

Immigration Policy and the U.S. AI Sector

A PRELIMINARY
ASSESSMENT

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CENTER *for* SECURITY *and* EMERGING TECHNOLOGY

Established in January 2019, the Center for Security and Emerging Technology (CSET) at Georgetown's Walsh School of Foreign Service is a research organization focused on studying the security impacts of emerging technologies, supporting academic work in security and technology studies, and delivering nonpartisan analysis to the policy community. CSET aims to prepare a generation of policymakers, analysts, and diplomats to address the challenges and opportunities of emerging technologies. During its first two years, CSET will focus on the effects of progress in artificial intelligence and advanced computing.

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Executive Summary

The United States' ability to attract foreign talent is a unique and crucial national security advantage. Historically, immigrants have helped America lead the world in technological innovation. Artificial intelligence is no exception. Foreign-born talent fuels the U.S. AI sector at every level, from student researchers in academic labs to foreign and naturalized workers in leading companies. Rather than displacing domestic workers, immigrants and visitors fill a critical AI talent gap in the United States – one that is likely to persist and possibly grow over time, even with the most ambitious domestic workforce development efforts. They lead many of America's top AI companies, contribute groundbreaking original research in AI disciplines, and handle much of the essential, ongoing work to deploy and manage AI throughout the public and private sectors.

To maintain America's AI advantage in an increasingly competitive global market for talent, U.S. employers need an efficient, accessible immigration system that allows them to recruit and retain the world's best and brightest. And those best and brightest, the great majority of whom want to come to the United States permanently, need a clear and realistic path toward long-term legal status.

Unfortunately, the current U.S. immigration system is not up to the challenge. This preliminary paper describes that system as it relates to AI talent, identifies features of the system that are doing the most harm to America's AI advantage, and proposes reforms. Drawing on agency data and background discussions with AI and immigration stakeholders, the authors find:

- U.S. immigration policy is making the AI sector less competitive for talent.

- Most of the fundamental problems have existed for years or decades, but recent policy changes have made the situation materially worse.
- Beyond any individual law or policy, a general climate of uncertainty, complexity, and restriction is discouraging foreign AI talent from coming to or staying in the United States.
- Immigration-related measures against illicit technology transfer, such as visa restrictions and screening measures, are causing serious harm. Congress and the relevant agencies should thoroughly review these measures.
- Current immigration law favors large companies and restricts labor mobility, harming AI workers, startups, and entrepreneurs.

To address these issues, policymakers should:

- Build new immigration pathways for AI students, workers, and entrepreneurs.
- Fix regulatory and administrative policies that make it harder to recruit and retain AI talent.
- Review and revise existing measures against illicit technology transfer.

This paper has four parts. First, it discusses the central role of foreign talent in the U.S. AI sector. Second, it describes key pathways in current immigration law for noncitizens to come to the United States to study or work in artificial intelligence. Third, it proposes policy actions to address the most significant immigration-related problems facing the U.S. AI sector. Fourth, it briefly discusses CSET's future research agenda.

1 Foreign talent in the U.S. AI sector

The U.S. AI sector relies and will continue to rely on immigrants.¹ Immigrants account for a large majority of graduate students in fields related to AI, such as computer science and electrical engineering. In the private sector, foreign talent is especially important for R&D-intensive companies and industries such as artificial intelligence.² U.S. tech employers with active AI programs, from major players like Google, Apple, and Amazon to AI-focused startups and academic labs, recruit several thousand noncitizens each year through temporary worker programs and sponsor several thousand more for lawful permanent residence through the employment-based green card system. Foreign-born experts and entrepreneurs, many of whom arrived in the United States as students or on other temporary status, founded many of the most successful companies active in AI in the United States, including Google, Nvidia, and Tesla.³ More than half of Silicon Valley's startups count one or more immigrants among their founders.⁴

Immigrants are filling a critical gap in the U.S. AI sector. For the foreseeable future, U.S. demand for AI talent will far outpace domestic supply.⁵ Although there is some debate over the extent of a labor shortage or "skills gap" in STEM fields overall,⁶ there is strong evidence that workers with AI-related skills are in extremely short supply.⁷ Meanwhile, state and federal agencies are only now putting policies in place to bolster the domestic workforce.⁸ These policies will take years or decades to bear fruit and are unlikely to fill the AI skills gap on their own.

Immediate supply and demand aside, the United States will always have an interest in ensuring that the top minds of the AI sector come to live, work, and fuel innovation here. Historically, America's legal and cultural

openness, economic strength, and world-leading academic institutions have drawn the world's best and brightest. These talented foreigners generally want to stay in the United States – and when given the chance, they do.⁹

For now, the United States is still a top destination for foreign AI students, workers, and entrepreneurs.¹⁰ But the global competition for talent is intensifying.

First, **the AI industry outside the United States is quickly maturing**, creating opportunities abroad for foreign-born students and workers who might have looked only to the United States before.¹¹ More than half of the world's AI and machine learning “unicorns” (startups valued at \$1 billion or more) are based outside the United States,¹² and money and talent are flowing to AI research hubs from London and Toronto to Bangalore, Beijing, and Berlin.¹³ China attracted 60 percent of global investment in AI between 2013 and 2018, and its homegrown companies, such as Alibaba and Baidu, are rapidly displacing U.S.-based multinationals as the most desired employers among China's young AI talent.¹⁴

Second, **other countries are overhauling their immigration systems** to attract and retain foreign talent. Countries such as Canada, China, France, the United Kingdom, and Australia have recently made changes aimed at students and workers in AI and other high-tech fields. These changes range from generous new visa programs,¹⁵ to extended stays and easier work authorization for foreign students,¹⁶ to significantly shorter processing times and dedicated support resources for immigrants with strategic skills.¹⁷ For example, Canada now processes many skilled worker permit applications in two weeks or less; in contrast, the complicated U.S. application process for H-1B skilled worker status can take six months or more (assuming slots are available).¹⁸ Amid strong growth in its overall immigration numbers, Canada attracted 24,000 skilled immigrants over the past two years through its fast-track program (including thousands from the United States); most are Indian nationals in high-tech fields like software engineering.¹⁹

Third, in addition to updating their immigration laws, **many other countries now provide generous incentives** to attract AI talent. U.S. allies and adversaries offer scholarships; stipends; generous benefits for spouses and dependents; business support services; and other perks to AI students, scholars, workers, and entrepreneurs.²⁰

At the same time, worrying trends are emerging in the United States. After years of robust growth, new enrollments by foreign students in U.S. universities are declining overall, although the data do not yet reflect declines in enrollment and stay rates among PhD students in AI disciplines.²¹ Meanwhile, growth in noncitizen STEM students and graduates' participation in the Optional Practical Training (OPT) work program slowed from 48 percent in 2016 to 13 percent in 2017.²² Recent surveys indicate that foreign students and workers, and the schools and employers that host

Edward Tse, founder and chief executive of Gao Feng Advisory Company, said the latest [visa-related] measures from Washington . . . “[are] going to create a silver lining for the Chinese because it’s going to force the Chinese to accelerate its own research and development[.] In particular, Made in China 2025 is a national imperative.”

Recent changes have also made this clear for Yudi, a Chinese engineer who graduated from Carnegie Mellon University in Pennsylvania with bachelor’s and master’s degrees in mechanical engineering, but now works at Hunan-based Farsoon Technologies, which built China’s first national 3D printing lab.

“I think many more students would come back, apply what they learned abroad and contribute to the 2025 plan,” he said. “It is definitely a positive thing for the 2025 plan.”

South China Morning Post, May 30, 2018

them, now face increasing delays and bureaucratic obstacles in the immigration process, are growing more and more concerned about the direction of immigration policy, and (in the case of individuals and private companies) are increasingly looking to move to jurisdictions with fewer constraints.²³ Horror stories involving talented foreign-born scientists and engineers struggling to enter or stay in the United States are circulating widely.²⁴ For example, prominent researchers from countries including the Netherlands and Israel were denied visas to attend major AI and cryptography conferences in the United States, prompting condemnation from other leading scientists and a flurry of media coverage.²⁵ In another especially high-profile incident, one of the nation’s top materials science researchers, a Chinese-born doctoral student at MIT, reportedly had to suspend his research after being denied reentry to the United States.²⁶

Some of the leading AI and STEM experts in the United States are speaking out publicly about these problems. For example, Oren Etzioni, CEO of the Allen Institute for Artificial Intelligence, published an op-ed in *Wired* earlier this year arguing that “increasingly restrictive immigration policies are systematically depriving our universities of some of the world’s top talent.”²⁷ Ian Goodfellow, a renowned machine learning researcher currently working for Apple, commented that his “collaborators’ visa restrictions have been one of the largest bottlenecks to our collective

research productivity over the past five years.”²⁸ And in a June 2019 letter to the MIT community, university president Rafael Reif cited similar issues as part of an “increasingly loud signal the US is sending to the world . . . that the US is closing the door – that we no longer seek to be a magnet for the world’s most driven and creative individuals. . . . [W]e should expect it to have serious long-term costs for the nation and for MIT.”²⁹

2 Current pathways for foreign AI talent

Current law provides several pathways into the United States for foreign-born AI students and workers. Most often, noncitizen AI workers enter the United States as students, visiting scholars, or temporary workers. Once present, many obtain lawful permanent residence (“green card” status) and eventually become U.S. citizens. This section describes these pathways as they relate to foreign AI talent.

STUDENTS

Foreign students are crucial to U.S. STEM industries, including AI.³⁰ Foreign college and graduate students generally arrive in the United States on F-1 student visas.³¹ The annual number of F visas is unlimited, and visa holders can remain in the United States until they complete their studies (including any additional degrees). By default, an F visa holder can work in the United States to a limited extent and may also be eligible for the Optional Practical Training (OPT) program either before or after graduation.³²

In the academic year 2017-2018, over 270,000 new international students enrolled in U.S. schools, down from over 300,000 in 2015-2016.³³ Foreign students on temporary visas are the majority in U.S. programs related to AI, especially at the masters' and doctoral levels. In 2017, 62 percent of PhD students and 70 percent of masters' students in U.S. computer science, information science, and computer engineering programs were non-resident aliens.³⁴

TEMPORARY WORKERS

U.S. immigration law offers foreign students and other immigrants several pathways into the workforce short of permanent resident (green card) status. These pathways are important not just for foreign nationals who

Table 1: Provisional estimates of annual entrants into immigration pathways for AI talent³⁵

PATHWAY	RELEVANT AI POPULATION	DURATION	NEW ENTRANTS (ANNUAL)	ENTRANTS IN TECHNICAL FIELDS (ANNUAL)	ENTRANTS WITH SIGNIFICANT AI SKILLS (ANNUAL)
OPT (extension of F-1)	Students and recent graduates from U.S. universities	Temporary (3 years)	275,000 ³⁶	145,000 ³⁷	Ten to fifteen thousand ³⁸
H-1B	Workers in “specialty occupations”	Generally temporary (3-6 years, extensions possible in some cases)	108,000 ³⁹	80,000 ⁴⁰	Several thousand
J-1	Professors, scholars, interns, and trainees	Temporary (up to 5 years)	300,000 ⁴¹	50,000-75,000 ⁴²	A few thousand
L-1	Transferees within multinational companies	Temporary (3-5 years)	30,000-50,000 ⁴³	10,000-15,000	About a thousand
O-1	Individuals of “extraordinary ability”	Temporary (3+ years)	10,000-15,000 ⁴⁴	One or two thousand	A few hundred
Employment-based green card	Employees of U.S. firms; “extraordinary ability” individuals	Indefinite	64,000 ⁴⁵	30,000-35,000	A few thousand

plan to stay in the United States temporarily, but also for those who are not yet able to pursue green cards but hope to stay in the United States long term. For those in AI and other high-tech fields, the H-1B visa is an important route to employment in the United States, with other visa categories playing secondary roles. In addition, the Optional Practical Training program allows F student visa holders to work in the United States after graduation, filling a gap created by restrictions on the employment-based programs.

The H-1B program

The H-1B program is the largest temporary skilled worker program under current law, with about 108,000 new petitions approved in fiscal year 2017.⁴⁶ H-1B status is available to workers in high-skilled positions (termed “specialty occupations”) who have job offers from U.S. employers.⁴⁷ In practice, most H-1B visa holders are Indian and Chinese tech workers.⁴⁸ H-1B status lasts three years and can be extended once, with additional one-year extensions for individuals stuck in the green card queue.⁴⁹

Unlike most other temporary worker statuses, H-1B status is capped: only 85,000 new H-1B workers can be admitted each year, with 20,000 of those slots reserved for holders of master’s degrees or above from U.S. universities. However,

universities and certain other (primarily nonprofit) employers are “cap-exempt,” raising the overall yearly total beyond the 85,000 cap.⁵⁰ Applications for cap-subject H-1B slots far exceed supply year after year, so the relevant federal agency, U.S. Citizenship and Immigration Services (USCIS), runs an annual lottery.⁵¹ Odds vary from year to year; one major high-tech employer reports a typical “win rate” of only 50 to 60 percent of the applications it enters, even though most of its employees qualify for the master’s category.⁵²

The H-1B program is controversial. Critics argue that the program has become an outsourcing mechanism for unscrupulous U.S. employers, citing accounts of large U.S. companies replacing entire IT departments with H-1B workers and noting that relatively low-paying IT staffing firms have historically been the leading users of the program.⁵³ Almost all of the public and regulatory debate around the H-1B program has focused on this small subset of companies.

But although staffing firms have been heavy users of the program, many other employers also rely on H-1B status to attract talent from abroad, including the leaders of the U.S. AI industry. From 2015 to 2018, companies with active AI programs⁵⁴ hired over 34,000 H-1B workers.⁵⁵ On average, these companies offer their H-1B employees higher wages⁵⁶ and sponsor more of them for green cards than other types of employers.⁵⁷ This suggests that AI employers are more often recruiting H-1B employees into long-term, high-demand roles – not simply replacing domestic workers with lower-wage, short-term foreign labor.

Optional Practical Training

Although less well known, the OPT program is at least as important as the H-1B program for bringing young AI talent into the U.S. workforce. F-1 students who are studying in STEM fields can work for up to three years under the STEM OPT sub-program, also known as the “STEM extension;” other students are eligible for one year only. Unlike the H-1B program, OPT numbers are not capped. The application process is less demanding for both participant and employer than for other immigration statuses.⁵⁸

OPT has grown rapidly in recent years, from about 80,000 approvals in 2008 to more than 276,000 in 2017.⁵⁹ The STEM extension, enacted in 2008, played a role in the increase, but the ultimate drivers are increased demand and barriers to entry into other temporary worker programs, most of which are too specialized for recent graduates. In theory, H-1B status would suit many or most of these graduates; in practice, the annual cap puts it out of reach for many. OPT has therefore become a crucial bridge to longer-term status for many graduates: by participating in OPT, they get up to three turns at the annual H-1B lottery and work authorization.

OPT and the STEM extension have become critical stopgaps for young foreign workers in the United States and their employers. According to federal data, pri-

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The best thing the U.S. government has done on immigration is OPT to allow international students a chance to stay and work for a time after graduation.”

Michelle Zatlyn, COO of globally leading cyber-security firm CloudFlare, in an interview with Forbes Magazine contributor Stuart Anderson

vate companies with active AI programs relied on the STEM extension to employ more than four thousand OPT participants between 2008 and 2015, with a sharp upward trend toward the end of the period; many, if not most, of these participants presumably lost the H-1B lottery in their first year of OPT.⁶⁰ As of late 2018, one leading user of the program, Intel Corporation, was relying on OPT (including but not limited to STEM OPT) to retain more than a thousand employees who had lost the H-1B lottery earlier that year.⁶¹ Intel has estimated that “without OPT, we would be able to hire just 30 percent of the highly skilled graduates we currently hire.”⁶²

Other temporary pathways

The H-1B and OPT programs are the most important existing channels into the U.S. AI sector for foreign talent. However, several specialized pathways are also important:

J-1 visas are important for academics, foreign-born interns, and trainees in U.S. companies. The J-1 program lets academic employers, including universities and other research institutions, sponsor foreign professors and researchers to study and work in the United States for periods ranging from several months to five years (for professors and certain scholars). According to the Institute of International Education, 71 percent of visiting scholars in American universities during academic year 2017-2018 used J visas.⁶³ Program numbers are uncapped, but renewals are not allowed, and once the participant leaves the country or finishes the exchange, a “cooling-off period” of one to two years typically applies before he or she can return for another exchange.⁶⁴ The program also offers shorter-term status (one year to eighteen months) to noncitizen interns and trainees of U.S. companies, as well as a “short-term scholar” program for six-month academic visits.⁶⁵ J-1 visa holders generally have to return to their countries for two years before applying for differ-

ent immigration status (e.g., H-1B), although this requirement can often be waived. In 2018, about 330,000 foreign nationals obtained J-1 visas, including roughly 55,000 scholars and 42,000 interns and trainees.⁶⁶

L-1 visas are important for foreign employees of multinational companies. These visas let multinationals transfer foreign managers and specialized workers to their U.S. offices on a temporary basis. To qualify for L status, the employee must have worked outside the United States for the sponsoring company for at least a year; status typically lasts three years, with extensions up to five years for specialized workers and seven years for managers.⁶⁷ USCIS approved about 30,000 individual L-1 petitions overall in fiscal year 2018, including continuing (renewal) petitions.⁶⁸ A similar number likely obtained L-1 status through the separate “blanket L-1” procedure available to certain large companies.⁶⁹

O-1 visas are relevant for AI “VIPs,” such as leading researchers and business executives. These visas are available to those with “extraordinary ability in the sciences, arts, education, business, or athletics” and can provide extensive evidence of the same in the form of major awards, extensive publications, patents, and so forth.⁷⁰ In practice, the program’s regulatory eligibility criteria are demanding, so most organizations choose not to rely on it. O status lasts for up to three years, but can be renewed as long as the holder is still pursuing the same activity that brought him or her to the United States initially.⁷¹ The program is small: in fiscal year 2018, there were no more than 17,000 participants of any sort (including shorter-term visitors, athletes, movie stars and the like).⁷²

PERMANENT RESIDENTS

Foreign AI workers who want to stay in the United States indefinitely – or who simply want the stability and flexibility of long-term legal status – can pursue lawful permanent residence, also known as green card status. Those already present in the United States on temporary visas can try to adjust to permanent status, but temporary status isn’t a prerequisite: workers outside the United States can also apply. Whether inside or outside the country, a foreign national pursuing a green card has three main options: sponsorship by a family member who is already a U.S. citizen or permanent resident; employment-based selection, which usually requires sponsorship by a U.S. employer;⁷³ or selection in the annual diversity lottery, which is limited to countries that have sent relatively few immigrants to the United States in recent years.⁷⁴

Family sponsorship and the diversity lottery indirectly affect the AI workforce,⁷⁵ but the employment-based process is the clearest path for foreign nationals who want to join the U.S. AI sector in the long term. However, several annual caps apply to employment-based green cards, leading to long waits for many workers in high-tech industries like AI. These are the key factors:

1. Under current law, about 140,000 employment-based green cards (including spouses and children, as discussed below) can be issued each year.⁷⁶
2. Of those 140,000,
 - a. up to 39,200 are available to “priority workers” (also known as first-preference immigrants or EB-1 immigrants), including individuals of “extraordinary ability,” “outstanding professors and researchers,” and some managers and executives;
 - b. up to 39,200 are available to second-preference (EB-2) immigrants, defined as professionals with advanced degrees or whose “exceptional ability” will “substantially benefit” the United States;
 - c. up to 39,200 are available to third-preference (EB-3) immigrants, defined as college graduates and skilled and unskilled workers qualified for roles unable to be filled by U.S. citizens;
 - d. up to 9,940 are available to fourth-preference (EB-4) immigrants, defined as certain “special immigrants” not relevant to AI (e.g., religious workers, NATO employees and certain translators); and
 - e. up to 9,940 are available to fifth-preference (EB-5) immigrants, defined as investors in projects that create 10 or more jobs in the United States.⁷⁷
3. An additional per-country annual cap applies to employment-based and family-based green cards, taken as a whole; that is, in any given year, any given country’s nationals can receive up to 7 percent of those green cards, or about 25,600 green cards in the aggregate (not including green cards awarded in the diversity lottery).⁷⁸

The caps have created large and persistent backlogs of green card applicants. Spouses and children of employment-based green card applicants count toward each of the three caps, meaning that the total number of *workers* admitted is significantly lower: in fiscal year 2017, spouses and children claimed 54 percent of the green cards set aside for first-, second- and third-preference immigrants.⁷⁹ Of all the major source countries for high-skilled foreign workers in the United States, the green card caps mainly affect Chinese and especially Indian nationals.

AI researchers and workers receive no special preference for green cards and must compete with the general population for each year's limited supply. Nevertheless, federal data indicate that AI-related employers actively seek green cards for their foreign-born employees. In today's extremely competitive market for AI talent, green card sponsorship is both a way for employers to potentially retain noncitizen employees for longer and (in many cases) a de facto necessity to compete effectively for talent in the first place. According to public records, companies with active AI programs have successfully completed the permanent labor certification process (a prerequisite for green card sponsorship) for more than 26,000 foreign nationals since 2015; China and India accounted for nearly three quarters of the total, with Canada in distant third place.⁸⁰

Permanent residence and naturalization

Lawful permanent residence is typically required for citizenship, which is required in turn for many federal jobs and grants and for security clearance. Green card holders can typically apply to become U.S. citizens after five years of lawful permanent residence.⁸¹

Some noncitizens may be able to naturalize sooner, including legal permanent residents who are veterans and servicemembers on active duty.⁸² The Department of Defense's Military Accessions Vital to the National Interest (MAVNI) program, authorized in 2008, provided a fast track to citizenship for noncitizens *without* green cards who had skills considered "vital to the national interest," such as certain language skills. However, the program was effectively suspended in late 2016 due to national security concerns.⁸³

3 Priority reforms

The United States has long benefited from the contributions of foreign-born students, scholars, engineers, and entrepreneurs.

To continue leading the world in artificial intelligence, the United States must remain the world's top destination for AI talent. But today, to live and work in the United States, immigrants with skills in AI and related fields must contend with limited, costly, and uncertain pathways to temporary or permanent residence and a rapidly deteriorating regulatory and administrative environment. Unsurprisingly, many are beginning to look to other countries instead.

To maintain and extend America's AI edge, policymakers should act quickly to reform the main pathways into the United States for foreign-born talent. In particular, policymakers should:

- Build new immigration pathways for AI students, workers and entrepreneurs
- Fix regulatory and administrative policies that make it harder to recruit and retain AI talent
- Review and revise measures against illicit technology transfer

1 BUILD NEW IMMIGRATION PATHWAYS FOR AI STUDENTS, WORKERS, AND ENTREPRENEURS

The problem

Outdated restrictions and gaps in policy impede the flow of talent into the U.S. AI sector. The annual caps on new H-1B visas and green cards are the most impactful restrictions.⁸⁴ (As previously discussed, because

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Increasingly restrictive immigration policies are systematically depriving our universities of some of the world’s top talent. The U.S. needs to reverse these policies before it’s too late... Providing 10,000 new visas for AI specialists, and more for experts in other STEM fields, would revitalize our country’s research ecosystem, empower our country’s innovation economy, and ensure that the United States remains a world superpower in the coming decades.”

Oren Etzioni, CEO, Allen Institute for Artificial Intelligence,
in a 2019 *Wired* op-ed

green cards are the typical path to naturalization, green card reforms are especially crucial for the federal and defense-related workforce, where U.S. citizenship is often a condition of entry.) These caps are not indexed to population, economic growth, or employment indicators, and they affect AI talent and workers in more routine occupations equally; there's no special exemption for workers in AI or other strategically important industries.

Green card applicants face additional challenges. Application backlogs and the per-country annual caps mean that nationals of oversubscribed countries have to wait years or even decades before being allowed to apply for green cards. These restrictions effectively bar many skilled AI and high-tech workers from a realistic chance at permanent residence, and with each year of delay, more applicants abandon the process and leave the country.⁸⁵ Today, most Chinese nationals would likely wait “only” several years to apply, and citizens of European countries could begin the process right away (although it might take many months or even years to finish it).⁸⁶ But in theory, an Indian national with H-1B status, a recent PhD in machine learning from Stanford and a well-paying position at Microsoft could reasonably expect to wait decades to be allowed to apply for a green card.⁸⁷ (38 percent of all U.S. math and computer science students were born in India, as were 26 percent of Silicon Valley’s technical professionals.⁸⁸)

While AI employees struggle with outdated numerical caps, recent graduates and entrepreneurs face a system that simply ignores them in key respects. Unlike other countries, such as Canada and France, the United States has no dedicated long-term visa for recent graduates, no matter how accomplished they are or how important their skills are to American interests.⁸⁹ STEM OPT provides a few years of work authorization; lacking options after that, foreign AI students who want to stay in the United States (and are willing to endure months or years of uncertainty) typically try their luck at the general H-1B lottery or seek out some other, narrower type of status.⁹⁰ The United States also lacks a temporary visa category or permanent residence track for foreign-born entrepreneurs, whether in AI or other fields.⁹¹ Immigrant startup founders are forced to try to fit into other, unrelated visa categories. Even if a founder is technically able to qualify for one of these categories, securing a visa may entail legal requirements and restrictions that interfere with business activity.⁹²

Effects on startups

The lack of an entrepreneur visa has an obvious impact on AI startups, but the current immigration system undermines entrepreneurs (whether immigrant or native-born) and their companies in other ways. Navigating the system takes time, money, and experience. Smaller and newer companies rarely have the resources to manage the temporary visa process for a potential employee, to pull together extensive documentation for an existing employee's green card application, or to hire outside counsel to help with immigration matters. And startups rarely have the "runway" to wait months or even more than a year for a potential employee's paperwork to clear, or for the annual H-1B lottery to roll around.⁹³

These barriers have serious consequences: a recent study by researchers at Cornell and the University of California, San Diego found that "foreign PhDs who require a work visa are just as likely as US PhDs to apply to and to receive offers for startup jobs, but they are 56% less likely to work in startups."⁹⁴ Unsurprisingly, large tech incumbents account instead for the lion's share of employment-based temporary visas and employer-sponsored green card applications. Smaller players are forced to rely on time-limited, less burdensome programs like OPT, to focus hiring on permanent residents or foreigners who already have H-1B status, or to give up on hiring talented noncitizen employees altogether.⁹⁵

The solutions

Lift restrictions on foreign talent in AI and other emerging fields. Congress should create new exemptions to the caps on H-1B visas and green cards for graduates from top U.S. AI programs, as well as researchers, technologists, and entrepreneurs in AI disciplines.⁹⁶ Alternatively, Congress could establish entirely new temporary visa and green card categories for AI and other emerging technologies. Many other, less strategic industries and groups of workers already benefit from special treatment of this sort.⁹⁷

In addition, or as an alternative, Congress could raise or remove the overall numerical limits on H-1B visas and employment-based green cards. This would benefit AI workers along with the rest of the noncitizen workforce. At a minimum, indexing the caps to population, economic growth, or labor market conditions would be more consistent with current demand for talent.

Finally, consistent with recent bipartisan legislation, Congress should eliminate the annual 7 percent per-country caps on green cards.⁹⁸

Create opportunities through regulation. The Executive Branch can also create and expand immigration opportunities for AI talent through regulatory policy. For example:

- USCIS should update the criteria used to determine “extraordinary ability,” a prerequisite for O-1 temporary visas and EB-1 green cards, to better cover highly skilled workers, scholars, and entrepreneurs in AI and other strategic fields.⁹⁹ This would allow those individuals uncapped, renewable temporary status and faster paths to permanent residence.
- The Secretary of Homeland Security should issue a determination making foreign-born AI workers categorically eligible for “national interest waivers.” This would let those workers apply for employment-based green cards without first lining up U.S. employers to sponsor them and conduct complicated labor market analyses on their behalf.¹⁰⁰ In turn, it would shorten and simplify the green card process for AI talent; however, the ultimate benefit would be limited because the overall and per-country numerical caps would continue to constrain annual numbers.
- The Department of Defense should explore reopening the MAVNI accelerated naturalization program and expanding it to include immigrants with AI skills.¹⁰¹
- USCIS, the Department of State and U.S. Immigration and Customs Enforcement should consider providing dedicated resources for noncitizens specializing in AI and other strategic fields, such as a “concierge service” or fast-track process.¹⁰² They should also educate adjudicators and con-

sular officers about the particularities of AI jobs, employers, and degree programs. This would help reduce bureaucratic misunderstandings, which often contribute to processing delays. For example, adjudicators might erroneously think that only computer science graduates have the education required for AI jobs, and deny H-1B visas to AI specialists who studied other disciplines – even though many top AI engineers originally studied physics, philosophy, and other subjects.¹⁰³

Expand or reallocate?

Although leading employers generally support higher immigration caps (or no caps at all), many critics of current policy instead suggest reallocating some green cards and temporary visas away from spouses, children, refugees, and others not admitted on the basis of skill and toward high-skilled workers, without increasing overall numbers.¹⁰⁴ However, current quotas are low enough that just reallocating some visas may not be enough to meet the America's talent needs in AI and other strategic industries. Foreign-born AI and STEM workers also have families of their own; preventing them from sponsoring family members would make the United States less attractive.

In addition, many immigrants admitted for reasons other than skill are skilled and educated nonetheless.¹⁰⁵ For example, in 2015, about 47% of noncitizens who received green cards in the family-based and diversity categories were college-educated, compared with roughly 29% of native-born citizens.¹⁰⁶ Other immigrants may have talents that blossom in the United States; Google's co-founder, Sergei Brin, arrived in the United States as a child refugee.¹⁰⁷ Reallocating visas away from "unskilled" immigration could therefore prevent many talented individuals from joining the U.S. AI sector. And finally, as MIT president Rafael Reif has observed, policies that "close the door" to immigrants, even if not targeted at high-skilled immigrants, nevertheless project an image that may deter immigrants of all sorts from choosing the United States.¹⁰⁸

For these reasons, higher overall thresholds on immigration, rather than reallocation within existing limits, would best serve the U.S. AI sector. That said, policy-makers should be aware that some reallocation proposals would likely benefit the AI sector to a degree, while others would have an uncertain or negative effect:

Expand or reallocate? continued..

- Allocating visas to AI workers specifically would directly help the AI sector.
- Favoring applicants with higher-paying jobs would indirectly help the AI sector, since AI employers generally offer higher salaries in connection with H-1B and green card sponsorship than employers in other industries.¹⁰⁹
- Tightening the regulatory threshold for H-1B qualifying “specialty occupations” to exclude routine IT work, as the current administration has proposed,¹¹⁰ could benefit AI employers at the expense of IT staffing companies, depending on the definitions used.
- Reallocating green cards currently distributed in the diversity lottery¹¹¹ to skilled workers would probably benefit the AI sector, since the major source nationalities for foreign-born STEM and AI workers aren't currently eligible for diversity visas.
- Giving preferences to U.S.-educated workers or graduate degree holders, another popular proposal,¹¹² would have an uncertain effect on the AI sector. Some talented AI specialists lack graduate degrees or were educated abroad and would be disfavored under this proposal. In addition, as foreign universities increasingly develop top-tier programs,¹¹³ AI workers will become less likely to have been educated in the United States, so a policy favoring U.S. universities could narrow the talent pool available to U.S. employers.

2 FIX REGULATORY AND ADMINISTRATIVE POLICIES THAT MAKE IT HARDER TO RECRUIT AND RETAIN AI TALENT

The problem

Immigrating to a new country is always challenging, and the complex provisions of U.S. immigration statutes add further friction to the process. But even apart from these structural factors, the regulatory and administrative system that implements U.S. immigration law is a significant obstacle to foreign AI students, workers, and entrepreneurs hoping to move to the United States.

Much of this damage is recent. To be sure, many of the regulations and agency practices causing problems today have existed for years or decades, and many of this paper's recommendations relate to these long-standing policies. Fluctuations in the relevant agencies' caseload may also play a role.¹¹⁴ But beyond these factors, the current administration's approach toward immigration has made it significantly

Kollol Das, a former electronic engineer and gaming startup founder from India who now specializes in machine learning, was offered two high-skilled tech jobs last fall, one based in New York and one based in Toronto.

He immediately chose the latter.

The H-1B process in the United States could have taken six months or longer, while the entire process in Canada – from being offered the position to moving to Toronto – took him less than two months. The visa portion of the process took about a week.

“The fact that the whole process is so long made it so that I didn’t even think further ahead,” said Das, who is currently a research lead at Sensibill, a Toronto-based financial services company that uses big data. Had the immigration process been the same? “Then I might have looked more at the kind of role I’d have in each place.”

Vox, March 19, 2019

more difficult to attract and retain foreign AI and STEM talent. In the past two years, the administration has enacted a slew of restrictive policies aimed directly at immigration by foreign students and high-skilled workers. More are in the wings.¹¹⁵ These policies have prompted pushback from foreign nationals and their schools and employers,¹¹⁶ frustrated companies seeking to recruit foreign-born talent,¹¹⁷ and contributed to a rash of well-publicized immigration horror stories involving high-skilled STEM students, workers and entrepreneurs.¹¹⁸

No change of course is in sight. Although the President has sometimes spoken positively about high-skilled immigration,¹¹⁹ the administration continues to enact new, restrictive policies and adjudicatory practices, and the federal immigration agencies have closed long-standing informal lines of communication with universities, employers, and professional groups. Processing delays are getting worse, prompting bipartisan concern in Congress; USCIS has a backlog of millions of cases and counting, and processing times for many key forms have increased significantly.¹²⁰ USCIS leadership has publicly conceded that recent policy changes, such as sweeping new interview requirements for many applicants, are contributing to these delays.¹²¹ Amid continuing uncertainty and mounting costs, some STEM employers have had to give up on international hiring altogether.¹²²

Effects on labor mobility

Because H-1B visas and employment-based green card applications are employer-sponsored and job-specific, a noncitizen AI worker who changes employers or jobs can lose her H-1B status or her position in the green card application queue. USCIS and the Department of Labor can approve job changes in some cases,¹²³ but even if a worker is eligible, the process requires significant time, money, and effort. It also involves subjective agency judgments, such as whether the new position is in the “same or a similar occupational classification” as the old position, or whether the new position is in a “specialty occupation.”¹²⁴

Given these barriers and recent trends toward harsher and less predictable adjudication, many employers are reluctant to accommodate foreign-born employees who want to change jobs, or to consider hiring them from other companies. And many would-be job changers are understandably afraid to risk another round with the bureaucracy. As a result, these employees often end up stuck working in their initial positions, even if much better opportunities appear elsewhere.¹²⁵

By limiting worker mobility, the current U.S. immigration system is creating a frustrating and unsustainable environment for AI workers, making them less inclined to stay and contribute to the United States over time. And at a macro level, because labor mobility is an important driver of productivity and innovation, it is also likely affecting the general health of the U.S. AI sector.¹²⁶

The solutions

Overhaul the regulatory agenda. The relevant federal agencies should revise problematic regulations and guidance, whether recent or long-standing, and abandon proposals that would create new barriers for AI talent:

- The administration should formally abandon plans to eliminate or restrict the Optional Practical Training program.¹²⁷ Any cuts to OPT would immediately disrupt the STEM student-to-workforce pipeline, with serious consequences for AI employers, and should be avoided. The administration should also vigorously defend the program in ongoing litigation challenging its legality.¹²⁸
- USCIS should withdraw its proposal to eliminate the 2016 International Entrepreneur Rule (IER), and USCIS should implement the rule.¹²⁹ The IER would allow many foreign-born startup founders to stay and work in the United States under the parole provisions of the Immigration and National-

ity Act.¹³⁰ This would partially fill the gap in options for immigrant entrepreneurs under existing law.

- USCIS should rescind, or Congress should override, its October 2017 guidance announcing that adjudicators can no longer defer to prior determinations of eligibility for H-1Bs and other temporary visa categories, including in the context of routine extensions.¹³¹ This guidance is contributing to a sharply higher rate of adjudicator requests for evidence (RFEs), making the immigration process much longer, costlier, and more uncertain.¹³² One tech industry group asserts that RFEs have “exponentially increased” and are “driv[ing] much longer timelines. . . . the RFEs USCIS currently issues are quite voluminous and require weeks if not months to prepare an effective response.”¹³³
- USCIS and DOS should withdraw recent policies requiring time- and resource-intensive in-person interviews for lower-risk employment-based green card applications and visa renewals.¹³⁴
- F-1 student status should continue as long as the student is studying in the United States; USCIS should not impose a years-based time limit, as the administration recently proposed.¹³⁵
- USCIS should withdraw its new policy that students who fall out of legal status (even if unknowingly or accidentally) are immediately deemed “unlawfully present,” which could result in their being barred from returning to the United States or obtaining a green card in the future.¹³⁶
- The administration should withdraw its plan to end work authorization for spouses of H-1B workers seeking employment-based green cards.¹³⁷ If enacted, this measure would reduce household incomes and increase uncertainty for many immigrant tech workers. Ending spousal work authorization would be especially harmful to immigrants in Silicon Valley and other AI hubs with high costs of living.¹³⁸
- USCIS and DOS should revise outdated reentry and travel restrictions for academics with J-1 status.¹³⁹ These policies date back decades to an era when visiting academics were less likely to frequently move in and out of the United States for meetings, conferences, and projects. Today, progress in AI relies on continuous international collaboration, and foreign-born, U.S.-based AI scholars need to be able to travel to some degree without losing their immigration status.¹⁴⁰
- USCIS should enact regulations allowing spouses and dependents of more senior F visa holders (e.g., PhD students) to work in the United States.¹⁴¹

Increase Congressional oversight. Congress should conduct hearings both to determine the agency policies that contribute most to backlogs at USCIS and the State Department, and to gain a more granular understanding of how current policy is affecting inflows of AI and STEM talent into the United States. If the relevant agencies fail to revise regulations and regulatory proposals that impede the inflow of AI and STEM talent, Congress should also enact legislation to block or override them. For example, if necessary, Congress should codify the current features of the OPT program.¹⁴²

Finally, although regulatory change is essential, many of the root causes of current problems are statutory. Congress should reform features in current law that create structural delays affecting AI workers, especially the annual and per-country caps for green cards and the annual H-1B cap.

3 REVIEW AND REVISE MEASURES AGAINST ILLICIT TECHNOLOGY TRANSFER

The problem

In response to concerns over illicit technology transfer and other security threats, especially by China,¹⁴³ federal agencies have increased security and counterintelligence measures within the immigration system and implemented “extreme vetting” of foreign nationals, including students and those in the employment-based immigration process.¹⁴⁴ Examples include new requirements for in-person interviews for broad categories of foreign nationals,¹⁴⁵ as well as sweeping travel and visa duration restrictions for Chinese students and scholars in certain fields.¹⁴⁶ Some have even proposed banning certain groups, such as Chinese STEM students, from the United States altogether.¹⁴⁷ At the same time, reports of mounting delays in the interagency security review process for visa applicants, known as the Security Advisory Opinion (SAO) program or “administrative processing,” may reflect increased scrutiny by the participating agencies, more referrals of visa applicants into the process, or both.¹⁴⁸

Taking national security seriously requires maintaining an accessible and efficient immigration system for the world’s leading AI talents *and* deploying targeted, properly-supported measures to protect America’s technological assets. Any sustainable strategy to prevent illicit technology transfer must consider both costs and benefits. To be sure, illicit technology transfer is a serious threat to the United States, and foreign nationals are sometimes to blame.¹⁴⁹ But for the most part, immigration policy is too blunt an instrument to use against the technology transfer threat. The national security benefits of current “extreme vetting” measures are uncertain, but they are clearly and seriously harming the U.S. AI sector.

“

Hottest topic among U.S.-based well-edu[cated] Chinese friends these days: how to migrate to Australia or Canada. Work in finance, int’l dev, IT, science...live in US 5+yrs but decide it’s time to give up on its immigration system filled [with] uncertainties, & in some cases, hostilities.”

Tweet posted by Zhaoyin Feng, a U.S.-based BBC correspondent, May 23, 2019

Broad-brush, resource-intensive “extreme vetting” policies in the immigration system make the process slower, costlier, and less predictable, increasing burdens on applicants and sponsors and causing widespread fear and disillusionment among foreign students and workers.¹⁵⁰ In turn, these measures disrupt AI research and limit the ability of the United States to attract the talent it needs to maintain leadership in AI.¹⁵¹ These trends pose national security risks to the United States – risks no less serious or urgent than IP theft.

As for the benefits, there is little public evidence that many current security measures within the immigration system are materially contributing to national security. Because this analysis is limited to open-source data, it’s not possible to conclude that current measures are ineffective overall: many of them are confidential, and details about publicly known measures and their results are scarce. It’s also unclear whether the relevant agencies compile data on outcomes in any meaningful way.

Nonetheless, what is known about the benefits is not encouraging. Recent publicly-disclosed security measures in the immigration system have swept broadly, targeting entire nationalities, disciplines, and visa types. Given the sheer numbers involved and the inherent difficulties of finding needles in haystacks, these measures are unlikely to be effective, especially when compared to measures outside the immigration system, such as enhanced cybersecurity efforts. With regard to Chinese students and scholars in particular, one senior intelligence community veteran explains:

The [screening] process will almost certainly fail at determining an individual’s future course of action. Few scholars come to the U.S.

with the premeditated intention of stealing technology that has, quite likely, yet to be invented. Also, there are 360,000 Chinese scholars and students in the U.S. Given the number of cases that have come into the American judicial and regulatory system it is unlikely that even one percent are involved in technology theft. American principles are that we don't judge an entire group by the actions of a very few.¹⁵²

The solutions

Focus efforts outside the immigration system. Many, if not most, of the vectors of illicit technology transfer are known.¹⁵³ DOS and its peer national security agencies should use investigatory, prosecutorial, and defensive tools *outside* the immigration system to target these specific bad actors and practices. The CSET paper *China's Access to Foreign AI Technology – An Assessment* explains these recommendations in greater depth with respect to China specifically.¹⁵⁴

As for security measures *within* the immigration system, further research is needed. Congress and the Executive Branch should thoroughly review existing safeguards, including the consular process and the SAO process. At the same time, the federal immigration agencies should reconsider and – where possible – narrow security measures in the immigration system that apply by default to large categories of noncitizens (e.g., nationality), such as broad interview requirements and entry-exit restrictions.

DOS should also increase transparency in the SAO process (to the extent possible given security needs) and impose clear time limits for interagency responses to SAO inquiries.¹⁵⁵ Finally, DOS should provide more resources and personnel, including scientifically trained personnel, for SAOs and other immigration-related security processes.¹⁵⁶

4 Next Steps

In the coming months, CSET plans to extend this preliminary analysis by:

- Collecting and analyzing agency data. Through Freedom of Information Act requests, CSET is seeking data on AI workers' interactions with the immigration system with the relevant federal agencies. CSET will continue to pursue these data and will integrate them into this analysis as they become available.
- Looking to other countries. CSET will publish a review of immigration policies in other countries and their impact on those countries' recruitment and retention of AI talent.
- Surveying AI stakeholders. CSET will survey AI students, scholars, workers, entrepreneurs and employers to gain a more detailed understanding of how the immigration system affects them.
- Researching the public sector's AI needs. CSET is working to understand the AI talent needs of U.S. defense and civilian agencies, the obstacles preventing these agencies from recruiting and retaining workers with AI expertise, and the most urgent policy reforms to help them compete for citizen and noncitizen AI talent while protecting national security.

CSET welcomes feedback on its research agenda. Please contact zachary.arnold@georgetown.edu with any suggestions.

Endnotes

1. We use the term “immigrants” colloquially in this paper. U.S. immigration law distinguishes between permanent “immigrants” (i.e., green card holders) and temporary “nonimmigrants.” See “What is the Difference Between and Immigrant Visa vs. Nonimmigrant Visa?”, U.S. Customs and Border Protection, https://help.cbp.gov/app/answers/detail/a_id/72/~/_/what-is-the-difference-between-an-immigrant-visa-vs.-nonimmigrant-visa-%3F.
2. Stephen Ross Yeaple, “The Innovation Activities of Multinational Enterprises and the Demand for Skilled-Worker, Nonimmigrant Visas,” in *High-Skilled Migration to the United States and its Economic Consequences*, (University of Chicago Press, 2018), 43, 57.
3. Benjamin Stupples, “Refused U.S. Visa Eight Times, Zoom CEO Is Now a Billionaire,” *Bloomberg*, April 18, 2019, <https://www.bloomberg.com/news/articles/2019-04-18/u-s-refused-his-visa-eight-times-now-zoom-ceo-is-a-billionaire>; Ian Hathaway, “Almost Half of Fortune 500 Companies Were Founded By American Immigrants or Their Children,” Brookings Institution, published December 4, 2017, <https://www.brookings.edu/blog/the-avenue/2017/12/04/almost-half-of-fortune-500-companies-were-founded-by-american-immigrants-or-their-children/>. See generally Sari Pekkala Kerr, William Kerr, Çağlar Özden, and Christopher Parsons, “High-Skilled Migration and Agglomeration,” *Annual Review of Economics* 9, (August 2017), section 6; Stuart Anderson, “International Students Who Started Billion-Dollar Companies,” *Frontlines*, July & August 2016, http://www.nafsa.org/_/File/_/ie_julaug16_frontlines.pdf.
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5. In referring to “AI talent” and similar terms in this paper, we include students, scholars, private-sector employees and entrepreneurs who work or study in organizations with significant AI activity (e.g., tech companies, startups, universities, nonprofit research institutions) and whose individual efforts contribute substantively to the development of AI technologies (e.g., machine learning software, computer vision systems, autonomous vehicles). There is no commonly accepted definition of the AI workforce. See Remco Zwetsloot et al., “Strengthening the AI Workforce” (March 2019) (previously provided to NSCAI).
6. Nir Jaimovich and Henry E. Siu, “High-Skilled Immigration, STEM Employment, and Nonroutine-Biased Technical Change,” in *High-Skilled Migration to the United States and its Economic Consequences* (University of Chicago Press, 2018), 177 (“A rough summary of the literature is that there is mixed or little evidence that such displacement [of native workers] exists.”) See also Kerr et al, “High-Skilled Migration and Agglomeration,” section 6 (“[S]tudies that look at variations across cities and regions tend to find results very consistent with agglomeration economies, quantifying the fact that high-skilled migrants boost innovation and productivity outcomes. These studies also rarely find adverse wage and employment consequences, and longer time horizons tend to show greater gains There are, however, some disagreements on the overall positive effects of high-skilled immigration on native workers.”).
7. See, e.g., Bruce Anderson, “LinkedIn’s 2018 US Emerging Jobs Report,” LinkedIn, published December 13, 2018, <https://business.linkedin.com/talent-solutions/blog/trends-and-research/2018/linkedin-emerging-jobs-report-2018>; Shelly Hagan, “These Are the Highest Paying Jobs for the Class of 2019,” *Bloomberg*, May 15, 2019, <https://www.bloomberg.com/news/articles/2019-05-15/big-data-skills-earn-high-pay-for-today-s-college-graduates>; Julianne Pepitone, “Where the Engineering Jobs are in 2019,” *IEEE Spectrum*, May 21, 2019, <https://spectrum.ieee.org/at-work/tech-careers/where-the-engineering-jobs-are-in-2019>. See also “Global AI Talent Report 2018,” 2018, <https://ifgagne.ai/talent/>.
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11. See generally Vivek Wadhwa, *The Immigrant Exodus* (Wharton Digital Press, 2012), 43-46; Iris Deng, “China’s AI Industry Gets the Most Funding, But Lags the US in Key Talent, Says Tsinghua,” *South China Morning Post*, July 17, 2018, <https://www.scmp.com/tech/china-tech/article/2155600/chinas-ai-industry-gets-most-funding-lags-us-key-talent-says>; “How Canada Became a Hotspot for Artificial Intelligence Research,” *DMZ: theReview*, <https://dmz.ryerson.ca/artificial-intelligence/>; Cade Metz and Adam Satariano, “Silicon Valley’s Giants Take Their Talent Hunt to Cambridge,” *The New York Times*, July 3, 2018, <https://www.nytimes.com/2018/07/03/technology/cambridge-artificial-intelligence.html>; Meng Jing, “Why Trump’s Clampdown on Academia is Forcing Many Chinese Researchers into a Difficult Corner,” *South China Morning Post*, June 13, 2019, <https://www.scmp.com/tech/policy/article/3014185/why-trumps-clampdown-academia-forcing-many-chinese-researchers>. See also Shulamit Kahn and Megan MacGarvie, “The Impact of Permanent Residency Delays for STEM PhDs: Who Leaves and Why,” NBER Working Paper No. 25175, October 2018, <https://www.nber.org/papers/w25175> (concluding that “the growth of science in countries of origin has an important influence on stay rates”).

12. Figure derived from CSET analysis of Crunchbase data.

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[processing-times/](#) (tabs for Form I-129, Petition for a Nonimmigrant Worker). USCIS offers 15-day “premium processing” for a \$1,410 fee, but this option has repeatedly been suspended in recent years. See, e.g., “Premium Processing Begins for Certain Cap-Subject H-1B Petitions on May 20,” U.S. Citizenship and Immigration Services, published March 29, 2019, <https://www.uscis.gov/news/alerts/premium-processing-begins-certain-cap-subject-h-1b-petitions-may-20>. Cap-subject applicants are bound by the government’s H-1B authorization cycle, which can add further delays. Employees selected in the April lottery can only start working once the new federal fiscal year begins in October. See generally “H-1B Cap Resource Page,” NAFSA, last modified May 18, 2019, https://www.nafsa.org/Professional_Resources/Browse_by_Interest/International_Students_and_Scholars/H-1B_Cap_Resource_Page/.

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25. See, e.g., Tom Spring, “RSA Conference 2019: Cryptographers’ Panel Decries Adi Shamir’s Visa Issues,”

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27. Oren Etzioni, “What Trump’s Executive Order on AI is Missing,” *Wired*, February 13, 2019, <https://www.wired.com/story/what-trumps-executive-order-on-ai-is-missing/>.
28. Ian Goodfellow (@goodfellow_ian), “I emphatically agree. My collaborators’ visa restrictions have been one of the largest bottlenecks to our collective research productivity over the last few years,” Twitter, February 13, 2019, https://twitter.com/goodfellow_ian/status/1095727254057840640.
29. L. Rafael Reif, “Immigration is a kind of oxygen,” published June 25, 2019, <https://president.mit.edu/speeches-writing/immigration-kind-oxygen>.
30. See generally “The Importance of International Students to American Science and Engineering,” National Foundation for American Policy, published October 2017, <https://nfap.com/wp-content/uploads/2017/10/The-Importance-of-International-Students.NFAP-Policy-Brief.October-20171.pdf>.
31. In this paper, we use the term “visa” colloquially, i.e., to describe a legal right to be physically present in the United States or a document conferring that right. Technically speaking, a visa is a document allowing a noncitizen to travel to a port of entry to seek admission to the U.S. The separate right to be present in the U.S. is often referred to as “legal status” or just “status.” See, e.g., “Student Visa vs. Student Status: What is the Difference?,” Department of Homeland Security, last modified January 27, 2016, <https://studyinthestates.dhs.gov/2016/01/student-visa-vs-student-status-what-is-the-difference>.
32. See 8 USC § 1101(a)(15)(F)(i); 8 CFR §§ 214.2(f)(5), (9)-(12).
33. Julie Baer, Rajika Bhandari, Natalya Andrejko, and Leah Mason, *Open Doors 2018* (Institute of International Education, 2018), 27.
34. Stuart Zweben and Betsy Bizot, *2017 CRA Taulbee Survey* (Computing Research Association, May 2018), <https://cra.org/wp-content/uploads/2018/05/2017-Taulbee-Survey-Report.pdf>.
35. Table 1 is based on CSET’s analysis of Department of Homeland Security and Department of State data from recent years. Unless otherwise noted, numbers of entrants with technical skills are CSET’s provisional estimates derived from aggregate figures for corresponding or similar visa categories. Estimates of entrants with significant AI skills are also based in part on a July 2019 expert poll conducted by CSET on the overall prevalence of AI skills in the tech workforce.
36. Estimate based on figures reported in Ruiz and Budiman, “Number of Foreign College Graduates Staying in US to Work Climbed Again in 2017, but Growth Has Slowed.”
37. Estimate based on figures reported in Ruiz and Budiman, “Number of Foreign College Graduates Staying in US to Work Climbed Again in 2017, but Growth Has Slowed,” and Neil G. Ruiz and Abby Budiman, “Number of Foreign College Students Staying and Working in U.S. After Graduation Surges,” Pew Research Center, published May 10, 2018, <https://www.pewresearch.org/global/2018/05/10/number-of-foreign-college-students-staying-and-working-in-u-s-after-graduation-surges/> (STEM students and graduates accounted for 53% of OPT approvals from 2008 to 2016).
38. Estimate based on Ruiz and Budiman, “Number of Foreign College Graduates Staying in US to Work Climbed Again in 2017, but Growth Has Slowed,” Ruiz and Budiman, “Number of Foreign College Students Staying and Working in U.S. After Graduation Surges,” and figures reported in Baer et al., *Open Doors 2018*, 29-30.
39. See Department of Homeland Security, “Characteristics of H-1B Specialty Occupation Workers,” published

- April 2018, https://www.uscis.gov/sites/default/files/files/nativedocuments/Characteristics_of_H-1B_Specialty_Occupation_Workers_FY17.pdf, 5.
40. CSET estimate based on figures in Department of Homeland Security, "Characteristics of H-1B Specialty Occupation Workers," 12.
41. Department of State, <https://travel.state.gov/content/dam/visas/Statistics/AnnualReports/FY2018AnnualReport/FY18AnnualReport%20-%20TableXVIB.pdf>.
42. CSET estimate based on figures reported in "Participant and Sponsor Totals 2018," Department of State, <https://j1visa.state.gov/basics/facts-and-figures/participant-and-sponsor-totals-2018>.
43. See discussion in "Other temporary pathways" section on page 8.
44. Estimate derived from total annual issuance of O-1 visas; see "FY2018 Annual Report - Table XVI(B)."
45. CSET estimate obtained by multiplying the total yearly cap on employment-based green cards (140,000) by a 46% proportion of principal applicants. See discussion in "Permanent residents" section on page 9.
46. Department of Homeland Security, "Characteristics of H-1B Specialty Occupation Workers," 5. This figure excludes renewals, but includes cap-exempt petitions. Precise figures for the "stock" of H-1B workers in the U.S. are not available, but the number is probably on the order of several hundred thousand. See Daniel Costa and Jennifer Rosenbaum, "Temporary Foreign Workers by the Numbers," Economic Policy Institute, published March 7, 2017, <https://www.epi.org/publication/temporary-foreign-workers-by-the-numbers-new-estimates-by-visa-classification/> (estimating about 460,000 H-1B workers as of 2013).
47. 8 USC § 1101(a)(15)(H)(i)(B). "Specialty occupations" are defined in 8 USC § 1184(i) and 8 CFR § 214.2(h)(4)(iii).
48. Department of Homeland Security, "Characteristics of H-1B Specialty Occupation Workers," 6, 12.
49. See discussion in "Permanent residents" section on page 9.
50. 8 USC § 1184(g).
51. See 8 C.F.R. § 214.2(h)(8)(iii); Stuart Anderson, "H-1B Visas All Gone For 16th Straight Year," *Forbes*, April 23, 2018, <https://www.forbes.com/sites/stuartanderson/2018/04/23/h-1b-visas-all-gone-for-16th-straight-year/#900f7786b04c>.
52. Cited in Declaration of Patrick Duffy, ECF #37-3 at 4, *Washington Alliance of Technology Workers v. Dep't of Homeland Security*, No. 16-cv-1170 (D.D.C., October 18, 2018) (hereinafter "Duffy Declaration").
53. See, e.g., Testimony by Dr. Ronil Hira, U.S. Congress, Senate, Judiciary Committee, *Immigration Reforms Needed to Protect Skilled American Workers*, 114th Congress, March 17, 2015, <https://www.judiciary.senate.gov/imo/media/doc/Hira%20Testimony.pdf>; Haeyoun Park, "How Outsourcing Companies Are Gaming the Visa System," *New York Times*, November 10, 2015, <https://www.nytimes.com/interactive/2015/11/06/us/outsourcing-companies-dominate-h1b-visas.html>.
54. In this preliminary paper, we focus on private companies with recognized expertise or substantial investment in artificial intelligence, as documented in publicly available analyses. Accordingly, we provisionally define "companies with active AI programs" to include (1) companies that have been identified in the Crunchbase database as specializing in AI and that (a) are publicly listed, (b) have 50 or more employees, or (c) have raised at least \$10 million in funding; (2) leading AI startups, as identified by market research firm CB Insights; and (3) companies that are especially active in hiring personnel with AI skills, as identified by market research firm Paysa. See "AI 100: The Artificial Intelligence Startups Redefining Industries," CB Insights, published February 6, 2019, <https://www.cbinsights.com/research/artificial-intelligence-top-startups/>; Paysa, "Learning and the Machine," published April 2017, <https://www.paysa.com/blog/wp-content/uploads/2017/04/Paysa-AI-Tech-Investment.pdf>.
55. Based on CSET's analysis of approved H-1B initial application counts listed in the USCIS H-1B Employer Data Hub (<https://www.uscis.gov/h-1b-data-hub>) (last accessed April 23, 2019).

56. Based on CSET's analysis of median wages offered to H-1B employees by the top 50 users of the H-1B program in 2018, as reflected in "Approved H-1B Petitions by Employer (Fiscal Year 2018: Oct. 1, 2018-Sept. 30, 2018)," U.S. Citizenship and Immigration Services, published March 27, 2019, <https://www.uscis.gov/sites/default/files/USCIS/Data/Employment-based/H-1B/approved-h-1b-petitions-by-employer-fy-2018.csv>.

57. Based on CSET's analysis of approved H-1B initial applications from 2015-2019 and approved, non-expired PERM labor certification records over the same period. See notes 55 and 80 for sources and discussion.

58. 8 C.F.R. § 214.2(f)(10)(ii).

59. Ruiz and Budiman, "Number of Foreign College Graduates Staying in US to Work Climbed Again in 2017, but Growth Has Slowed."

60. Figure derived from CSET analysis of Immigration and Customs Enforcement data. On our provisional definition of "companies with active AI programs," see note 54.

61. See Duffy Declaration at 4.

62. See Duffy Declaration at 4-5.

63. 8 USC § 1101(a)(15)(J); 22 CFR §§ 62.3-4, 62.20-21; Baer et al, *Open Doors*, 109.

64. 8 USC § 1101(a)(15)(J); 22 CFR §§ 62.20-21. See generally Hannas, Mulvenon, and Puglisi, *Chinese Industrial Espionage*, 145-46; "12- and 24-Month Bars for Professors and Research Scholars," University of Michigan, <https://internationalcenter.umich.edu/scholars/j1-scholars/12-and-24-bars>.

65. See Roy Maurer, "What Employers Need to Know About the J-1 Visa for Interns and Trainees," Society for Human Resources Management, published January 29, 2018, <https://www.shrm.org/resourcesandtools/hr-topics/talent-acquisition/pages/j1-visa-interns-trainees-hr.aspx>.

66. CSET estimates based on State Department Exchange Visitor Program data.

67. 8 USC §§ 1101(a)(15)(L); 8 CFR § 214.2(l).

68. USCIS, "Approved L-1 Petitions by Employer - FY2018," published December 2018, https://www.uscis.gov/sites/default/files/USCIS/Resources/Reports%20and%20Studies/Immigration%20Forms%20Data/BAHA/L1_FY18_Approved_Petitions_021919.pdf. The exact number of new entrants in the specialized worker category was not disclosed.

69. See discussion in Costa and Rosenbaum, "Temporary Foreign Workers by the Numbers." The Department of State reported issuing about 74,000 L-1 visas in FY2018, so the total number of participants could not have been higher than that. See "FY2018 Annual Report - Table XVI(B)."

70. See generally 8 USC § 1101(a)(15)(O); 8 CFR § 214.2(o)(3).

71. 8 CFR §§ 214.2(o)(6)(iii)(A), 214.2(o)(12).

72. See "FY2018 Annual Report - Table XVI(B)." The State Department figures include, among others, visas that were issued but never actually used and multiple visas issued to the same individual.

73. Applicants who meet "extraordinary ability" criteria or who receive national interest waivers can "self-sponsor." See discussion in Section 3.1.

74. 8 USC § 1153(c); 22 CFR § 42.33. Specifically, the diversity lottery is closed to nationals of any country that sent more than 50,000 green card recipients in the preceding five years. In the most recent lottery, for example, nationals of China, India, Canada and Mexico (among others) were excluded. The 2017 lottery saw 22.4 million applications for 50,000 slots. See Phillip Connor, "Applications for US Diversity Visa Lottery Remained Near Record in 2017," Pew Research Center, published August 23, 2018, <https://www.pewresearch.org/fact-tank/2018/08/23/applications-for-u-s-visa-lottery-more-than-doubled-since-2007>.

75. For example, foreign nationals' children may make valuable contributions to the AI sector once they join the workforce. For example, the founders of Google and Nvidia both came to the United States as children. See also Rani Molla, "More than Half of the Most Valuable US Tech Companies Were Founded by First- or Second-

Generation Immigrants,” Vox, May 30, 2018, <https://www.vox.com/2018/5/30/17385226/kleiner-perkins-mary-meeke-immigration-tech-founders-jobs-slides-code-conference> (companies founded by second-generation immigrants include Apple, Amazon, and Oracle).

76. 8 USC § 1151 (d). The 140,000 cap is adjusted upward by the number of family-based green cards not claimed in the prior year's lottery, if any. *Id.*

77. 8 USC § 1153(b).

78. 8 USC § 1152(a); *Annual Flow Report: Lawful Permanent Residents*, U.S. Department of Homeland Security (August 2018, 3), https://www.dhs.gov/sites/default/files/publications/Lawful_Permanent_Residents_2017.pdf.

79. Figure derived from CSET analysis of Department of Homeland Security statistics; see “Table 7. Persons Obtaining Lawful Permanent Resident Status by Type and Detailed Class of Admission: Fiscal Year 2017,” Department of Homeland Security, last modified October 2, 2018, <https://www.dhs.gov/immigration-statistics/yearbook/2017/table7>. See 8 USC § 1153(d); Alex Nowrasteh, “Employment-Based Green Cards Are Mostly Used by Family Members,” *Cato at Liberty*, July 7, 2016, <https://www.cato.org/blog/employment-based-green-cards-are-mostly-used-family-members>; Memorandum and Opinion, ECF #31, *Wang v. Pompeo*, No. 18-cv-1732 (D.D.C., December 6, 2018), available at <https://www.courtlistener.com/recap/gov.uscourts.dcd.198784/gov.uscourts.dcd.198784.31.0.pdf> (rejecting an argument that the Immigration and Nationality Act should be interpreted not to include spouses and children toward the caps).

80. Figures derived from CSET analysis of Department of Labor PERM records; see “OFLC Performance Data,” U.S. Department of Labor, <https://www.foreignlaborcert.doleta.gov/performance/cfm>. On our provisional definition of “companies with active AI programs,” see note 54. For employers, the PERM process “involves a set of technical, expensive, and highly time-consuming steps [and] complex strategies that extend over a period of typically six to eight months,” so it is likely they only complete the process for employees with a strong chance of obtaining green cards and staying employed in the United States. See Anna Angel, “5 Key Considerations When Initiating a PERM Labor Certification for Your Employee,” Ogletree Deakins, published June 9, 2017, <https://ogletree.com/insights/2017-06-09/5-key-considerations-when-initiating-a-perm-labor-certification-for-your-employee/>.

81. See generally 8 USC § 1427.

82. See 10 USC § 504(b)(2); William A. Kandel and Lawrence Kapp, *Expedited Citizenship through Military Service*, (Congressional Research Service, August 23, 2018), available at <https://fas.org/sgp/crs/homsec/IF10884.pdf>.

83. Kandel and Kapp, *Expedited Citizenship through Military Service*; Dave Philips, “Army Suspends Its Purge of Immigrant Recruits,” *The New York Times*, August 9, 2018, <https://www.nytimes.com/2018/08/09/us/mavni-program-army-discharge-immigrants.html>; Tara Copp, “Here’s the Bottom Line on the Future of MAVNI: Many Foreign-Born Recruits May Soon be Out,” *The Military Times*, July 6, 2018, <https://www.militarytimes.com/news/your-military/2018/07/06/heres-the-bottom-line-on-the-future-of-mavni-many-foreign-born-recruits-may-soon-be-out>.

84. See, e.g., Shulamit Kahn and Megan MacGarvie, NBER Working Paper Series, “The Impact of Permanent Residency Delays for STEM PhDs: Who Leaves and Why,” October 2018, <https://www.nber.org/papers/w25175.pdf>; Anna Maria Mayda, Francesc Ortega, Giovanni Peric, Kevin Shihd, and Chad Sparbere, “The Effect of the H-1B Quota on the Employment and Selection of Foreign-born Labor,” *European Economic Review* 108 (September 2018) (the 2004 H1B cap reduction significantly reduced H1B hiring overall, although no effect was apparent for certain subsets of the workforce, including computer-related occupations in the aggregate).

85. Kahn and MacGarvie, “The Impact of Permanent Residency Delays for STEM PhDs: Who Leaves and Why.”

86. David Bier, “Immigration Wait Times from Quotas Have Doubled: Green Card Backlogs Are Long, Growing, and Inequitable,” *Cato at Liberty*, June 18, 2019, <https://www.cato.org/publications/policy-analysis/immigration-wait-times-quotas-have-doubled-green-card-backlogs-are-long>.

87. See Bier, “Immigration Wait Times from Quotas Have Doubled: Green Card Backlogs Are Long, Growing, and

Inequitable.” As of April 2018, 306,601 Indian applicants were in the queue (excluding spouses and children), including about 35,000 first preference applicants and 217,000 second preference applicants. “Approved Employment Based Immigrant Petitions Awaiting a Priority Date Based on the May 2018 Department of State Visa Bulletin,” U.S. Citizenship & Immigration Services, published April 23, 2017, https://www.uscis.gov/sites/default/files/files/nativedocuments/Count_of_Approved_I-140_I-360_and_I-526_Petitions_as_of_April_20_2018_with_a_Priority_Date_On_or_After_May_2018.PDF. For Chinese nationals, the figures were 67,031, 23,530 and 16,617, respectively.

88. Baer et al, *Open Doors*, 32; “Share of Residents in Technical Occupations with a Bachelor’s Degree or Higher, by Place of Origin,” *Silicon Valley Indicators* (Silicon Valley Institute for Regional Studies, 2017), <https://siliconvalleyindicators.org/data/people/talent-flows-diversity/tech-talent/share-of-residents-in-technical-occupations-with-a-bachelors-degree-or-higher-by-place-of-origin/>.

89. Current law requires foreign students to demonstrate, as a condition of admission, that they don’t intend to stay in the United States after graduation. See 8 USC §§ 1101(a)(15)(F), (J); 8 USC § 1184(b).

90. Other options might include a J exchange visa, a position with a cap-exempt H-1B employer or marriage to a U.S. citizen (for example).

91. For relevant programs in other countries, see, e.g., “La French Tech,” La French Tech, <https://www.lafrenchtech.com/en/>; “Start-Up Visa,” UK Government, <https://www.gov.uk/start-up-visa>; “Immigrate with a Start-Up Visa: About the Process,” Government of Canada, <https://www.canada.ca/en/immigration-refugees-citizenship/services/immigrate-canada/start-visa/about.html>.

92. See Raad Ahmed, “U.S. Work Visa Options For Entrepreneurs: A Beginner’s Guide,” *Forbes*, November 14, 2018, <https://www.forbes.com/sites/theyec/2018/11/14/u-s-work-visa-options-for-entrepreneurs-a-beginners-guide/#1244c58e4203>, for an overview of the workarounds available to particularly determined foreign entrepreneurs and their constraints. The E-2 “treaty investor” visa may help some cash-rich entrepreneurs, but is off limits to nationals of many countries, including China and India. “Treaty Countries,” U.S. State Department, <https://travel.state.gov/content/travel/en/us-visas/visa-information-resources/fees/treaty.html>.

93. See, e.g., Angus Loten, “For Small Firms, Visas Are a Big Headache,” *Wall Street Journal*, August 21, 2013, <https://www.wsj.com/articles/for-small-firms-visas-are-a-big-headache-1377129500>.

94. Michael Roach and John D. Skrentny, “U.S. Visa Policies and STEM PhD Employment in Technology Startups (working paper, January 29, 2019), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3317154.

95. See Mayda et al, “The Effect of the H-1B Quota on the Employment and Selection of Foreign-born Labor”; Roach and Skrentny, “U.S. Visa Policies and STEM PhD Employment in Technology Startups.”

96. See 8 USC §§ 1151(b), 1184(g)(5) (annual caps for green cards and H-1B visas, respectively).

97. These include (for example) fashion models (8 USC § 1101(a)(15)(H)(i)(B)), professional athletes (8 USC §§ 1101(a)(15)(P)(i)(a), 1184(c)(4)(A)), citizens of Chile (8 USC §§ 1101(a)(15)(H)(i)(B)(1), 1184(g)(8)(A)), and certain ministers (8 USC §§ 1101(a)(27)(C), 1153(b)(4)).

98. See, e.g., Laura D. Francis, “Bill to Remove Caps on Employment-Based Visas OK’d,” *Bloomberg Law*, July 10, 2019, <https://news.bloomberglaw.com/daily-labor-report/house-oks-bill-to-remove-country-caps-on-employment-based-visas>.

99. See 8 CFR § 204.5(h)-(i) (current EB-1 criteria), 214.2(o)(3) (current O-1 criteria). The broader statutory requirement for O-1 status is “extraordinary ability in the sciences, arts, education, business, or athletics which has been demonstrated by sustained national or international acclaim . . . and whose achievements have been recognized in the field through extensive documentation.” 8 USC § 1184(a)(15)(O)(i). The requirement for EB-1 green cards is similar. 8 USC § 1153(b)(1)(A)(i). The EB-1 category is also open to “outstanding” professors and researchers; similarly stringent documentation requirements apply. See 8 CFR § 204.5(i).

100. 8 USC § 1153(b)(2)(B)(i).

101. The program was suspended in 2016 due to national security concerns. A 2017 RAND study was unable to draw general conclusions about the security risks of the program due to data limitations, but noted that there were

no publicly disclosed incidents of terrorism or espionage involving MAVNI recruits. Beth J. Asch, Jennie W. Wenger, and Troy D. Smith, *The Military Accessions Vital to the National Interest (MAVNI) Program: Army Performance, Cost, Security Risk, and Potential Pool for Recruiting*, (RAND Corporation, 2017), available at <https://www.documentcloud.org/documents/4578092-MAVNI-RAND-Report.html>; see also Philips, "Army Suspends Its Purge of Immigrant Recruits."

102. Compare, e.g., "Global Skills Strategy: About the Process," Government of Canada, last modified March 18, 2019, <https://www.canada.ca/en/immigration-refugees-citizenship/services/work-canada/hire-foreign-worker/temporary/global-skills-strategy.html>.

103. See generally Roy Maurer, "How to Mitigate the Most Common Requests for Evidence," Society for Human Resource Management, published February 7, 2018, <https://www.shrm.org/resourcesandtools/hr-topics/talent-acquisition/pages/uscis-common-h1b-requests-for-evidence.aspx>.

104. For a recent example at the highest level, see Michael Shear, "Trump Immigration Proposal Emphasizes Immigrants' Skills Over Family Ties," *The New York Times*, May 15, 2019, <https://www.nytimes.com/2019/05/15/us/politics/trump-immigration-kushner.html>.

105. See, e.g., Jeanne Batalova, Michael Fix, and Peter A. Creticos, *Uneven Progress: The Employment Pathways of Skilled Immigrants in the United States* (Migration Policy Institute, October 2008), 28-29, <https://www.migrationpolicy.org/sites/default/files/publications/BrainWasteOct08.pdf>; Ann M. Simmons, "African immigrants are more educated than most — including people born in U.S.," *Los Angeles Times*, Jan. 12, 2018, <https://www.latimes.com/world/africa/la-fg-global-african-immigrants-explainer-20180112-story.html>.

106. David Bier, "Family & Diversity Immigrants Are Far Better Educated Than U.S.-Born Americans," *Cato at Liberty*, January 25, 2018, <https://www.cato.org/blog/family-diversity-immigrants-are-far-better-educated-us-born-americans>.

107. Stéphanie Thomson, "5 refugees who changed the world," *World Economic Forum*, November 23, 2015, <https://www.weforum.org/agenda/2015/11/5-refugees-who-changed-the-world/>.

108. See Reif, "Immigration is a kind of oxygen."

109. See "Strengthening the H-1B Nonimmigrant Visa Classification Program" (proposed rule), Office of Information and Regulatory Affairs, Reginfo.gov, posted Fall 2017, <https://www.reginfo.gov/public/do/eAgendaViewRule?pubId=201710&RIN=1615-AC13>; see, e.g., Daniel Costa, "H-1B Visa Needs Reform to Make it Fairer to Migrant and American Workers," *Economic Policy Institute*, published April 5, 2017, <https://www.epi.org/publication/h-1b-visa-needs-reform-to-make-it-fairer-to-migrant-and-american-workers/>.

110. See discussion in "The H-1B program" section on page 6.

111. See, e.g., Jacqueline Thomsen, "House Freedom Caucus Backs Bill to End Diversity Visa Lottery," *The Hill*, November 6, 2017, <https://thehill.com/homenews/house/359063-house-freedom-caucus-backs-bill-to-end-diversity-visa-lottery>.

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