

Role of foreign talent in the U.S. & U.S. success in recruiting foreign AI talent

June 29, 2023 | Washington, DC

International Talent Programs in the Changing Global Environment,
National Academies of Sciences, Engineering, and Medicine

cset.georgetown.edu

Key points

- Foreign-born talent is critical to U.S. STEM; AI is a case in point
- Scholarly research and CSET analysis point to significant domestic benefits and an ongoing need for foreign talent
- Foreign-born students in STEM/AI
- What attracts talent to the U.S. and what repels it?
- Current indicators in global talent mobility are mixed to negative for the U.S.

Foreign-born talent in U.S. AI and STEM R&D

Foreign-born talent in U.S. AI & computing: anecdotal

Sergei Brin (co-founder, Google)	<i>Refugee/dependent (child)</i>
Clement Delangue (co-founder, HuggingFace)	<i>Temporary worker</i>
Oren Etzioni (Allen Institute, Univ. of Washington)	<i>Student</i>
Andrew Grove (CEO, Intel)	<i>Refugee</i>
Jensen Huang (co-founder, Nvidia)	<i>Dependent (child)</i>
Yann LeCun (Turing Award winner for neural networks)	<i>Visiting scholar, temporary worker</i>
Fei-Fei Li (creator of ImageNet)	<i>Dependent (child)</i>
Satya Nadella (CEO, Microsoft)	<i>Student</i>
Andrew Ng (Stanford, Google Brain, Coursera)	<i>Student</i>
Judea Pearl (Turing Award winner in AI)	<i>Student</i>
Sundar Pichai (CEO, Google)	<i>Student</i>

Foreign-born talent in U.S. AI & computing: anecdotal

“We typically average 1,400 to 1,700 Master’s- and Ph.D.-level foreign-national college hires a year. . . . We estimate without OPT [foreign student work authorization] we would be able to hire just 30% of the highly skilled graduates we currently hire.” - *Director of Global Labor Relations and Workforce Policy, Intel*

“My collaborators’ visa restrictions have been one of the largest bottlenecks to our collective research productivity over the last few years.” - - *Ian Goodfellow (GAN inventor), Apple*

“At the Allen Institute for Artificial Intelligence, nearly two-thirds of our research scientists are immigrants, several of whom are also university professors. Our PhDs hail from Egypt, Germany, India, Iran, Israel, Japan, Korea, Norway, the UK, Taiwan, Vietnam, and the United States.” - *Oren Etzioni, CEO, Allen Institute for AI*

Foreign-born talent in American STEM: the research

- *Necessary caveat:* Few reliable, large-scale datasets exist on STEM immigration
 - Particularly for emerging areas such as AI
 - Federal agency datasets are fragmentary, difficult to merge, often highly aggregated
 - Foreign student data a partial exception
- A body of research has nonetheless accumulated and points to some tentative conclusions

Foreign-born talent and STEM innovation

- Immigrants patent at twice the rate of the native-born ([Hunt and Gauthier-Loiselle 2010](#))
- Chinese or Indian engineers led about 25 percent of all high-tech businesses in Silicon Valley in the early 2000s ([Wadhwa 2012](#))
- 87 percent of top university patents in semiconductor manufacturing and 84 percent in IT had at least one foreign-born inventor ([PNAE 2012](#))
- Historical analyses
 - “A 1 percentage point increase in immigrant college graduates' population share increases patents per capita by 9-18 percent” ([Hunt and Gauthier-Loiselle 2010](#))
 - 1920s immigration quotas drove “large and persistent decline in invention by US scientists” ([Moser and San 2020](#))

Foreign-born talent and domestic labor

- “A large body of economic evidence suggests that high-skilled immigrants generally have neutral or positive impacts on domestic employment and wage levels” ([Zwetsloot 2021](#))
- Foreign-born STEM workers drive wage gains for natives, particularly college-educated natives ([Peri et al. 2015](#))
- Immigration restrictions drive offshoring, especially for large firms ([Glennon 2020](#))
- Macro dynamics may not always hold at the micro level - abuses have been documented (e.g. [Preston 2015](#))

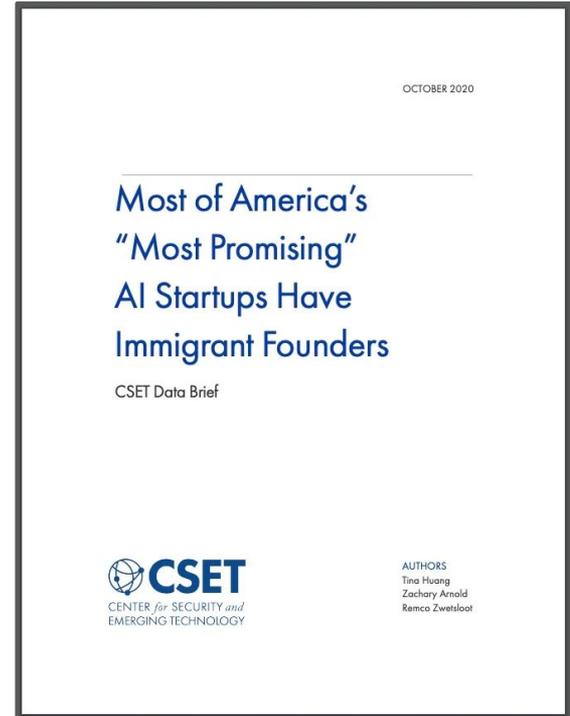
Foreign-born talent in American STEM: CSET findings

- [Arnold et al. 2019](#): ~15,000-30,000 annual entrants have significant AI skills
 - Most are on temporary status (F-1, H-1B, etc.)
 - Optional Practical Training is as or more significant than the much better-known H-1B program



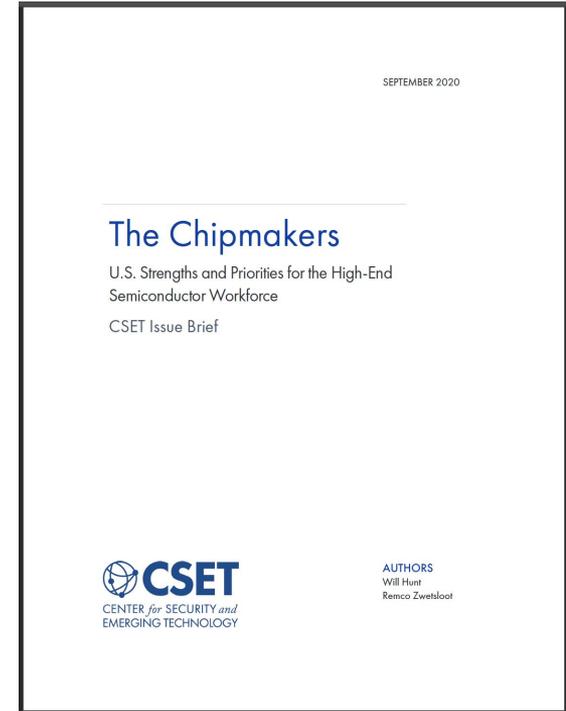
Foreign-born talent in American STEM: CSET findings

- [Huang et al. 2020](#): 66% of the “most promising” U.S. AI startups (as identified by *Forbes* and subject-matter experts) had at least one immigrant founder
 - 42% of founders were immigrants
 - 72% of founders arrived on student visas



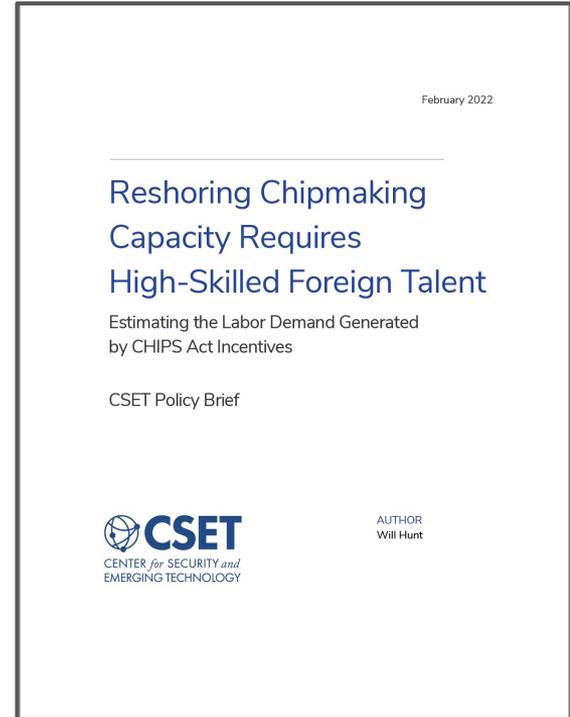
Foreign-born talent in American STEM: CSET findings

- [Hunt and Zwetsloot 2020](#): “Approximately 40 percent of high-skilled semiconductor workers in the United States were born abroad”
 - India and China are leading sources
 - "More than 100,000 innovators in electrical engineering migrated to the United States between 2000–2010, far more than migrated to any other nation"

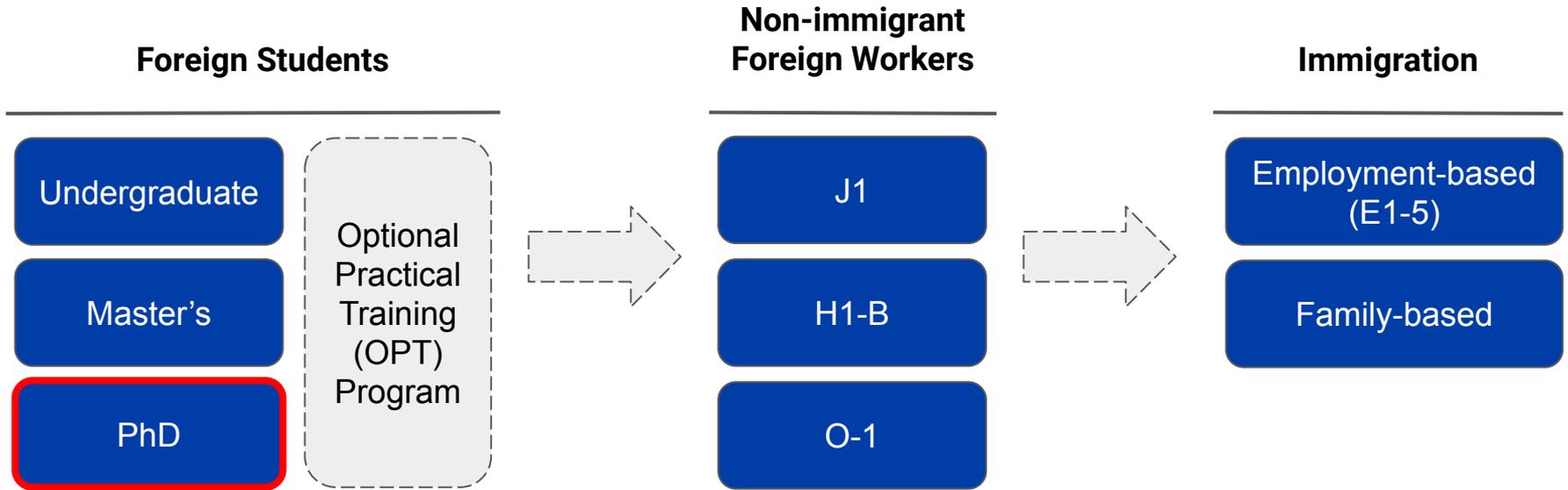


Foreign-born talent in American STEM: CSET findings

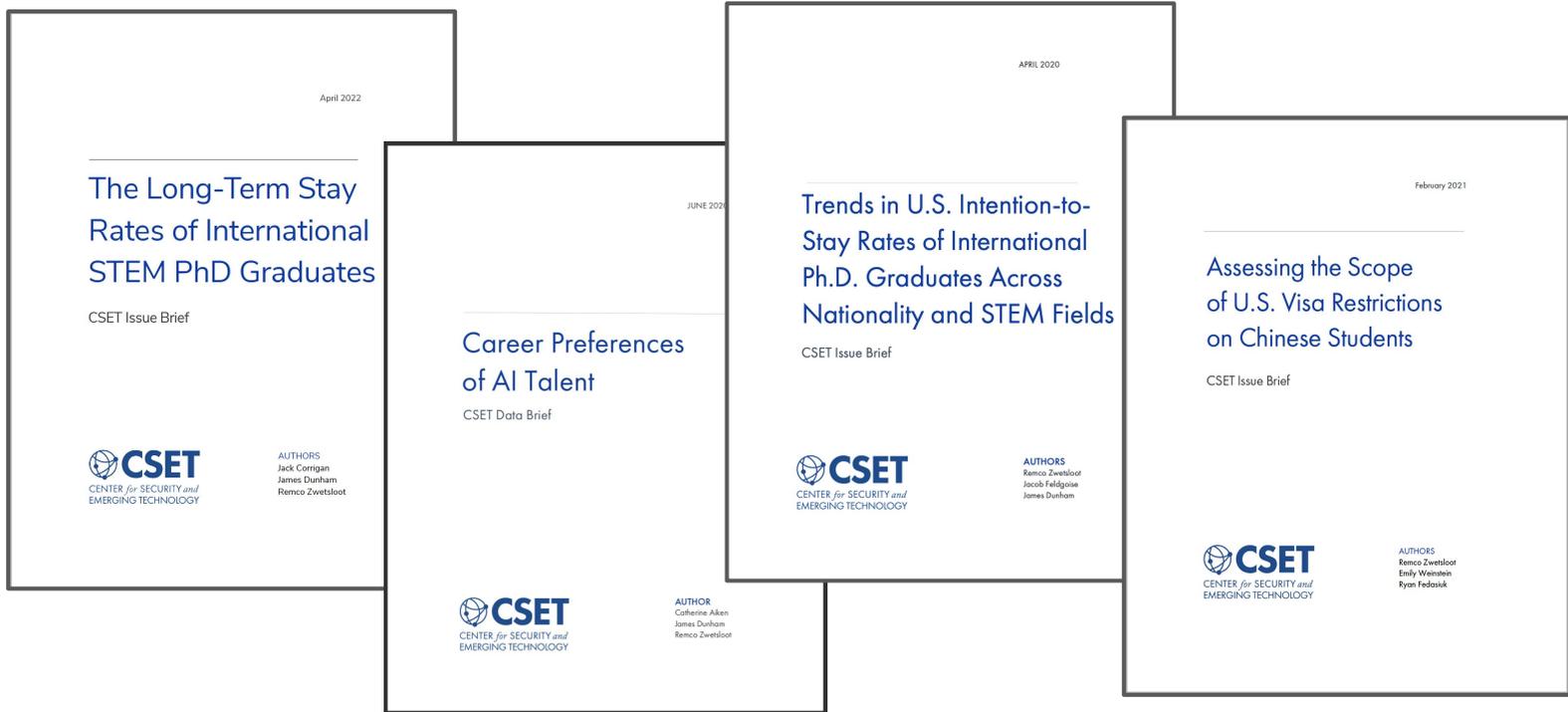
- [Hunt 2022](#): “CHIPS Act incentives may require the immigration of more than 3,500 additional foreign-born workers over the next decade”
 - Under conservative assumptions; plausibly, “*most* job openings at new fabs for [engineering] occupations would need to be filled by foreign workers” (emphasis added)



Much of CSET's research on foreign-born talent has focused on PhD students.



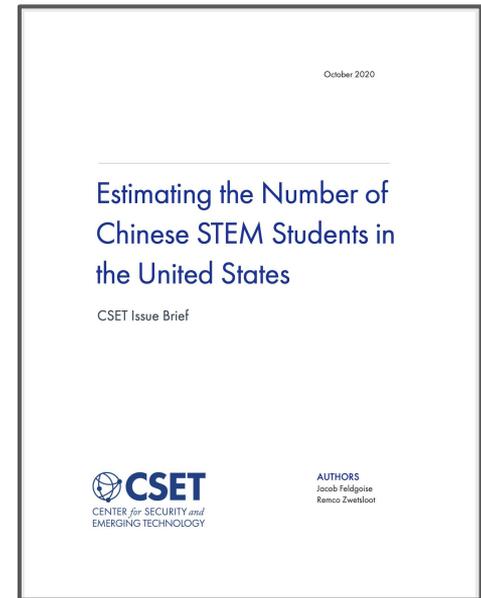
Foreign-born STEM students in America: CSET research



How common are foreign-born students in STEM fields?

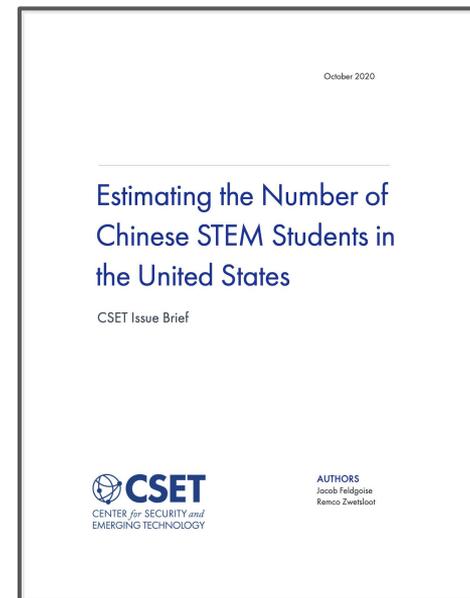
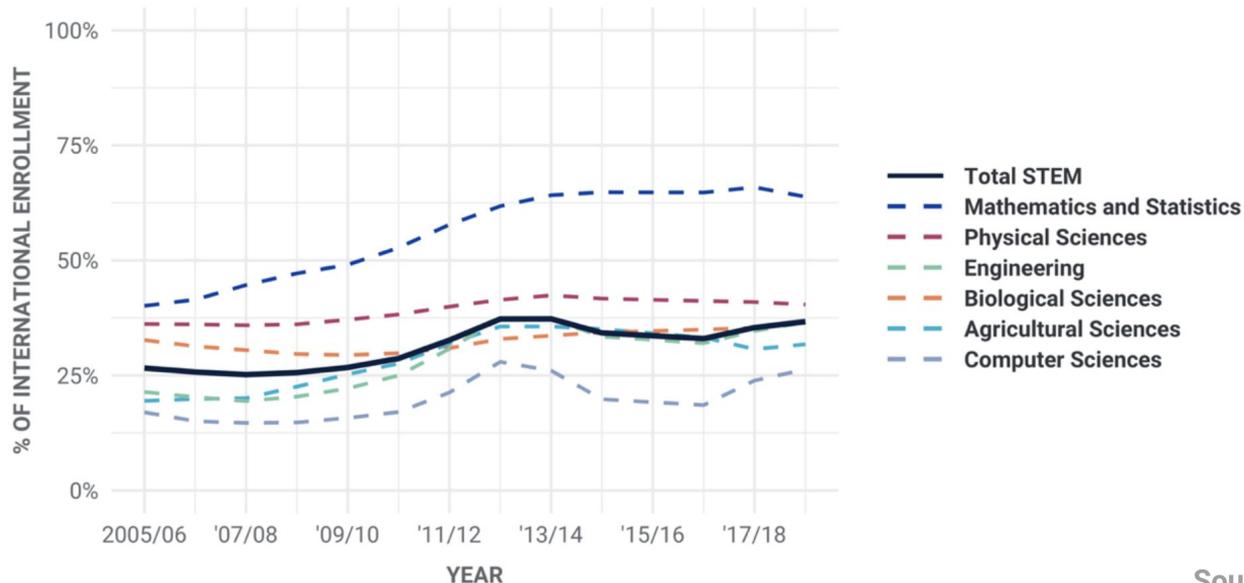
Foreign-born students make up a large share of graduate-level STEM enrollment.

	Foreign-born Students as % of U.S. Total	
	Undergraduate	Graduate
Agricultural Sciences	3%	30%
Biological Sciences	3%	20%
Computer Sciences	9%	55%
Engineering	9%	53%
Mathematics & Statistics	16%	51%
Physical Sciences	6%	35%
Total STEM	7%	44%



Sources: NSF NCSES, IPEDS, NSF Science and Engineering Indicators
Note: Data are from 2018/19 school year

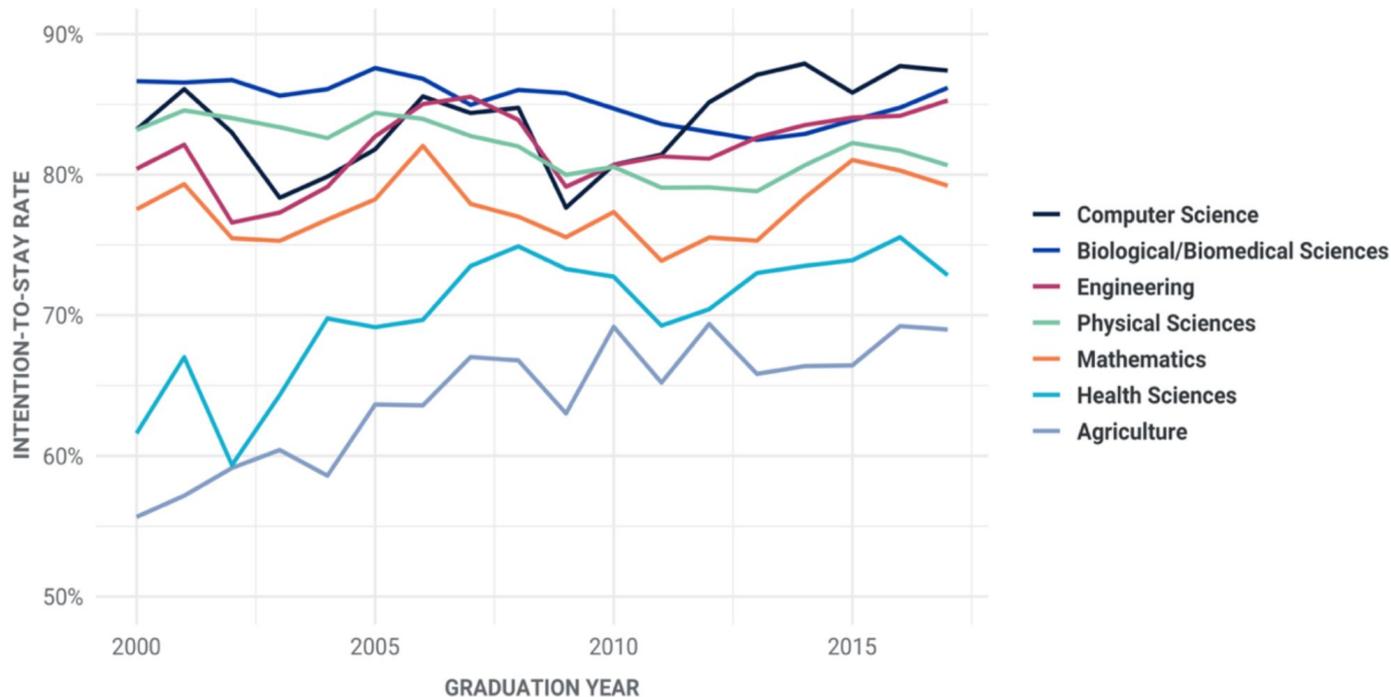
Chinese nationals are a large share of foreign STEM graduate enrollment.



Sources: NSF Science and Engineering Indicators
Note: Data for 2015/16 is missing and was imputed as the average of 2014/15 and 2016/17.

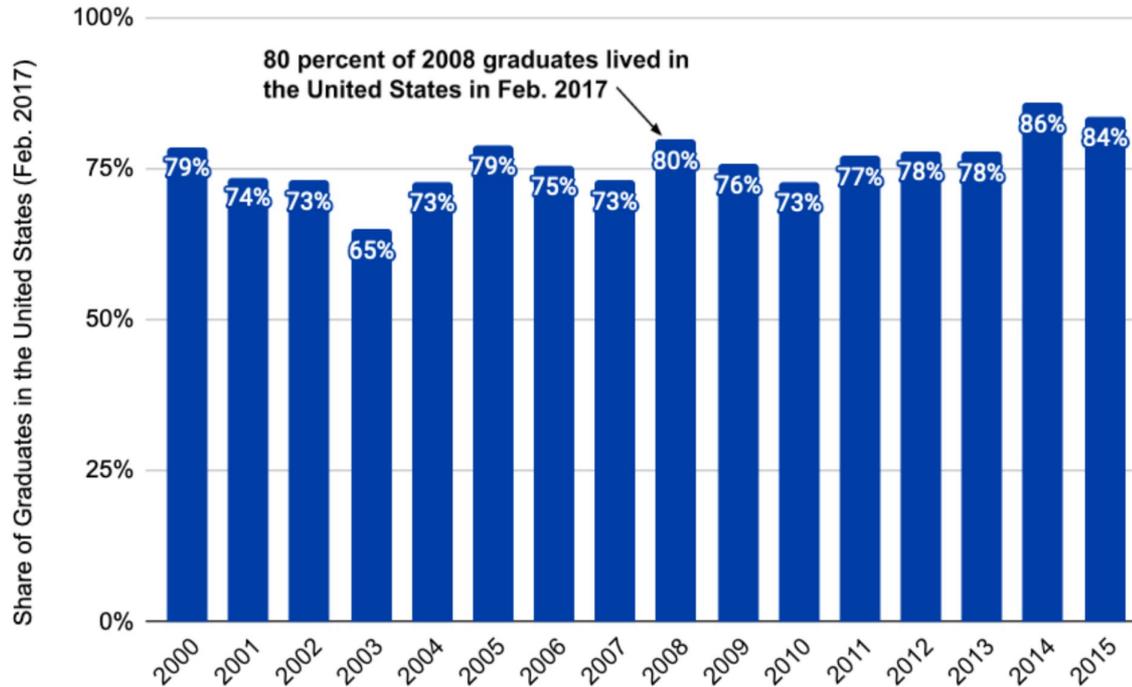
**Do foreign-born STEM PhD recipients stay
in the United States after graduating?**

As of 2019, in most STEM fields, over 70% of foreign-born PhD recipients intended to stay in the U.S.



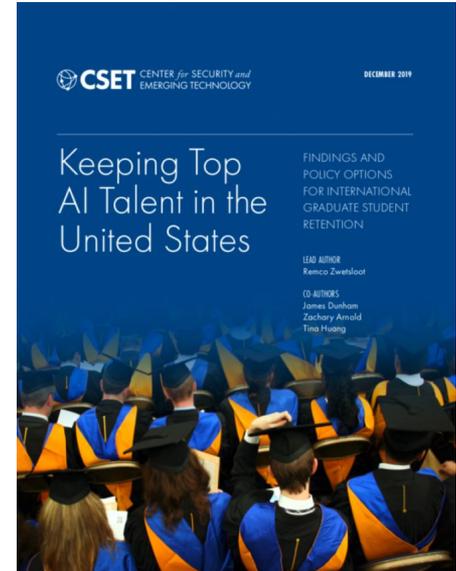
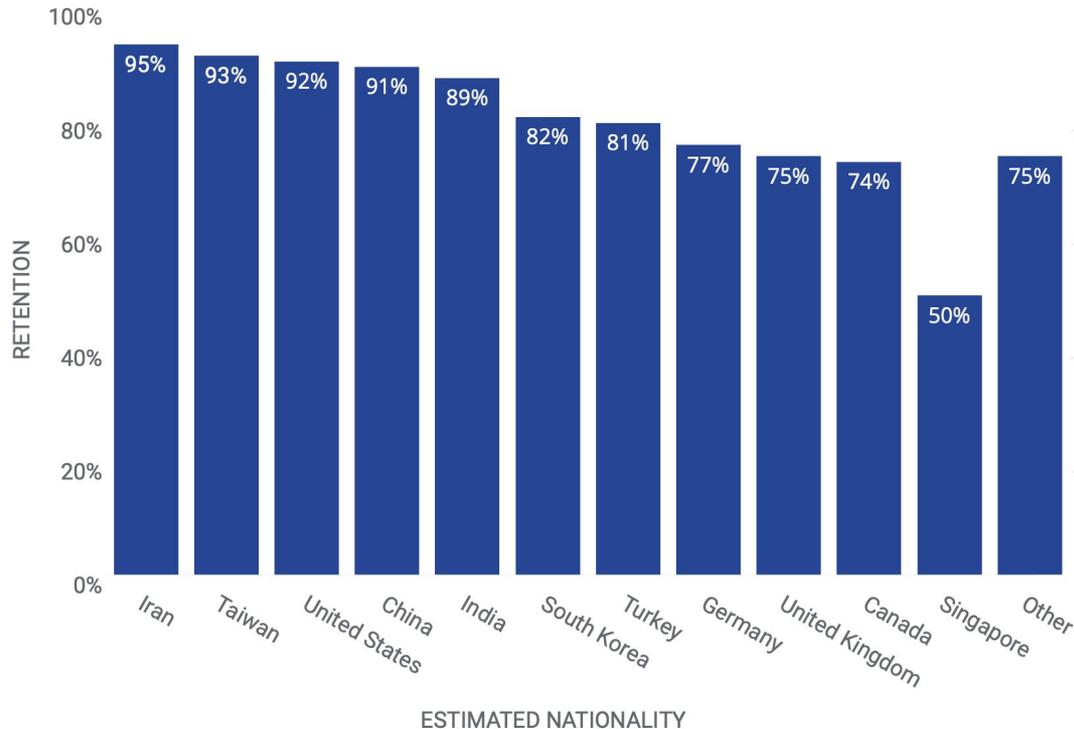
Source: NSF Survey of Earned Doctorates.

77% of foreign-born STEM PhD recipients in 2000-2015 were still living in the U.S. as of 2017.



Source: 2017 NSF Survey of Doctorate Recipients.

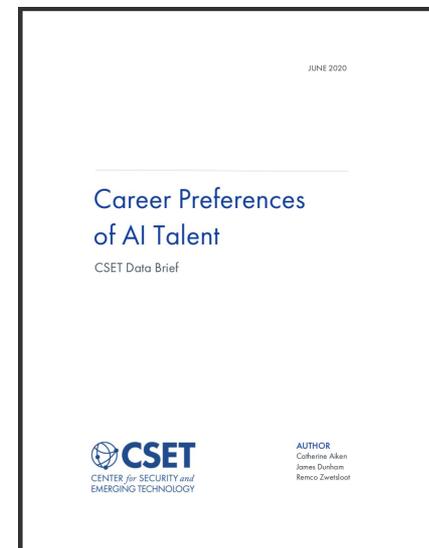
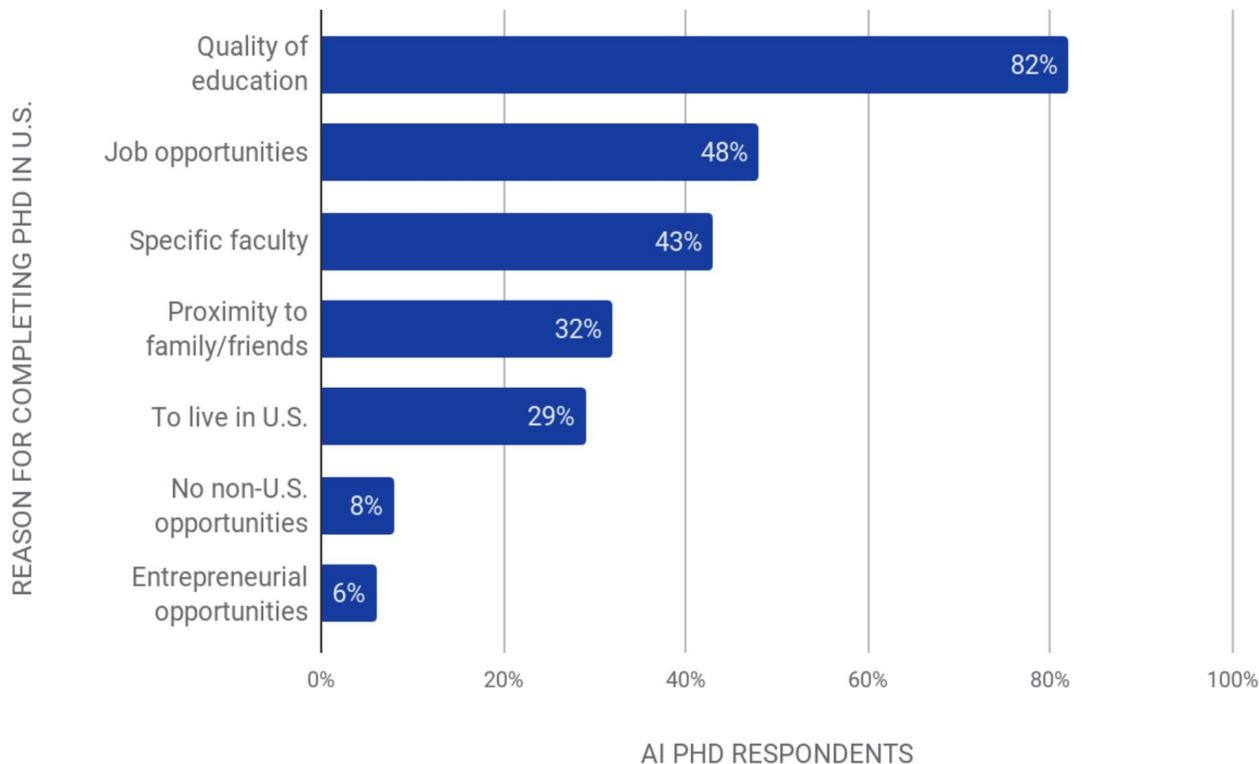
82% of top U.S.- trained AI PhDs were still living in the U.S. five years after graduation.



Source: CSET U.S. AI PhD Career Data

What attracts AI talent? What repels it?

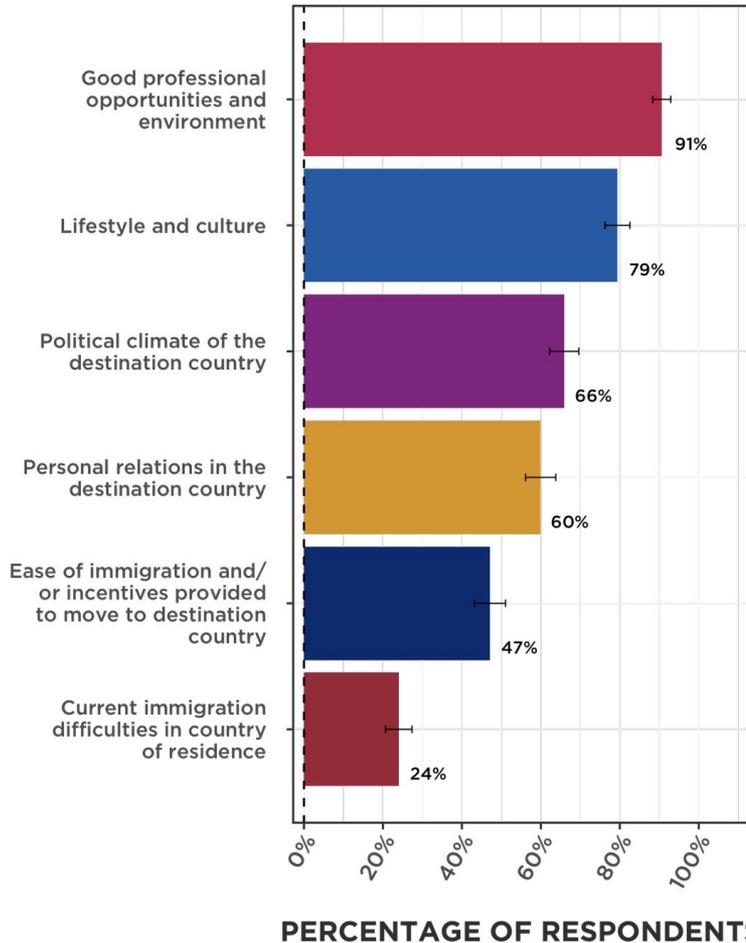
AI PhD Students: Quality of U.S. education and job opportunities are most attractive.



Source: CSET U.S. AI PhD Survey

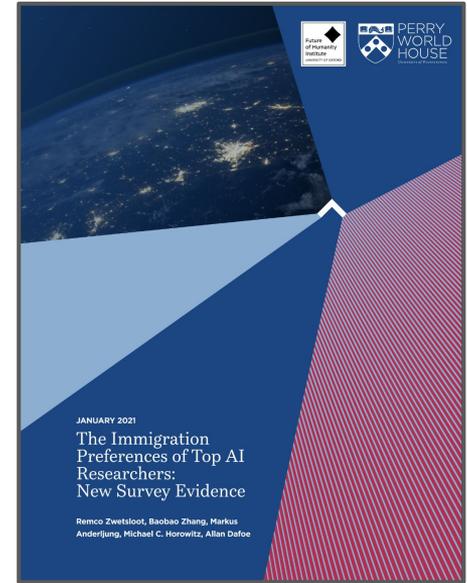
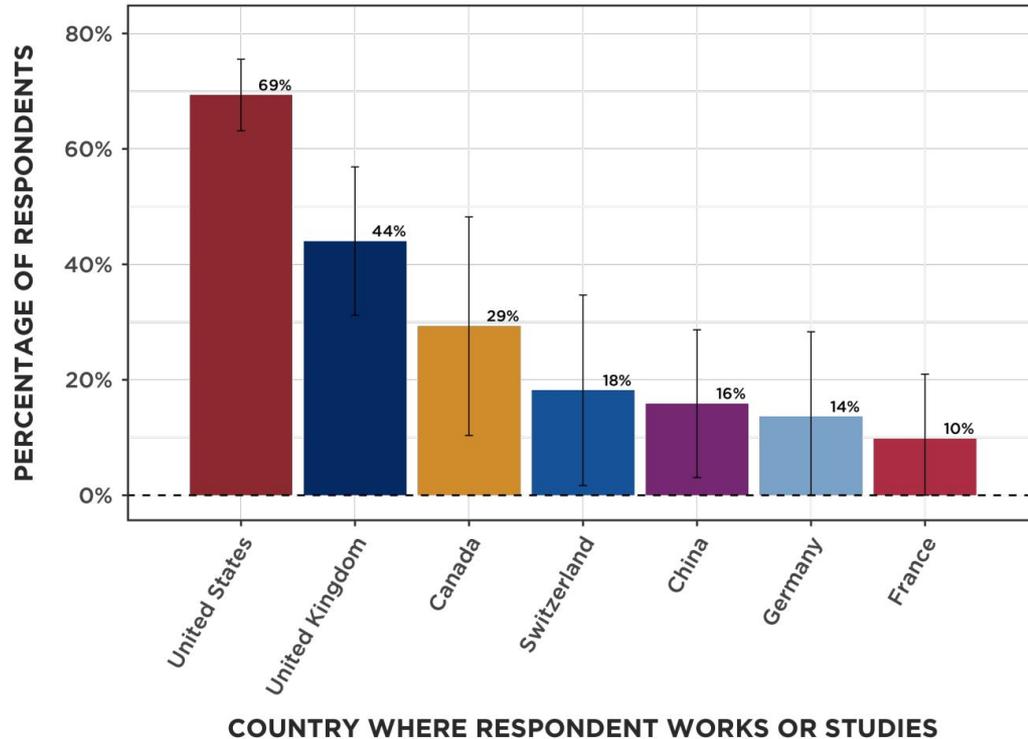
AI researchers: professional opportunities & culture most impact immigration decisions.

IMMIGRATION FACTOR



Source: Survey of AI researchers conducted by Oxford Future of Humanity Institute and Perry World House

AI researchers in the U.S. consider visa/immigration issues a serious problem for conducting AI research.



Source: Survey of AI researchers conducted by Oxford Future of Humanity Institute and Perry World House

What attracts AI researchers to the U.S. and what repels them?

Attracts

- Higher education system
- Professional opportunities (incl. leading AI companies)
- Culture

Repels

- Immigration policy
- Increasingly good professional opportunities elsewhere

Current trends and indicators

Other countries are highly competitive in emerging R&D areas

Top five producers of **AI** research

By highly cited articles (English-language, 2016-2021)

Organization	Country	Articles	Average citations per article
Chinese Academy of Sciences	China	4,246	114.8
Tsinghua University	China	3,111	119.1
Google	United States	2,506	314.1
Stanford University	United States	2,255	178.5
Massachusetts Institute of Technology	United States	2,146	140.4

"Highly cited articles" include the 10% of articles in each year with the most citations.



ETO Research Almanac | almanac.eto.tech

Other countries are highly competitive in emerging R&D areas

Top five producers of **NLP** research

By highly cited articles (English-language, 2016-2021)

Organization	Country	Articles	Average citations per article
Microsoft	United States	757	116.9
Google	United States	701	252.4
Carnegie Mellon University	United States	593	231.3
Chinese Academy of Sciences	China	462	76
Facebook	United States	444	178.3

"Highly cited articles" include the 10% of articles in each year with the most citations.



ETO Research Almanac | almanac.eto.tech

Other countries are highly competitive in emerging R&D areas

Top five producers of **computer vision** research

By highly cited articles (English-language, 2016-2021)

Organization	Country	Articles	Average citations per article
Chinese Academy of Sciences	China	2,022	145.9
University of Chinese Academy of Sciences	China	1,133	133.5
Tsinghua University	China	1,045	172.4
Wuhan University	China	889	99.3
Google	United States	752	430.5

"Highly cited articles" include the 10% of articles in each year with the most citations.

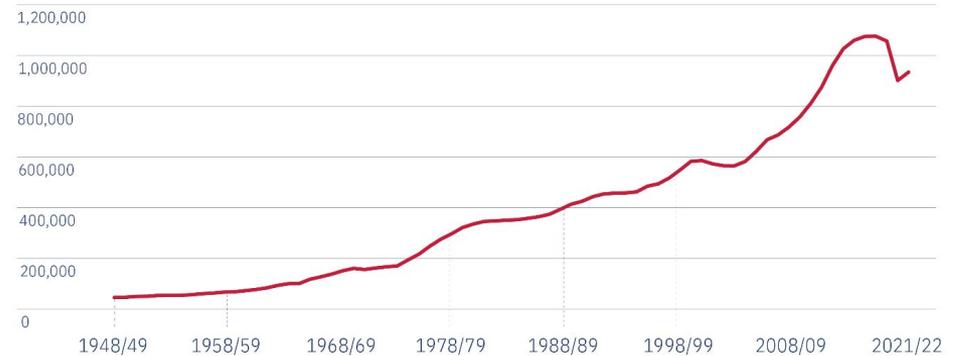


ETO Research Almanac | almanac.eto.tech

Mixed indicators from key temporary status programs

- New foreign student enrollments have recovered post-pandemic, but overall numbers remain well below trend
 - Growth from India and other countries offsets significant decline in Chinese students (-9% between 2021 and 2022)
- H-1Bs remain far oversubscribed

INTERNATIONAL STUDENTS, 1948/49 – 2021/22



In 2021/22, the total number of international students **increased by 4%** from the prior academic year.

Warning signs from up north

- Canadian skills-based immigration programs are increasingly drawing foreign-born talent out of the United States
 - [Arnold 2020](#): 128% increase in successful Express Entry applications by U.S.-resident noncitizens (2017-2019) - more than 20,000 in total
 - [Esterline 2023](#): “Approximately 45,000 invitations went to skilled workers who received their postsecondary education in the U.S—88 percent of whom were not U.S. citizens”
- Foreign student enrollment in Canada grew **31%** in 2022 (US: 4%)

Caps, delays and red tape continue to add friction



US Visa Processing Delays Called Worst Since 9/11

Visa Bottlenecks Are Creating Headaches for Employers, Workers



Andrew Kreighbaum
Reporter



US reports a significant spike in student visa refusals for 2022

14 Jun 2023

Short on time? Here are the highlights:

- *The US rejected 35% of all F-1 student visa applications in 2022*

A status quo scenario

- Slow leveling and (potentially) decline of talent inflows to U.S.
 - U.S. attractors persist; U.S. deterrents persist, or grow; attractors elsewhere grow
 - Uneven across research fields and economic sectors
- Effects on U.S. STEM: drag on overall innovation and growth, potential shortages in strategic areas
- Who benefits?
 - Reallocation to other countries with relatively open immigration, strong R&D/university bases: Canada, UK, Australia, other Europe poised to benefit
 - China an increasingly common “destination” for Chinese nationals, also

U.S. Immigration Landscape for Tech Talent

Students/F1

Optional Practical Training (OPT)

Workers/H-1B

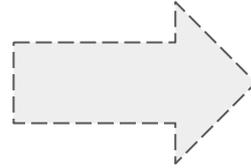
Employer sponsored
3 years, 1x renewal
Annual lottery, 85,000 cap

Distinguished Workers/O-1

Sustained national and international acclaim

Entrepreneurs/IER

DHS grants parole stay, case-by-case
Substantial ownership and public benefit



Green card for Permanent Residency

140,000 annual cap
7% per country quota (9,800)

Policy Solutions

Students/F-1

1. Extend STEM OPT length
2. Create “study and stay” programs
3. Allow dependents to work

Workers/H-1B

1. Lift or increase 85,000 cap
2. Provide exemptions for AI talent
3. Remove annual lottery
4. Lottery draw more than once a year

Green card

1. Lift or increase 140,000 cap
2. Eliminate 7% per-country quota
3. Provide exemptions for AI talent

Entrepreneurs

1. Actually implement?
2. Expedite processing times
3. Realistic and clear requirements



- Research at <https://cset.georgetown.edu/publications>
- Sign up to receive research the day it's issued, subscribe to our biweekly newsletter, and get invited to our events at <https://cset.georgetown.edu/sign-up/>
- Watch CSET webinars and request briefings, if needed
- Share your questions and knowledge gaps

cset.georgetown.edu | policy.ai | [@csetgeorgetown](https://twitter.com/csetgeorgetown) | cset@georgetown.edu