

National & Economic Security , International
Collaboration, Export Controls, and Foreign
Talent impacts on the Future of Research

Chaouki Abdallah
EVPR, Georgia Institute of Technology

February 7-8, 2023

**GOVERNMENT-UNIVERSITY-INDUSTRY RESEARCH
ROUNDTABLE**



My role

- CRO at R1 university (with classified research ability) tasked with research integrity and security, member of roundtable, but also an international student and international collaborator.
- Informed by my experience, I will discuss the increasingly important and greying area between national security and economic security, considerations of international collaboration, export controls, and foreign talent on the future of research

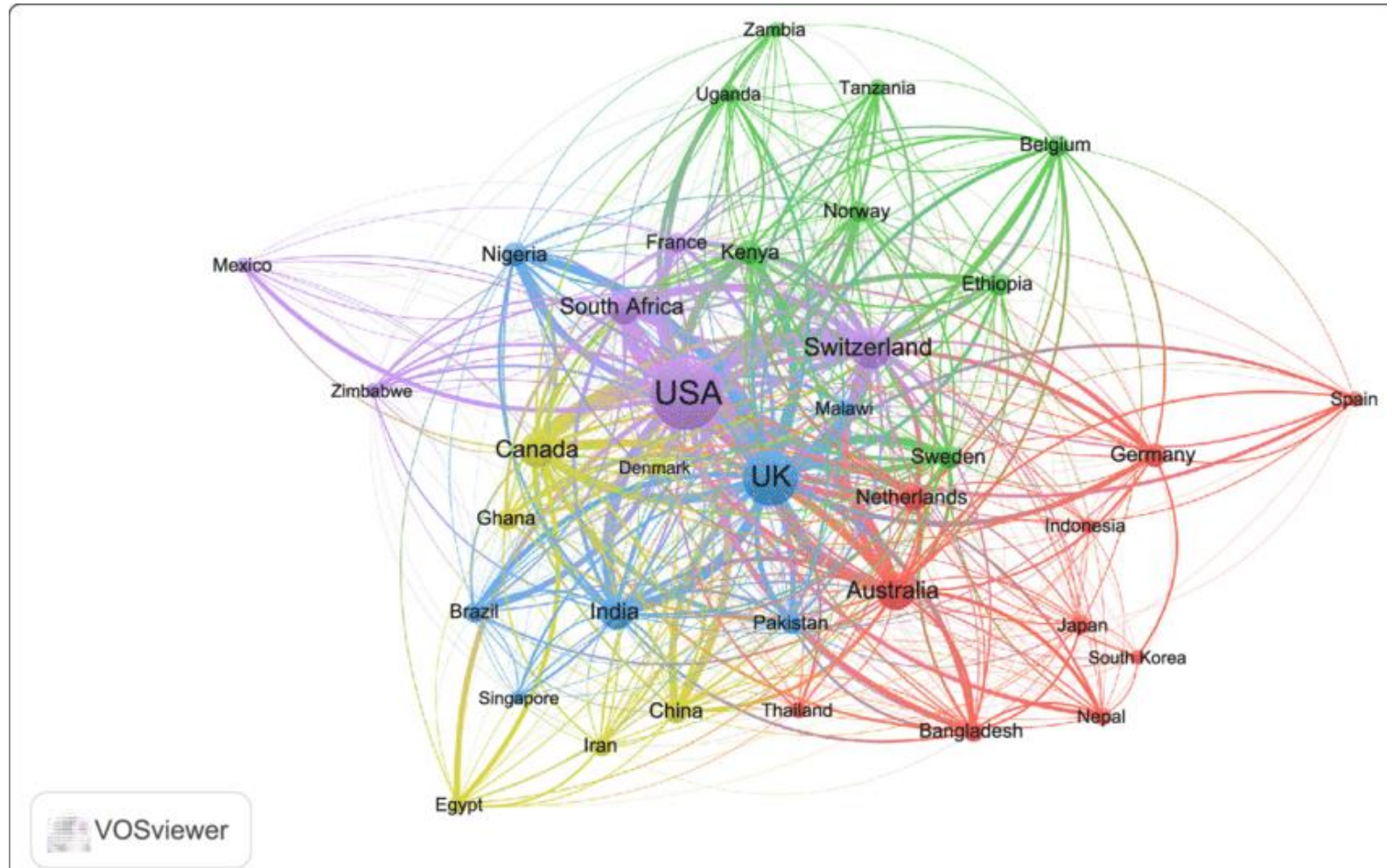
Disclaimers:

- **I do not speak for my university nor for the roundtable.**
- **CCP Not China**

The National Science, Technology, and Security Roundtable has been convened to provide a neutral venue where individuals from the national intelligence and law enforcement communities can meet with representatives from industry and the academic research community to discuss current threats, benefits, and potential risks.

Take Aways

- ❖ All research is dual use.
- ❖ It is the network(s), stupid!
- ❖ It is a team sport.
- ❖ Make it easy to do the right thing, and hard to do the wrong thing!



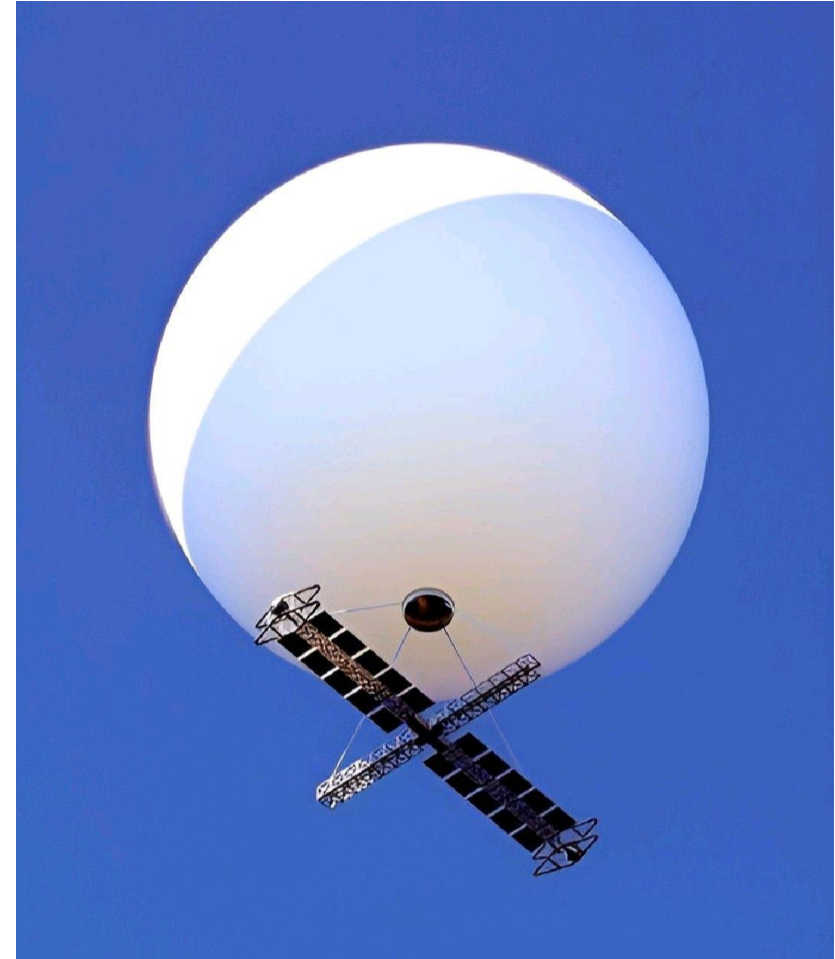
Bibliometric analysis of scientific publications on "sustainable development goals" with emphasis on "good health and well-being" goal (2015-2019)

Dual Use

[When all research is dual use](#), Sam Weiss Evans, Issues, Spring 2022

In a March 2022 [paper in *Nature Machine Intelligence*](#), researchers from a US pharmaceutical company who were building artificial intelligence systems for virtual drug discovery issued a wake-up call to their colleagues. After years of working on a suite of **models to improve toxicity** prediction, the researchers were invited to an international security conference to give a presentation on how such **models could be misused to create chemical and biological weapons**—something they had not previously considered, even though they had worked with neurotoxins and Ebola. “

The thought had never previously struck us,” they wrote. **By simply changing their models to search for molecules with more toxicity rather than less and running the trained algorithm for under six hours, the researchers were able to generate 40,000 molecules that were likely lethal**, including the nerve agent VX and many new molecules that were predicted to be even more potent than known chemical warfare agents. “We were **naive** in thinking about the potential misuse of our trade,” the researchers wrote. **“We are not trained to consider it.”**



Why can we not continue doing what we've been doing?

- [It was an innocuous-looking photograph that turned out to be the downfall of Zheng Xiaoping, a former employee with energy conglomerate General Electric Power.](#) January 16, BBC
- Fundamental (basic & applied) vs proprietary research bright lines are being blurred.

*"**Fundamental research** means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons." NSDD-189*

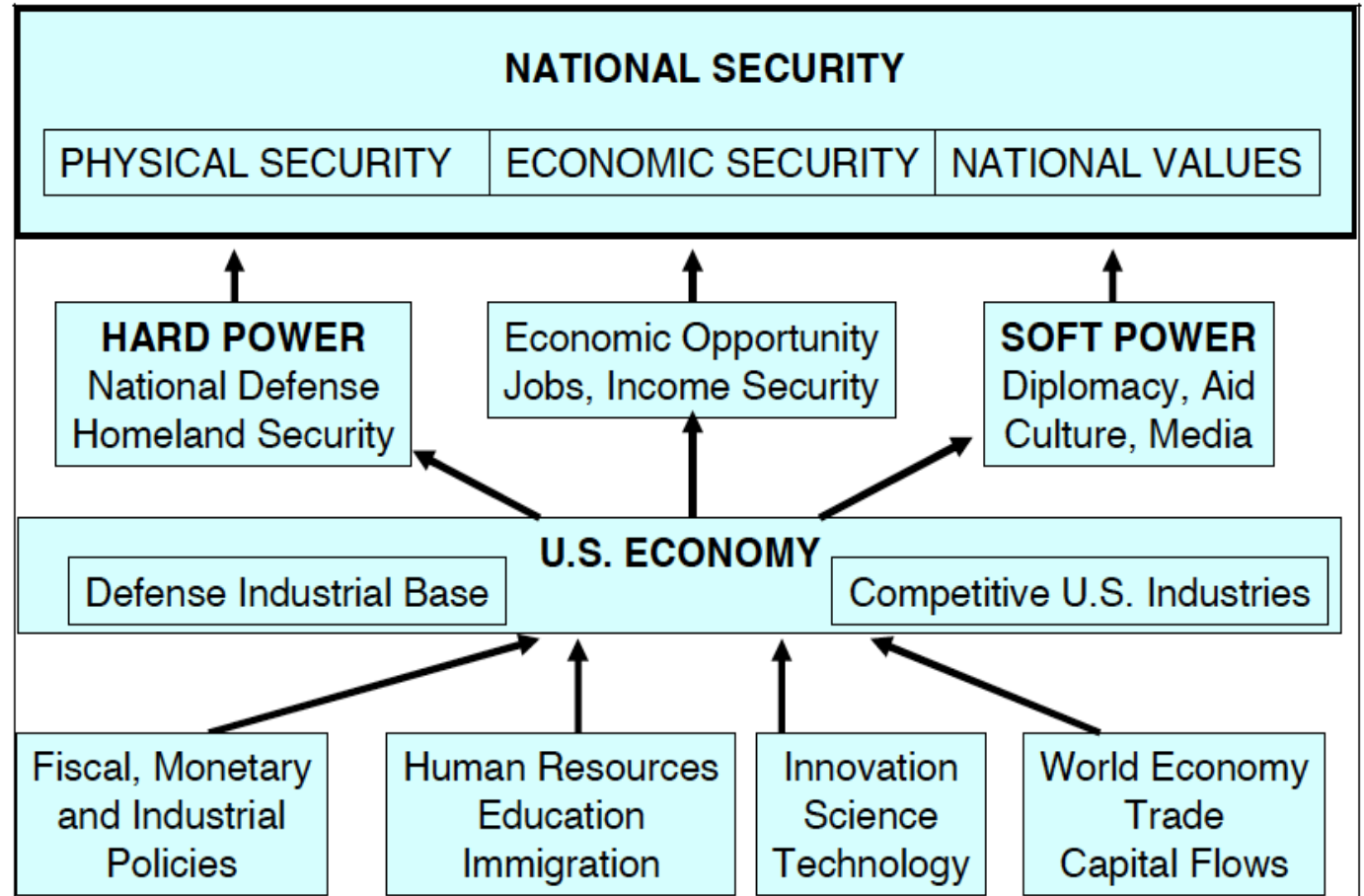
Economic Security IS National Security

Economics and National Security: Issues and Implications for U.S. Policy

[D. Nanto](#) Published 4 January 2011

- US-EU collaboration on AI led by national security offices
- US-India collaboration also led by national security.

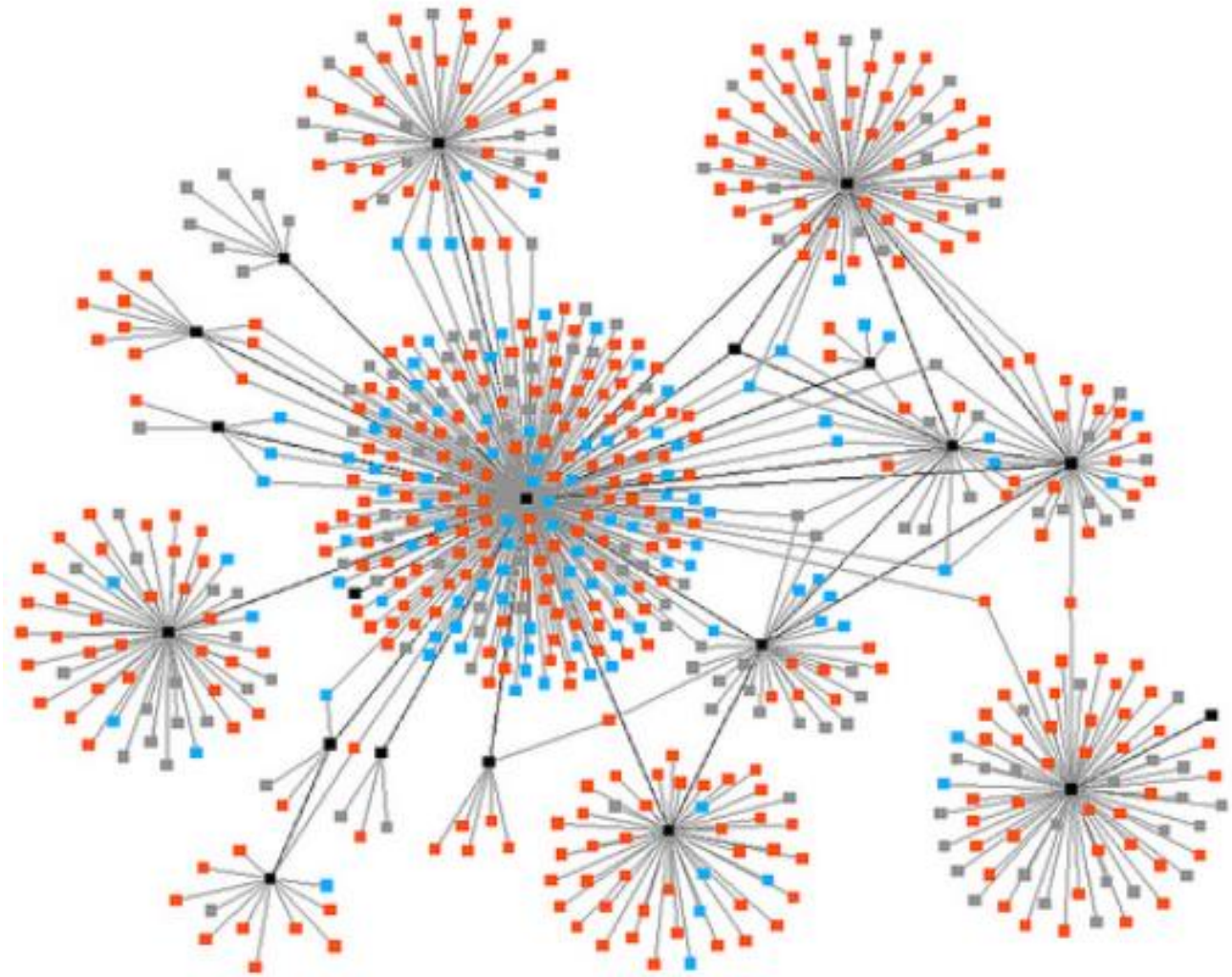
Figure 1. The Economy and National Security



Source: Congressional Research Service

Networks Everywhere

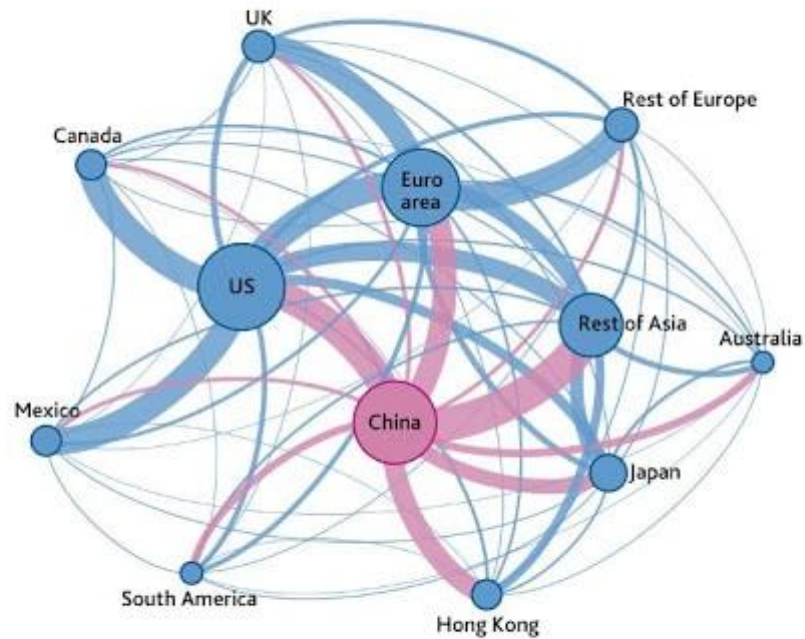
1. Trade networks
2. International collaboration networks
3. Talent networks
4. Investment networks



What makes us strong, can also make us weak

China & international trade networks

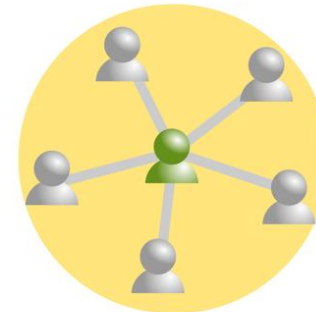
Network of global goods trade, 2018



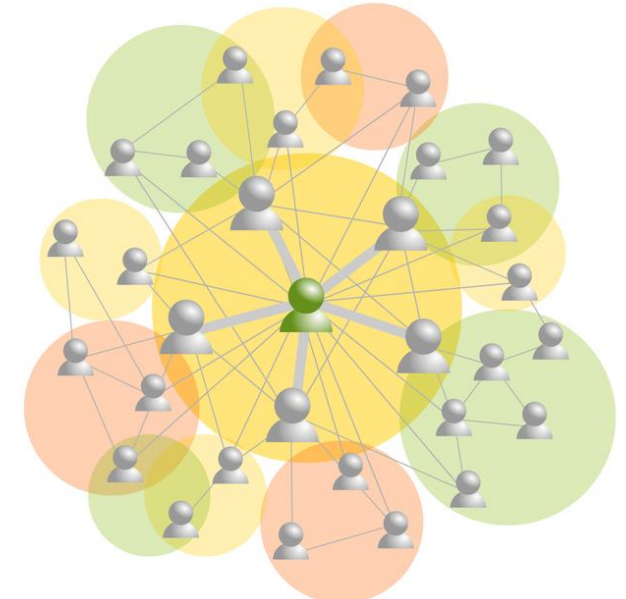
Sources: IMF Direction of Trade Statistics & Bank of England calculations.

Line thickness is proportional to total goods trade between regions. Circle size is proportional to regions' total goods trade with the other regions shown in the chart. Pink lines denote direct trade links with China. Data based on nominal 2018 US dollars.

The Strength of Weak Ties



CONNECTIONS THROUGH STRONG TIES



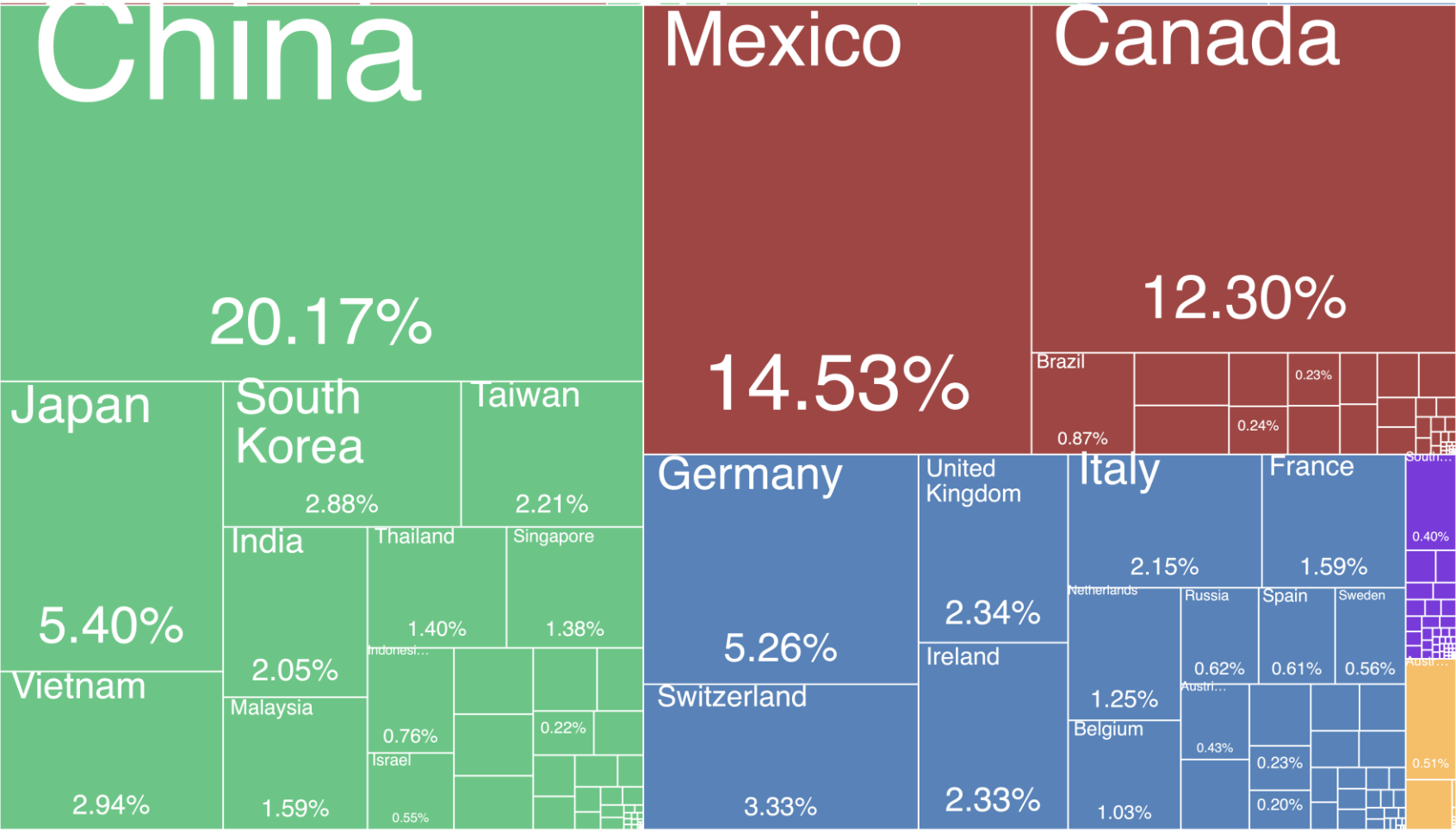
CONNECTIONS THROUGH WEAK TIES

© 2012 CHESS MEDIA GROUP

[The Next Pandemic will be Digital, 2021](#)

US Exports vs US Imports by Partner

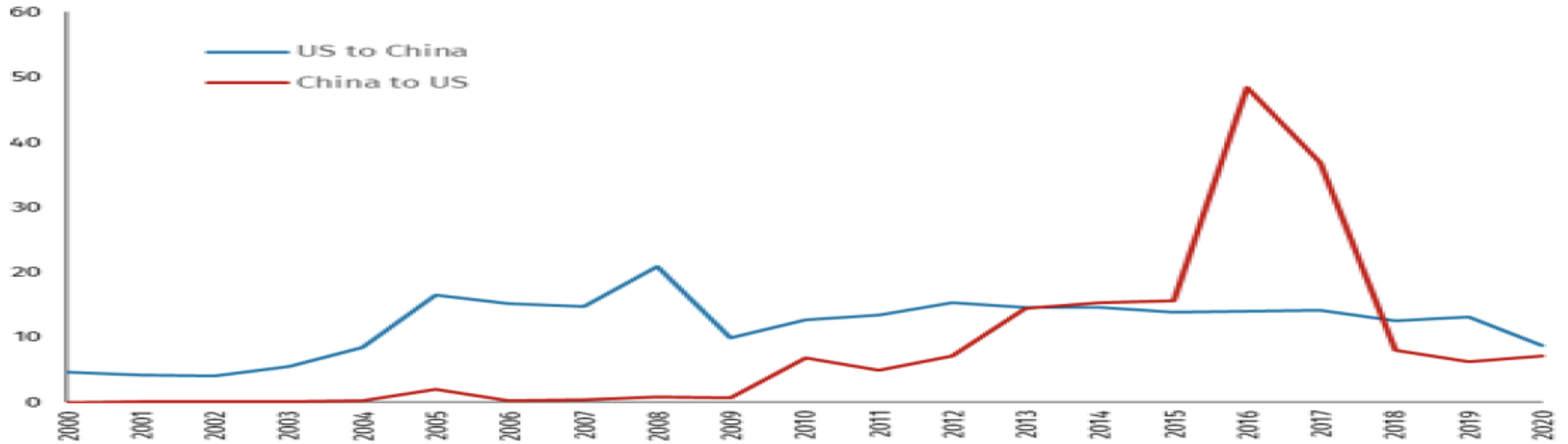
\$2.48T



[Economic Complexity Index](#)

Figure ES-1: Annual Value of FDI Transactions between the US and China, 2000-2020

USD billion



Source: Rhodium Group.

The In-Network of Talent

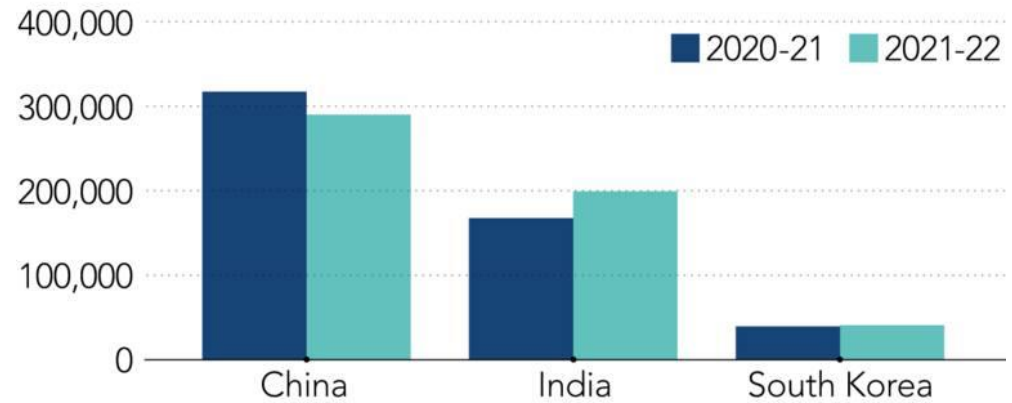
[Chinese students in U.S. plummet as COVID, tensions create barriers](#)

[Enrollment from India rebounds by nearly 20% in 2021-22 academic year](#)

November 14, 2022

The Out-Network of Talent is growing....

Top three countries of origin for international students in the U.S.



Source: Institute of International Education, U.S. State Department

The Companies Holding the Most AI Patents

Number of active AI and machine learning patent families held by company*



* Largest owners in 2021
Source: LexisNexis PatentSight



Who owns the IP?



The Hidden Networks



Large Language Models (LLM)

Conversational AI



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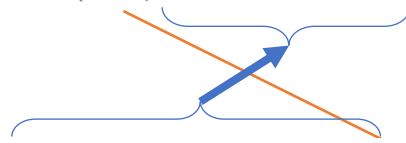
Language model

From Wikipedia, the free encyclopedia

A **language model** is a [probability distribution](#) over sequences of words.^[1] Given any sequence of words of length m , a language model assigns a probability $P(w_1, \dots, w_m)$ to the whole sequence.

Information Theory (1940s)

$$P(w_t | w_{t-k}, \dots, w_{t-1})$$



*The storm wreaked **havoc***

Claude Shannon

From Wikipedia, the free encyclopedia

Claude Elwood Shannon (April 30, 1916 – February 24, 2001) was an [American mathematician](#), [electrical engineer](#), and [cryptographer](#) known as a "father of information theory".^{[1][2]}

As a 21-year-old [master's degree](#) student at the [Massachusetts Institute of Technology](#) (MIT), he wrote his thesis demonstrating that electrical applications of [Boolean algebra](#) could construct any logical numerical relationship.^[3] Shannon contributed to the field of [cryptanalysis](#) for national defense of the United States during [World War II](#), including his fundamental work on codebreaking and secure [telecommunications](#).

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- 1 [Biography](#)
 - 1.1 [Childhood](#)
 - 1.2 [Logic circuits](#)
 - 1.3 [Wartime research](#)
 - 1.4 [Information theory](#)

Claude Shannon



Born April 30, 1916
Petoskey, Michigan, U.S.
Died February 24, 2001 (aged 84)
Medford, Massachusetts, U.S.

Dr. Larry Heck





Conversational AI

Large Language Models (LLM)



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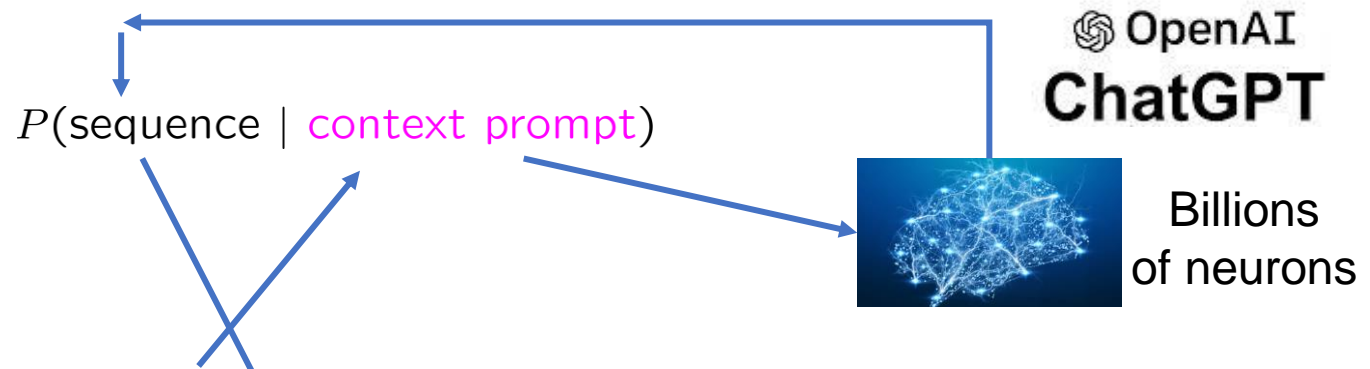
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Discuss the the economic security, strategic competition, and the U.S. research enterprise, considering the changing position of US leadership in global science and technology:

Economic security, strategic competition, and the U.S. research enterprise are closely **linked**, as the United States' technological leadership plays a critical role in its economic prosperity and global competitiveness. The changing position of U.S. leadership in global science and technology has significant implications for these areas.

Dr. Larry Heck

ChatGPT

Discuss the the economic security, strategic competition, and the U.S. research enterprise, considering the changing position of US leadership in global science and technology:

Economic security, strategic competition, and the U.S. research enterprise are closely **linked**, as the United States' technological leadership plays a critical role in its economic prosperity and global competitiveness. The changing position of U.S. leadership in global science and technology has significant implications for these areas.

Economic security: The United States' technological leadership is a key driver of its economic prosperity. New technologies and innovations can lead to the creation of new industries and jobs, as well as increased productivity and competitiveness for existing industries. However, as other countries invest heavily in research and development and build their own technological capabilities, the United States' technological edge may be at risk, which could have negative consequences for its economic prosperity.

Strategic competition: The United States' technological leadership is also critical for its strategic competitiveness, as it allows the country to maintain a military and economic advantage over other nations. However, as other countries invest in their own technological capabilities, the United States may find itself at a disadvantage in areas such as military technology, cyber security, and artificial intelligence.

U.S. research enterprise: The U.S. research enterprise plays a critical role in maintaining the United States' technological leadership. However, the research enterprise is facing several challenges, including limited funding, a shortage of skilled workers, and intellectual property theft. Additionally, the lack of coherent policies to address these challenges can make it difficult for the research enterprise to remain competitive in the global market.

The changing position of U.S. leadership in global science and technology highlights the need for the United States to continue investing in research and development, attracting and retaining a highly skilled workforce, protecting intellectual property, and developing policies to address trade and immigration issues. It's also important to establish policies and regulations that prioritize user's privacy and security in the development and use of new technologies. This will help the US to remain competitive and maintain its position as a global leader in science and technology.

International Collaboration Networks

- **Training language models to follow instructions with human feedback**

[Long Ouyang](#), [Jeff Wu](#), [Xu Jiang](#), [Diogo Almeida](#), [Carroll L. Wainwright](#), [Pamela Mishkin](#), [Chong Zhang](#), [Sandhini Agarwal](#), [Katarina Slama](#), [Alex Ray](#), [John Schulman](#), [Jacob Hilton](#), [Fraser Kelton](#), [Luke Miller](#), [Maddie Simens](#), [Amanda Askell](#), [Peter Welinder](#), [Paul Christiano](#), [Jan Leike](#), [Ryan Lowe](#)

- **Combined Measurement of the Higgs Boson Mass in pp Collisions at $\sqrt{s} = 7$ and 8 TeV with the ATLAS and CMS Experiments**, G. Aad et al. [5,154 authors total] (ATLAS Collaboration), (CMS Collaboration), Physical Review Letters, 114, 191803, published 14 May 2015.



It is a Team Sport

There are huge and long-term costs to innovation and economic growth of allies taking distinct approaches to **export controls, placing limits on university-based open research collaboration between domestic and foreign scientists, or imposing constraints on foreign direct investment.** All three of these national security policies can substantially affect beneficial cross-border research collaboration and commercial exchange in advanced technologies. But they are rarely considered together. They should be.

G7: Balance security and collaboration

HARRY G. BROADMAN AND CHAOUKI ABDALLAH
SCIENCE, 16 Jun 2022, Vol 376, Issue 6599, p. 1248

- Australian Strategic Policy Institute: [Picking Flowers, Making Honey.](#)
- Responsible internationalisation: Guidelines for reflection on international academic collaboration. Stockholm: STINT, 2020.
- The Danish Ministry of Higher Education and Science published a report on 25 May which calls for a “paradigm shift” in the Danish approach to international research and innovation and offers practical guidelines for Danish educational and research institutions to “reduce risks and increase the potential for benefits in international research and innovation collaboration”.
- [Canadian security services block more than 30 grant proposals](#), Feb 6, 2023
- The Danish measures are part of broader efforts by Nordic countries to combat intellectual espionage and information misuse in international research collaborations. While cooperation with countries such as China and Russia tends to be foregrounded as current security threats, most of the measures are designed to be applied more generally.
- Team USA: Recent semiconductor October 7 rules:

On January 27, Netherlands and Japan Said to Join U.S. in Curbing Chip Technology Sent to China (ASML, Nikon, Tokyo Electron) A new agreement is expected to expand the reach of U.S. technology restrictions on China issued last year.

G7 Partners Network: Linked by Values

Research Integrity

- Academic Freedom
- Freedom from Discrimination, Harassment, and Coercion
- Equity, Diversity, and Inclusion
- Institutional Autonomy
- Open Science and Access to Research
- Fostering Public Trust
- Transparency, Disclosure, and Honesty

Research Security

- Balancing National and Global Interests
- Maintaining Openness and Research Security
- Collaboration and Dialogue
- Proactive Efforts
- Risk Proportionality
- Shared Responsibilities
- Accountability and Responsibility
- Adaptability

[G7 Security & Integrity of the Global Research Ecosystem \(SIGRE\)](#)

Parting Thoughts & the Future of Research

- Future research must be collaborative, inclusive, and well communicated.
- Research universities should be partnership builders, connecting local communities, government, industry, and others to plan for and respond to the challenges facing society.
- Make it easy to do the right thing, and hard to do the wrong thing!

