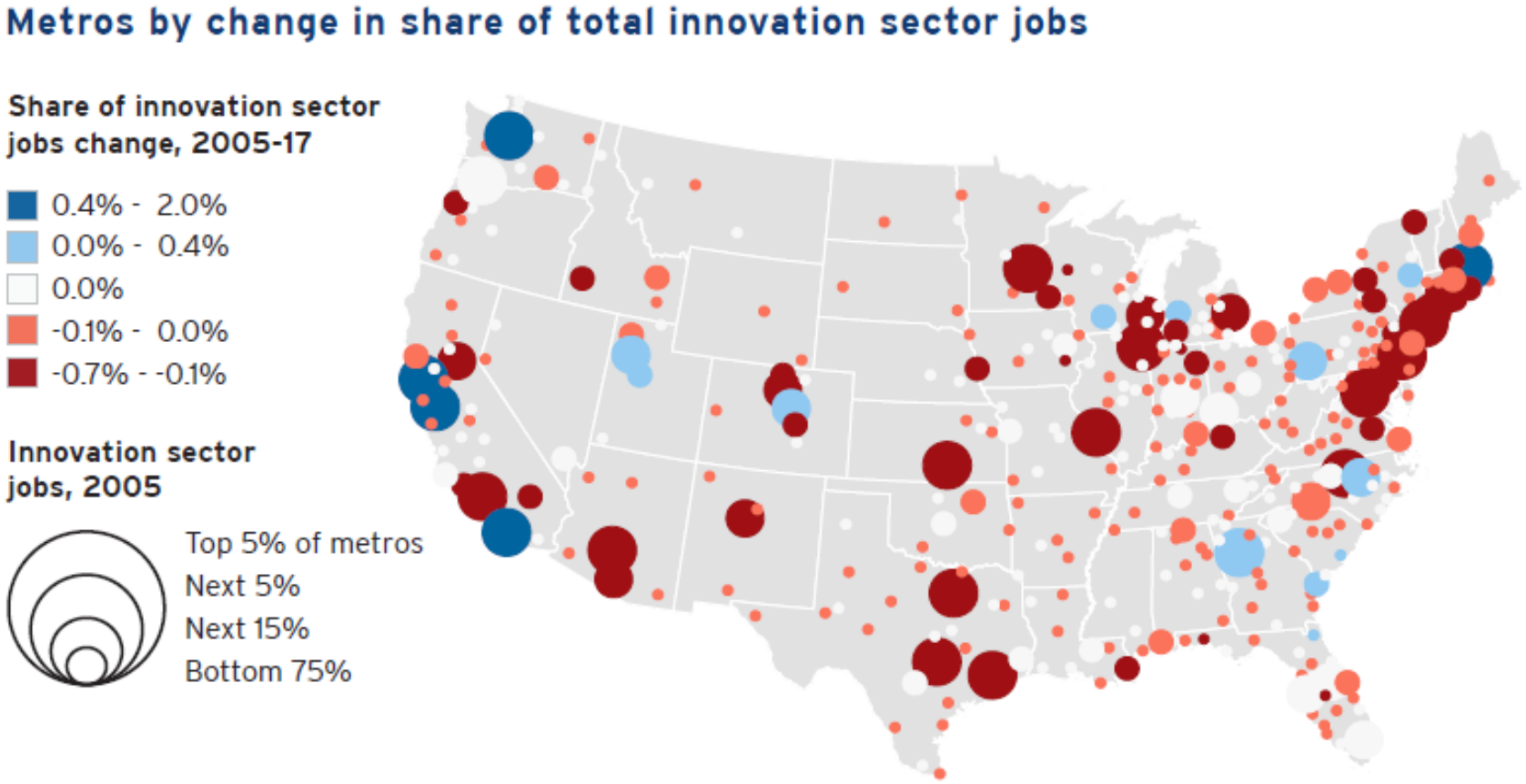


Source: Robert Atkinson and Caleb Foote, "Federal Support for R&D Continues Its Ignominious Slide," August 2019

Gains From Innovation Are Not Evenly Distributed

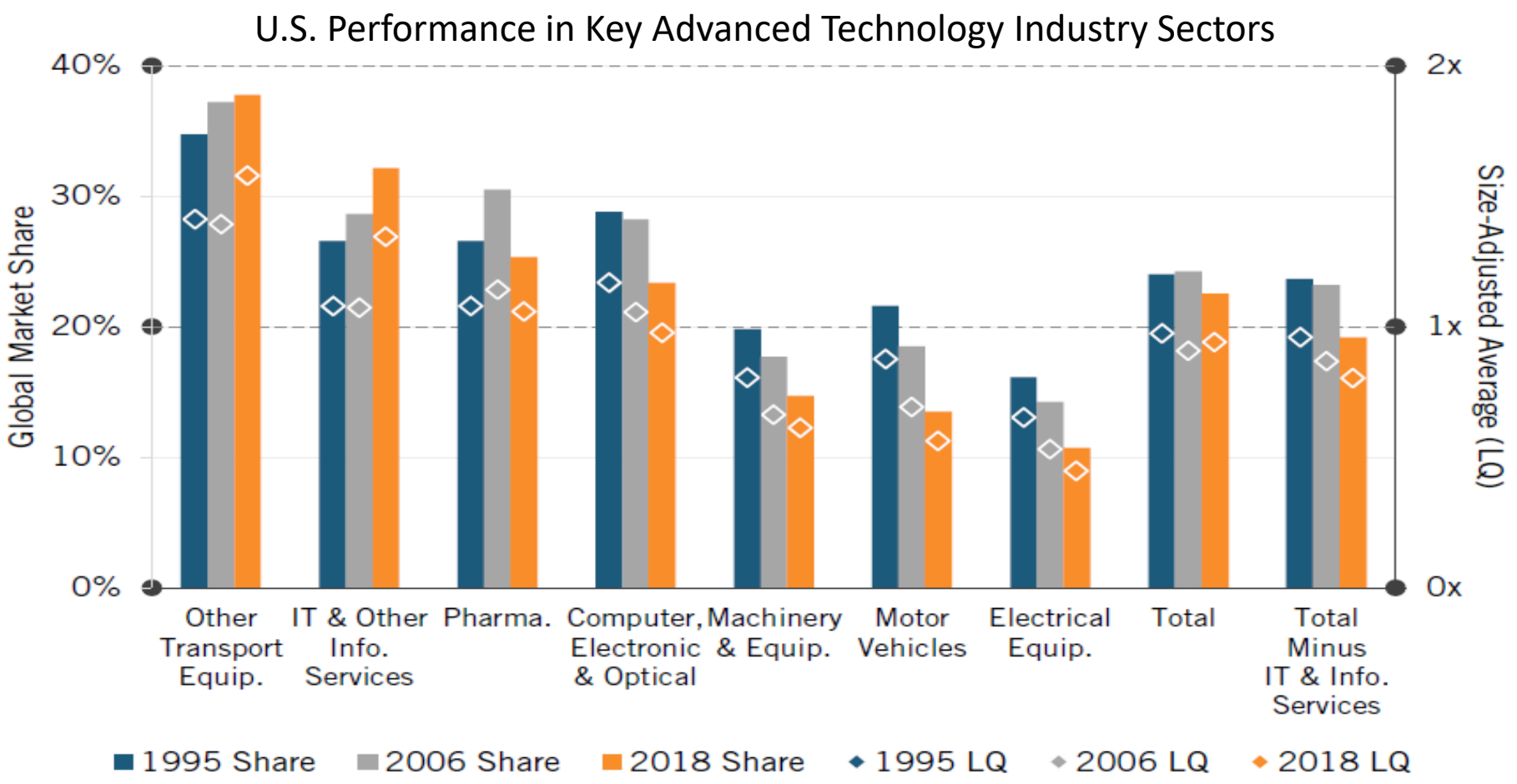
One-third of jobs in innovation-based industries are concentrated in just 14 U.S. counties.



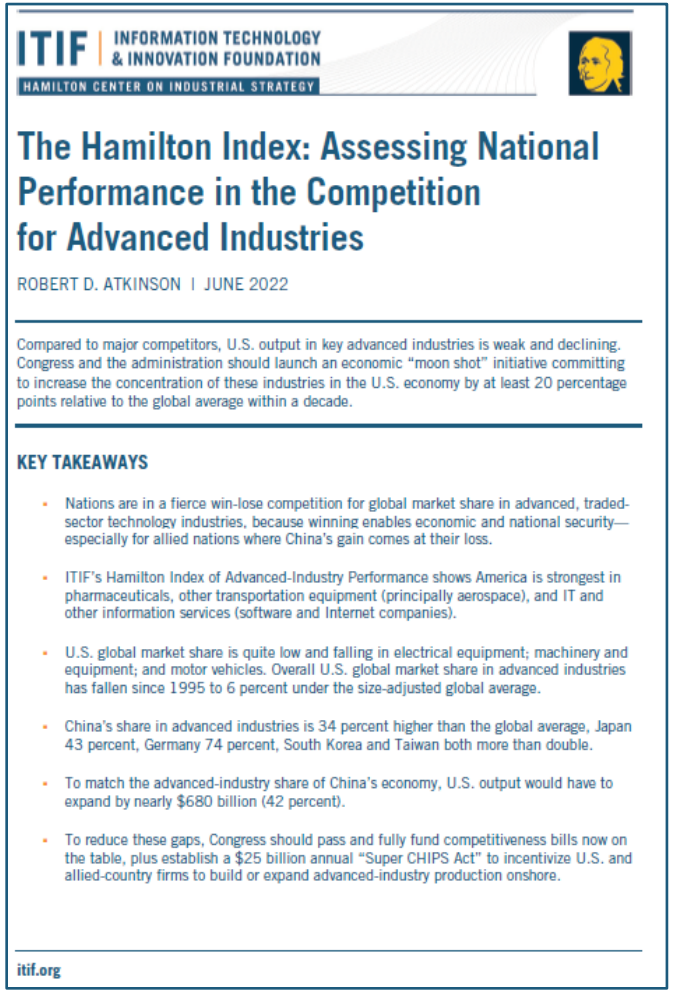


Source: ITIF and Brookings, "The Case for Growth Centers: How to Spread Tech Innovation Throughout America," December 2019

Losing Competitiveness in Advanced-Technology Industries



Source: ITIF, "The Hamilton Index: Assessing National Performance in the Competition for Advanced Industries"



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HAMILTON CENTER ON INDUSTRIAL STRATEGY

The Hamilton Index: Assessing National Performance in the Competition for Advanced Industries

ROBERT D. ATKINSON | JUNE 2022

Compared to major competitors, U.S. output in key advanced industries is weak and declining. Congress and the administration should launch an economic "moon shot" initiative committing to increase the concentration of these industries in the U.S. economy by at least 20 percentage points relative to the global average within a decade.

KEY TAKEAWAYS

- Nations are in a fierce win-lose competition for global market share in advanced, traded-sector technology industries, because winning enables economic and national security—especially for allied nations where China's gain comes at their loss.
- ITIF's Hamilton Index of Advanced-Industry Performance shows America is strongest in pharmaceuticals, other transportation equipment (principally aerospace), and IT and other information services (software and Internet companies).
- U.S. global market share is quite low and falling in electrical equipment; machinery and equipment; and motor vehicles. Overall U.S. global market share in advanced industries has fallen since 1995 to 6 percent under the size-adjusted global average.
- China's share in advanced industries is 34 percent higher than the global average, Japan 43 percent, Germany 74 percent, South Korea and Taiwan both more than double.
- To match the advanced-industry share of China's economy, U.S. output would have to expand by nearly $680 billion (42 percent).
- To reduce these gaps, Congress should pass and fully fund competitiveness bills now on the table, plus establish a $25 billion annual "Super CHIPS Act" to incentivize U.S. and allied-country firms to build or expand advanced-industry production onshore.

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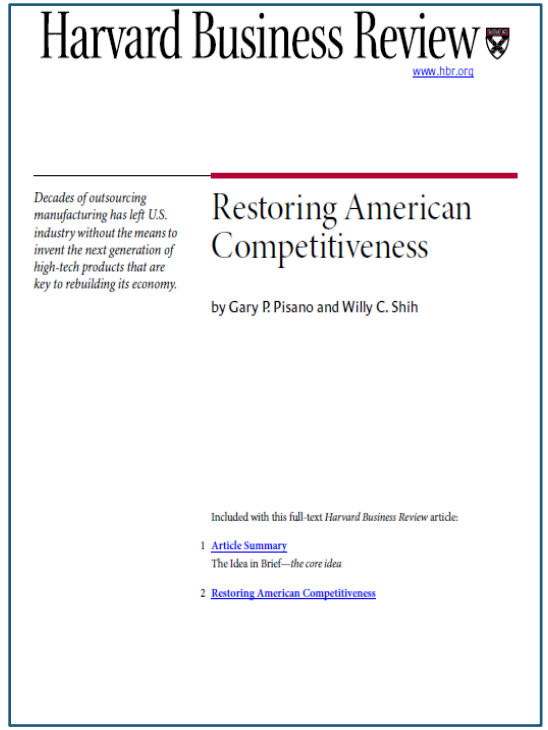
Failure to Manufacture at Scale Products Innovated Here

Gone

- Fabless chips
- Compact fluorescent lighting
- LCDs, TVs, mobile computers
- Lithium ion, lithium polymer, and NiMH batteries
- Crystalline and polycrystalline silicon solar cells
- Personal computers, low end servers, consumer networking gear
- Advanced composites used in consumer applications, advanced ceramics
- IC packaging

At Risk

- Flash memory
- LEDs for solid state lighting
- Next generation "electronic paper"
- Thin-film solar cells
- Blade servers, mid-range servers
- Optical communication components
- Core network equipment
- Carbon composite components for aerospace and wind energy


Harvard Business Review
www.hbr.org

Decades of outsourcing manufacturing has left U.S. industry without the means to invent the next generation of high-tech products that are key to rebuilding its economy.

Restoring American Competitiveness

by Gary P. Pisano and Willy C. Shih

Included with this full-text *Harvard Business Review* article:

1 Article Summary
The Idea in Brief—*the core idea*

2 Restoring American Competitiveness

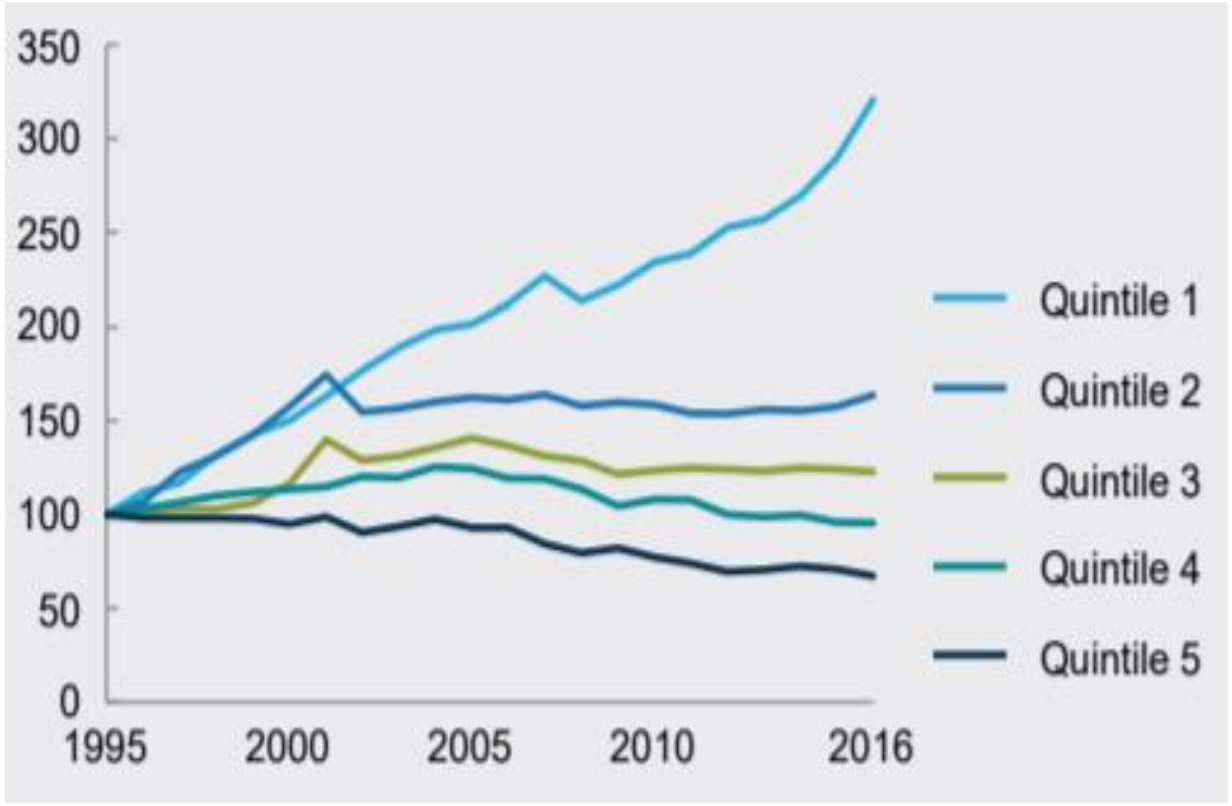
Source: Gary P. Pisano and Willy C. Shih, "Restoring American Competitiveness" *Harvard Business Review*

Productivity Faltering and Gaps Opening Among Firms

U.S. Manufacturing Labor Productivity Growth

2010-2019	2001-2010	
17.3%	-39.1%	Apparel and leather and applied products
9.0%	24.5%	Paper products
6.0%	21.5%	Printing and related support activities
4.5%	78.8%	Computer and electronic products
0.8%	20.2%	Furniture and related products
0.0%	59.5%	Motor vehicles, bodies and trailers, and parts
-0.7%	10.1%	Nonmetallic mineral products
-1.4%	28.2%	Other transportation equipment
-1.9%	18.9%	Petroleum and coal products
-2.3%	40.1%	Durable Manufacturing Sector
-2.3%	17.9%	Electrical equipment, appliances, and components
-2.7%	29.8%	Textile mills and textile product mills
-3.2%	32.8%	Non-Durable Manufacturing Sector
-3.6%	13.4%	Manufacturing Sector
-4.2%	41.1%	Fabricated metal products
-4.5%	16.7%	Plastics and rubber products
-5.4%	31.9%	Machinery
-5.7%	50.9%	Primary metal products
-7.3%	25.1%	Wood products
-11.5%	10.2%	Food and beverage and tobacco products
-12.0%	29.3%	Chemical products
-15.2%	36.8%	Miscellaneous manufacturing

Labor Productivity Gap Between Most/Least Innovative Firms



Sources: Robert Atkinson, "U.S. Manufacturing Productivity Is Falling, and It's Cause for Alarm," *Industry Week*, July 12, 2021
James Manyika et al., McKinsey Global Institute, "Superstars: The Dynamics of Firms, Sectors, and Cities Leading the Global Economy"

Policy Responses in the "CHIPS and Science Act of 2022"

- ✓ Increases NSF funding by $81 billion from FY 23 to FY 27.
- ✓ Establishes NSF Technology, Innovation, and Partnerships (TIP) program.
- ✓ Provides $10 billion to launch 20 regional technology and innovation hubs.
- ✓ Creates $1 billion RECOMPETE pilot program, providing block grants to promote economic development in distressed communities.
- ✓ Triples funding for MEP, authorizes 10 more Manufacturing Institutes.
- ✓ Provides $76 billion in tax, grant, and R&D support for semiconductors.

Source: ITIF, "Three Cheers for the CHIPS and Science Act of 2022! Now, Let's Get Back to Work"

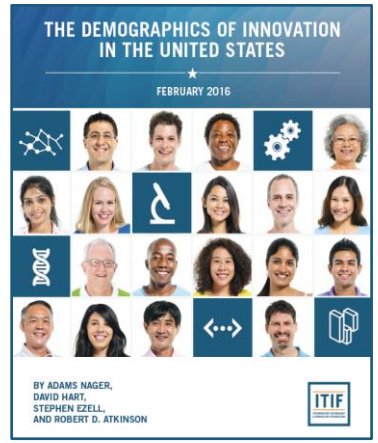
Next Steps Toward Bolstering America's Innovation System

- ✓ Congress must authorize these programs; relevant agencies must swiftly and effectively implement the programs.
- ✓ Address serious gaps in America's domestic STEM talent pipeline.
- ✓ Restore R&D tax credit generosity (U.S. 24th out of 24 in OECD).
- ✓ Seek to match the advanced-industry share of China's economy, meaning U.S. output would have to expand $680 billion (42%).
- ✓ Establish a $25 billion annual "Super CHIPS Act" to incentivize U.S. and allied-country firms to build or expand U.S. advanced-industry production.

Source: ITIF, "Three Cheers for the CHIPS and Science Act of 2022! Now, Let's Get Back to Work"; ITIF, "Th Hamilton Index"

Research Questions To Consider

- The U.S. proposes to launch many new-innovation supporting programs as part of the CHIPS and Science Act: How to evaluate their effectiveness?
- Productivity levels continue to decline across the U.S. and Europe, though less so in many Asian countries: What explains this? What lessons from interventions?
- Comparative assessments of economic impact/return from various U.S. innovation policy interventions (e.g., MEP, I/UCRCs) and more cross-country assessments.
- How many U.S. universities have formal innovation incubators/accelerators: What's been their collective impact?
- What are the current demographics of innovation in the U.S.?



Thank You!

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