High-Skilled Migrants: S&E Workers in the United States

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Abstract

Universities and employers want easier access to foreign science and engineering (S&E) students and workers. Most U.S. residents with degrees in S&E fields are U.S.-born citizens, and there are far more U.S. citizens with S&E degrees, about 15 million, than are employed in S&E occupations, about 5 million. Foreign students and workers in S&E occupations are concentrated in computer-related jobs, and their presence raises trade-offs for U.S. students and workers. For example, making it easier for U.S. employers to hire foreign S&E workers allows employers to specify precisely the qualities desired to fill a particular job quickly while limiting options for U.S. workers who could fill that job with some retraining. This article reviews the trade-offs between the competing goods raised by foreign S&E students and workers and the efforts of U.S. government agencies to reconcile them.

Keywords

skilled migration, H-1B, science and engineering workers, labor certification

> The U.S. has the best university system in the world, yet about half of our technical graduate school slots are filled by foreigners. As long as we don't train enough scientists, engineers or software designers ourselves, immigration is a saving grace. . . . Come to think of it, with jobs available why have a quota at all? . . . Our view is, borders should be open.
>
> —*Wall Street Journal* (1990)

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> In 1985, the Policy and Research Analysis Division of the National Science Foundation . . . projected a "shortfall" of 692,000 bachelor's degrees in natural science and engineering. The study was a deceptively simple one. It held that as the participation rate of 22-year-olds in natural science and engineering degrees had been stable for decades, and the number of 22-year-olds was dropping, there would be a shortfall of degrees.
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> —Rep. Howard Wolpe (1992)

Foreign science and engineering (S&E) students and workers inspire extreme assertions. Intel chairman Craig Barrett urged the U.S. government "to staple a green card" or immigrant visa to the diplomas of foreign students who graduate from U.S. universities with S&E degrees, asserting that such graduates are needed to keep U.S. IT firms and the U.S. economy competitive, an idea embraced in the Stopping Trained in America PhDs From Leaving the Economy (STAPLE) Act introduced in April 2009 (Barrett, 2006, p. 15).[1] Microsoft's Bill Gates testified that there is a "terrible shortfall in the visa supply for highly skilled scientists and engineers" and that "it makes no sense to tell well-trained, highly skilled individuals—many of whom are educated at our top universities—that they are not welcome here." Gates wants the 65,000 a year cap on the number of H-1B visas eliminated ("Gates Urges Change," 2007, p. A-8).[2]

On the other side, Professor Norm Matloff and other critics say that the H-1B program allows employers to hire "cheap" foreign workers tied to a particular U.S. employer. Most hope to be sponsored for an immigrant visa by their U.S. employer, making them "loyal" employees during their typical six-year stint as an H-1B worker. Matloff emphasizes that most foreign graduates of U.S. universities, and most foreigners holding H-1B visas, are young, which usually means lower wage and benefit costs. Finally, Matloff asserts that most foreigners with H-1B visas are not the world's best and brightest. The U.S. Department of Labor requires employers seeking certification to obtain immigrant visas for foreigners to categorize the skills required for the job on a scale of 1 to 4, with 1 for "beginning level employees . . . who perform routine tasks that require limited, if any, exercise of judgment" and 4 for workers who "plan and conduct work requiring judgment and the independent evaluation." About half of the employers seeking immigrant visas for foreigners to fill S&E-related jobs categorized the job as Level 2, "perform moderately complex tasks that require limited judgment," and a higher share of the jobs were Level 1 than Level 4 (Matloff, 2008).

There are three key facts about U.S. S&E or science, technology, engineering, and mathematics (STEM) workers. First, most U.S. residents with degrees in S&E and STEM fields are U.S.-born citizens. Second, there are far more U.S. citizens with S&E and STEM degrees than are employed in S&E and STEM occupations, about 15 million versus 5 million, raising questions about why U.S. citizens who earn degrees in programs acknowledged to require concentrated study do not work or remain in such fields.[3] Third, foreign students and foreign-born workers in S&E occupations are concentrated in several ways—among doctoral students in S&E and among employees of

computer services firms; that is, the highest shares of foreign students are in fields that generally require lengthy postdoctoral apprenticeships, and most IT workers with H-1B visas are employed by outsourcing firms such as Infosys and Wipro that provide IT services to U.S. firms.

This article explores the trade-offs involved in admitting foreign scientists and engineers to fill U.S. jobs. U.S. employers who assert that the U.S. government should make it easy for them to scour the world for workers and ease the entry into the United States of the foreigners they select argue that the result will be more competitive U.S. firms and a more competitive U.S. economy. U.S. scientists and engineers who cannot find the jobs or wages they expect, on the other hand, believe that employers prefer foreigners because they are willing to work "hard and scared" to keep their U.S. jobs and be sponsored by their employers for U.S. immigrant visas.

Other actors play leading roles in the debate over the need for foreigners to fill student and work slots in S&E. U.S. research universities and the government agencies that fund them often want foreign students to fill classes and to serve as "postdocs" on research projects. The concentration of foreign students in STEM fields and the usual practice of newly minted PhDs in STEM fields working 5 or more years in postdoctoral apprenticeships before getting "real" jobs may encourage capable U.S. students to gravitate from doctoral programs in STEM fields to alternatives such as medicine, law, and business. Lifetime earnings are typically much higher for professionals in these fields than for STEM PhDs.

The S&E Work Force

Most U.S. workers have not graduated from college. Among the 151 million U.S. workers in 2008, one fifth had a bachelor's degree and one eighth had a master's, PhD, JD, or MD; that is, a third of U.S. workers had at least a college education. About 30% of U.S. workers had some college but not a degree, including almost 10% who had 2-year associate's degrees and 37% had a high school diploma or less (10% did not complete high school). Among computer programmers, more had less than a bachelor's degree, 30%, than an advanced degree, 20%. Among civil engineers, the mode was a bachelor's degree, but a sixth had less than a college degree. Half of biochemists and biophysicists, and three fourths of economists, had more than a bachelor's degree (Table 1).

There is no single definition of S&E or the workers employed in S&E industries and occupations—commonly used definitions generated an S&E workforce of 5 million to 23 million (including 21 million employed)[4] in 2006, or 4% to 15% of the 144 million employed workers.[5] Arrayed from fewest to most, one can start with those employed in S&E occupations, add those in S&E related occupations, such as secondary school teachers of math and science and technicians, add those who use S&E knowledge (including doctors and other health professionals), and finally consider those with at least one degree in an S&E-related field, regardless of their current occupation.[6]

Table 1. Education and Training: Selected U.S. Occupations, 2008

	High school or less (%)	Some college (%)	BA or BS (%)	Higher degree (%)
All occupations	37	30	21	12
Chief executives	14	23	39	25
Legislators	14	23	39	25
Farmers	54	27	16	4
Computer programmers	6	24	50	20
Civil engineers	4	12	56	28
Biochemists and biophysicists	1	6	43	50
Economists	1	1	23	75

Source: Bureau of Labor Statistics (2008).

S&E is sometimes considered high tech, which also has several definitions. The U.S. Bureau of Labor Statistics (BLS) defines high-tech workers in terms of Standard Occupational Classification (SOC) codes (Hecker, 2005, p. 58).[7] BLS considers high-tech jobs to be those that require an in-depth knowledge of the principles of S&E acquired through postsecondary schooling. So defined, the United States had 14.4 million high-tech workers in 2002, and their median annual earnings ranged from almost $100,000 for engineering and computer managers to less than $30,000 for some technicians, about the average for all U.S. workers.[8]

There are other definitions of S&E and high tech that yield different numbers and worker profiles. The National Science Foundation's Science and Engineering indicators reported 15.7 million U.S. workers with at least one degree in an S&E field in 2003, but only 4.9 million employed in occupations that it defined as S&E. A quarter of all S&E workers, and 40% of PhD holders in S&E occupations, were foreign born in 2003 (National Science Foundation, 2007).[9] Industry association AeA (formerly the American Electronics Association) put the number of high-tech workers at 5.6 million in 2006 (American Electronics Association, 2007).[10]

Regardless of definition, there are far more U.S. residents with S&E degrees than are employed in S&E jobs. The question is why. Do those with S&E degrees never enter the S&E work force, or do they enter but remain only a short time? Lowell and Salzman (2007) reported a great deal of U.S. student interest in S&E—a third of U.S. high school seniors report an interest in broadly defined S&E fields, and a third of BS degrees are awarded in S&E fields. However, a year or two after graduation, only about half of S&E graduates are working in S&E occupations or continuing their S&E studies. S&E training may be useful in other fields, including management, but the fact that there are two workers with S&E credentials for every worker employed in S&E a year after graduation raises questions about the retention of workers with S&E credentials (Table 2).

Table 2. U.S. Science and Engineering (S&E) Workforce, 2006

Occupation	All (Millions)	BS or more (Millions)
(1) Employment in S&E	5.0	5.0
(2) Employment in S&E	4.3	5.8
Education		
One S&E degree	16.6	
Highest degree S&E	12.4	
Job in S&E	2.6	

Source: National Science Board (2010).

Answers to questions about why U.S. citizens avoid advanced S&E studies and jobs differ for science and engineering. In science, where most PhD students and doctoral recipients are foreign born, one answer is lifetime earnings. Obtaining a PhD in science typically takes longer than earning a JD or MBA, and often longer than the education and residency requirements for an MD. After earning a PhD at about 30, newly minted science PhDs often work as postdocs for at least several years, earning less than $50,000 a year in the labs of senior professors while searching for a "regular" teaching or research job that may pay twice as much. As a result of lengthy education and extended postdocs, PhD bioscientists can expect to earn $1 million less than MBAs graduating from the same university in their lifetimes, and $2 million less if stock options are taken into account. Lifetime earnings may be one reason why high-ability U.S. students gravitate to law and business (Teitelbaum, 2003).

The number of degrees conferred in biology fell during the 1980s at the bachelor's, master's, and PhD levels, although the drop was least for PhDs (Table 3). There was a rebound in the 1990s, when the number of biology degrees conferred rose at each level of education, rising most for bachelor's degrees. This pattern was reversed after 2000, when the number of degrees rose at each level, with the fastest increase for PhDs in biology.

The engineering labor market is different. Most engineering employers do not pay a significant wage premium for advanced degrees. Many engineering employers recruit aggressively when the demand for engineering services is high, as during the U.S. defense buildup of the 1980s and the IT boom of the 1990s. However, when defense spending dropped sharply in the early 1990s and when the tech boom collapsed after 2000, employers laid off engineers who had difficulty finding another engineering job because there were few employers hiring during sectorwide downturns. When the demand for engineering services again rises, most employers prefer to hire young graduates who may have more up-to-date skills and expect lower salaries than older engineers who may have found other jobs during the downturn.

The number of bachelor's degrees conferred in engineering fluctuated from a high of 97,000 in the mid-1980s to fewer than 75,000 between the late 1990s and 2002–2003, and was 11% higher in 2007–2008 than in 1980–1981 (U.S. employment rose 47% during this period, from 99 million in 1980 to 146 million in 2007). The number

Table 3. U.S. Degrees in Biology, 1980–1981 to 2007–2008

	Bachelor's	Master's	PhD
1980–1981	43,003	5,759	3,591
1981–1982	41,425	5,667	3,611
1982–1983	39,767	5,693	3,331
1983–1984	38,445	5,468	3,435
1984–1985	38,229	5,100	3,408
1985–1986	38,320	5,043	3,352
1986–1987	37,977	4,980	3,397
1987–1988	36,576	4,857	3,606
1988–1989	35,957	5,009	3,535
1989–1990	37,204	4,906	3,837
1990–1991	39,377	4,796	4,034
1991–1992	42,781	4,816	4,323
1992–1993	46,868	4,974	4,595
1993–1994	51,157	5,390	4,724
1994–1995	55,790	5,824	4,881
1995–1996	60,750	6,544	5,035
1996–1997	63,679	6,925	5,094
1997–1998	65,583	6,788	5,236
1998–1999	64,608	6,913	5,024
1999–2000	63,005	6,781	5,180
2000–2001	59,865	6,955	4,953
2001–2002	59,415	6,937	4,823
2002–2003	60,104	6,990	5,003
2003–2004	61,509	7,657	5,242
2004–2005	64,611	8,199	5,578
2005–2006	69,178	8,681	5,775
2006–2007	75,151	8,747	6,354
2007–2008	77,854	9,565	6,918
Change 1980–2008 (%)	81	66	93
1980s (%)	–16	–13	–2
1990s (%)	64	44	25
2000s (%)	30	38	40

Source: National Center for Educational Statistics (2010).

of master's degrees in engineering showed much less variability, rising in most years; the number of master's doubled between 1980–1981 and 2007–2008. The most significant change was in engineering doctorates. The number rose steadily over the past quarter century, dipped briefly in the late 1990s, and was much higher in 2007–2008 than in 1980–1981, suggesting different forces are affecting the number of bachelor's, master's, and PhDs in engineering (Table 4).

Table 4. U.S. Degrees in Engineering, 1980–1981 to 2007–2008

	Bachelor's	Master's	PhD
1980–1981	75,355	17,216	2,608
1981–1982	80,632	18,475	2,676
1982–1983	89,811	19,949	2,871
1983–1984	95,295	21,197	3,032
1984–1985	97,099	22,124	3,269
1985–1986	97,122	22,146	3,456
1986–1987	93,560	23,101	3,854
1987–1988	89,406	23,839	4,237
1988–1989	85,982	25,066	4,572
1989–1990	82,480	25,294	5,030
1990–1991	79,751	25,450	5,330
1991–1992	78,058	26,430	5,533
1992–1993	78,662	29,149	5,894
1993–1994	78,662	30,172	6,011
1994–1995	78,569	30,031	6,173
1995–1996	78,086	28,946	6,431
1996–1997	75,757	27,106	6,250
1997–1998	74,649	27,327	6,038
1998–1999	72,665	26,738	5,461
1999–2000	73,419	26,726	5,421
2000–2001	72,975	27,272	5,604
2001–2002	74,679	27,057	5,245
2002–2003	77,319	30,670	5,333
2003–2004	78,227	35,197	5,981
2004–2005	79,743	35,133	6,601
2005–2006	81,610	33,530	7,471
2006–2007	82,072	32,162	8,123
2007–2008	83,853	34,592	8,167
Change 1980–2008 (%)	11	101	213
1980s (%)	9	47	93
1990s (%)	–8	5	2
2000s (%)	15	27	46

Source: National Center for Educational Statistics (2010).

The H-1B Program and IT

During the late 1980s, U.S. employment grew rapidly, from 107 million in 1985 to 117 million in 1989. However, the unemployment rate remained high. After peaking at almost 10% in 1982, the jobless rate remained above 5% throughout the 1980s (Council of Economic Advisors, 2010, Tables B-36 and B-42). Labor force expansion kept pace with employment, rising from 114 million in 1985 to 124 million in 1989,

but some employers complained of difficulty in finding a sufficient number of skilled workers.

The H-1B program in the Immigration Act of 1990 aimed to reduce labor market mismatches. High unemployment rates suggested there were sufficient U.S. workers, but not enough with employer-desired education and skills, especially in fast-growing industries such as IT and related high-tech fields.[11] The U.S. government launched programs to improve the education and skills of U.S. workers in these fields, but until these programs could provide sufficient workers, U.S. employers via the H-1B program were given easy access to foreign professionals coming to the United States to fill jobs that "require theoretical and practical application of highly specialized knowledge to perform fully." The Immigration Act of 1990 also more than doubled the number of immigrant visas available to foreigners (and their families) who were desired by U.S. employers, from 54,000 a year to 140,000 a year.

The number of H-1B visas was capped at 65,000 a year, about 3 times the number of temporary foreign professionals requested by U.S. employers in the late 1980s.[12] The expectation was that the number of H-1B visas issued would rise quickly and then fall, as the United States produced more workers with the skills employers sought. This did not happen. Instead, the number of H-1B visas rose slowly, reaching the 65,000 cap for the first time in FY97.

H-1B visa holders are foreigners with at least a bachelor's degree or equivalent requested by U.S. employers to fill professional or "specialty occupation" jobs that normally require a bachelor's degree. Most H-1B visa holders are admitted initially for 3 years; U.S. employers can request a 3-year renewal of their visas. Unlike most temporary visas, the H-1B visa allows dual intent; that is, the foreigner may say that his or her purpose in coming to the United States is to fill a job *and* to become an immigrant. U.S. employers may sponsor H-1B visa holders for immigrant visas, a process that often takes several years and requires the employer to obtain a certification from the Department of Labor (DOL) that no qualified U.S. workers (including legal immigrants) are available to fill a particular job.[13] After receiving an immigrant visa, the now immigrant–foreigner may leave the employer who sponsored him or her for another U.S. job, and many do.

The U.S. unemployment rate dipped below 5% in 1997, and remained below 5% until 2002. The spread of computers and rising stock prices ushered in a new knowledge-based economy (knowledge becomes a product) that some thought would expand indefinitely, ending recessions and associated spikes in unemployment. Some of the IT employers at the heart of the computer revolution argued that a combination of a knowledge-based economy and the feared Y2K problem (computers malfunctioning as the date changed from 1999 to 2000) justified raising the cap on admissions of H-1B workers. They further argued that the presence of H-1B workers did not hurt similar U.S. workers because there were more vacant IT jobs than jobless workers with IT skills and that not admitting foreigners with H-1B visas could threaten the economy generally, and computer-dependent businesses in particular.

IT-related employers pressured Congress to raise the cap on H-1B visas. Many employers called foreigners for whom they were seeking H-1B visas the "best and brightest" of the global labor force and asked the government to minimize barriers to their entry and employment. The Clinton White House countered with a proposal in 1998 that U.S. employers who paid H-1B workers at least $75,000 a year could have them enter under the regular H-1B easy attestation process, but employers of lower-paid H-1B workers would have to certify that they did not lay off U.S. workers to make room for H-1B workers (Thibodeau, 2010).

Major tech firms, such as Intel, as well as so-called job shops that sent H-1B workers from one U.S. firm to another, opposed the $75,000 minimum wage for H-1B workers. They persuaded Congress to limit the U.S. worker recruitment requirement to H-1B dependent employers, those with at least 50 workers and at least 15% H-1B workers, and willful violators of H-1B regulations. The American Competitiveness and Work Force Improvement Act of 1998 raised the cap on H-1B visas from 65,000 a year to 115,000 in 1999 and 2000 and 107,500 in 2001. It also imposed a $500 per H-1B visa training fee on employers to generate funds to train U.S. workers to fill the rising number of IT jobs and required H-1B-dependent employers and willful violators of H-1B regulations to attempt to recruit U.S. workers and not lay off U.S. workers to hire H-1B foreigners.

Congress again raised the cap on H-1B visas to 195,000 a year for FY01, FY02, and FY03 in the American Competitiveness in the Twenty-First Century Act of 2000 (the cap reverted to 65,000 a year in FY04). The employer-paid training fee was raised to $1,000 per H-1B visa, and H-1B visas issued to foreigners employed by U.S. universities and research institutions were exempted from the cap.[14] This second increase in the H-1B cap occurred in October 2000, just before a National Research Council committee released a report concluding that H-1B foreigners keep "wages from rising as fast as might be expected in a tight labor market" (National Research Council Commission on Physical Sciences, Mathematics, and Applications, 2001). Committee chair Alan Merten, president of George Mason University, said, "We feel [the number of H-1Bs] is so large that we are totally dependent on it, and it depresses wages" (quoted in "Congress: H-1Bs Increased, Amnesty," 2000). However, the committee did not recommend a particular annual quota for H-1B visas, saying that the number is a "political decision."

The number of H-1B visas returned to the original 65,000 a year in FY04. Instead of trying to raise the H-1B cap at a time of high unemployment for IT-related workers (the unemployment rate for IT workers in 2004 was 5.7% vs. 5.5% for all U.S. workers), employers carved out another exemption from the cap. Under the L-1 Visa and H-1B Visa Reform Act of 2004, an additional 20,000 H-1B visas a year were made available to foreigners who earned master's or PhD degrees from U.S. universities. The 2004 act also imposed a $500 per H-1B visa fee on employers to fund efforts to detect fraud in the H-1B program and underpayment of wages.

Employers requested all available H-1B visas in FY05, FY06, and FY07. The DOL approved almost all employer requests within seconds via the Internet, but the Department of Homeland Security (DHS) used a lottery to select foreigners for H-1B visas; that is, employers could submit only one application for each foreigner for whom they sought an H-1B visa and could not rank the foreigners they requested.[15] The result was considerable frustration for employers and foreigners who had been offered jobs but were unsure if they would receive H-1B visas. Microsoft's Bill Gates, in an April 2005 discussion of improving U.S. competitiveness, said, "I'd certainly get rid of the H1-B visa cap" ("Gates Urges Change," 2007). Microsoft opened a research center in Canada, ostensibly because too few H-1B visas were available.

The 2008–2009 recession and criticism of the H-1B program prevented employers from winning another increase in the 65,000 per year cap. Instead, most employer H-1B reform efforts focused on countering the increasingly aggressive enforcement of H-1B regulations. For example, in January 2010, the DHS issued a memo to clarify that U.S. employers of H-1B workers must have an employer–employee relationship with them, restricting the ability of staffing firms to send H-1Bs from one U.S. job to another to be supervised by someone from the firm where they were placed. The outsourcer Broadgate complained that the requirement that it have an employer–employee relationship with the H-1B workers it brought into the United States threatened its business model. Broadgate sued the DHS in June 2010 to overturn the memo and lost.

Critics of the H-1B program have consistently raised two major complaints: wage depression and lack of enforcement of worker protections. Worker advocates allege that H-1B visa holders are often cheap substitutes for U.S. workers, so that admitting H-1B workers distorts U.S. labor markets because wages held down by the presence of H-1B foreigners deter U.S. workers from embarking on S&E careers to avoid competing with young foreigners who are tied to their U.S. employer. The H-1B program allows U.S. employers to specify very precisely the qualifications expected of new hires, avoiding the need to hire and retrain jobless or underemployed U.S. workers with general S&E skills, and providing them with the specific skills needed to perform the job.

Second, the employer-friendly nature of the H-1B program can lead to abuses of workers that are hard to detect and correct. The assumption in 1990 was that college-educated U.S. (and foreign) workers could and would complain loudly about employer violations of regulations, minimizing the need for the detailed certification and oversight procedures that are an integral component of the H-2A and H-2B programs. (These programs admit unskilled farm and nonfarm workers, respectively.) For this reason, the Immigration Act of 1990 allows the DOL to investigate employers of H-1B workers only after receiving complaints of potential violations. Most complaints about labor law violations come from aggrieved workers. However, since H-1B visa holders hope to be sponsored by their employers for immigrant visas, they rarely complain, and the DOL has few opportunities to investigate.

Government Regulation of H-1Bs

The trade-off at the heart of H-1B regulations gives U.S. employers easy access to foreign professionals in exchange for a cap on admissions to protect U.S. workers. The easy attestation procedure helps employers in fast-changing industries to recruit foreign employees, but the cap, critics allege, has failed to protect U.S. workers. There are several reasons for this protection failure, ranging from limitations enshrined in law, such as restrictions on DOL enforcement activities, to the fact that most H-1B foreigners want to please their employers to be sponsored for immigrant visas.

DOL OFLC

U.S. employers begin the process of hiring foreigners who will receive H-1B visas by filing Labor Condition Applications (LCAs) with the DOL's Office of Foreign Labor Certification (OFLC) via the Internet. The OFLC reviews LCAs electronically, using a computer algorithm, "only for completeness and obvious inaccuracies," as specified in law. The DOL approves more than 99% of employer LCAs within seconds, including some that offer wages below the minimum or prevailing wage (General Accounting Office [GAO], 2006, p. 14).

Employers make four promises or attestations in their LCAs. Employers promise (a) to pay H-1B foreigners the higher of the prevailing or actual wage paid to similar U.S. workers, (b) that the employment of the H-1B workers will not adversely affect similar U.S. workers, (c) there has not been a strike or lockout that has made the job to be filled by the H-1B worker vacant, and (d) the employer has notified workers at the place of employment of its intent to hire H-1B workers (most employers post a copy of their LCA on a bulletin board in the workplace). Only H-1B-dependent employers, those with 15% or more H-1B workers, and employers who have committed a "willful failure" to meet H-1B program requirements or who misrepresented a "material fact" in their LCAs during the previous 5 years must make three more attestations, namely that they (a) did not displace a U.S. worker 90 days before or after requesting an H-1B worker, (b) took good-faith steps to recruit U.S. workers and offered jobs to qualified U.S. workers, and (c) did not transfer H-1B workers to other U.S. employers who displaced U.S. workers to open jobs for them.[16]

These regulations mean that most U.S. employers may lawfully advertise for "H-1Bs only," and some do. Most U.S. employers may also lawfully lay off U.S. workers and replace them with H-1B workers. Indeed, the insurance firm American International Group in September 1994 lawfully laid off 130 U.S. programmers and outsourced the work to Syntel, an Indian–American firm that used H-1B workers in the United States and supporting workers in India. The laid-off U.S. programmers, as a condition of receiving severance pay, were required to train their H-1B replacements.

Employers do not pay to have their LCAs "certified" or approved by the DOL. However, when they submit an I-129 nonimmigrant visa petition to the DHS's U.S. Citizenship and Immigration Services (USCIS) agency and the DOL's certification, they must pay a $1,500 filing fee (those with 26 or more employees)[17] plus a $500 fraud-prevention fee. USCIS reviews employer petitions to have a particular foreigner receive an H-1B visa and checks the foreigner's credentials. If the foreigner is inside the United States, USCIS issues the H-1B visa. If the worker is outside the United States, he or she takes the approved DHS petition to a U.S. consulate for the issuance of an H-1B visa.[18]

GAO reviewed 960,000 employer H-1B attestations filed between January 2002 and September 2005 and reported that the DOL certified almost all of them—approval rates ranged from 99.4% to 99.7% (GAO, 2006, p. 13). The law does not require employers to submit supporting documentation and emphasizes that the DOL should process employer LCAs quickly. GAO found the DOL review of employer LCAs to be so cursory that it recommended eliminating the DOL from the process, that is, it suggested that employers simply file their LCAs and petitions directly with USCIS.

Before the mid-1990s, most H-1B requests were for (physical) therapists. Since then, computer-related occupations have dominated requests for H-1B visas. In FY05, 45% of the H-1B requests were for computer-related workers, and almost a third were for jobs in California and New York.[19] USCIS reported that 42% of the newly approved H-1B foreigners in FY05 had BA degrees and 39% had master's degrees, suggesting that most H-1Bs have advanced degrees. About 49% of H-1B visas in FY05 were issued to Indians, followed by 9% to Chinese nationals.

The jobs and wages in the LCAs filed by employers attesting to their need for H-1B workers are available from the U.S. DOL.[20] The DOL classifies the jobs for which H-1B workers are sought into four levels based on the skills required: entry, qualified, experienced, and fully competent. More than half of the LCAs filed in recent years have been for the lowest-skill level, Level 1, meaning that the job requires a BA degree and the wage is in the 15th to 20th percentile of wages in that occupation ranked from low to high.[21] Newly approved H-1B foreigners in computer-related occupations had a median annual wage of $50,000 in FY05, down from $55,000 in FY01. H-1B foreigners who were approved for continued U.S. employment in computer-related occupations (most had 3-year visas approved for another 3 years) had a median wage of $68,000 in FY05, down from $69,000 in FY01 (Wasem, 2007, p. 10).

DOL WHD Enforcement

The DOL's Wage and Hour Division (WHD) investigates complaints filed against employers who have workers with H-1B visas. WHD, which received 1,026 H-1B-related complaints between FY00 and FY05, has had authority since 1998 to do random audits of employers found to be willful violators of H-1B regulations for 5 years

after they are listed. WHD began to conduct such audits in April 2006, performing two audits of willful violator employers in each of the DOL's 10 regions.

Violations of H-1B regulations are classified in four levels: nonwillful (honest mistakes), substantial (honest mistakes made 10 or 20 times), willful, and willful and substantial, the most serious. Aggrieved parties must complain within 12 months of a violation to the DOL. Most complaints allege underpayment of wages or misclassification of a job, as when a job classified as Level 1 requires work at Level 2 or 3.[22] In such cases, WHD typically requires employers to provide back wages to affected workers, often $10,000 or more a year. Other violations include not providing equal benefits or working conditions to H-1B and U.S. workers, deducting the fees employers pay to USCIS from the wages of H-1B workers, and having excessive early termination penalties, as when an H-1B worker who breaks a 3-year contract must repay $10,000 or $20,000 for the "training" provided in his or her first several weeks in the United States.

WHD can impose civil money penalties (CMPs) that generally range from $1,000 to $10,000 per violation. The WHD district that includes Silicon Valley handled about 75 cases a year that resulted in CMPs from 2006 to 2008. Because of the public access requirement—employers filing LCAs must agree to make payroll data available—the DOL typically has access to more information from employers of H-1B workers than on other employers, which speeds up investigations.

WHD can debar a U.S. employer from bringing new H-1B workers into the United States for 1 to 3 years. This does not mean that the employer is excluded from the H-1B program; debarred employers can continue to employ the H-1B workers they have in the United States but cannot obtain additional H-1B visas. The DOL's WHD has won the authority to hold corporate owners of job shops personally liable for back wages, an effort to prevent them from going bankrupt when they are ordered to pay back wages.

The major problem with complaint-based enforcement is that most H-1B workers hoping to be sponsored by their employers for immigrant visas do not complain. In the words of the GAO, "H-1B workers may be vulnerable to abuse since their dependency on their employer [to remain lawfully in the United States] may lead to reluctance to complain" (GAO, 2000, p. 21).

DHS USCIS and DOS

The DHS's USCIS agency plays a key role in the H-1B program because it reviews the employer's petition to hire a foreigner and issues H-1B visas to foreigners in the United States. Critics have accused USCIS of making the H-1B program even more employer-friendly by not closely scrutinizing employer petitions and by taking other steps to facilitate the hiring of H-1B foreigners. For example, in April 2008, USCIS issued an "emergency rule" that lengthened optional practical training (OPT) for foreign graduates of U.S. universities from 12 to 29 months if they work for U.S.

employers who participate in the voluntary E-Verify program that allows employers to submit data on newly hired workers to ensure that they are legally authorized to work in the United States.

Many employers hire foreign graduates of U.S. universities under OPT in the summer after they graduate and apply for H-1B visas on their behalf in the spring of the following year. Lengthening OPT training to 29 months gives employers 2 years rather than 1 to obtain an H-1B visa for the foreigner. A suit by the Programmer's Guild alleging that lengthened OPT was a backdoor effort to raise the H-1B ceiling was dismissed.

The DHS has toughened its enforcement of H-1B regulations. A review of 246 H-1B petitions filed in 2005–2006 on behalf of new H-1B workers and employers seeking extensions of H-1B visas found that 21% involved fraud or technical violations of H-1B regulations (DHS, 2008). The DHS review of sample applications aimed to verify that the employer existed, that the foreigner had the stated credentials and was or would be employed as specified in the application, and that the H-1B visa holder would be paid the prevailing wage.

The DHS found 28 cases of foreigners not working at the specified location, 14 cases of pay below the prevailing wage (sometimes because the employer deducted fees paid to the DHS from the worker's wages), and 10 cases of foreigners not having the degrees they had claimed. Seven employers had nonexistent businesses; six other businesses were substantially different from the one described by the employer. Fraud was more common among those claiming bachelor's than graduate degrees, in business analysis and accounting than in computer-related occupations, and in newly established firms with fewer than 25 employees.

Patterns and Trade-Offs

IT industry leaders often assert that the H-1B program allows U.S. employers to hire the world's best and brightest to keep their firms and the U.S. economy competitive. Critics contend that the H-1B program allows U.S. employers to hire young foreigners with the exact skills desired rather than older U.S. workers who may be able to learn the skills required to fill a particular job.

The United States greatly benefits from the arrival of highly skilled foreigners. Years of education are the single best predictor of U.S. earnings, and foreigners with at least a college degree are likely to have higher-than-average U.S. earnings and pay higher-than-average taxes while consuming fewer tax-supported services. The major policy issue is whether easy access to highly skilled foreigners distorts U.S. labor markets and affects the education and career choices of U.S. students. There may also be economic, national security, or other issues involved with having foreign-born temporary workers constitute a high share of S&E workers.

One empirical question is how many of those admitted under the H-1B program are the world's best and brightest. Immigrant visa data suggest that most H-1Bs are not considered the "best and brightest." There are 44,000 EB-1 first-preference immigrant

visas a year available for foreigners with "extraordinary ability" and another 44,000 EB-2 visas a year for foreigners with "advanced degrees." However, most H-1B visa holders seek EB-3 visas, available to foreigners with at least a BA degree as well as low-skilled workers. There are no waits for EB-1 and EB-2 visas, but there are long waits for EB-3 visas, especially for nationals of China and India.

H-1B Wage Data

Matloff (2008) examined wage data from ETA Form 9089 filed by employers seeking certification to obtain immigrant visas for specified foreigners in 2006. Most of these foreigners held H-1B visas, so the data from the DOL's PERM system provide insights into wages paid to H-1B workers but not the level of education of the foreigner for whom the immigrant visa was sought.

Employers seek DOL certification that the foreigner they are sponsoring for an immigrant visa is uniquely qualified to fill a particular job. About 29% of the 52,000 jobs for which employers sought DOL certification were classified (by employers) as Level 1, 40% as Level 2, 20% as Level 3, and 12% as Level 4; that is, almost 70% were Levels 1 and 2. Some 65% of the 6,500 software engineer jobs were in Levels 1 and 2, whereas 80% of the 2,400 programmer jobs and the 600 electrical engineering jobs were in Levels 1 and 2. A third of the 52,000 foreigners for whom immigrant visas were requested were Indian, followed by 10% from China.

Matloff examined which U.S. firms sponsored the 52,000 foreigners for immigrant visas in 2006. Microsoft sponsored 1,200; Intel, 1,100; and Motorola almost 500. The foreigners these companies sponsored were mostly requested to fill Level 1 and Level 2 jobs. The exceptions were Texas Instruments and Sun, which had 35% and 19% of the immigrants sponsored fill Level 4 jobs, many with nationals of Canada and the United Kingdom. Matloff concluded that the best and brightest foreign workers *are* paid premium wages, but there are relatively few of them, and they come disproportionately from Canada and the United Kingdom.

Matloff (2008) also reviewed studies of the effects of H-1B workers on wages in computer-related occupations. He described two types of savings from hiring H-1B workers, paying H-1B workers less than U.S. workers (Type 1 savings) and hiring younger H-1B workers who have lower salaries than U.S. workers (Type 2 savings), and concluded that the major employer savings are Type 2, from hiring younger workers. Matloff found that employers save up to 20% by paying H-1B workers less (Type 1) and up to 40% by hiring younger H-1B workers (Type 2).

The Migration Infrastructure

The drafters of the H-1B program in 1990 imagined U.S. employers seeking U.S. workers and, not finding them, recruiting workers abroad. This procedure is rarely followed. Instead, U.S. employers often encounter the foreigners for whom they seek H-1B visas via internships held by foreign students or during interviews with foreign

students on U.S. campuses where they study. Larger U.S. firms with operations abroad have employees there that they want to bring to their U.S. operations, but most use the L-1 intracompany transfer visa rather than the H-1B visa for such intracompany transfers.

The major development not anticipated in 1990 was the rise of intermediaries. These come in many forms, from IT-service firms such as Wipro and Infosys, multinationals that provide a wide range of tech services to firms from a base in India and subsidiaries in the United States, to job shops or body brokers that bring H-1B foreigners into the United States and send them from one job to another. Many of the violations associated with the H-1B program are found in body shops.

For example, the *Wall Street Journal* on June 21, 2001, profiled an Indian who arrived in the United States with an H-1B visa in November 2000 to work for ChristAm, a Texas body shop. ChristAm did not abide by the contract it made with the Indian worker, never paid him because it could not find a U.S. job for him, and went out of business. U.S. employers must pay H-1B workers the prevailing wage promised in their LCAs, but many H-1B holders who are not paid, or not paid promised wages, are reluctant to complain for fear that they will be ordered to leave the United States because they do not have a job.

In an extreme case, Atlanta-based Deep Sai Consulting Inc., in November 1999, was charged with harboring illegal migrants after it brought 43 Indian programmers to the United States for jobs that did not materialize. Prosecutors charged that Deep Sai was engaged in "white-collar alien smuggling."

Many body shops require H-1B visa holders to sign contracts that include penalties if the worker leaves his or her U.S. employer. Disputes arise when a worker posted to another U.S. employer is hired by that employer, and the body shop demands damages from the foreign worker. A San Mateo County court in April 2001 ruled that a $25,000 penalty in the contracts between Compubahn and its H-1B employees was unlawful and that Compubahn cannot include such a penalty in future contracts. In response to this and similar court decisions, most body brokers now provide "training" for the first week or two after the H-1B visa holder arrives in the United States and demand that the $10,000 to $20,000 cost of this training be repaid if the H-1B foreigner quits before the end of his or her contract.

The second development not anticipated by the framers of the H-1B program was how lucrative bringing skilled migrants into the United States would be for lawyers. Most employers pay about $3,000 per H-1B application to immigration lawyers and pay this fee twice because of the renewal of the H-1B visa after 3 years. If the employer sponsors the foreigner for an immigrant visa, there is a third fee for routine legal work. Admitting 100,000 H-1B foreigners a year, including those hired by universities and nonprofits, could generate legal fees of more than $300 million a year, helping to explain the keen interest of the American Immigration Lawyers Association in the H-1B program.

Conclusions

The United States is a nation of immigrants with a history of admitting and integrating newcomers from many nations who begin their U.S. journeys at all rungs of the job ladder, from low skilled to professionals. Most of the immigrants during the third wave of immigration to the United States—between the 1880s and 1914—were low skilled. Since 1965, amendments to the Immigration and Nationality Act changed priority for admission from national origins to family unification and employer sponsorship of particular foreigners; correspondingly, immigration from Asia has increased. Asian immigrants include large numbers of foreign student graduates of U.S. universities and professionals educated abroad.

One major way that highly skilled foreigners become U.S. immigrants is to arrive as students and earn a degree in an S&E field, become a temporary worker with an H-1B visa, and be sponsored by their employer for an immigrant visa. Some students become immigrants via marriage to U.S. citizens, and some foreigners earn degrees abroad and arrive as H-1B temporary workers. The wage and opportunity gaps between the United States and migrant countries of origin have supported the development of a migration infrastructure that helps students and workers enter the United States and, once here, to become immigrants.

With the notable exception of the Bracero program between 1942 and 1964, the United States has long favored immigrants over temporary foreign workers. This began to change with the Immigration Act of 1990, which introduced a trade-off during a time of rapid economic change. The H-1B program gave employers easy access to foreigners with at least a bachelor's degree but capped the number of H-1B visas to protect U.S. workers at three times prevailing admissions levels.

A combination of a late 1990s economic boom associated with the diffusion of computers and related technology, difficulty filling some nursing jobs, more foreign student graduates who received U.S. job offers, and the rise of intermediaries who brought foreigners into the United States and placed them in a series of temporary U.S. jobs pushed the number of employer requests for H-1B visas over the 65,000 a year cap in 1997. Congress responded by increasing the number of H-1B visas several times, to 195,000 a year just as the IT bubble burst in 2001 (H-1Bs issued to nonprofits such as universities were exempt from the cap). Then Federal Reserve Chairman Alan Greenspan, in February 2000, endorsed raising the number of H-1B visas, stated, "The benefits of bringing in people to do the work here, rather than doing the work elsewhere, to me, should be pretty self-evident" (Greenspan, 2000).

The H-1B cap reverted to 65,000 a year in 2004, plus 20,000 more H-1B visas for foreigners who earned master's and PhD degrees from U.S. universities. Employers requested more than 85,000 H-1B visas until FY08 and enlisted luminaries from Bill Gates to Alan Greenspan to testify before Congress on the need for more H-1B visas. Congress failed to act because employers refused to agree with critics of the H-1B

program that all employers, not just H-1B-dependent employers, should try to recruit U.S. workers before hiring H-1B workers.

The 2008–2009 recession reduced employer requests for highly skilled temporary foreign workers. The Senate Democrats Real Enforcement with Practical Answers for Immigration Reform (REPAIR) proposal for comprehensive immigration reform, released in April 2010, would develop a new system for checking the legal status of newly hired workers and require all employers to use it, offer a path to legal immigrant status for most unauthorized foreigners in the United States, and establish a Commission on Employment-Based Immigration to make recommendations on the number of temporary foreign workers.

REPAIR includes the STAPLE Act, which would give immigrant visas to foreigners earning advanced degrees from U.S. universities in STEM fields who receive U.S. job offers. However, REPAIR would also make the H-1B program less employer-friendly by modifying wage-determination requirements, prohibiting U.S. employers from advertising only for H-1B workers, and requiring all employers to try to recruit U.S. workers before hiring H-1Bs. REPAIR would limit the share of H-1B workers in the workforces of employers with 50 or more employees and give the DOL more power to investigate employer compliance with wage requirements and other promises made in attestations seeking approval to hire skilled foreigners.

The past two decades have witnessed a new flow of migrant workers into the United States, mostly Indians with at least a bachelor's degree who are hired primarily by IT-related firms. Their employers argue that H-1B workers are vital to the competitiveness of their own firms and the United States economy. Critics counter that the H-1B program is a mechanism that allows U.S. employers to specify precise requirements for the young foreign workers they prefer to hire. Congressional Democrats appear to have accepted both arguments, agreeing to make it easier for STEM graduates to become immigrants but accepting the need for more protections for U.S. workers in the H-1B program.

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Notes

1. Barrett was chairman of the board of Intel Corporation from May 2005 to May 2009. Rep. Jeff Flake (R-AZ) introduced the STAPLE Act in April 2009.
2. Quote based on Gates's testimony before the House Committee on Science and Technology.

3. Other U.S. occupations with more U.S.-citizen trained workers than employees include nursing and teaching, occupations dominated by women who may not return to full-time work after having children.
4. Note that many of the almost 2 million U.S. residents holding S&E degrees but not employed in 2006 are likely retired.
5. The National Science Board, which generated these estimates in chapter 3 of *Science and Engineering Indicators 2008*, favors using the broadest 21 million count, representing 17 million employed workers with S&E degrees and over 4 million with a degree in a related field such as health or technology.
6. According to the National Science Foundation (NSF), there were about 19 million U.S. residents with at least an S&E or related degree employed in 2006, including 5 million persons employed in S&E occupations, 5.2 million in S&E-related occupations, and almost 9 million in other occupations (NSF, 2008).
7. High-tech SOCs include SOC 15-0000: engineers; 17-2000: engineering related technicians; 17-3000: life scientists; 19-1000: physical scientists; 19-2000: related technicians; and 19-4000, 11-3020, 11-9040, and 11-9120: managers of these occupations.
8. An industry is considered high tech by the Bureau of Labor Statistics (BLS) if it has at least twice the average 4.9% share of workers with high-tech SOC codes; that is, if it has at least 9.8% S&E workers. BLS distinguishes three levels of high-tech industries. Level I includes 14 industries with at least 5 times the average almost 5% share, that is, over 25%; Level II includes 12 industries with 15% to 25% high-tech workers, and Level III includes 20 industries with 10% to 15% high-tech workers (Hecker, 2005, p. 59).
9. More than half of the PhD holders resident in the United States in 2003 in computer science and civil, electrical, and mechanical engineering were born abroad.
10. AeA President William T. Archey testified before the House Committee on Education and Labor on February 7, 2007, that (a) "not enough" U.S.-born students pursue careers in science and engineering; (b) that "it is difficult to obtain an H-1B visa for a foreign national, and once you have them, it is even more difficult to get a green card to keep them," and (c) it is "absurd" that the United States "tells them [foreign students earning graduate degrees in S&E in the United States] to go home." Testimony available at http://www.docstoc.com/docs/5790371/Archey-Testimony-02-07-07doc.
11. Weinstein (n.d.) asserts that the Policy and Research Analysis Division of NSF in 1985 projected the demand for S&E workers and estimated that S&E salaries would have to double from their 1982 levels to attract sufficient U.S. students: "Not only will the salary costs of PhD-level researchers and teachers rise substantially, but also the scarce talent lured into the PhD-level S&E career paths will not be available for other uses" (The NSF's Real Shortage Study section). NSF analysts thought that foreign students and professionals could fill the demand–supply gap without pushing up wages:

    One way to do this is to ensure that foreign students have equal access to graduate student support funds provided through federal agencies. Another approach is to grant permanent resident status or immigrant status to foreign students successfully completing PhD

degrees at U.S. institutions. . . . A growing influx of foreign PhD's into U.S. labor markets will hold down the level of PhD salaries to the extent that foreign students are attracted to U.S. doctoral programs as a way of immigrating to the US. (The NSF's Real Shortage Study section)

12. Since 2004, some 6,800 visas (H-1B1) have been reserved for nationals of Chile (1,400) and Singapore (5,400) under free-trade agreements (FTAs) with these countries. Senator Diane Feinstein (D-CA), in a July 25, 2003, speech announcing that she would oppose the Chile and Singapore FTAs because they impinged on congressional powers with "stealth immigration agreements," emphasized that the H-1B provision in the Singapore and Chile FTAs added management consultants, disaster relief claims adjusters, physical therapists, and agricultural managers to the occupations in which H-1B visas could be issued and eliminated "highly" from the alternative "highly specialized knowledge" requirement of the H-1B program—individuals seeking H-1B visas must normally have a BA or specialized knowledge. Since 2005, there have been 10,500 E-3 visas available for Australians requested by U.S. employers who satisfy H-1B program rules.
13. The Immigrants Support Network (ISN) reported in 2001 that most H-1Bs assumed their hard work would prompt their U.S. employers to sponsor them for immigrant visas or green cards. However, the expansion of the H-1B program in the late 1990s meant there were more H-1B visa holders competing for a fixed number of immigrant visas. On behalf of ISN, Silicon Valley entrepreneur Kanwal Rekhi argued that the United States should reduce the number of immigrant visas for extended family members to make more immigrant visas available for foreign professionals. He said, "It's time to go back to the original setup, where you allow professionals and only their spouses and children, not one's brothers, sisters, parents. . . . The U.S. cannot take everyone in the world." The U.S. Commission for Immigration Reform made a similar recommendation in the mid-1990s. See "Labor: Guest Workers" (2001).
14. Benderly (2010) says that lobbyists for the tech industry struck a deal with those of the research universities—the universities supported raising the cap on H-1B visas in exchange for winning the ability to hire as many H-1Bs as they wanted.
15. For example, U.S. Citizenship and Immigration Services announced that it received 150,000 employer requests for the 65,000 H-1B visas on April 2, 2007, the first day it accepted applications for FY08. It took the 123,480 that it said satisfied basic requirements and said it would select the 65,000 recipients of H-1B visas by lottery. For FY07, the H-1B cap was reached by June 2006, that is, before FY07 began on October 1, 2006.
16. Between October 1, 2003, and March 7, 2005, these additional attestations were not required; for example, H-1B-dependent employers could displace U.S. workers to hire H-1B workers.
17. The fee is $750 for employers with 25 or fewer employees.
18. The U.S. Department of Commerce screens applicants for H-1B visas from "countries of concern," including India and China, as well as North Korea and Iran.
19. About 90% of employer requests were for one H-1B worker.

20. The H-1B program allows employers to use a prevailing wage determined by a state workforce agency (SWA), a collective bargaining agreement, or a private employment survey. The Department of Labor has advised employers of its preference for SWA-calculated prevailing wages.
21. In IT jobs, the employer must use Level II "qualified" if the foreigner has an MS or more.
22. One aggrieved party was the ex-wife of an H-1B worker who complained because her husband's support payments were too low, which was the result of wages that were too low.

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