

**THE WORLD HAS CHANGED SINCE 1990,  
 U.S. IMMIGRATION POLICY HAS NOT**

**BY STUART ANDERSON**

**EXECUTIVE SUMMARY**

Changes in technology over the past 25 years have increased the demand for high-skilled labor in America at the same time U.S. limits on high-skilled immigration have remained stuck at levels set in 1990. Before the iPhone, the iPad, YouTube, Netflix, Amazon and Google, back when Mark Zuckerberg was still in kindergarten, Congress passed its last major piece of legislation on high-skill immigration. The 1990 Immigration Act set in law the 140,000 quota on employment-based green cards, the per country limits that restrict Indian and Chinese immigrants, the 65,000 numerical limit on H-1B visas, along with other measures that, with only minor modifications, have not changed in 25 years. In the meantime, fundamental changes in technology and commerce – the Internet becoming a part of daily life, for example – have greatly expanded the demand for skilled technical labor as America’s immigration laws have restricted access to much of that labor at levels established 25 years ago. Many of today’s major technologies and companies did not exist nor could have been imagined by lawmakers when Congress debated the 1990 Act. The research documents the enormous changes in the U.S. economy and technology since 1990 and contrasts that with the lack of change in America’s policies on employment-based immigration.

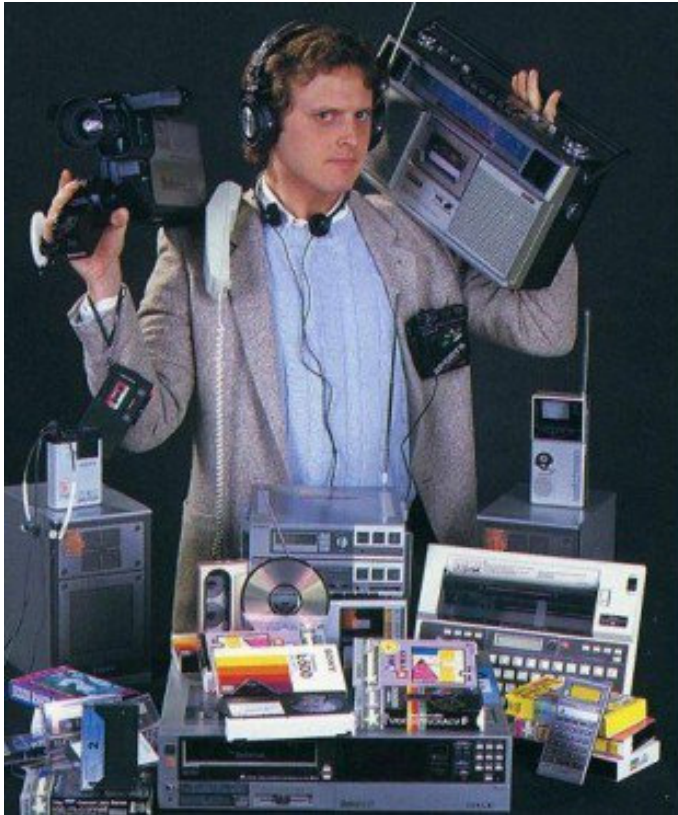
**Table 1  
 Technological Advances Since 1990**

<b>TECHNOLOGICAL ADVANCE</b>	<b>1990</b>	<b>2015</b>
<b>World Wide Web*</b>	Did not exist	3.2 billion users worldwide, integrated into operations of all major companies.
<b>Smartphones</b>	Did not exist	Over 2 billion owners; have transformed entire industries.
<b>Mobile Applications</b>	Did not exist	Over 179 billion app downloads yearly on mobile devices.
<b>Social Media</b>	Did not exist	74% of U.S. Internet users visit a social media site.
<b>Streaming Music</b>	Did not exist	164 billion songs streamed in U.S. in 2014.
<b>Streaming Video</b>	Did not exist	84% of Internet traffic will be streaming video by 2018.
<b>Gaming over the Internet</b>	Did not exist	671 million people worldwide play online games.

Source: National Foundation for American Policy, Money, The Telegraph, Forbes, Pew Research Center, Nielsen SoundScan, Cisco, comScore. \*Software for World Wide Web not distributed widely until 1991; in 1990 World Wide Web did not exist for individuals on a global scale.

For the most sophisticated work, U.S. employers today seek people with graduate degrees in technical fields. At U.S. universities, foreign nationals accounted for 77 percent of full-time graduate students in electrical engineering and 71 percent in computer science in 2013. In 2013, there were 8,130 full-time U.S. graduate students in electrical engineering and 11,481 in computer science. These are small numbers, which include lawful permanent residents (green card holders), relative to a U.S. labor force of over 150 million and an \$18 trillion economy.

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*Photo and caption courtesy of Mark Perry, Carpe Diem.*

Thanks to  
**capitalism**  
all of these things  
now fit in your  
**pocket**

Among the key findings in the research:

- Between 1990 and 2013, the number of computer scientists and systems analysts in the U.S. labor force increased by 381 percent, from 472,549 to 2.3 million. The number of computer software developers increased by 131 percent. And these numbers include only those individuals formally listed within those occupational categories by government classifications, which generally exclude counting those in management, marketing, teaching, etc. In comparison, during the same period, the number of people in the U.S. civilian labor force overall increased by only about 24 percent.
- Between 1990 and 2010, the supply of college degree holders outside the United States increased by 184 million people (or 155 percent), larger than the entire U.S. labor force. As a result, the U.S. share of world college degree holders declined from 26 percent to 18 percent between 1990 and 2010.

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- The employment-based based green card quota of 140,000, half of which goes to dependents, has not changed since 1990 and the per country limit has made wait times far longer for immigrants from large countries, particularly India and China. The annual limit of 65,000 on H-1B visas established in 1990 has not changed, only exemptions were added for universities and non-profit and government research institutes, as well as a 20,000 exemption for foreign nationals with graduate degrees from U.S. universities. Employers have exhausted the supply of H-1B visas every fiscal year for more than a decade.
- Between 1996 and 2013, research and development (R&D) expenditures increased around the world by more than \$1 trillion (in current dollars). Inside the United States, R&D spending increased by \$245 billion. But the U.S. share of global research and development expenditures declined from 36 percent in 1996 to 27 percent in 2013, according to the National Science Foundation.
- The demand for high-skilled labor has increased significantly since 1990 due to the emergence of new technologies, new companies and new ways of delivering content and services to consumers. Many of today's major technologies and companies did not exist when Congress debated the 1990 Act.
- While the Internet existed in 1990, the World Wide Web did not exist for individuals on a global scale. Back in 1990, members of Congress could not have known that the Internet would become an enormous commercial force that would change life for businesses and consumers – and increase the demand for skilled labor.
- Computing power has increased beyond most people's imaginations. A UC Berkeley researcher estimated that the Apple iPhone 6 is about "1 million times more powerful than an IBM computer from 1975," an IBM computer that filled a room compared to a device that fits in one's pocket.
- International students have played a key role over the past two decades. The number of U.S. citizens and lawful permanent residents who received graduate degrees between 1995 and 2013 in electrical engineering declined by 5 percent for Ph.D.s and 11 percent for master's degrees. At the same time, the number of international students between 1995 and 2013 who received Ph.D.s in electrical engineering increased by 105 percent and by 124 percent for master's degrees.
- Between 1990 and 2013, the number of Ph.D.s in computer science increased by 250 percent for international students and by 135 percent for U.S. students (including lawful permanent residents). During those same years, the number of master's degrees in computer science earned by U.S. students increased by 55 percent and by 292 percent for international students.

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- The demand for high-skilled labor to meet increased demand for new products and services can be seen in the enormous increase in the market capitalization of a half dozen companies over the past 20 years. Apple, Intel, Cisco Systems, Oracle, Microsoft and Qualcomm have a combined market capitalization today of over \$1.6 trillion, a \$1.4 trillion increase in value (adjusted to 2015 dollars) since 1995. A look at a dozen technology-related companies that did not exist in 1990, such as Amazon, Facebook and Google, shows a collective a market capitalization for those companies of over \$1.1 trillion. (The German stock market has a market capitalization of \$1.2 trillion.) The demand for high-skilled labor is also seen at Domino's and other non-tech businesses that incorporate software and highly skilled workers into their operations to serve customers.

A grant from the Ewing Marion Kauffman Foundation funded the research for this NFAP paper. The contents of this publication are solely the responsibility of the National Foundation for American Policy.

## BACKGROUND

On October 27, 1990, the U.S. Congress passed the Immigration Act of 1990 (“the 1990 Act”). Twenty-five years have passed and, with only minor exceptions, Congress has not updated employment-based immigration law to reflect the enormous changes in the world and the increased demand for – and economic importance of – individuals with technical skills.<sup>1</sup>

The 1990 Act established two numerical limits that have contributed to what many employers today see as a dysfunctional immigration system. These limits are 1) a 140,000 annual limit on *employment-based immigrant visas* (also known as “green cards”) for permanent residence, including a “per country” limit, and 2) a 65,000 annual limit on *H-1B temporary visas*.

The two categories are complementary, since, in practice, a high-skilled foreign national almost always is first granted H-1B status before gaining permanent residence (since it can take years to gain permanent residence). An individual who receives an immigrant visa or green card obtains permanent residence, meaning he or she can remain in the United States permanently (barring the commission of a serious crime or long absences from the country). In contrast, a temporary visa, such as an H-1B, generally has a set term that does not allow an individual to stay permanently. H-1B status is typically three years, with a renewal for an additional three years, and an extension permitted when a green card application is pending more than 180 days. Increasing the number of employment-based green cards to accompany any increase in H-1B visas would help prevent larger backlogs for skilled immigrant green cards.

## LIMITS ON EMPLOYMENT-BASED GREEN CARDS

While the 1990 Act increased the number of employment-based green cards, the past 25 years has shown the new annual limit was set too low. The overall annual limit on employment-based immigration was increased from 54,000 to 140,000, although the comparison is not precise because Congress reconfigured the preference categories in the 1990 Act.

In reality, the legislation did not permit 140,000 new scientists and engineers to obtain permanent residence each year, as supporters of the bill might have assumed. More than half of the 140,000 quota in a typical year is used by the dependents (spouses and children under 21) of the principals sponsored, about 54 percent in FY 2012.<sup>2</sup> Only

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<sup>1</sup> The bill contained changes to family immigration and modified rules on naturalization, deportation, exclusion and other areas of immigration law. The focus of this analysis is on the 1990 Act’s lasting impact on business immigration.

<sup>2</sup> *2012 Yearbook of Immigration Statistics*, Office of Immigration Statistics, Department of Homeland Security, 2013. Of the 143,998 employment-based green cards issued in FY 2012, 65,909 went to principals and 78,089 went to dependents.

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120,000 of the 140,000 employment-based immigrant visas are reserved for the top three preferences. Also, up to 10,000 of the third preference could be used for “Other Workers,” usually for jobs that do not require a college degree.<sup>3</sup> That means typically no more than about 60,000 individual skilled immigrants gain permanent residence each year in America – representing only about 0.02 percent of the U.S. population.

Moreover, the legislation retained per-country limits on employment-based immigration. Under those limits generally no more than 7 percent of a preference category can be filled by nationals of a single country. In practice, this provision has harmed individuals from countries with large populations, having a significant impact on immigrants from India and China that could not have been anticipated back in 1990. During the 1990s and in later decades, an increased number of Indian and Chinese students came to the United States to attend U.S. universities, particularly to study engineering and computer science. When recruiting on campuses, U.S. employers used H-1B visas to hire these highly skilled individuals and later sponsored many for permanent residence.

Due to the per country limits, the wait times grew longer for Indian and Chinese immigrants. While the wait for many employment-based immigrants is a quite long 6 to 10 years, an analysis by the National Foundation for American Policy has found the theoretical wait time for an Indian national in the employment-based third preference (EB-3) is 70 years.<sup>4</sup> Since 1998, Congress has twice provided backlog relief for employment-based immigrants by allowing a number of additional green cards to become available. The second time was aimed at reducing the wait times for health care workers. These infusions of green cards did not solve the long-term problem of the low annual quota.

## LIMITS ON H-1B VISAS

H-1B visas are important because they generally represent the only way to hire high-skilled foreign nationals, including international students, to work long-term in the United States.<sup>5</sup> Contrary to popular belief, Congress did not “create the H-1B program” in 1990. For years, employers could use H-1 visas to hire workers, particularly skilled professionals, to work in the United States. Prior to the 1990 Act, no numerical limit existed on such workers. In the 1990 Act, Congress established a new designation for H-1 skilled workers – H-1B – and imposed an annual limit of 65,000 on H-1B visas. It is clear in retrospect Congress did not have a clear idea whether that number would be sufficient in later years. Congress also added a series of new labor condition application requirements.

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<sup>3</sup> Section 203(e) of the Nicaraguan and Central American Relief Act (NACARA) has reduced the 10,000 immigrant visas for “Other Workers” by 5,000 a year since NACARA passed in November 1997.

<sup>4</sup> Stuart Anderson, *Waiting and More Waiting: America’s Family and Employment-Based Immigration System*, NFAP Policy Brief, National Foundation for American Policy, October 2011. The 70-year wait estimate is derived from calculating that there exists a backlog of 210,000 or more Indians in the most common skilled employment-based category (the 3<sup>rd</sup> preference or EB-3) and dividing that by the approximately 2,800 Indian professionals who receive permanent residence in the category each year under the law.

<sup>5</sup> An L-1 visa requires an individual to work at least one year abroad prior to an application and is limited to managers, executives and employees with “specialized knowledge.”

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“From an employer’s perspective, the changes to H-1 were not positive. The new requirements delayed the application process and were essentially protectionist in nature,” recalled Warren Leiden, counsel emeritus, Berry Appleman and Leiden, and executive director of the American Immigration Lawyers Association when the 1990 Act became law.<sup>6</sup>

Within a short time, the annual limits on both H-1B visas and employment-based green cards established in the 1990 Act proved to be too low. The H-1B cap of 65,000 went into effect in Fiscal Year (FY) 1992. But in FY 1997, the 65,000 annual limit was exhausted.

After much debate, in 1998, Congress responded by passing the American Competitiveness and Workforce Improvement Act, which increased the annual number of H-1B visas to 115,000 in FY 1999 and 2000 and to 107,500 in FY 2001. However, that increase also proved insufficient and in 2000 Congress passed the American Competitiveness in the 21<sup>st</sup> Century Act. That raised the H-1B limit to 195,000 in FY 2001, FY 2002 and FY 2003. The temporary increase in H-1B visas also included a permanent exemption from the H-1B cap for universities and non-profit research institutes.

After an economic downturn temporarily decreased the demand for high-skilled labor, only 79,100 H-1B petitions were issued against the annual limit in FY 2002 and 78,000 in FY 2003. (This illustrates H-1B visas are responsive to market conditions.) Congress allowed the new limit of 195,000 to expire and the annual limit returned to 65,000 in FY 2004, where it has remained since that time. In late 2004, Congress exempted 20,000 H-1B petitions a year from the annual limit for individuals with a master’s degree or higher from a U.S. university.

Since Congress permitted the annual limit to return to 65,000, the supply of visas has been exhausted before the end of every fiscal year from FY 2004 through FY 2016. In fact, in FY 2016 the annual limit was reached within the first week of filing in April 2015 – about 6 months before the fiscal year was set to begin on October 1, 2015, something that has happened several times.

## **INCREASED DEMAND FOR HIGH-SKILLED WORKERS**

Even though U.S. immigration levels for high-skilled workers have remained roughly at 1990 levels, technological improvements over the past 25 years have greatly increased demand for high-skilled professionals, particularly those with computer-related skills.

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<sup>6</sup> Interview with Warren Leiden via email.

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From 1990 to 2013, computer scientists and systems analysts in the U.S. labor force increased by 381 percent, from 472,549 to 2.3 million. Computer software developers increased by 131 percent.<sup>7</sup> These numbers include only people formally listed within those occupational categories by government classifications, which generally do not include those in management, marketing, teaching and other positions.<sup>8</sup> In contrast, during the same period, the number of people in the U.S. civilian labor force overall increased by about 24 percent.<sup>9</sup>

**THE GLOBAL MARKET FOR LABOR**

Critics of immigration generally ignore the existence of the global labor market. But the increasing supply of technical skills available outside the United States affects everything from the salaries offered to U.S. workers to the decisions made by U.S. employers on where to invest. Between 1990 and 2010, the supply of college degree holders outside the United States increased by 184 million people (or 155 percent), larger than the entire U.S. labor force. As a result, the U.S. share of world college degree holders declined from 26 percent to 18 percent between 1990 and 2010.<sup>10</sup>

**Table 2**  
**Growth of Educated Labor Force Outside of the United States**

	<b>1990</b>	<b>2010</b>	<b>Percent Increase</b>
<b>Number of College Degree Holders Outside of the United States</b>	119 million	303 million	+155 percent

Source: Barro-Lee Educational Attainment Database.

In addition, between 1996 and 2013, research and development (R&D) expenditures increased around the world by more than \$1 trillion (in current dollars). Within the United States, R&D spending increased by \$245 billion. However, the U.S. share of global research and development expenditures fell from 36 percent in 1996 to 27 percent in 2013, according to the National Science Foundation.<sup>11</sup>

<sup>7</sup> National Science Foundation Survey of College Graduates, 1993 and 2013.

<sup>8</sup> See *The Most Misleading Statistic in Immigration: Examining Claims About Jobs For Science and Engineering Degree Holders*, NFAP Policy Brief, National Foundation for American Policy, April 2015.

<sup>9</sup> *2015 Economic Report of the President*.

<sup>10</sup> Barro-Lee Educational Attainment Database.

<sup>11</sup> National Science Foundation unpublished estimates; measured in current dollars, PPP (purchasing power parity).



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**Table 3  
Decline in U.S. Share of World College Degree Holders**

	<b>1990</b>	<b>2010</b>
<b>U.S. Share of World College Degree Holders</b>	26 percent	18 percent

Source: Barro-Lee Educational Attainment Database.

Globalization can also be seen at U.S. universities. Today, when employers recruit on U.S. campuses they find that international students account for 77 percent of the full-time graduate students in electrical engineering and 71 percent in computer science.<sup>12</sup> Put another way, 8,130 U.S. citizens or lawful permanent residents were full-time graduate students in electrical engineering in 2013 and 11,481 were full-time graduate students in computer science. Those are small numbers for an economy as large as that of the United States.

**Table 4  
Full-time Graduate Students and the Percent of International Students by Field (2013)**

<b>Field</b>	<b>Percent of International Students</b>	<b>Number of Full-time International Graduate Students</b>	<b>Number of Full-time U.S. Graduate Students</b>
<b>Electrical Engineering</b>	77%	26,530	8,130
<b>Computer Science</b>	71%	27,787	11,481

Source: National Science Foundation, Survey of Graduate Students and Postdoctorates in Science and Engineering, <https://ncesdata.nsf.gov/webcaspar/>. U.S. students include lawful permanent residents.

## **DECLINE IN U.S. ELECTRICAL ENGINEERING DEGREES, BUT INCREASE IN COMPUTER SCIENCE**

The number of U.S. citizens and lawful permanent residents who received Ph.D.s and master’s degrees in electrical engineering actually declined (by 5 percent for Ph.D.s and 11 percent for master’s) between 1995 and 2013, though increases by international students played an important role in compensating for that decline. During the same

<sup>12</sup> National Science Foundation, Survey of Graduate Students and Postdoctorates in Science and Engineering, <https://ncesdata.nsf.gov/webcaspar/>. U.S. students include lawful permanent residents. If one includes part-time students, 67 percent of graduate students in electrical engineering and 57 percent in computer science are international students.

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period, the number of international students in electrical engineering who received Ph.D.s increased by 105 percent and master's degrees by 124 percent.<sup>13</sup>

The story is better in computer science but the growth in graduate degrees by international students outpaced U.S. students. Between 1990 and 2013, the number of Ph.D.s in computer science awarded to U.S. students (including lawful permanent residents) increased by 135 percent and by 250 percent for international students. During the same period, the number of master's degrees in computer science awarded to U.S. students increased by 55 percent and by 292 percent for international students.<sup>14</sup> In general, international students in STEM fields are more likely to study in the United States at the graduate level. And this has been true in computer science. Bachelor's degrees awarded to U.S. students between 1990 and 2013 increased by 59 percent compared to 11 percent for international students.<sup>15</sup>

## **TECHNOLOGICAL INNOVATION HAS INCREASED THE DEMAND FOR HIGH-SKILLED LABOR**

The world of 2015 differs dramatically from the one that existed in 1990 when Congress set the annual limits on H-1B visas and employment-based green cards. As noted, the demand for high-skilled labor has increased significantly since 1990 due to the emergence of new technologies, new companies and new ways of delivering content and services to consumers. A review of major technologies and companies that did not exist when Congress debated the 1990 Act explains the significant increase in the demand for high-skilled labor.

## **THE INTERNET AS A COMMERCIAL FORCE**

While the Internet existed in 1990, the World Wide Web did not exist on a global scale for individuals. Back in 1990, members of Congress could not have known that the Internet would become an enormous commercial force that would change life for businesses and consumers – and increase the demand for skilled labor.

Engineers created the Internet but it was designed for people with strong technical backgrounds, which limited its usefulness to the general public. That changed in 1991. "In the summer of 1991 Tim Berners-Lee, a computer systems analyst at CERN, released the first World Wide Web software to the high-energy physics community," according to Pamela Samuelson and Hal R. Varian of the University of California, Berkeley. "Shortly thereafter an NSF-funded team at the National Center for Supercomputing Applications (NCSA) at the University of Illinois incorporated the WWW architecture into Mosaic, a user-friendly Internet browser . . . The Web put a friendly face

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<sup>13</sup> National Science Foundation, Webcaspar, IPEDS Completion Survey by Race. Data on electrical engineering degrees awarded were not available prior to 1995.

<sup>14</sup> National Science Foundation.

<sup>15</sup> Ibid.

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on the Internet, providing an interface that a 10-year old, or even a 50-year old, could easily understand. Perhaps more importantly, the back-end protocols for authoring and distributing Web pages (HTML and HTTP) were easy to understand and use as well, facilitating the rapid deployment of Web servers.”<sup>16</sup>

It took time for the Internet to develop into a commercial force. A good example of this can be seen in a *Today Show* clip from 1994, which was featured in a January 2015 Super Bowl ad. The clip shows former *Today Show* host Katie Couric asking an assistant, “Can you explain what Internet is?”<sup>17</sup> It wasn’t until the mid-1990s that Internet commerce started to take off. In 1994, Stanford graduate students Jerry Yang and David Filo began Yahoo!. In 1995, Jeffrey Bezos started Amazon.com as “Earth’s Biggest Bookstore.” Also in 1995, Pierre Omidyar put the Internet auction site eBay online.<sup>18</sup>

The development of web browsers boosted Internet commerce. Marc Andreessen, who later cofounded Netscape, led the team that in 1993 released Mosaic. “Mosaic is the celebrated graphical ‘browser’ that allows users to travel through the world of electronic information using a point-and-click interface,” explained *Wired* magazine. “Mosaic’s charming appearance encourages users to load their own documents onto the Net, including color photos, sound bites, video clips, and hypertext ‘links’ to other documents. By following the links – click, and the linked document appears – you can travel through the online world along paths of whim and intuition.”<sup>19</sup> Within a few years, Microsoft launched Internet Explorer, marking an escalation in what became known as the “browser wars.”

One indicator of the growth of the Internet is the increase in the number of hosts. “The Internet grew from 313,000 hosts in 1990 to 43,230,000 in 2000,” according to Pamela Samuelson and Hal Varian. As of 2012, there were more than 500 million Internet hosts just in the United States. (“An Internet host is a computer connected directly to the Internet. The number of hosts is one indicator of the extent of Internet connectivity.”)<sup>20</sup> Worldwide, “the number of Internet users has increased from 738 million in 2000 to 3.2 billion in 2015.”<sup>21</sup>

## SMARTPHONES

No smartphones existed in 1990. But by 2016, smartphone users are expected to exceed 2 billion, meaning one-quarter of the world’s population will own one. By 2018, 2.56 billion, or about one-third of the people on Earth will possess a smartphone.<sup>22</sup> And the impact of the smartphone is expected to grow. “Smartphones will remake entire

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<sup>16</sup> Pamela Samuelson and Hal R. Varian, “The ‘New Economy’ and Information Technology Policy,” University of California, Berkeley, July 18, 2001. NSF is National Science Foundation.

<sup>17</sup> <https://www.youtube.com/watch?v=U1jwWwJ-Mxc&x-yl-ts=1422579428>.

<sup>18</sup> World Wide Web Timeline, Pew Research Center, March 11, 2014.

<sup>19</sup> Gary Wolfe, “The (Second Phase of the) Revolution Has Begun,” *Wired*, October 1994.

<sup>20</sup> *The World Factbook*, Central Intelligence Agency, 2015.

<sup>21</sup> Jacob Davidson, “Here’s How Many Internet Users There Are,” *Money*, May 26, 2015.

<sup>22</sup> Sophie Curtis, “Quarter of the World Will Be Using Smartphones in 2016,” *The Telegraph*, December 11, 2014.

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industries, at unheard-of speed,” according to *The Economist*. “Uber is a household name, operating in 55 countries, but has yet to celebrate its fifth birthday. WhatsApp was founded in 2009, and already handles 10 billion more messages a day than the SMS global text-messaging system. The phone is a platform, so startups can cheaply create an app to test an idea – and then rapidly go global if people like it. That is why it will unleash creativity on a planetary scale.”<sup>23</sup>

IBM’s Simon Personal Communicator, released in 1992, is considered the first “smartphone.” The phone allowed users to access, send and receive emails. It cost \$899 with a two-year contract and “had a monochrome touchscreen, a stylus, and a charging base station. When using data, you could expect to charge the phone after about 60 minutes of use.”<sup>24</sup> In 1996, Nokia introduced a smartphone with a small physical keyboard, and by the early 2000s, more advanced versions of the smartphone came with Research In Motion’s Blackberry and later the Palm OS and Windows Mobile. Still, smartphones remained primarily a workplace-oriented device with an ability to perform web functions as an added feature.

**Table 5**  
**Leading Mobile Apps**

<b>TOP MOBILE APPLICATIONS</b>
<b>1) Facebook</b>
<b>2) You Tube</b>
<b>3) Google Play</b>
<b>4) Google Search</b>
<b>5) Pandora</b>
<b>6) Google Maps</b>
<b>7) Gmail</b>
<b>8) Instagram</b>
<b>9) Apple Maps</b>
<b>10) Yahoo stocks</b>

Source: comScore, June 2014.

“In 2007, the wireless industry took a dramatic turn . . . when Apple announced the iPhone in January 2007 and launched it months later in June,” notes Pocketnow, a technology website, in a history of the smartphone. “Apple’s idea of the smartphone combined powerful multimedia functions with the same email and Web browsing features as all other smartphones previously had. It had a large color display with a capacitive digitizer, and its user interface was *finally* finger-friendly . . . The real context switch brought with the iPhone, though, was how websites displayed on mobile. Thanks to the WebKit browser debuted in iOS, no longer were they hacked-up, dumbed-down versions

<sup>23</sup> “Planet of the Phones,” *The Economist*, February 28, 2015.

<sup>24</sup> Taylor Martin, “The Evolution of the Smartphone,” Pocketnow.com, July 28, 2014.

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of the full desktop sites, but fully rendered, color web pages via mobile. This helped bridge the gap between the bite-sized version of the Internet consumed on earlier smartphones and the full-blown Internet experience we enjoy today.”<sup>25</sup>

Whether the phone is produced by Apple, Samsung or another company, it is the computing power that makes today’s smartphones so different from anything conceived of 25 years ago. “Apple’s iPhone 6 is roughly 1 million times more powerful than an IBM computer from 1975 – which took up an entire room – according to a rough estimate by UC Berkeley’s Bokor,” reports CNet. “The iPhone, priced starting at \$650, is also a lot cheaper than a full-fledged desktop computer selling anywhere between \$1,000 and \$4,000 a decade ago – and it can do so much more.”<sup>26</sup>

The iPhone and other smartphones helped unleash applications or “apps.” Apple created an App Store (and competitors followed suit). Thousands of games and other applications flooded the marketplace, which created demand for individuals with the technical skills who could develop and support these applications. According to the research firm comScore, as of June 2014, the leading mobile apps were 1) Facebook, 2) You Tube, 3) Google Play, 4) Google Search, 5) Pandora, 6) Google Maps, 7) Gmail, 8) Instagram, 9) Apple Maps, and 10) Yahoo stocks. None of the companies providing these apps existed in 1990.<sup>27</sup> There were an estimated 179 billion app downloads to mobile devices by 2014.<sup>28</sup>

## **SOCIAL MEDIA**

A long time ago (or at least prior to 1990), when someone wanted to communicate with a friend, loved one or business associate, he or she needed to dial a telephone or write a letter. Those days have passed and technology-based companies have earned billions of dollars by changing the way we interact one another. Email was perhaps the first such advancement. Since then, cell phone technology has made texting often more common than speaking on the phone.

Today, 74 percent of adults who are online use at least one social network website.<sup>29</sup> Social networks developed and proved popular as a way to connect with school friends and soon evolved into a way to make new friends. Classmates.com started in 1995 and SixDegrees.com, which allowed the creation of user profiles, began in 1997. In 2002, Jonathan Abrams created Friendster. In 2003, LinkedIn was founded and focused on professional networking, while Myspace aimed at non-business users.<sup>30</sup>

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<sup>25</sup> Ibid.

<sup>26</sup> Roger Cheng, “Moore’s Law is the Reason Your iPhone is So Thin and Cheap,” CNet, April 16, 2015.

<sup>27</sup> Dan Frommer, “These are the 25 Most Popular Mobile Apps in America,” Quartz, August 21, 2014.

<sup>28</sup> Niall McCarthy, “Mobile Apps Usage by the Numbers,” *Forbes*, October 29, 2014.

<sup>29</sup> “Social Networking Fact Sheet,” Pew Research Center, 2014.

<sup>30</sup> “The History of Social Networking,” Digital Trends, August 5, 2014.

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*Facebook Founder Mark Zuckerberg circa 1990.*

In 2004, Mark Zuckerberg and his co-founders launched Facebook, which soon eclipsed Myspace to become the world's most popular social networking site. "Facebook is king for a reason. It wasn't just through luck that founder Mark Zuckerberg's darling came to reign supreme over the social media kingdom," explains Digital Trends. A key difference between Facebook and Myspace (formerly listed as MySpace) is that Facebook adopted a platform that made it possible for developers to create apps for Facebook. For example, the romantic social network site Zoosk started as a photo sharing application that turned into a dating site that utilized the Facebook platform.<sup>31</sup>

Digital Trends and others cite the Facebook platform, which opened up opportunities for many software developers, as a key element in the company's success. "The open API [application programming interface] made it possible for third-party developers to create applications that work within Facebook itself," notes Digital Trends. "Almost immediately after being released, the platform gained a massive amount of attention. At one point in time, Facebook

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<sup>31</sup> Stuart Anderson, "Zoosk: An 'Only in America' Immigrant Success Story," *Forbes*, January 15, 2012.

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had hundreds of thousands of apps built on the platform, so many that Facebook launched the Facebook App Store to organize and display them all. Twitter, meanwhile, created its own API and enjoyed similar success as a result.”<sup>32</sup>

Twitter, founded in 2006, allows users to send out “tweets” of 140 characters or less and is one of the world’s most visited websites, according to Alexa.<sup>33</sup> Twitter is often in the news for controversies caused when celebrities or athletes post something considered controversial. But it is also used by performers and companies (and individuals) to connect with fans and consumers.

## **PORTABLE AND STREAMING MUSIC AND VIDEO**

In the 1950s when someone wanted portable music, he or she needed to walk around with a transistor radio. By the 1970s and 1980s, portable music came in the form of the Sony Walkman, but was limited to what could fit on a 90 minute cassette tape. Apple changed all that.

In 2001, Apple released the first iPod, which allowed portable music in the form of digital files to be downloaded onto a device. In that same year, Apple created iTunes and later the iTunes Store as a way for consumers to purchase and download audio and video files. Later, individuals could download songs and videos onto their smartphones.

Eventually, music sites developed that gave listeners the option to stream songs or pay to download them. Among the most popular of these have been Pandora, Spotify and Rhapsody. Technological developments made these companies possible. “Before the rise of the MP3, even the most fanatical music fan, with a basement stacked high with LPs, tapes and CDs, wouldn’t have had a fraction of the 20 million songs available on a child’s smartphone via services like Spotify or Rhapsody,” according to Eric Brynjolfsson and Andrew McAfee, authors of *The Second Machine Age*.<sup>34</sup> In 2014, approximately 164 billion songs were streamed online in the United States.<sup>35</sup>

Video and books also became much more portable. In 2007, Amazon launched Kindle, its first e-book reader. A later version, Kindle PaperWhite, could store 2,000 books, which is more books than most people will read in a decade.<sup>36</sup> Other Kindle versions allow consumers to download movies and TV shows.

The first “tablet” to sell millions of copies was Apple’s iPad, which was released in 2010. By April 2011 the company had sold more than 15 million units. The original iPad had a 9.7 inch screen and was portable, since it weighed less

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<sup>32</sup> “The History of Social Networking,” Digital Trends, August 5, 2014.

<sup>33</sup> Alexa.com.

<sup>34</sup> Eric Brynjolfsson and Andrew McAfee, *The Second Machine Age* (New York: W.W. Norton & Company, 2014), p. 109.

<sup>35</sup> Nielsen SoundScan, as cited in “Nielsen Music: 2014 At-A-Glance,” January 2, 2015.

<sup>36</sup> Mike Flacy, “Amazon Doubles Kindle Paperwhite Storage, Now Holds 2,000 Books,” Digital Trends, August 15, 2014.

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(and took up less space) than a laptop. Consumers could use it in meetings or for playing music or video. Apple came out with new versions and competitors introduced their own tablets.

Online streaming of television and movies also did not exist prior to 1990. Reed Hastings and Marc Randolph started Netflix in 1997 as a company that rented consumers DVDs by mail for a monthly subscription. But Hastings saw online streaming of video as the future, particularly given the immediacy it provided consumers. Streaming technology allowed Netflix to produce original programming and to make hours of content available to consumers without the need for scheduled viewing time, as in traditional television. Today, Netflix has “over 62 million members in over 50 countries.”<sup>37</sup> Netflix’s competitors include Hulu (and Amazon). Cisco estimates that by 2018, 84 percent of Internet traffic will be streaming video.<sup>38</sup>

Technological improvements have made other forms of entertainment available that would have been impossible 25 years ago. Satellite radio and podcasting are two examples. Due to today’s technology, fans can follow favorite sports teams through online streaming of broadcasts or by reading and commenting on numerous sports blogs. Dating sites, such as eHarmony, Match.com, Zoosk and others have exploded in popularity, with tens of millions of users making connections facilitated by the World Wide Web. Technological advancements have not only increased the demand for high-skilled labor in the first instance but the constant improvement in the products and services have created additional demand as the products and services became easier for the consumer to use.

## **GAMING AND 3-D PRINTING**

Not only have the graphics improved in the multi-billion dollar gaming industry, but the ability to play online with friends or almost anyone in the world has transformed gaming. An estimated 671 million people worldwide play games online.<sup>39</sup> Microsoft’s Xbox and Sony’s Playstation (and various updated versions), along with the Nintendo Wii, have been the primary machines used by gamers in recent years.

The world has likely yet to realize the full potential of another post-1990 technology – 3D printing. “Additive manufacturing is often referred to as 3D printing, as it works in a similar way to a laser printer,” explains *The Engineer*. “The technique builds a solid object from a series of layers - each one printed directly on top of the previous one.”<sup>40</sup> Using a computer file, such as a CAD file, has allowed hobbyists to make everything from toys to classic car parts using 3D printers. On a larger scale, Airbus revealed that it used more than 1,000 3D printed parts to complete production on the new Airbus A350 XWB jet.<sup>41</sup> Doctors recently treated three babies by using a 3D

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<sup>37</sup> Netflix.com.

<sup>38</sup> Carla Marshall, “By 2018, 84% of Internet Traffic Will Be Video Content,” ReelSEO, 2015.

<sup>39</sup> Amarpal Singh, “Asia Pacific Has Largest Daily Online Gaming Audience,” comScore, June 11, 2013.

<sup>40</sup> Jon Excell and Stuart Nathan, “The Rise of Additive Manufacturing,” *The Engineer*, May 24, 2010.

<sup>41</sup> Dan Simmons, “Airbus Had 1,000 Parts 3D Printed to Meet Deadline,” BBC.com, May 6, 2015.



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printer to make “devices that helped keep their airways open so they could breathe properly, thus saving their lives,” one of many examples of the new technology being used in the medical field.<sup>42</sup>

## **SOME SOFTWARE WITH YOUR PIZZA?**

In 2011, Internet pioneer Marc Andreessen, now a venture capitalist, observed that software was poised to dominate the global economy. “My own theory is that we are in the middle of a dramatic and broad technological and economic shift in which software companies are poised to take over large swaths of the economy,” wrote Andreessen. “More and more major businesses and industries are being run on software and delivered as online services – from movies to agriculture to national defense.”<sup>43</sup>

Today, “software companies” is an elastic term, since even companies delivering traditional products and services rely on software, which means greater demand for people with such skills. Andreessen pointed out the oil industry, financial services and stalwarts like Wal-Mart and Fedex utilize software for logistics and other purposes to gain an edge on competitors and satisfy customers.

Andreessen also could have written about pizza. “The atmosphere at company headquarters feels more like Silicon Valley than a fast-food company,” observed economist Stephen Moore during a visit to Domino’s. “Most employees here are computer programmers and technicians monitoring in real time what people are ordering, how long it is taking to fill an order, and the online complaints and comments that stream in. Their mission is to streamline the pizza-making process from the time the order arrives to when the pie is handed off at the customer’s front door. If the goal is delivery in 30 minutes or less, every innovation that shaves 10 or 15 seconds is a major money saver when you’re selling a billion pies a year.”<sup>44</sup> In short, software and technology have spread throughout the economy.

## **CONCLUSION**

Technological innovation has fueled a demand for high-skilled labor that could not have been imagined by members of Congress when they established numerical limits on H-1B visas and employment-based green cards in the 1990 Act. It is possible that those immigration limits would have proved sufficient had America experienced no technological advancements. But today over 2 billion people own smartphones and walk around texting, downloading apps and watching videos. The World Wide Web did not exist for the general public when the 1990 Act passed but today few consumers or businesses could imagine living in a world without an Internet. Social media sites, such as Facebook and Twitter, did not exist, nor did streaming music or video, or online gaming.

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<sup>42</sup> Ashley Welch, “Meet 3 Kids Alive Today Thanks to a 3D Printer,” CBS News, April 29, 2015.

<sup>43</sup> Marc Andreessen “Why Software Is Eating the World,” *The Wall Street Journal*, August 20, 2011.

<sup>44</sup> Stephen Moore, The Weekend Interview, “How Pizza Became a Growth Stock,” *The Wall Street Journal*, March 13, 2015.

**Table 6**  
**Companies That Did Not Exist in 1990**

<b>COMPANY</b>	<b>MARKET CAPITALIZATION</b>
<b>Google</b>	<b>\$436 billion</b>
<b>Facebook</b>	<b>\$264 billion</b>
<b>Amazon</b>	<b>\$244 billion</b>
<b>Netflix</b>	<b>\$ 52 billion</b>
<b>Uber</b>	<b>\$ 41 billion</b>
<b>YouTube</b>	<b>\$ 40 billion (part of Google, not incl. in Total Value)</b>
<b>eBay</b>	<b>\$ 35 billion</b>
<b>LinkedIn</b>	<b>\$ 24 billion</b>
<b>Twitter</b>	<b>\$ 19.5 billion</b>
<b>Snapchat</b>	<b>\$ 10 billion</b>
<b>Skype</b>	<b>\$ 8.5 billion</b>
<b>Spotify</b>	<b>\$ 8 billion</b>
<b>Pandora</b>	<b>\$ 4 billion</b>
<b>TOTAL VALUE</b>	<b>\$1.15 trillion</b>

Source: National Foundation for American Policy. Market capitalization according to Yahoo Finance as of week of August 7, 2015. Google is separated into two stocks. Skype was purchased by Microsoft in May 2011. Spotify was valued at \$8 billion as of April, 10, 2015 (New York Times). YouTube was acquired by Google and would be valued at \$40 billion if a separate entity, according to Adweek (September 3, 2014). Uber and Snapchat values as of February 15, 2015 (The Street).

The value of technology-related companies that did not exist in 1990 reflects the demand for their products and services, and the need for skilled labor to meet that demand. A compilation of a dozen companies that did not exist in 1990, such as Amazon, Facebook and Google, reveals a collective market capitalization for those companies of over \$1.1 trillion. (See Table 6.) And the demand for skilled labor is not just in “tech” companies. As noted, Domino’s and other non-tech businesses incorporate software and highly skilled workers into their operations to better serve customers.

The demand for the products and services produced by high-skilled labor can also be seen in the enormous increase in the market capitalization of a half dozen well-known technology companies over the past 20 years. Apple, Intel, Cisco Systems, Oracle, Microsoft and Qualcomm have a combined market capitalization today of over \$1.6 trillion, compared to a combined market capitalization of \$200 billion (adjusted to 2015 dollars) in 1995.<sup>45</sup> At \$1.6 trillion, these 6 companies have a combined market capitalization higher than the stock markets of Canada (\$1.2 trillion), France (\$1.3 trillion) and Germany (\$1.2 trillion).<sup>46</sup> The value of Apple has increased over \$600 billion in 2015 dollars

<sup>45</sup> Source: Xignite, Yahoo Finance.

<sup>46</sup> Steve Goldstein, “Here’s the Map of the World if Size Were Determined by Market Cap,” MarketWatch, August 14, 2015.

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over the company's value in 1995. Intel and Cisco Systems both have market capitalizations of over \$140 billion, an increase from \$70 billion and \$122 billion respectively (in 2015 dollars) since 1995. Qualcomm's market capitalization has increased from \$3 billion in 1995 to \$99 billion in 2015. Oracle increased from \$24 billion to \$173 billion over the past 20 years, while Microsoft's value rose from \$77 billion to \$380 billion.<sup>47</sup>

**Table 7**  
**Increase in Value of 6 U.S. Technology Companies Since 1995**

<b>COMPANY</b>	<b>MARKET CAP IN 2015</b>	<b>MARKET CAP IN 1995 (in 2015 dollars)</b>	<b>INCREASE IN VALUE IN 20 YEARS</b>
<b>Apple</b>	\$683 billion	\$8 billion	+\$678 billion
<b>Microsoft</b>	\$380 billion	\$77 billion	+\$303 billion
<b>Oracle</b>	\$173 billion	\$24 billion	+\$149 billion
<b>Cisco Systems</b>	\$145 billion	\$23 billion	+\$123 billion
<b>Intel</b>	\$141 billion	\$70 billion	+\$ 71 billion
<b>Qualcomm</b>	\$ 99 billion	\$ 3 billion	+\$ 97 billion
<b>TOTAL</b>	<b>\$1.6 trillion</b>	<b>\$205 billion</b>	<b>+\$1.4 trillion</b>

Source: Xignite, Yahoo Finance. Market capitalizations as of the week of August 7, 2015.

Given all the changes in technology over the past 25 years, it is not plausible to argue that there has been no significant increase in the demand for high-skilled labor in America since 1990 when current high skill immigration visa limits were set into law. To argue that Congress established the correct immigration limits 25 years ago, at a time before the World Wide Web, smartphones, mobile apps, social media, and online streaming and gaming, is to deny reality.

The report has not attempted to list every technology or exciting company that has emerged on the scene since 1990. But it has shown that we live in a different world than the one that existed in 1990. Our country's immigration laws should reflect the world not of 1990, but of 2015 and beyond.

<sup>47</sup> All 1995 market capitalization figures were adjusted to 2015 dollars using the Department of Labor's CPI Inflation Calculator. Some gains may reflect acquisitions since 1995. Current market capitalization may reflect perceived future demand for a company products and services.

## ABOUT THE AUTHOR

Stuart Anderson is Executive Director of the National Foundation for American Policy, a non-profit, non-partisan public policy research organization in Arlington, Va. Stuart served as Executive Associate Commissioner for Policy and Planning and Counselor to the Commissioner at the Immigration and Naturalization Service from August 2001 to January 2003. He spent four and a half years on Capitol Hill on the Senate Immigration Subcommittee, first for Senator Spencer Abraham and then as Staff Director of the subcommittee for Senator Sam Brownback. Prior to that, Stuart was Director of Trade and Immigration Studies at the Cato Institute in Washington, D.C., where he produced reports on the military contributions of immigrants and the role of immigrants in high technology. He has an M.A. from Georgetown University and a B.A. in Political Science from Drew University. Stuart has published articles in the *Wall Street Journal*, *New York Times*, *Los Angeles Times*, and other publications. He is the author of the book *Immigration* (Greenwood, 2010).

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