

**THE INCREASING IMPORTANCE OF IMMIGRANTS TO  
SCIENCE AND ENGINEERING IN AMERICA**

**BY STUART ANDERSON**

**EXECUTIVE SUMMARY**

Immigrants have played an increasingly important role in contributing to science and engineering advancements in America, as demonstrated by their awards, research, entrepreneurship and education. This analysis finds that while historically immigrants have always made important contributions to the country, objective measures indicate those contributions have increased significantly since the 1960s, when major restrictions on immigration were lifted, and, in particular, over the past 20 years, as immigrants have found important niches in science and technology fields.

The research illustrates that the right laws can play an important part in whether a country benefits from increased globalization, particularly rising educational achievement in India, China and elsewhere. The passage of the Immigration and Nationality Act of 1965, which eliminated the discriminatory national origin quotas and opened the door to Asian immigrants, and the Immigration Act of 1990, which increased employment-based green card numbers, were key factors in enhancing the ability of America to assimilate talented individuals from around the world into our culture and economy. While some of the rise in indicators like immigrant Nobel Prize winners reflects an overall increase in the reputation and capability of American institutions and researchers post-1960, a greater openness to immigration helped make the United States the leading global destination for research in many different science and technology fields, including computers, cancer research and many others.

The research found:

- Between 1901 and 1959, only one immigrant to the United States (William Francis Giauque) won the Nobel Prize in Chemistry, while between 1960 and 2013, 23 immigrants won the Nobel Prize for Chemistry.
- From 1901 to 1959, 9 immigrants to the United States won the Nobel Prize for Medicine, but 28 immigrants were awarded the Nobel Prize for Medicine from 1960 to 2013.
- In Physics, 15 immigrants won the Nobel Prize from 1901 to 1959, while 21 immigrants won the Nobel Prize for Physics between 1960 and 2013.
- Between 1960 and 2013, immigrants won 72 Nobel Prizes in Chemistry, Medicine and Physics, compared to 25 between 1901 and 1959.

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- Immigrants have been awarded 24 of the 68 Nobel Prizes won by Americans in Chemistry, Medicine and Physics since 2000.
  
- Workforce statistics illustrate the increased role of foreign-born scientists and engineers in America. The percentage of individuals with Ph.D.s working in science and engineering occupations in the United States who are foreign-born rose from 23 percent in 1993 to 42 percent in 2010, a near doubling of the proportion of foreign-born in less than 20 years.
  
- An Israeli-born immigrant entrepreneur developed the prototype for attack drones, which are today a key part of U.S. military strategy.
  
- Refugee scientists, who entered America in the 1930s despite restrictive U.S. immigration policies, were decisive in helping America become the first country to develop the atomic bomb. It was the refugees themselves who approached President Franklin Roosevelt, with a letter signed by Albert Einstein, Leo Szilard and Alexander Sachs, to plant the seed for what became the Manhattan Project.
  
- Many of today's immigrant cancer researchers come from countries that would have been barred from immigrating under U.S. law prior to 1965, including China, India, and South Korea. At the top 7 cancer research centers, 42 percent of the researchers are foreign-born, including 62 percent at the University of Texas MD Anderson Cancer Center and 56 percent at Memorial Sloan-Kettering Cancer Center in New York.
  
- In 2011, foreign nationals accounted for 71 percent of the full-time graduate students in electrical engineering at U.S. universities, compared to 44 percent in 1982. International students accounted for 65 percent of full-time graduate students in computer science in 2011, compared to 35 percent in 1982.
  
- The importance of immigrant entrepreneurs to American innovation and the U.S. economy has increased dramatically over the past 40 years. Prior to 1980, only 8 U.S. publicly-traded companies funded with venture capital (or 7 percent) had an immigrant founder or co-founder, according to the National Venture Capital Association. But between 2006 and 2012, 92 companies with venture backing that became publicly traded (or 33 percent) had at least one immigrant founder, a significant increase from both the 1970s and 1980s. Notable publicly traded companies with an immigrant founder or co-founder include Google, eBay, LinkedIn and Tesla Motors.

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- Looking to the next generation of publicly traded companies, particularly in the technology sector, a December 2011 National Foundation for American Policy study found, “Immigrants have started nearly half of America’s 50 top venture-funded companies and are key members of management or product development teams in more than 75 percent of our country’s leading cutting-edge companies.”

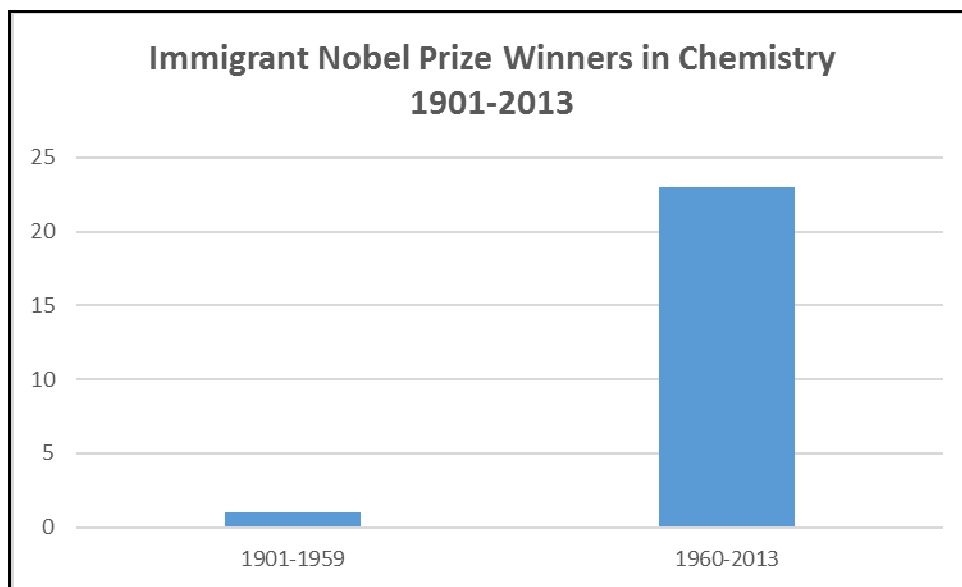
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## SCIENTIFIC ACHIEVEMENT

Immigrants have made significant contributions to America in scientific fields over the course of the 20<sup>th</sup> century up to the present day. One objective measure of the contributions made by immigrants is the number of Nobel Prizes awarded to immigrants over the past 113 years. It is possible to measure how those contributions have increased over time.

The Nobel Prize, which is considered the most prestigious award in science, started in 1901 and has been given annually by the Royal Swedish Academy of Sciences. Between 1901 and 1959, only one immigrant to the United States (William Francis GIAUQUE) won the Nobel Prize in Chemistry. But over approximately the same number of years between 1960 and 2013, 23 immigrants won the Nobel Prize for Chemistry.<sup>1</sup> (See Figure 1.)

**Figure 1**



Source: Royal Swedish Academy of Sciences, National Foundation for American Policy, George Mason University Institute for Immigration Research.

In 2013, all three winners of the Nobel Prize in Chemistry were immigrants to the United States. Michael Levitt, a professor at the Stanford University School of Medicine, was born in South Africa. Martin Karplus, who was born in Austria, is a professor at Harvard University. And Israeli-born Arieh Warshel teaches at the University of Southern California, in Los Angeles.

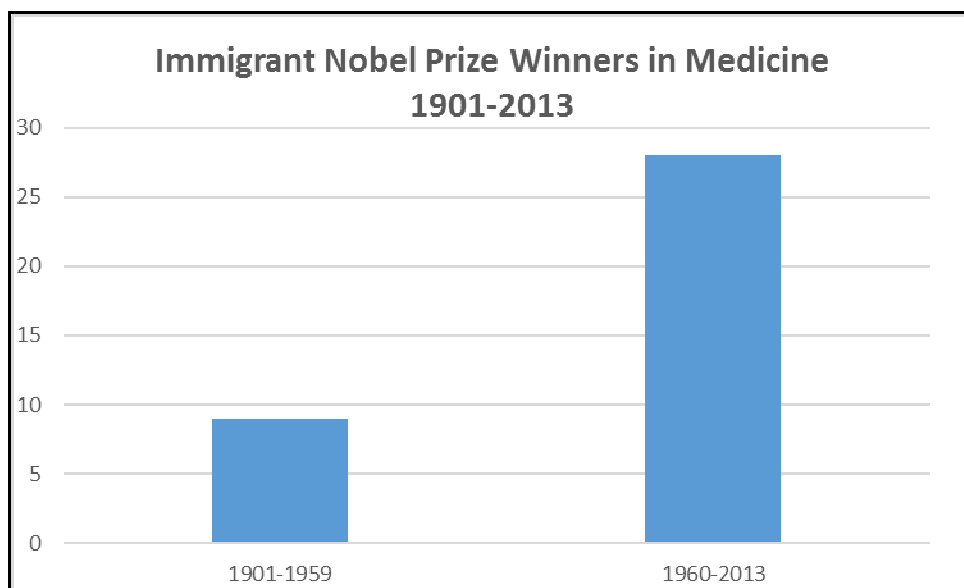
<sup>1</sup> Royal Swedish Academy of Sciences, National Foundation for American Policy, George Mason University Institute for Immigration Research.

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The Royal Swedish Academy of Sciences awarded the Nobel Prize to the three men “for the development of multiscale models for complex chemical systems,” essentially developing the models used in computers to test chemical interactions and processes. “Chemists used to create models of molecules using plastic balls and sticks,” noted the Royal Swedish Academy. “Today, the modelling is carried out in computers. In the 1970s, Martin Karplus, Michael Levitt and Arieh Warshel laid the foundation for the powerful programs that are used to understand and predict chemical processes. Computer models mirroring real life have become crucial for most advances made in chemistry today.”<sup>2</sup>

Similar to the Nobel Prize for Chemistry, prizes for Medicine also have seen a trend of increasing immigrant contribution. From 1901 to 1959, 9 immigrants to the United States won the Nobel Prize for Medicine. But from 1960 to 2013, 28 immigrants were awarded the Nobel Prize for Medicine.<sup>3</sup>

**Figure 2**



Source: Royal Swedish Academy of Sciences, National Foundation for American Policy, George Mason University Institute for Immigration Research.

Elizabeth Blackburn, born in Tasmania, Australia, shared the 2009 Nobel Prize for Medicine with Jack Szostak (Harvard Medical School), a British-born immigrant to the U.S., and American-born Carol Greider (Johns Hopkins University School of Medicine). Greider was Elizabeth Blackburn’s student in 1985 when they “published a paper announcing the discovery of the enzyme telomerase.”<sup>4</sup>

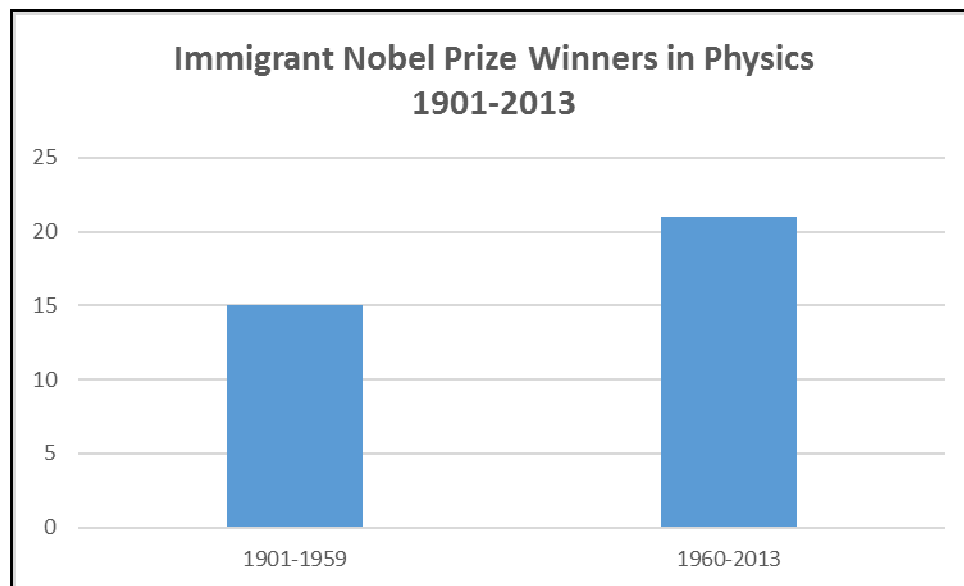
<sup>2</sup> Press Release, The Royal Swedish Academy of Sciences, October 9, 2013.

<sup>3</sup> Royal Swedish Academy of Sciences, National Foundation for American Policy, George Mason University Institute for Immigration Research.

<sup>4</sup> Goutam Naik, “U.S. Cell-Aging Researchers Awarded Nobel,” *The Wall Street Journal*, October 6, 2009, A5.

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Dr. Blackburn and Dr. Szostak were able to establish that “repeated DNA sequences make up the tips of each chromosome.”<sup>5</sup> Since the enzyme serves an important function in the health of cells, the discovery has helped launch research into cancer, cardiovascular disease and other age-related illnesses.<sup>6</sup> In naming Elizabeth Blackburn “Scientist of the Year” in 2007, *Discover Magazine* wrote, “Imagine that this scientist kept a to-do list: On it would be a cure for cancer and, further down, understanding the diseases associated with aging. Elizabeth Blackburn is the 59-year-old Tasmanian-born scientist responsible for launching one of the hottest fields in the life sciences, the study of telomeres. These tiny strips of DNA cap the ends of chromosomes, and her research promises to yield potent therapeutics for many of the scourges that plague humanity.”<sup>7</sup>

**Figure 3**

Source: Royal Swedish Academy of Sciences, National Foundation for American Policy, George Mason University Institute for Immigration Research.

In Physics, 15 immigrants won the Nobel Prize from 1901 to 1959, while 21 immigrants won the Nobel Prize for Physics between 1960 and 2013. As discussed later, the prevalence of so many immigrant winners of the Nobel Prize for Physics prior to 1959 owes not to generous U.S. immigration policies, which were restrictive during that time period, but to the rise of fascism in Europe, which drove out many outstanding Jewish scientists. One of the few ways around restrictive U.S. immigration laws prior to World War II was to receive a job offer from a U.S.

<sup>5</sup> Ibid.

<sup>6</sup> Ibid. See also Stuart Anderson, *Immigration* (Greenwood, 2010).

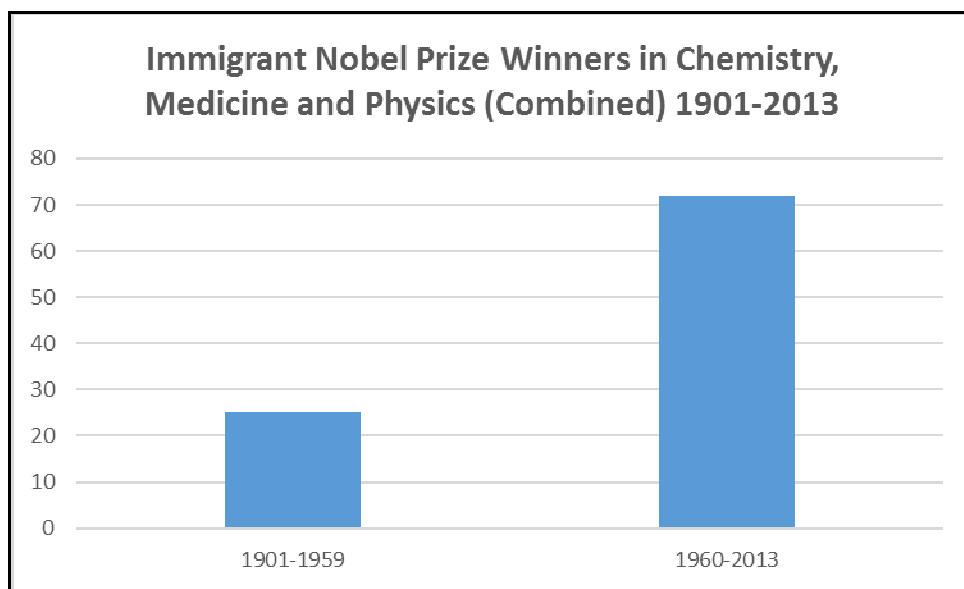
<sup>7</sup> Linda Marsa, “Scientist of the Year Notable: Elizabeth Blackburn,” *Discover Magazine*, December 6, 2007.

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university. That “loophole” is how the United States gained the contributions of such notable scientists as Enrico Fermi.

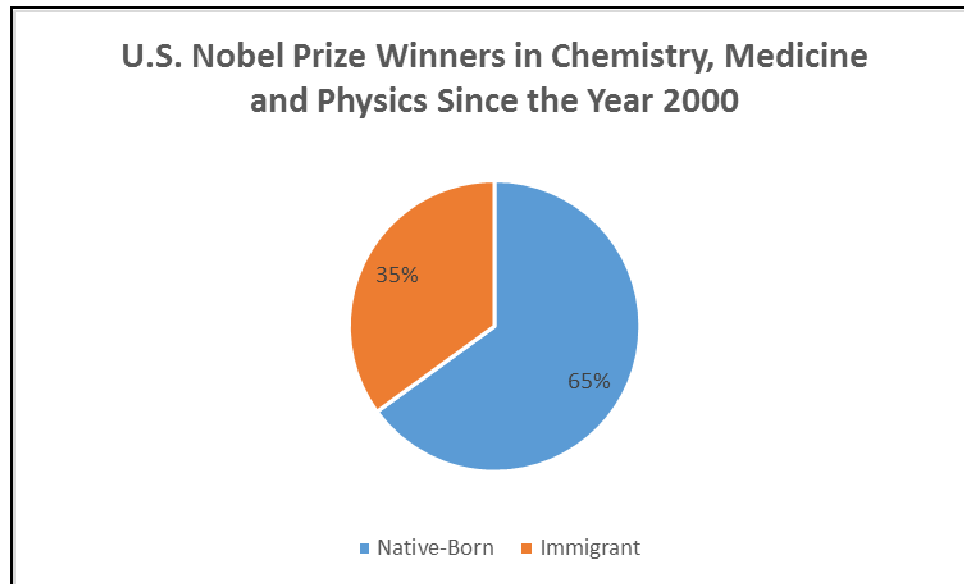
If one combines the Nobel Prizes awarded in the three science categories, then it possible to see the division on immigrant contributions before and after 1960 even more clearly. Between 1960 and 2013, immigrants won 72 Nobel Prizes in Chemistry, Medicine and Physics, compared to 25 between 1901 and 1959.

**Figure 4**



Source: Royal Swedish Academy of Sciences, National Foundation for American Policy, George Mason University Institute for Immigration Research.

Another way to look at the data is to examine the percentage of immigrants among U.S. Nobel Prize recipients in science fields since the year 2000. Out of the 68 Nobel Prizes won by Americans in Chemistry, Medicine and Physics since 2000, 24, or 35 percent, were awarded to immigrants. (See Figure 5.)

**Figure 5**

Source: Royal Swedish Academy of Sciences, National Foundation for American Policy, George Mason University Institute for Immigration Research.

## **KEY CONTRIBUTIONS BY REFUGEE SCIENTISTS TO NATIONAL DEFENSE DESPITE STRICT IMMIGRATION QUOTAS POST-1921**

Congress passed legislation in 1921 that aimed to restrict the immigration of Jews, Italians, and other southern and eastern European immigrants not of “Nordic” descent.<sup>8</sup> Since the 1921 bill had a “sunset” provision, legislators opposed to immigration wasted little time in pursuing even more restrictive measures. They succeeded with the passage of the Immigration Act of 1924. To further diminish the number of alleged inferior immigrants the law set a quota from a particular country of no more than 2 percent of the 1890 population of that country of origin – a date selected because it preceded the large waves of immigrants from Italy and Russia in particular.<sup>9</sup> To appreciate how drastically these quotas and other immigration regulations affected immigration levels, note that the bill caused a 99 percent decline in the number of Russian immigrants admitted to the United States, from 1.1 million for the years 1910 to 1919, to 2,463 for the years 1930 to 1939, a decline of more than 99 percent.<sup>10</sup>

<sup>8</sup> See also Anderson, *Immigration* for a discussion of the history of immigration and the role of refugee scientists.

<sup>9</sup> E.P. Hutchinson, *Legislative History of American Immigration Policy, 1798 – 1965* (Philadelphia, PA: University of Pennsylvania Press, 1981), p. 194.

<sup>10</sup> Table 2 of the *2008 Yearbook of Immigration Statistics*, Office of Immigration Statistics, Department of Homeland Security, 2009.



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The 1921 and 1924 bills affected the lives of millions of people and its effects lasted generations. The 1921 and 1924 acts also influenced the plight of those who sought refuge from Nazi policies of the 1930s and 1940s and enshrined in U.S. law for decades a racial and ethnic basis for denying entry to people based on false distinctions among nationalities.

Advocates of the bills played up anti-Jewish sentiment in gaining legislative support. Rep. Johnson used a document quoting U.S. consuls abroad as saying that without legislative action the United States would face an onslaught of Jews who were “abnormally twisted,” “inassimilable,” “filthy, un-American, and often dangerous in their habits.” Historian John Higham notes, “The House Committee on Immigration appended these comments to its own report in favor of the suspension bill and used them to suggest that the present immigration was largely Jewish. This strategy made a strong impression. It left a conviction in various quarters that the chief purpose of the immigration law of 1921 was to keep out the Jews.”<sup>11</sup>

Here is the irony: The “inassimilable” Jewish scientists who fled Europe in the 1930s and came to America likely did more to ensure America’s freedom and bolster the nation’s defenses than did any of the members of Congress who voted for the 1921 and 1924 legislation.

A number of Jewish refugee scientists were able to overcome the restrictions by their notoriety and the guarantee of employment by certain universities. Research by economists Petra Moser (Stanford and NBER), Alessandra Voena (University of Chicago) and Fabian Waldinger (University of Warwick) found the relative influx of Jewish scientists from Germany after Adolf Hitler’s rise to power increased patenting by U.S. inventors by 31 percent in émigré fields, particularly chemistry. The entry of the Jewish scientists led to a “substantial increase in U.S. invention,” according to the research. Moser, Voena and Waldinger concluded, “This analysis indicates that the arrival of the émigrés encouraged U.S. invention by helping to attract domestic inventors to the research fields of émigrés . . . Moreover, data on the prior patent histories of entrants indicate that the majority of entrants to the fields of émigrés had never patented in the 166 classes in our data before, suggesting that the émigrés’ arrival affected an overall increase in invention, rather than a shift across fields.”<sup>12</sup>

In 1939, the race was on between Germany and the United States to see who would be the first to develop a bomb that could provide enormous, perhaps even decisive, influence over world affairs. At the time, the U.S. military was barely aware such a race had started.

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<sup>11</sup> John Higham, *Strangers in the Land, Patterns of American Nativism 1860-1925* (New York: Antheum, 1973), pp. 309-310.

<sup>12</sup> Petra Moser, Alessandra Voena and Fabian Waldinger, *German Jewish Emigres and U.S. Invention*, December 21, 2013. Available at the Social Science Research Network, pp., 1, 4. The study did not measure the effects of scientists who fled to America from other countries.

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Fission had first been discovered in Germany and that greatly disturbed the foreign-born scientists who had immigrated to America to flee persecution. They feared that Hitler's military establishment would be the first to develop a weapon of mass destruction. Italian-born physicist Enrico Fermi, a winner of the Nobel Prize, contacted the U.S. Navy about these concerns but could not convince officials of the gravity of the situation. Hungarian-born scientist Leo Szilard, Fermi and other scientists knew they needed to leapfrog the bureaucracy.

The scientists contacted the German-born Albert Einstein, believing he was among the few men of sufficient stature who could gain the attention of President Roosevelt. Einstein, Szilard and Russian-born Alexander Sachs drafted a letter to the President. When Sachs managed to meet with Roosevelt, he showed him Einstein's letter, and convinced him of the need to act. "Alex, what you are after is to see that the Nazis don't blow us up," the president said.

Sachs replied, "Precisely." Roosevelt called in an aide and told him, "This requires action."<sup>13</sup> That planted the seeds of the Manhattan Project to develop the atomic bomb.

Before practical work on the atomic bomb was even conceived, substantial theoretical work by the European refugees who arrived between 1930 and 1937 laid the groundwork. The most significant work was done by Eugene Wigner (who came from Hungary), George Gamow (Russia), Felix Bloch (Switzerland), Hans Bethe (Germany), Edward Teller (Hungary), and Victor Weisskopf (Austria). This theoretical underpinning paved the way for Niels Bohr, born in Denmark, and Enrico Fermi to make their breakthrough.

Edward Teller and George Gamow had set up a series of meetings among astronomers and theoretical physicists who shared the goal of exploring the key energy issues of the period. It was at that Washington conference in 1939 that Bohr and Fermi first publicly addressed the idea that neutrons were emitted when uranium fission takes place. This opened the way to "chain reaction" and the development of the atomic and hydrogen bombs.

Leading up to and during the Manhattan Project, considerable collaboration between American and foreign-born scientists took place. "At every point where European and American scientists came together, there was the same high degree of acceptance. As the atomic project grew and many more Americans and Europeans joined in, cooperation became even more prominent," writes Laura Fermi, author of *Illustrious Immigrants*, which chronicles European immigrants of the 1930s and 1940s.<sup>14</sup>

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<sup>13</sup> Richard Rhodes, *The Making of the Atomic Bomb* (New York, NY: Simon & Schuster, 1986), p. 314.

<sup>14</sup> Laura Fermi, *Illustrious Immigrants* (Chicago: University of Chicago Press, 1968), p. 187.

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While there is still debate about the issue, many historians believe the decision to drop the atomic bomb on Japan shortened the war and saved thousands of American lives that would have been lost in a land invasion of Japan. The United States benefitted both during World War II and during the Cold War in being the nation to develop nuclear weapons first. But the immigrants who arrived as refugees from Europe produced a legacy that outlasted the Manhattan Project.

When in 1954 the Atomic Energy Act established a distinguished award to recognize scientific achievements in the field of atomic energy, the first winner was the Italian-born Enrico Fermi. In all, 5 of the first 8 winners of what became known as the Enrico Fermi Award (so named after his death) were immigrants. In addition, four of the nuclear scientists who came to the United States from Europe in the 1930s later received a Nobel Prize for physics: Felix Bloch, born in Switzerland, won it in 1952, Emilio Segre (Italy) won in 1959, and Maria Mayer (Poland) and Eugene Wigner (Hungary) won the award in 1963.

The development of the atomic bomb at a secret site in Los Alamos, New Mexico, is one of the great scientific and military accomplishments of the modern era. Many scientists played important roles but among the key figures were George Kistiakowsky, a Russian emigre who designed the bomb's plutonium core, and Hungarian-born John von Neumann, who devised a computer language that turned mathematical procedures into a language to instruct the computer. Hans Bethe believed that without John von Neumann, the development of modern computers would at best have been delayed ten years or more.<sup>15</sup>

Why did the immigrant physicists succeed? Clearly these were some of the most highly-skilled people on earth but it was something more. Beyond their skills, Laura Fermi notes the unique characteristics and emotions that the foreign-born scientists brought to the atomic project: "The determination to defend America at all costs spurred the newcomers no less than the Americans, and the European-born may have come to this determination somewhat earlier than the native-born, driven by stronger personal emotions. The picture of their country under Nazi power in the event of a German victory was something the Americans could imagine only with difficulty."<sup>16</sup> That was not the case for those who had already seen their countries overrun.

Fermi notes that "It was not only gratitude to the country that had offered them asylum or pride in their new citizenship but also the fear of dictators that drove them to work to the limit of their physical and mental endurance."<sup>17</sup>

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<sup>15</sup> Ibid., p. 290.

<sup>16</sup> Ibid., p. 188.

<sup>17</sup> Ibid., p. 188.

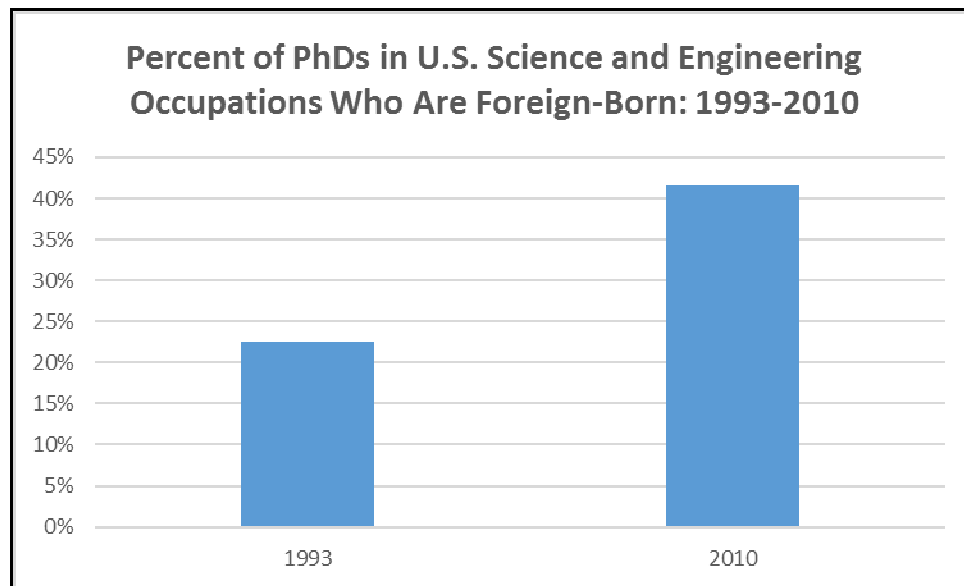
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The contribution of immigrants to America's national defense can also be seen more recently. *The Economist* called Abe Karem, who came to the United States from Israel in the 1970s, "the aerospace engineer behind America's most successful and most feared military drone." He founded Leading Systems "in the garage of his Los Angeles home." The initial model was built using plywood, fiberglass and an engine that would fit in a go-cart. "I wanted to prove that performance is largely a result of inspired design and highly optimised and integrated subsystems, not the application of the most advanced technology," he said. The result, according to *The Economist*, was "a drone that would ultimately transform the way America wages war."<sup>18</sup>

### **SIGNIFICANT RISE IN PERCENTAGE OF ADVANCED DEGREE HOLDERS WHO ARE FOREIGN-BORN WORKING IN SCIENCE AND ENGINEERING OCCUPATIONS**

Workforce statistics illustrate the increasing importance of foreign-born scientists and engineers in the U.S. economy. The percentage of individuals with Ph.D.s working in science and engineering occupations in the United States who are foreign-born rose from 23 percent in 1993 to 42 percent in 2010, a near doubling of the proportion of foreign-born in less than 20 years. Similarly, the percentage of individuals with master's degrees working in U.S. science and engineering occupations who are foreign-born rose from 20 percent in 1993 to 35 percent in 2010, according to the National Science Foundation.<sup>19</sup>

**Figure 6**



Source: National Science Foundation, SESTAT.

<sup>18</sup> "The Dronefather," *The Economist*, Technology Quarterly, December 1, 2012.

<sup>19</sup> National Science Foundation, SESTAT. Numbers rounded off. S&E degree holders also work in non-S&E occupations.

## **CONTEMPORARY AND HISTORICAL CONTRIBUTIONS BY IMMIGRANTS TO CANCER RESEARCH IN AMERICA**

While military contributions are important, if there is one group of immigrants most Americans would likely welcome above all others it is cancer researchers. Immigrants play a larger role in cancer research today than ever before: 42 percent of the researchers at the top 7 cancer research centers are foreign-born.<sup>20</sup> At the University of Texas MD Anderson Cancer Center, 62 percent of the cancer researchers are immigrants. At Memorial Sloan-Kettering Cancer Center in New York, 56 percent of the researchers are foreign-born.<sup>21</sup>

We know that immigrants are playing an increasingly important role in cancer research compared to many decades ago for two reasons. First, the pace and scope of cancer research has expanded dramatically over the past 25 to 30 years. Second, prior to the 1965 Immigration and Nationality Act's repeal of the national origins quotas, individuals from the leading source countries for cancer researchers could not have worked in America, particularly those born in Asian countries. Twenty-one percent of the cancer researchers at the top 7 cancer research institutes were born in China, while another 10 percent were born in India. Cancer researchers in the United States today come from more than 50 countries, including Taiwan and South Korea.<sup>22</sup>

Four immigrant cancer researchers have won the Nobel Prize: Elizabeth Blackburn (2009), born in Australia, Baruj Benacerraf (1980), born in Italy, and Carl and Gerty Cori (1947), husband and wife researchers born in Austria-Hungary.

Dr. Rainer Storb, head of the Transplantation Biology Program and one of the founders of the Fred Hutchinson Cancer Research Center, was born in Germany and came to Seattle in the 1960s on a Fulbright Fellowship. He became a U.S. citizen and helped create Seattle's marrow transplantation program.<sup>23</sup> According to ScienceWatch, Storb has been the 10th most cited physician-scientist and the 43rd most cited scientist overall worldwide, including the second most-quoted researcher in the field of oncology.<sup>24</sup> When Storb first started in the transplant field doctors generally didn't offer them to patients over 40 because of the fear they couldn't survive them. "Starting in the mid-1990s, Storb developed what came to be called a mini-transplant because he drastically reduced levels of chemotherapy and radiation; eradication of cancer was accomplished through the action of

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<sup>20</sup> Stuart Anderson, *The Contributions of Immigrants to Cancer Research in America*, NFAP Policy Brief, National Foundation for American Policy, February 2013.

<sup>21</sup> Ibid.

<sup>22</sup> Ibid.

<sup>23</sup> Rainer Storb, M.D., profile, Medical Advisory Board, Gabrielle's Angel Foundation for Cancer Research.

<sup>24</sup> Information received from Fred Hutchinson Cancer Research Center.

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immune cells from the donor graft. In many cases, patients are not hospitalized when undergoing the procedure. Patients as old as 78 have received the treatment.”<sup>25</sup>

Contemporary contributions by immigrant cancer researchers are part of a story that has lasted for more than a century. (See Table 1.) George H.A. Clowes, born in the United Kingdom, introduced the first chemotherapy treatment, while Leo Loeb, born in Germany, helped establish that mammary cancer was hereditary. In 1907, immigrants Loeb and Clowes were two of the 11 founding members of the American Association for Cancer Research.<sup>26</sup> Today, the American Association for Cancer Research has 34,000 members.

When Baruj Benacerraf came to the United States after his family left France in 1939, he was rejected by 10 medical schools because at the time such schools maintained quotas against Jewish and foreign applicants (and he happened to be both). Benacerraf, who was born in Venezuela, eventually was admitted to the University of Virginia. He became a U.S. citizen and served as a doctor in the U.S. Army after World War II. He conducted research, publishing more than 600 papers in his career, and is credited with leading the Sidney Farber Institute, later called the Dana-Farber Cancer Institute, out of “administrative turmoil” when he took over in 1980. That same year he was awarded the Nobel Prize in Physiology or Medicine for “his work on how the human body distinguishes its own cells from foreign bodies.”<sup>27</sup>

Among the most well-known physicians at Johns Hopkins is Dr. Alfredo Quiñones-Hinojosa, Professor of Neurosurgery and Oncology at Johns Hopkins University and director of the Brain Tumor Surgery Program. He also leads the Brain Stem Tumor Cell Laboratory. Known by many as Dr. Q, he describes in his autobiography how as a teenager he entered America on a tourist visa and worked illegally over a long summer as a farm worker. He later benefitted from the 1986 Immigration Reform and Control Act, signed by President Ronald Reagan, which gave legal status to many undocumented immigrants. With little knowledge of English, he entered community college in San Joaquin, later graduated from the University of California, Berkeley, and earned a degree in medicine from Harvard Medical School. Dr. Q performs 250 brain surgeries a year on patients – over 2,000 surgeries in his career – and continues to lead a research laboratory.<sup>28</sup>

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<sup>25</sup> Rainer Storb, Featured Researchers, Fred Hutchinson Cancer Research Center.

<sup>26</sup> Appreciation to Kathleen Case, archivist, American Association for Cancer Research for invaluable assistance with the history of cancer research.

<sup>27</sup> Neena Satija and Mark Feeney, “Baruj Benacerraf, 90; shared 1980 Nobel Prize,” *The Boston Globe*, August 3, 2011. He shared the Nobel Prize in 1980 with George Snell and Jean Dausset.

<sup>28</sup> Q&A, October 16, 2011. <http://www.q-and-a.org/Transcript/?ProgramID=1361>.

**Table 1**  
**Notable Immigrant Cancer Researchers: Past and Present**

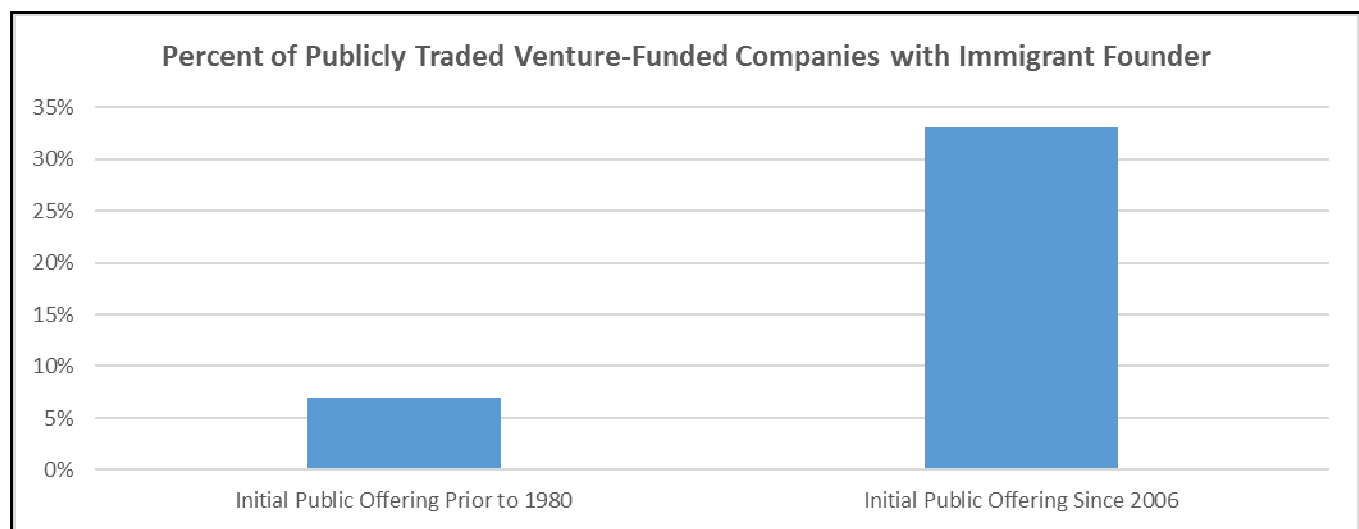
<b>Immigrant</b>	<b>Place of Birth</b>	<b>Contribution to Cancer Research and Medicine</b>
Baruj Benacerraf	Venezuela	Earned Nobel Prize (1980) for “discoveries concerning genetically determined structures on the cell surface that regulate immunological reactions,” led Sidney Farber Institute
Elizabeth Blackburn	Australia	Earned Nobel Prize in Physiology or Medicine (2009) “for the discovery of how chromosomes are protected by telomeres and the enzyme telomerase”
George H.A. Clowes	United Kingdom	Introduced first chemotherapy, an original founder of American Assoc. for Cancer Research
Carl Cori	Austria-Hungary	Earned Nobel Prize (1947) with wife Gerty Cori for “their discovery of the course of the catalytic conversion of glycogen”
Gerty Cori	Austria-Hungary	First woman to earn Nobel Prize (1947), shared with husband Carl
Tom Curran	United Kingdom	Past President of American Assoc. for Cancer Research; he “pioneered laboratory studies of a novel molecule called HhAntag to treat brain cancer without the need for traditional chemotherapy or radiation”
Emmanuel Farber	Canada	Past President American Assoc. for Cancer Research; pioneer in liver cancer research, toxicology and chemical carcinogenesis
Peter Jones	South Africa	Former Director of USC Norris Comprehensive Cancer Center, noted researcher in field of epigenetics
Waun Ki Hong	South Korea	Considered one of the founders of cancer chemoprevention; key researcher at MD Anderson; past Pres., American Assoc. for Cancer Research
Leo Loeb	Germany	In 1907 helped establish mammary cancer was hereditary; pioneer in examining link between cancer and reproductive hormones; an original founder (and past President) of American Assoc. for Cancer Research
Frank McCormick	United Kingdom	A leader in the development of “targeted cancer therapies”; President of American Assoc. for Cancer Research
Enrico Mihich	Italy	Made notable advances in chemotherapy and in the understanding of host-defense mechanisms; past President of American Assoc. for Cancer Research
Andrew Schally	Poland	Earned Nobel Prize (1977) for “discoveries concerning the peptide hormone production of the brain”
Carl Voegtlin	Switzerland	First head of the National Cancer Institute (1938-1943); past President, American Assoc. for Cancer Research

Source: American Association for Cancer Research; National Foundation for American Policy.

## IMMIGRANT ENTREPRENEURS

The importance of immigrant entrepreneurs to American innovation and the U.S. economy has increased dramatically over the past 40 years. Only 7 percent of U.S. publicly-traded companies funded with venture capital had an immigrant founder or co-founder prior to 1980, according to the National Venture Capital Association. But the number of such companies with at least one immigrant founder increased from 8 prior to 1980, to 48 between 1980 and 1989, representing 20 percent of venture-funded companies that became publicly traded during that time. That trend has continued. Between 2006 and 2012, 33 percent (or 92) of the companies with venture backing that became publicly traded had at least one immigrant founder, a significant increase from both the 1970s and 1980s.<sup>29</sup>

**Figure 7**



Source: Analysis of publicly traded companies from Thomson Reuters database; Stuart Anderson and Michaela Platzer, *American Made: The Impact of Immigrant Entrepreneurs and Professionals on U.S. Competitiveness*, National Venture Capital Association, 2006, and *American Made 2.0*, National Venture Capital Association, 2013.

More important than the percentages are the companies themselves. Venture-funded companies with an immigrant founder or co-founder that became publicly traded in recent years include Google, eBay, Facebook, LinkedIn, Tesla Motors and others. The amount of wealth generated by immigrant-founded companies has been immense. “Venture-backed publicly traded immigrant-founded companies have a total market capitalization of \$900 billion (as of June 2013),” according to the National Venture Capital Association. “If immigrant-founded

<sup>29</sup> Stuart Anderson, *American Made 2.0: How Immigrant Entrepreneurs Continue to Contribute to the U.S. Economy*, National Venture Capital Association, July 2013.



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venture-backed public companies were a country, then the value of its stock exchange would rank 16<sup>th</sup> in the world, higher than the exchanges of Russia, South Africa and Taiwan.”<sup>30</sup>

The next generation of publicly traded companies is also likely to have a large number of companies with immigrant founders or co-founders, since “Immigrants have started *nearly half* of America’s 50 top venture-funded companies and are key members of management or product development teams in more than 75 percent of our country’s leading cutting-edge companies.” Among the top venture-backed companies, immigrant founders have created “an average of approximately 150 jobs per company in the United States.”<sup>31</sup>

**Table 2**  
**Full-time Graduate Students and the Percent of International Students by Field (2011)**

Field	Percent of International Students	Number of Full-time International Graduate Students	Number of Full-time U.S. Graduate Students
<b>Electrical Engineering</b>	71.4	21,933	8,802
<b>Computer Science</b>	64.5	19,605	10,802
<b>Industrial Engineering</b>	60.6	4,998	3,253
<b>Economics</b>	55.3	7,823	6,335
<b>Materials Engineering</b>	53.8	3,163	2,714
<b>Chemical Engineering</b>	52.8	4,036	3,603
<b>Mechanical Engineering</b>	50.7	8,150	7,934
<b>Mathematics &amp; Statistics</b>	45.6	8,354	9,949
<b>Civil Engineering</b>	45.6	6,554	7,809
<b>Physics</b>	43.6	5,844	7,569
<b>Other Engineering</b>	42.3	7,682	10,499
<b>Chemistry</b>	40.2	8,200	12,203

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.

<sup>30</sup> Ibid.

<sup>31</sup> Stuart Anderson, *Immigrant Founders and Key Personnel in America’s Top 50 Venture-Funded Companies*, NFAP Policy Brief, National Foundation for American Policy, December 2011.

## INTERNATIONAL STUDENTS

When U.S. employers venture onto college campuses today, they will find that a high percentage of the graduate students in science and engineering are international students. Foreign nationals accounted for 71 percent of full-time graduate students in electrical engineering, 65 percent in computer science, 61 percent in industrial engineering, and more than 50 percent in economics, chemical engineering, materials engineering, and mechanical engineering in 2011.<sup>32</sup> (See Table 2.) In comparison, in 1982, foreign nationals accounted for 44 percent of the full-time graduate students in electrical engineering and 35 percent in computer science.<sup>33</sup>

International students have played an increasingly important role in America, both on campus and as a source of science and engineering talent that America assimilates. International students enhance the ability of U.S. universities to conduct research and offer high quality academic programs to U.S. students in science and engineering fields. In 2011, in electrical engineering, at 153 U.S. universities, representing nearly 88 percent of the U.S. graduate school programs in EE, the majority of full-time graduate students were international students. In computer science, at 170 universities, representing 79 percent of the U.S. graduate school programs in computer science, the majority of full-time graduate students were international students.<sup>34</sup> (See Table 3.)

**Table 3**  
**U.S. University Graduate Programs with a Majority of International Students**

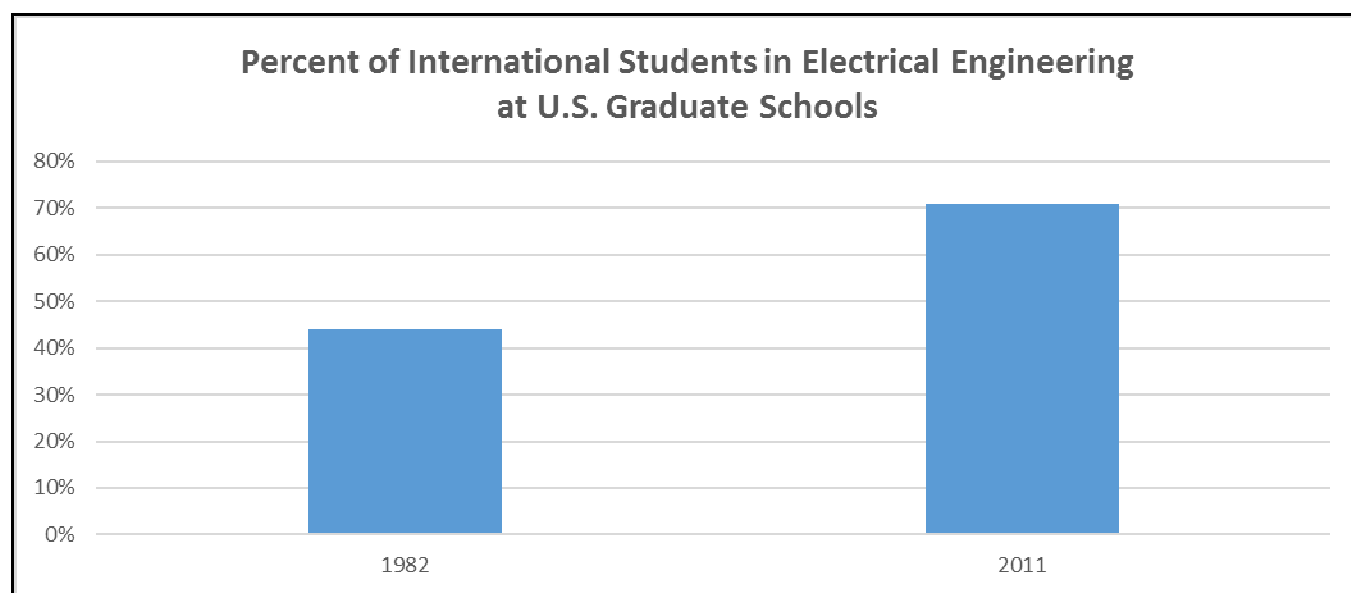
Field	Number of U.S. Universities with More Than 50 Percent International Students in Graduate School Program (2011)	Percentage of U.S. Universities with a Majority of International Students in Graduate School Program (2011)
Electrical Engineering	153	88 percent
Computer Science	170	79 percent

Source: National Science Foundation, Survey of Graduate Students and Postdoctorate, <https://ncesdata.nsf.gov/webcaspar/>. U.S. students include lawful permanent residents; National Foundation for American Policy analysis.

<sup>32</sup> National Science Foundation, Survey of Graduate Students and Postdoctorate, [webcaspar.nsf.gov](https://ncesdata.nsf.gov/webcaspar/).

<sup>33</sup> Ibid.

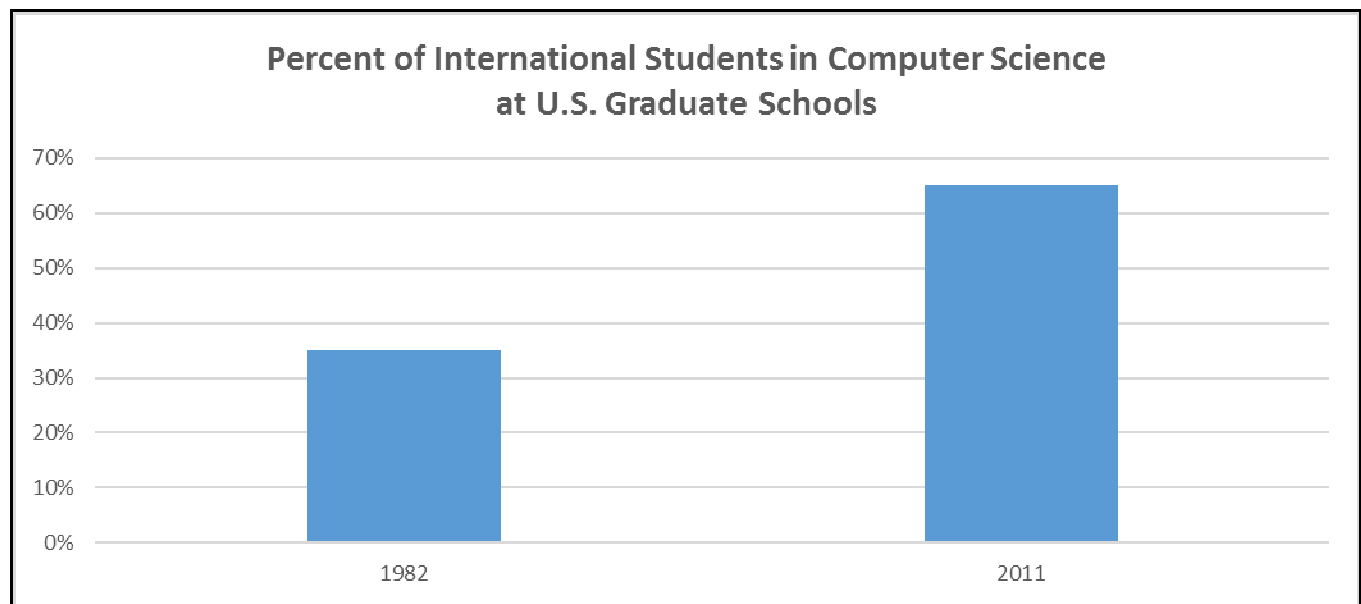
<sup>34</sup> National Science Foundation, Survey of Graduate Students and Postdoctorates in Science and Engineering, <https://ncesdata.nsf.gov/webcaspar/>. U.S. students include lawful permanent residents; National Foundation for American Policy analysis. See also Stuart Anderson, *The Importance of International Students to America*, NFAP Policy Brief, National Foundation for American Policy, July 2013 and *International Educator* May/June 2014.

**Figure 8**

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.

International students are key to supporting research at U.S. universities, which helps retain and attract top faculty. At schools such as Rice University, Indiana University, Purdue University, Ohio State, and others, international students generally comprise 60 to 80 percent of the graduate students in electrical engineering, computer science, chemical engineering, and other fields. In 2010, U.S. universities conducted 51 percent of all basic research performed in the United States, according to the National Science Foundation.<sup>35</sup>

<sup>35</sup> National Center for Science and Engineering Statistics, National Patterns of R&D Resources: 2010–11 Data Update, National Science Foundation, NSF13-319, April 2013, Table 3.

**Figure 9**

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.

## CONCLUSION

America has benefitted from its openness to foreign-born talent. While historically, these contributions have been significant, the data show the importance of foreign-born scientists and engineers has increased over time. Many more immigrants have earned Nobel Prizes in science fields in the past 54 years (1960-2013), than in the prior 60 year period (1901-1959). In fields such as cancer research, immigrants who would have been blocked from coming to America prior to 1965 are today saving lives and working on breakthroughs to cure more people in the years ahead. Immigrant entrepreneurs, often combining their talents with native-born Americans, have started an increasing percentage of the cutting-edge companies that drive jobs, growth and innovation. And a look at the key role international students play in keeping science and engineering programs robust at U.S. universities indicates the next generation of immigrants will also make important contributions to America.

## 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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