

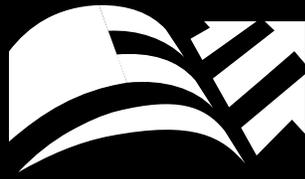
A REPORT FROM THE PARTNERSHIP FOR A NEW AMERICAN ECONOMY

JUNE 2012



PATENT PENDING

HOW IMMIGRANTS ARE REINVENTING
THE AMERICAN ECONOMY



PARTNERSHIP FOR A
**NEW AMERICAN
ECONOMY**

THE PARTNERSHIP FOR A NEW AMERICAN ECONOMY brings together more than 450 Republican, Democratic, and Independent mayors and business leaders who support immigration reforms that will help create jobs for Americans today. The Partnership's members include mayors of more than 35 million people nationwide and business leaders of companies that generate more than \$1.5 trillion and employ more than 4 million people across all sectors of the economy, from Agriculture to Aerospace, Hospitality to High Tech, and Media to Manufacturing. Partnership members understand that immigration is essential to maintaining the productive, diverse, and flexible workforce that America needs to ensure prosperity over the coming generations.

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EXECUTIVE SUMMARY

The future of the American economy rests on our ability to innovate and invent the new products that will define the global economy in the decades ahead. This report seeks to highlight one key aspect of this challenge that is often overlooked: the crucial role that foreign scientists, engineers, and other researchers play in inventing the products and dreaming up the ideas that will power the American economy in the future. As the magnet for the world's brightest minds, America has prospered greatly from the global innovators who have come here to do research and invent products. However, many of these innovators face daunting or insurmountable immigration hurdles that force them to leave the country and take their talents elsewhere. The problem is particularly acute at our research universities, where we train the top minds, only to send them abroad to compete against us.

This report aims to quantify both the role that foreign-born inventors play in the innovation coming out of US universities, and the costs we incur by training the world's top minds and sending them away. University research is responsible for 53% of all basic research in America. Much of this research leads

to patented inventions, new companies, and jobs for American workers.

It is widely acknowledged that foreign-born faculty, postdoctoral fellows, researchers, and students play an important role in US university research. This report explains precisely how great that role is. Accessing the US Patent and Trademark Office's public, online database, the report identifies the 10 universities and university systems that were assigned the most patents in 2011.¹ Using publicly-available documents, patent filing data, and in some cases, university-provided data, the report then determines the percentage of patents awarded to those schools that had at least one foreign-born inventor, a key gauge of their contribution.²

The findings confirm that America's economic strength goes hand in hand with our ability to attract the brightest minds to America. Foreign-born inventors played an invaluable role in cutting-edge research in 2011. Their presence was invaluable in university communities at nearly every level, from tenured professors down to graduate students and postdoctoral

76%

OF PATENTS AWARDED TO THE TOP 10 PATENT-PRODUCING US UNIVERSITIES IN 2011 HAD AT LEAST ONE FOREIGN-BORN INVENTOR.

- During that same period, more than half of all patents (54%) were awarded to the group of foreign inventors most likely to face visa hurdles: students, postdoctoral fellows, or staff researchers.
- Foreign-born inventors played especially large roles in **cutting-edge fields** like semiconductor device manufacturing (87%), information technology (84%), pulse or digital communications (83%), pharmaceutical drugs or drug compounds (79%), and optics (77%).
- The almost 1,500 patents awarded to these universities boasted inventors from **88 different countries**.

researchers in the US on temporary visas—many with no clear path to stay in America and apply their skills.

The patents themselves represent only the beginning of how these foreign-born innovators contribute to our country’s competitiveness. In many cases, the inventors turned their work into successful startup ventures employing Americans. In many other cases, the patents were licensed out to companies, providing a valuable avenue to expand the inventors’ work. And the 10 universities the report studies, which earn hundreds of millions of dollars in patent revenues each year, invest much of those funds into additional research, furthering the cycle of innovation.

But in order to ensure that such foreign-born innovators continue to contribute to US economic growth, America must make reforms that will enable more immigrant innovators to stay in the US for the long term. All too often, as the report demonstrates, students, postdoctoral researchers, and junior staff scientists at US universities face exceptional hurdles to gaining the visas they need to work in the United States after leaving academia. Many inventors also struggle to find a way to settle permanently in the country in the years that follow.

TOP TEN PATENT-PRODUCING UNIVERSITIES, 2011

SCHOOL	NUMBER OF PATENTS
University of California System	369
Stanford University	169
Massachusetts Institute of Technology	168
University of Wisconsin – Madison	143
University of Texas System	134
California Institute of Technology	110
University of Illinois System	97
University of Michigan System	95
Cornell University	91
Georgia Institute of Technology	90
TOTAL	1,466

RECOMMENDATIONS

Continuing to train the world’s top innovators and then sending them abroad to compete against us is a self-defeating strategy. To keep more of these innovators in the United States, Congress should enact the following key budget-neutral immigration reforms that would lead directly to increased innovation, more and stronger American companies, and more jobs for American workers:

Green Cards for STEM Grads: 99% of the patents in this report were from the critical fields of Science, Technology, Engineering, or Math (“STEM”) from US universities. To keep the innovators behind these patents in the United States, we should grant permanent residency, or green cards, to foreign students who earn graduate degrees in STEM fields.

A Startup Visa: There is no visa in the US for foreign-born entrepreneurs who want to start companies that employ American workers, even if they have already raised millions in startup capital from US investors. Creating a startup visa would allow more of the advanced research being produced at US universities to be turned into businesses that employ American workers.

Raise or Remove H-1B Caps: The H-1B temporary high-skilled visa is often the only option for foreign-born STEM graduates who want to stay in the US and work on cutting-edge research at American companies. But the arbitrary caps on H-1B visas, currently set at 65,000 per year, are exhausted almost every year, often within days. In Fiscal Year 2012, the annual supply was used up in less than two and a half months, and as the economy improves, the supply will go even more quickly. This deprives our companies of the innovators they need to launch new products that create American jobs. The caps on H-1B visas should be removed or at least raised to levels that allow companies to recruit and retain the workers they need.

Other countries aren’t waiting for the US to take action. The United Kingdom, Singapore, Ireland, Canada, Australia, and other nations have already taken bold steps to ease the visa process for foreign students, innovators, and entrepreneurs. If US political leaders don’t reform the country’s broken immigration system soon, they risk jeopardizing one of the country’s biggest assets – our ability to leverage our preeminent universities to attract talented foreigners and make them part of the great American success story.

And in the last three decades, the America's world-class research universities have dramatically stepped up their pursuit of patents.¹⁶ From 1985 to 2008, the number of US patents awarded to America's colleges and research universities increased almost fivefold.¹⁷ By 2009, colleges and universities were performing more than half (53%) of all basic research – the earliest-stage work on cutting-edge concepts and products – in the United States.¹⁸ The \$55 billion spent on research and development work conducted by colleges and universities that year placed them second behind private industry as the top performer of such work – ahead of the federal government.¹⁹

One reason that university research is so important is that it is a critical means by which our country stays ahead in the areas of Science, Technology, Engineering, and Mathematics (STEM). For the last 10 years, the STEM sector has boasted job growth fully three times greater than the rest of the US economy.²⁰ But America is currently in danger of falling behind in this innovation-rich sector. Currently, the US is short so many native-born graduate students pursuing STEM degrees that by 2018, the country is projected to have 230,000 jobs requiring graduate-level STEM training that it will not be able to fill with native-born workers.²¹ In this vacuum, foreign students and graduates like Korlach have stepped in to fill enrollment gaps, contributing to crucial inventions along the way.²²

Academic patenting activity shows the fundamental role universities play in advancing STEM research. While US universities were assigned about 2% of all US patents in 2008,²³ they earned a much higher proportion of patents in several key STEM areas: Universities received more than one in six of all US patents issued for molecular biology and microbiology, as well as almost one in 10 patents for pharmaceutical drugs.²⁴

²⁵ Academic research institutions are also estimated to possess more than a third of patents in the field of genetics and on specific human gene sequences,²⁶ thought by some experts to hold the key to future advances in medicine.²⁷

At the same time, patents are becoming an ever-more important

part of how already-established STEM companies compete – especially firms in the information technology space. In 2011, for instance, Google paid \$12.5 billion to acquire Motorola's US smartphone business, largely because of the 17,000 patents the company held.²⁸ And earlier this year, Microsoft paid \$1.1 billion to buy AOL's patent portfolio, at a rate of about \$1.2 million per patent – marking a new high point for such a sale.²⁹

As this report demonstrates, university patents often result in promising new products that spawn new startups or divisions of companies that create jobs for Americans workers. From 1980 to 2010, more than 6,000 new companies were created to commercialize research conducted at US universities.³⁰ In fiscal year 2008, that translated into 1.6 companies founded per day.³¹ In many cases, immigrant students played a central role turning such innovations into US-based businesses: Companies like Sun Microsystems, which is now a part of Oracle, were founded by foreign-born student innovators on American campuses.³² And such immigrant-founded firms create an enormous number of American jobs. One recent study looking at just one of the 10 schools in our sample, the Massachusetts Institute of Technology, found that foreign-born alumni of that school have founded 2,340 US-based companies – firms that together employ more than 100,000 people.³³

Experts at the universities we studied see such foreign-born students as critical to America's continued success. "Everything you hear about these students is true," says Steven W. McLaughlin, Vice Provost for International Initiatives at the Georgia Institute of Technology. "They start companies and contribute in huge and enormous ways to our country and our economy."³⁴ Paul M. DeLuca, Jr., Provost and Vice Chancellor for Academic Affairs at the University of Wisconsin-Madison, echoes that point, saying that in his more than 40 years at the school, he has seen foreign students and research trainees contribute to some of the university's most successful inventions. As he explains it, "There are numerous examples where our foreign students and trainees have



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JONAS KORLACH
*GERMAN-BORN BIOCHEMISTRY
PhD GRADUATE FROM CORNELL,
WHOSE TECHNOLOGY TO READ
THE HUMAN GENOME BECAME
A COMPANY EMPLOYING 285
PEOPLE IN CALIFORNIA*

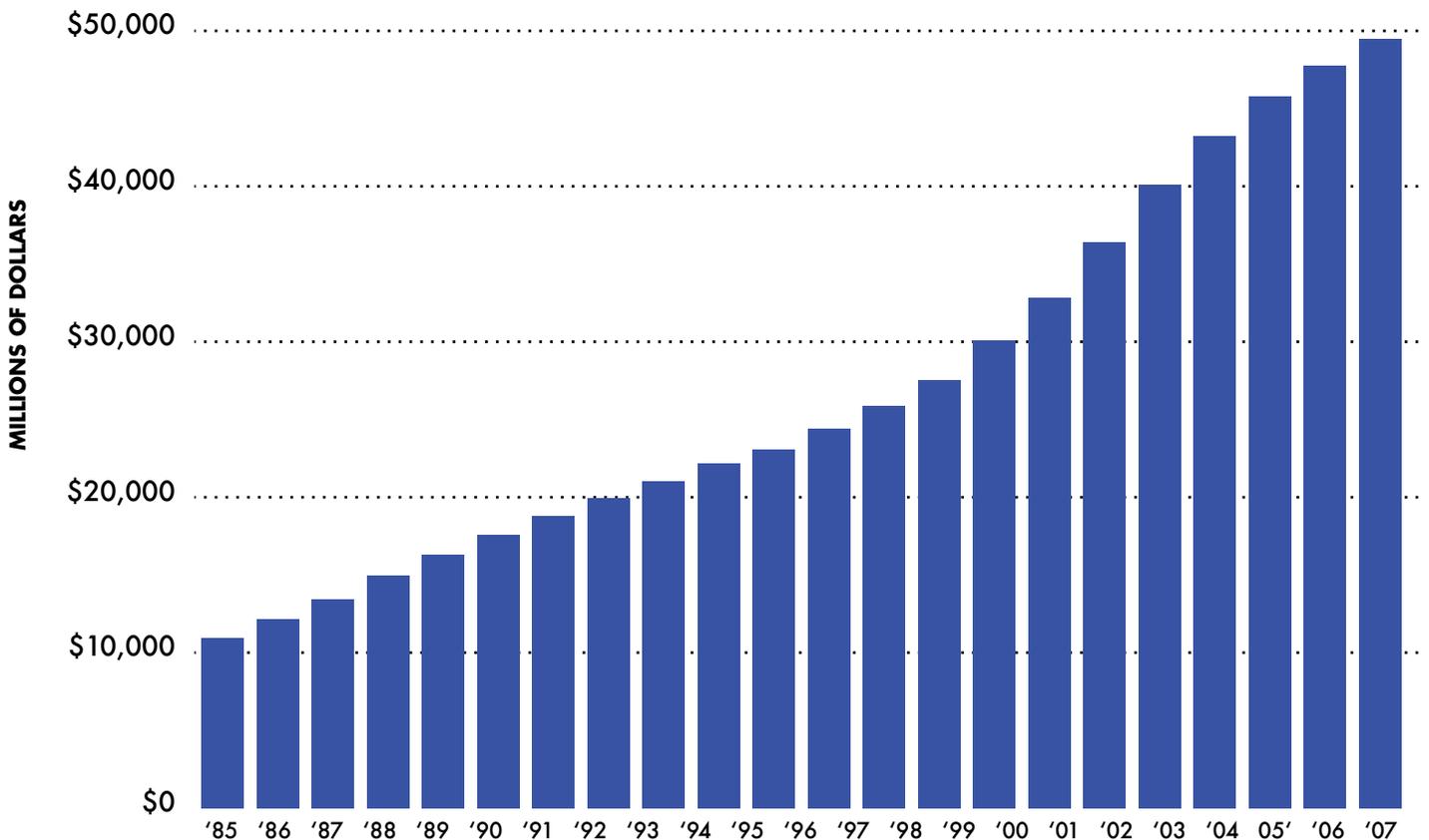
contributed to intellectual property that has had an enormous economic and intellectual impact on Wisconsin and beyond.”³⁵

But whether the students, researchers, and faculty members behind the inventions analyzed in this report will stay to be the next Jonas Korchach or power the next Sun Microsystems is placed in doubt by the difficult path these innovators face to settling permanently in America. US law provides for a temporary visa of between 12 and 29 months for graduates to stay and work in areas related to their studies, but unlike some key competitors such as Canada and Australia, the US currently lacks any sort of dedicated visa program that would help international students studying in the country gain permanent residency after graduation.³⁶ The result of that failing, coupled with current US visa backlogs for workers and their families,³⁷ is that many of our universities educate some of the bright-

est minds in the world, only to send them abroad to compete against us after graduation.

Jonas Korchach’s story is indicative of the obstacles so many of today’s foreign-born STEM graduates must overcome to remain in this country. Despite his critical contribution to an enormously promising invention, a US Congresswoman had to speak up on his behalf to help him secure a temporary residency visa in 2004. “I felt so humbled and honored to have her support,” Korchach says today, “but I wonder what happens to all the foreign students who aren’t as lucky as I am.”³⁸ The answer: They form an ever growing reverse brain drain, something the US must take strong steps to stop. Our future economic growth depends on it.

THE GROWING IMPORTANCE OF UNIVERSITY RESEARCH AND DEVELOPMENT TO US INNOVATION
 SPENDING ON R&D AT US UNIVERSITIES INCREASED FIVE-FOLD OVER PAST 25 YEARS



CREATING THE INNOVATIONS OF TOMORROW

Nationally, immigrants currently make up just 16.5% of the US population over age 25, but account for a far greater share of this country's innovations.³⁹ Studies have shown that among the American population with advanced degrees, immigrants are three times more likely than native-born to file a patent.⁴⁰ Between 1990 and 2000, more than one in four of the Nobel Prize winners based in the United States were immigrants.⁴¹ And in recent years, immigrants have been the innovators behind some of the country's most forward-looking businesses: From 1995 to 2005, foreign-born entrepreneurs helped found 25% of all new high-tech companies, creating 450,000 jobs.⁴²

This report's analysis of the patents awarded to the top 10 patent-producing US universities in 2011 makes it abundantly clear that immigrants play a vital role in America's cutting-edge innovations. More than three out of every four patents considered had at least one foreign national listed as an inventor. Although 99% of these patents were in the science, technology, engineering, and math fields, they spanned a great diversity of subjects and boasted inventors from countries all

around the world. A Singaporean student at Stanford University invented a state-of-the-art camera that lets users change what's in focus in a photograph long after snapping the image.⁴³ At the University of California-Berkeley, scientists from China and Romania developed a unique method for quickly detecting cell death – a key sign of a biochemical attack.⁴⁴ And the scientists and engineers at Massachusetts Institute of Technology who invented a tiny, foldable automobile could practically hold a global summit in their own laboratory – they hail from Germany, Hong Kong, Australia, and Argentina.⁴⁵

Many of the innovators behind these patents were not professors who had secured visas with their school's help to stay here and continue to innovate, but students or researchers whose ability to remain in this country is more likely to be in doubt. More than half the patents awarded to these universities had a foreign inventor who was in a junior or trainee-type position – a student, a postdoctoral fellow, or a researcher not yet in a professorial role.

KEY FINDINGS:

- More than three out of every four patents at the top 10 patent-producing US universities (76%) had at least one foreign-born inventor.
- More than half of the patents (54%) were awarded to the group of foreign-born inventors most likely to face visa hurdles: students, postdoctoral fellows, or staff researchers.
- The percentage of patents with an immigrant inventor at the 10 schools studied ranged from almost 65% at Cornell to nearly 90% at Georgia Tech and the University of Illinois.



PATENT #8,066,827

A New Metal That Can Be Melted and Molded Like Plastic

A Cyprus-born researcher at Caltech was a key inventor of a "glassy" metal as strong as steel that can be molded like a plastic. The metal is already being commercialized and may soon appear in products like dental implants, watches, and electronics.

Our findings underscore a fact that America’s university leaders have long known: Talented students from around the globe play a key role in driving innovation at America’s state-of-the-art research institutions – and have for decades. “Cornell University has benefited from the talents and intellect of international students and scholars from our first classes nearly 150 years ago,” Cornell University President David J. Skorton explains. “Today these talented colleagues make enormous contributions to the innovative and forward-thinking technological and scientific endeavors at Cornell – including activities that result in new companies, new products, and new jobs – in addition to adding immeasurably to the cultural fabric of our community.”⁴⁶

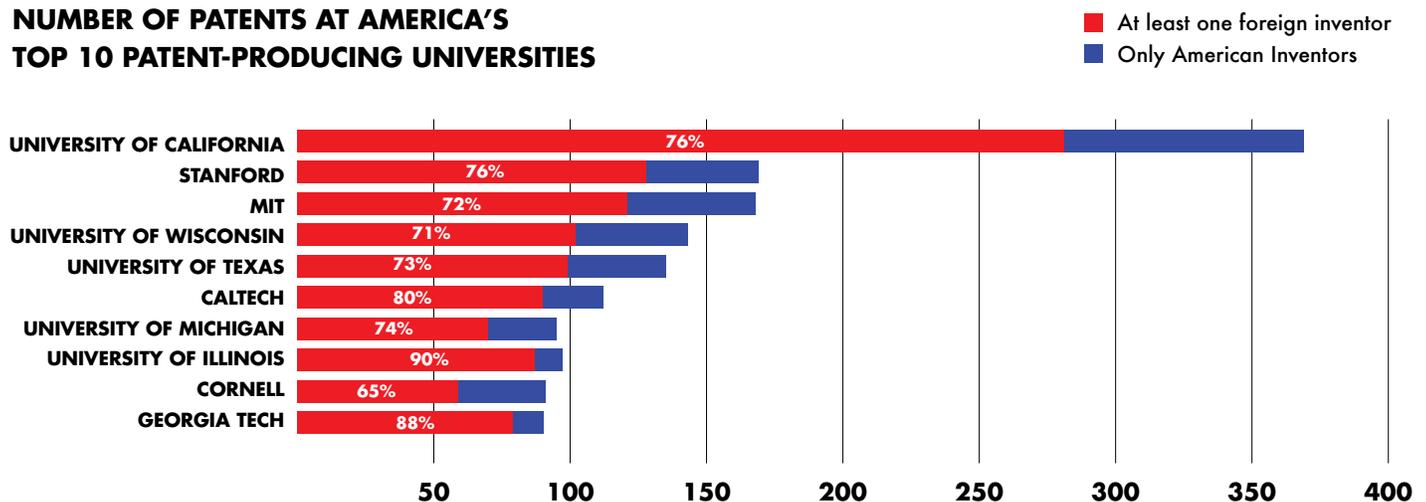
Foreign-born inventors are critical contributors at every research university we studied. The share of patents with at least one foreign inventor ranged from 65% at Cornell University, to close to 90% at two schools – the Georgia Institute of Technology and the University of Illinois. And foreign, non-faculty inventors, a group that includes students, postdoctoral researchers, and junior research staff, played a particularly large role at as well: Their contributions ranged from almost 46% of patents at the University of Texas to more than 60% of the patents at the University of Illinois, the California Institute of Technology, and the Georgia Institute of Technology.

Although many schools do not keep sufficient demographic data to allow us to determine the per capita patent rate for foreign students, postdoctoral researchers, and staff, the evidence available suggests that the role of foreign inventors often far outpaces the total number of foreign students enrolled at the university. At the University of Illinois, for instance, nine out of 10 of the patents had at least one foreign national listed as an

inventor, and almost 64% of patents had a foreign inventor who was not yet in a professorial role. This was despite the fact that in the fall of 2011, fewer than 47% of the graduate students studying STEM on Illinois’s two patent-producing campuses were in the US on temporary visas.^{47 48} And although the school doesn’t track the exact share of professors who were born abroad, in 2011, 26% of the full-time faculty at the schools were foreign citizens.^{49 50} Lesley Millar, head of the University of Illinois’s Office of Technology Management, suggests that with the school’s ever-growing international enrollment, the number of international inventors involved in patents could soar even higher in coming years. “It takes a global village,” she says, “to achieve success in entrepreneurship.”⁵¹

There is no one profile for the foreign inventors behind the patents at the top US patent-generating universities. The 1,466 patents we considered boasted inventors from 88 different countries. In addition to larger nations like South Korea, Canada, and Germany, inventors also came from less expected places like Guyana, Mauritius, Croatia, and Turkmenistan. Some countries made particularly large contributions: More than one in five of the overall patents examined had an inventor from China. India played a large role in patent generation, too, with more than one in seven patents having an inventor from that country. Some nations with few citizens studying in the United States still had a surprising impact. Although French students make up just .03% of the total population of US university students, French non-faculty inventors contributed to 2.2% of all the patents examined.^{52 53} When including patents by French professors and non-university-associated professionals into the mix, more than 4.3% of the inventions

NUMBER OF PATENTS AT AMERICA’S TOP 10 PATENT-PRODUCING UNIVERSITIES



were conceived with the help of French countrymen. Similar stories exist across the board. In fact, according to the Institute of International Education, a group that tracks international student enrollment trends, no country studied in this report provided more than 1% of all US university students in the 2010-2011 school year.⁵⁴

Many foreign-born scholars explained that for them the real draw of coming to America was the unique climate of innovation in US academia and the country's spirit of entrepreneurship. Shota Atsumi, a chemical and biomolecular engineer, says he came to the United States in 2002 after being frustrated by the hierarchical academic culture in his native Japan. "It's very difficult there for a young scientist to have any real independence there," Atsumi says, "and it's not an easy place to take risks." Arriving at the University of California-Los Angeles as a postdoctoral researcher in 2006, Atsumi and his mentor, Prof. James C. Liao, began exploring entirely new ways to generate environmentally-friendly fuel. Atsumi remembers the tough time they had their first year in the laboratory. "I was at that lab working even on Thanksgiving Day," Atsumi says, "because we so very much wanted a good result!"⁵⁵

After a year of exhibiting that sort of work ethic – and weathering many failed experiments along the way – Atsumi and Liao developed a way to make a petroleum replacement called isobutanol from E. coli bacteria, which can serve as a substitute for petroleum or be added to traditional fuels to cut down on harmful carbon monoxide emissions.⁵⁶ Their invention has since been licensed to the Colorado renewable energy startup

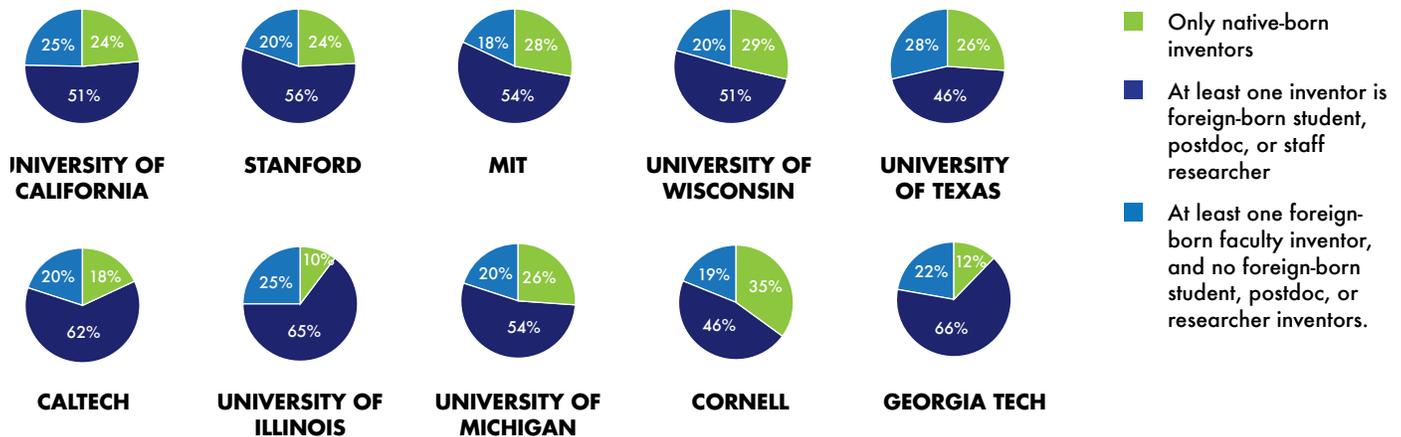
Gevo, which plans to open the world's first commercial-grade isobutanol plant later this year. The Minnesota-based facility will employ 28 people; it already has a purchase order from the US Air Force and an agreement to potentially provide renewable bottles to The Coca-Cola Company.⁵⁷

Atsumi has since become a professor at University of California-Davis, a position that allowed him to obtain his green card with the school's help and sponsorship of his application. In a sign of the prevalence and importance of foreign-born scientists to the US culture of innovation, the company that bought Atsumi's technology has its own ties to immigrants in academia. One of Gevo's original founders was Peter Meinhold, a German immigrant who helped discover a cost-effective way to make renewable fuels while earning his PhD at Caltech.^{58 59} Officials at that university cite his startup as one of their great success stories of the last 10 years.⁶⁰

Marios Demetriou, a senior research associate at Caltech, is one of the school's other major recent successes. Demetriou, a Greek from Cyprus, originally came to the United States in the 1990s as an undergraduate to study mechanical engineering. Almost immediately, he says he felt his attitude towards his studies begin to shift. "I was way more motivated once I got here," Demetriou explains. "That's the thing about the United States: It's a country where people willing to work hard really have good prospects."⁶¹

Demetriou remained in the United States to earn Master's and PhD degrees, and then began a postdoctoral research post at Caltech in 2001. It was an exciting place for him to be.

PERCENT OF PATENTS WITH FOREIGN-BORN STUDENT, POSTDOCTORAL FELLOW, RESEARCHER, AND FACULTY INVENTORS AT TOP 10 PATENT-PRODUCING UNIVERSITIES



Demetriou specializes in amorphous or “glassy” metals. Unlike traditional metals, which must be shaved into shapes, glassy metals can be melted down to the consistency of honey and molded like plastic, resulting in far less wasted material. Such metals had been invented at Caltech in the 1960s, but were brittle, expensive to produce, and prone to cracking, which limited their commercial appeal.⁶² In 2011, however, Demetriou and his mentor had a breakthrough: They discovered a way to produce an amorphous metal that was as strong as the strongest steel, but less prone to cracking—a development that’s been called “ingenious.”⁶³ “Humans have been working with steel for 3,000 years,” Demetriou says of the work. “It’s not very often something comes along that can actually compete with it.”⁶⁴

He’s certainly not alone in his enthusiasm. In 2011, Demetriou co-founded a startup, Glassmetal Technology, which aims to incorporate the metal into everyday products like dental implants, watches, and electronics. The firm already has a 10,000 square foot facility in Pasadena, California; five employees; and what Demetriou says is a sufficient amount of funding to support it “for the next several years.”⁶⁵ His work also got a big vote of confidence this spring: Rumors surfaced

that Apple was exploring using glassy metals to make the next version of the iPhone impervious to scratches, denting, and other damage.^{66 67}

Demetriou will also have the option to work at his company fulltime. Unlike many other immigrants who face visa headaches if they want to work at a startup, Demetriou married an American citizen in 2005 and is now a citizen himself. “I’m really fortunate I decoupled my work situation and my citizenship,” he says. “It gives me real flexibility.”⁶⁸



PATENT #7,936,392
A New Way to Focus Pictures

 A Malaysian-born PhD graduate of Stanford University was one of the key inventors behind The Lytro camera, a digital camera he brought to market in February that lets the user adjust what’s in focus after the picture has already been taken.

FOREIGN-BORN INVENTORS ON PATENTS AT TOP 10 UNIVERSITIES ORIGINATED FROM 88 COUNTRIES





IMMIGRANT INNOVATIONS CREATE AMERICAN JOBS

According to Walter Isaacson's recent biography, one of the main concerns for Apple co-founder and CEO Steve Jobs over the final months of his life was a talent crisis in America. At a dinner of Silicon Valley executives attended by President Barack Obama in February 2011, Jobs reportedly told the President that a lack of talented US engineers was costing America jobs: Apple was employing 700,000 factory workers in China, Jobs said, because he couldn't find the 30,000 engineers he needed to supervise such factory work here in the United States.⁶⁹

Implicit in Jobs' statement was a fact that holds true in the American economy, especially regarding immigration: Highly talented workers – the innovative, game changers in our economy – help create jobs for everyone else. A recent study conducted by the American Enterprise Institute and the Partnership for a New American Economy made this observation more concrete. The study found that each foreign-born graduate with an advanced degree from a US university who works in the US in a STEM field creates, on average, 2.62 American jobs.⁷⁰

The role of immigrants in entrepreneurship has always made them particularly effective job creators. According to the Kauffman Foundation, which studies entrepreneurship, immigrants were more than twice as likely to start new businesses each month in 2010 than native-born Americans.⁷¹ On college campuses, many university officials find that foreign-born students play an outsized role commercializ-

ing innovations that began in the lab. Fred Farina, the Chief Innovation Officer at the California Institute of Technology, says the immigrant students on his campus are often particularly interested in starting their own ventures. "When our students come from other countries," Farina explains, "they often have the American Dream in mind – and that's a powerful motivation."⁷²

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FRANK FARINA
CHIEF INNOVATION OFFICER
CALIFORNIA INSTITUTE OF
TECHNOLOGY

Our research uncovered some 2011 patent recipients who have already turned their work into highly successful businesses. Wenyuan Shi, a professor of microbiology at University of California, Los Angeles, earned a patent in 2011 for the active ingredient in a lollipop he developed that doubles as a dental treatment for children. Shi describes himself as "an interesting example of the American Dream." Born in Hangzhou, China, and raised as a communist and former member of the Little Red Guard, he came to the United States in 1985 to earn a PhD at the University of Wisconsin–Madison. In more recent years, he has worked with dozens of foreign-born students and researchers to patent a series of inventions that aim to more effectively

kill bacteria in the mouth, preventing dental problems like gum infections and tooth decay before they start. "I truly believe," Shi says, "we could revolutionize the way dentistry is treated in this country."⁷³

He isn't alone in exhibiting such confidence about his work. C3 Jian, a startup Shi created to commercialize his inventions,

has raised more than \$80 million from dental insurers and government sources since its founding in 2005. The firm also recently gained approval from the Food and Drug Administration to test an anti-cavity drug in humans, and the company is hiring rapidly.⁷⁴⁻⁷⁵ C3 Jian currently employs almost 40 people — a number Shi says will grow to 50 by the end of 2012 — and the majority of those employees were born in America.⁷⁶ On the day we spoke with Shi last November, there were five new job vacancies listed on C3 Jian's website — all in Marina del Rey, California.⁷⁷

With the baby boomers entering retirement, health care is a growing part of our economy, expected to create more than one in four new American jobs between 2010 and 2020.⁷⁸ The immigrant inventors in this study played a particularly prominent role in health-care-related patents. Fewer than 5% of US medical students were foreign nationals in 2011, according to the American Association of Medical Colleges,⁷⁹ and just 14% of people who were assigned residencies or fellowships last year through the national “match” system were foreign nationals from foreign medical schools.⁸⁰⁻⁸¹ But 43% of patents for surgical techniques had a foreign inventor who wasn't a professor.

The foreign-born innovators captured in our sample played important roles in several of the country's most rapidly expanding industries — the very places where they're likely to have the largest impact as job creators and founders of tomorrow's hottest companies. For example, the Bureau of Labor Statistics predicts that the field of computer and information technology will add jobs almost 60% faster than the rate expected for the overall US economy between 2010 and 2020.⁸² And more than five out of six patents in this field had at least one foreign-born inventor, with foreign-born researchers in non-faculty positions contributing to more than six out of ten IT inventions.

And many of the remaining patents were in fields growing even faster. The US government estimates that job growth in STEM

fields from 2008 to 2018 will be 73% faster than the rate of job-growth in the rest of the economy.⁸³ Perhaps unsurprisingly, with the exception of about a dozen patents in areas like metalworking, ladder design, and jewelry, every patent in our 1,466 sample group is in a STEM area — more than 99% of them.

THE ROLE OF FOREIGN-BORN INNOVATORS IN HIGH-GROWTH FIELDS OF THE ECONOMY:

- Foreign nationals were listed as inventors on more than five out of six (84%) information-technology patents.
- Almost eight out of ten (79%) patents for pharmaceutical drugs or drug compounds were invented or co-invented by a scientist born abroad.
- Immigrants contributed to 75% of patents in the molecular biology and microbiology fields.

Workforce studies examining immigrant workers in these high-growth fields have found that they are likely to have attained a higher level of education than their native-born counterparts — one indication that they're well positioned to continue innovating if they leave academia and enter the private sector. A recent study by the Brookings Institution found that in 2010, immigrants were more than 50% more likely than their native-born counterparts to hold a PhD across all fields.⁸⁴ In IT, 87% of immigrants had a bachelor's degree or higher, compared with 73% of native-born workers.⁸⁵

Immigrant innovators like Wenyuan Shi mainly create jobs either by starting companies themselves or by making discoveries that become the basis for new startups. But even technologies that do not result in new companies per se can still meaningfully contribute to US job creation.

Ashlesh Murthy, a former PhD student in cellular and molecular biology at the University of Texas at San Antonio, is used to facing pretty daunting odds, both in his scientific endeavor

BENEFITING FROM IMMIGRANT INNOVATORS: RANDAL ECKERT, C3 JIAN

Randal Eckert, 34-years-old and with a PhD in molecular biology, calls himself a “farmer at heart.” Born and raised in Washington State, Eckert is part of a fifth generation agricultural family. But he's a long way from the farm now. Eckert is currently head of preclinical research at C3 Jian, the Los Angeles-based biotechnology firm founded by Chinese immigrant Wenyuan Shi. Eckert worked with Shi as a graduate student at UCLA and helped pioneer one of the molecules the company is now testing as a future anti-cavity drug. He became the first employee of Shi's venture when it was founded in 2006. “I feel lucky to have this position,” Eckert says. “Bringing a technology developed in the lab directly to the consumer is what I've always wanted to do. A lot of scientists never have that opportunity.”

ors and his personal life. As a child from a middle-class family in Bangalore, India, he needed an extremely high score on a merit test just to earn admission to the medical school in India where he earned his degree: In a year when 50,000 or 60,000 students from his state took the entrance test, he scored among the top 100, securing one of the relatively rare spots set aside for merit-based candidates.⁸⁶

So when he arrived in America to pursue a Master's Degree in 2001, it was little surprise he once again tackled a Herculean project. Working with Professors Bernard Arulanandam and Guangming Zhong – immigrants themselves from Malaysia and China – Murthy began testing a new protein related to chlamydia, trying to figure out if it could be made into a workable vaccine against the bacteria. “Scientists in the infectious disease community kept telling us, “This is never going to work. How can you even envision something like this?” Murthy recalls today, chuckling. Within six years, Murthy had injected his vaccine into a mouse for the first time; by late 2008, the University of Texas had sold an exclusive license for the vaccine to the pharmaceutical giant Merck.

Murthy says he has no doubt his vaccine – which formally received its patent in early 2011 – has created many American jobs. The infusion of funds that came into UT-San Antonio labs as a direct result of the Merck deal allowed the school to hire four more research staffers, and when Murthy relocated to Midwestern University last year, he hired a lab technician so he could continue vaccine-work there. Merck, for its part, says it cannot pinpoint the exact number of scientists working on the chlamydia project but one spokesman said “easily more than a dozen” people are involved in the effort.⁸⁷ For Murthy, that’s a point of pride. “My mentor Dr. Arulanandam once said to me, ‘If you give me your 100%, I’ll give you my 200%,’” he says. “It motivates me to know that I’m not just responsible for my own job, but someone else’s livelihood too.”

The royalties and licensing fees that universities receive from patents like Murthy’s are also a growing source of revenue. The ten schools we considered in our report brought in close to half a billion dollars in licensing fees and royalties in fiscal year 2010, more than three times what they earned from such sources just 15 years earlier.⁸⁸ Robin Rasor, President of the Association of University Technology Managers, says the portion of those funds that accrues to universities is used to endow professorships, build state-of-the-art facilities, and fund more research – often in the very lab where the patent originated. “To an individual department or laboratory, this money can make a huge difference in what they’re able to accomplish,” she says.⁸⁹

In other words, the licensing of just one technology developed by a foreign-born inventor can have a spillover effect, fuelling more innovation among other students on campus. That concept has already been demonstrated in the existing literature on immigrant innovation. One 2008 study by researchers at Princeton University and McGill University found that for every 1% increase in the share of foreign-born university graduates in the United States, overall patents per capita in the country rise by 15%.⁹⁰

An especially large share of the the patent revenue received by these schools can be traced to foreign-born inventors. In the University of Michigan system, for instance, more than two out of three patents with executed licenses or an option on them had at least one immigrant inventor. Just being included on a university’s patent-list is a vote of confidence in the potential commercial success of an invention. Many universities pursue patents on only what they consider to be the most financially promising inventions. In fiscal year 2010, for instance, 530 inventions were disclosed to MIT’s technology transfer office but the school filed for patents for only 184 of them.⁹¹ Rasor says that is because it is common for universities to spend \$50,000 or \$100,000 in legal fees associated with each patent application. “At that price,” she says, “you want to file most of your applications for technologies you can actually make some money on.”⁹²

PATENT LICENSURE REVENUE EARNED BY UNIVERSITIES, FY 2010:

University of California System	\$104.4 million
Stanford University	\$65.5 million
Massachusetts Institute of Technology	\$69.2 million
University of Wisconsin	\$54.0 million
University of Texas System	\$38.3 million
California Institute of Technology	\$51.6 million
University of Illinois System	\$15.2 million
University of Michigan	\$39.8 million
Cornell University	\$9.0 million
Georgia Institute of Technology	\$2.3 million

Source: Association of University Technology Managers.

But the most promising technologies are not just a boon for the universities and scientists involved in the invention. Some innovations – and the companies that develop from them – can also help re-energize local economies hard hit by unemployment. In McAllen, Texas, a city in the southern part of the state, one promising nanotechnology startup that originated at the University of Texas-Pan American is already being heralded as a potential magnet for other, high-tech manufacturers to the region.⁹³ The firm, FibeRio, is based on a technology invented by Karen Lozano, a Mexican-born mechanical engineering professor who immigrated to the US in the 1990s to enroll in graduate school at Rice University. Raised in a family where her mother, a seamstress, left school after the sixth grade, and her father worked long hours delivering vegetables to restaurants, Lozano says she was taught the value of education and hard work at an early age. She also learned responsibility: All throughout graduate school, Lozano sent home \$400 to her parents each month, a hefty portion of the \$1,000 monthly stipend she received from her university.⁹⁴

When Lozano became a professor at UT-Pan American in 2000, she focused her considerable intellect on a new challenge. For years Lozano and her colleagues had been frustrated by the painfully slow process of making the miniscule nanofibers they worked with in the lab – as well as all the unhealthy chemical solvents that went into producing them.⁹⁵ So in 2006, she and another foreign-born colleague developed a greener, more cost-effective solution: A machine that used the spinning motion of a centrifuge to manufacture nanofibers more than 900 times faster than the solutions then on the market.⁹⁶ Ellery Buchanan, FibeRio's CEO, says Lozano's fibers have a wealth of consumer applications. Nanofibers can be used to make thinner, more absorbent diapers or to give textiles added insulation. They can also strengthen medical sutures and enable air filters to capture ever-tinier particles. "We believe our company could transform the materials industry," Buchanan says, "through the unlimited availability of nanofibers."⁹⁷

Lozano, who still works closely with the company, says seeing the startup she helped build still amazes her.⁹⁸ "I go to the company every Friday," Lozano says, "and every Friday I see a new face." Indeed, the company is growing rapidly. FibeRio has already shipped its machines to firms in America, Australia, Japan, and Europe. And although the firm employs about two dozen people now, it's planning to expand to 250 within the next five years.⁹⁹ Lozano says that contributing to McAllen, a city just two and a half hours from her native Monterrey, Mexico, has been particularly rewarding: Community leaders are so enthusiastic about her company they have discussed branding the area as a "fiber valley," friendly to high-tech textile companies and other firms eager to use FibeRio's technology.¹⁰⁰ "I used to come to Texas often as a kid, and I admired the US so much," Lozano says. "Sometimes my life now feels like a dream."¹⁰¹



PATENT #8,029,857

A More Efficient Way To Purify Seawater

An Indian-born postdoctoral fellow at the University of California-Los Angeles was part of a team that invented a water filtration membrane that used nanotechnology to desalinate water more efficiently than had ever been done before. A startup has already raised \$75 million to commercialize their invention, which could help reduce worldwide water shortages.

BENEFITING FROM IMMIGRANT INNOVATORS: KIAL GRAMLEY, FIBERIO

Kial Gramley is one American-born worker who benefitted from the work of Karen Lozano, the Mexican-born engineer who invented the technology behind FibeRio, a nanotechnology manufacturing company in the Rio Grande Valley in South Texas. After deploying to Afghanistan with the 173rd Airborne Brigade Combat Team and then earning his MBA at University of Texas-Pan American, Gramley took a job as Vice President of Marketing and Business Development at FibeRio in 2009. The Harlingen, Texas, native says the position not only represented a major "leap" for his career, but also allowed him to live near his close-knit family. "Truly satisfying jobs don't always exist in the areas where you happen to be from," Gramley says, "so this is truly a huge opportunity for me."



IMMIGRATION CHALLENGES FACED BY IMMIGRANT INNOVATORS

Despite their major contribution as inventors and job creators in America, many talented foreign-born scholars say they have endured serious frustrations with the US immigration system, which is grossly outdated for the needs of our modern-day, innovation-driven economy. In an era when many companies say they don't have enough US-born engineers and scientists to fill all their STEM jobs¹⁰² – and the vast majority of new jobs are created by small businesses and startups¹⁰³ – many would-be immigrants still encounter a puzzling reality: Visa rules make it hard for them to stay on as the workers and entrepreneurs our country so desperately needs. And when some of them give up and leave, it costs our economy acutely.

For many innovators, the problems begin while they are still in the university setting. There are three basic types of visas that such students or researchers use: Full-time students typically have an F-1 visa, the standard student visa,¹⁰⁴ while postdoctoral researchers usually use either the J-1 visa, a cultural exchange visa administered by the US State Department, or the H-1B visa, which allows specialized workers like scientists or postdoctoral fellows to work on campus in a research capacity.^{105 106} In most cases, the H-1B visa is valid for only a three- or six-year period before the worker must return home or qualify to remain through a different visa category.¹⁰⁷ And with the J-1 visa, which is held by many of the country's roughly 23,000 foreign postdocs, the window of opportunity can feel even more limited: Any student with a skill that is in short-supply back home – or with funding from their national government – is required to move back to his or her native country after graduation, and remain there for two years.^{108 109}

Murthy, the inventor of the chlamydia vaccine, saw firsthand the Kafkaesque complications that can result from the current J-1 visa system. Because of the urgent nature of his vaccine

work, Murthy was able, after six months of petitioning, to obtain a letter from the Indian government saying it would not require him to fulfill the mandatory two year stay at home after completing his research,¹¹⁰ something lawyers say can be very difficult to achieve.¹¹¹ But after receiving that letter of support and beginning to apply to the US Department of State for a formal waiver of the requirement, Murthy was told that it was unnecessary, and that his particular J-1 visa had never required him to return home in the first place.¹¹²

With that knowledge, Murthy changed his visa to a H-1B visa in 2009. But when he went home to visit his family the following year, Murthy was stuck there for a month due to confusion over whether he should have been subject to the requirement he return home. University of Texas officials pulled out all stops to help Murthy return to Texas, calling a local Congressman and convincing the US State Department to reach out to the embassy in Chennai to insist that Murphy be permitted re-entry.¹¹³ At that point, it was critical to get Murthy back to Texas for ongoing negotiations with Merck. "I joke with friends," Murthy says, "that to deal with the US immigration system, it helps to make yourself indispensable!"

What many Americans don't realize is that the sort of confusion surrounding Murthy's case isn't uncommon. Many foreign-born graduates face immigration options after graduation that are bewilderingly complex and discouraging. The government currently gives full-time students on an F-1 student visa a 12-month grace period called Optional Practical Training (OPT) (with an extension for some students, described below). During this time, students can stay in the US after graduation without applying for a formal family or employment-sponsored immigrant visa.¹¹⁴ (Foreign researchers who came to the US for postdoctoral positions aren't given such a transition period.)¹¹⁵

Even though an employer isn't sponsoring them, recent graduates on OPT must be able to prove that they are working or interning in a field directly related to their field of study,¹¹⁶ and many immigration attorneys say there is little flexibility if the participant is laid off or part of a startup that doesn't survive its early launch: Former students who spend 90 days without employment during this period lose their right to stay in the country.¹¹⁷

The OPT window is also fairly brief, which creates its own pressures for innovators. Historically, recent graduates had a 12-month OPT window, but in 2008 the Department of Homeland Security extended that period to 29 months for foreign-born professionals who earned graduate degrees in STEM fields.¹¹⁸ McLaughlin says that even with that extended time frame, however, many students find the visa process to be so complicated that they spend much of their time looking for employment and working on visa paperwork. "Many students feel the clock is ticking over their heads," McLaughlin says.¹¹⁹

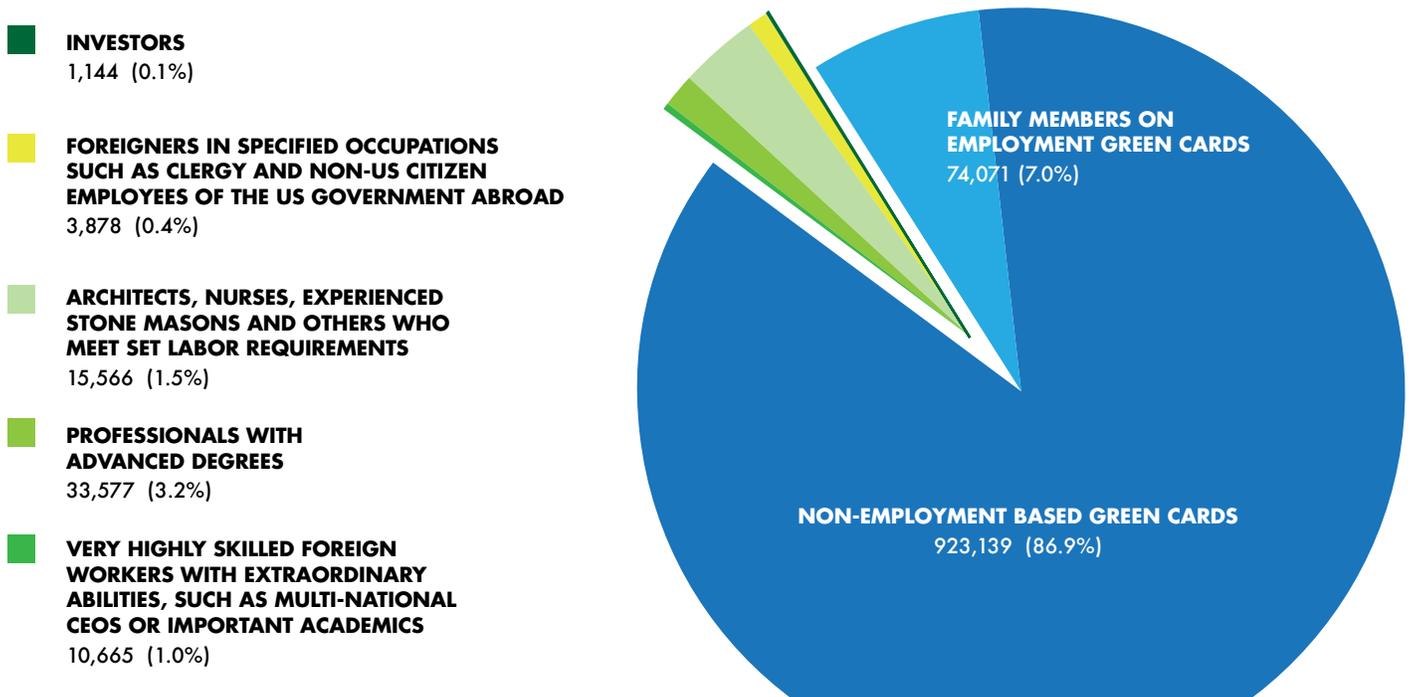
When recent graduates finish their OPT period, many pursue what is known as a "non-immigrant visa," one that allows them to stay in the US temporarily but doesn't put them on a path

to citizenship. We outline some of the visas in that category in the chart below – and some of their drawbacks for researchers pursuing them.

The H-1B visa, which is commonly used by students after graduation, is often a cause of particular frustration for many students and inventors. Although many foreign workers at high-tech companies are in America on H-1B visas, securing a good job offer after graduation does not guarantee the visa will be available.¹²⁰ The government currently caps the number of H-1B visas made available annually to the private sector at 65,000, with an additional 20,000 set aside for students with Master's or PhD degrees earned in the United States.¹²¹ Both caps are routinely met within days of when the visas are made available for the new year, leaving many potential H-1B workers disappointed. In recent years, the H-1Bs set aside for graduate-degree holders have reached the cap even faster than the rest of the H-1B visa pool.¹²²

Many employers that want to hire innovative foreign students also say it is typically impossible to sponsor them for H-1B visas. The average employer can expect to pay \$6,000 or more in legal and mandatory government fees for each prospec-

LESS THAN 7% OF GREEN CARDS ARE GRANTED FOR EMPLOYMENT REASONS



NUMBER OF DAYS BEFORE H-1B VISA CAPS WERE REACHED, 2005-2012

YEAR APPLICATIONS WERE FILED*	DAYS UNTIL GENERAL H-1B VISA CAP MET	DAYS UNTIL H-1B CAP FOR FOREIGN GRADUATES MET
2005	132	Not met
2006	56	Not met
2007	2	30
2008	7	7
2009	265	20
2010	301	266
2011	236	202
2012	72	68

Source: Department of Homeland Security press releases.

*Applications are filed on April 1 for visas valid the following fiscal year.

** In the early years of the program, the caps were not met.

tive H-1B visa holder they sponsor, and more still if they are sponsoring a foreign worker for the first time.¹²³ The requirement that prospective sponsoring companies prove that they are economically stable and definitively able to pay salaries going forward – a measure designed to prevent against fraud – excludes many early startups from the process completely.¹²⁴ Sarah Zehr, an Assistant Dean and Director of the Engineering Career Services at the University of Illinois, says all those financial and paperwork burdens have created a system where many employers are loath to interview otherwise qualified international students, and many foreign students can't work at the cutting-edge companies most appealing to them. "We have so many talented international students here," Zehr says, "but often it's like they're starting the interview process with three black marks after their name simply because of their citizenship."¹²⁵

When students apply for green cards – the visas that would allow them to reside in the US permanently – they often encounter a new set of daunting obstacles. Currently, the US offers only 140,000 green cards each year to workers petitioning through employment-based categories, a cap set in 1990, and an amount many economists say is vastly insufficient to meet the needs of our 150 million person labor market.^{126 127} And it's easy to see why: That total allotment of green cards

would not even be sufficient to grant permanent residency to every graduate student or postdoctoral researcher in the science, engineering, and healthcare fields currently in the US on a temporary visa – a group that numbered close to 190,000 in 2009.¹²⁸ And as it is now, that limited number of visas must be shared by recent graduates, professionals at all tenure levels, and all highly-skilled workers trained in their home country, such as Indian-educated engineers, Mexican architects, or British MBAs. On top of that, the same pool of visas is used by workers' family members -- and most years over half of these green cards for workers actually go to spouses and children. As a result, the caps have led to huge bottlenecks, and almost 250,000 workers who are already here in the US on temporary visas are currently in line for employment green cards¹²⁹ – often facing uncertain waits that can stretch for years.

Ill-advised country quotas add to the scope of that problem. The policy, which restricts to 7% annually the share of green cards that can be issued to nationals of any one country, means that immigrants from some nations – not coincidentally, those with the most inventors competing for spots – face extraordinarily long wait times to become permanent residents.¹³⁰ For perspective, that means that a country like China, which had more than 300 patents in our sample set, is not entitled to any more visas than tiny Iceland, which had six patents. A recent policy paper by the National Foundation for American Policy demonstrates the difficulty such quotas pose for Chinese and Indian nationals. The report estimated that Indian citizens seeking employment-based green cards through one of the more popular categories face a 70-year wait.¹³¹ Chinese nationals in that same situation face an estimated backlog of two decades.¹³²

While waiting for a green card, immigrants working in the United States endure restrictions that make it very difficult for them to contribute to the American economy to the full extent of their abilities. Many visas restrict the bearer's movement to other employers and on promotions even within their current company.¹³³ The H-1B visa does not allow the bearer's spouse to work, limiting their family's income and potentially stalling the spouse's career.¹³⁴ And scientists without US citizenship are often prohibited from taking part in any university research that deals with sensitive security or military matters – a situation that can result in some sections of a laboratory being "off limits" to its key employees.¹³⁵

In the hunt to get a green card, many experts say the current system does not reward risk. Madeleine Sumpton, a policy analyst with the Migration Policy Institute, a nonpartisan research group, says students and researchers who opt to work

for a large corporation that can sponsor green cards and help pay any related legal costs often face fewer headaches with the US visa system.¹³⁶ Having a successful career within the bounds of academia can also open up lower-stress avenues to obtain a green card with an employer's sponsorship.¹³⁷ "It's immigrants seeking more flexibility or hoping to pursue entrepreneurship," Sumpton says, "who run into the most problems."¹³⁸ In other words, in a world in which great gambles and leaps of faith often produce the most innovative and game-changing companies, the US immigration system is painfully out of sync.

Indeed, many innovators we interviewed got their green cards through university sponsorship, especially since the H-1B temporary high-skilled visa caps do not apply to researchers while they are working at a university, buying them more time to apply. The government offers five different types of employment-based green cards for workers at different skill levels. In the category that generally has the shortest wait for visas – the "priority worker category," or EB1 – the government sets aside visas specifically for "outstanding professors and researchers."¹³⁹ Many universities have a policy of applying for those visas only for more permanent employees – like tenure-track professors or senior researchers heading up a campus laboratory.¹⁴⁰ Companies are also able to sponsor their most talented workers for such visas.¹⁴¹

Some students and researchers hoping to avoid some of the backlogs and limitations of the employer-sponsored visa system opt to apply for a special subset of green cards set aside for immigrants demonstrating "extraordinary" or "exceptional" abilities or talents.¹⁴² Those visas can be self-sponsored, meaning an employee can apply on his or her own behalf, without needing a company to file the application.¹⁴³ This gives foreign-born scholars more flexibility to work where they want, or even to start their own small businesses. Applying successfully for an extraordinary visa, however, is incredibly difficult.¹⁴⁴ To qualify, scientists must demonstrate they have earned national or international recognition for their work, something that often isn't easy for students who have just finished their graduate studies.¹⁴⁵ Candidates who have earned Master's degrees can often face particular challenges meeting such standards.¹⁴⁶ Researchers wanting to apply on their own under the less rigorous "exceptional ability" category face their own obstacles: Before applying, they first must gain a waiver from United States Citizenship and Immigration Services stating their presence in the US is in the "national interest," an expensive process that often takes many months.^{147 148}

Many lawyers we spoke to said it has become more difficult in recent years to apply for such ability-based green cards.¹⁴⁹ John

Gallini, a Boston-based immigration attorney who specializes in student and scholar cases, says recent regulations in response to a 2010 court case have injected more subjectivity into the decision process; instead of just checking off that scholars have met the basic guidelines to get a talent visa – like having scholarly articles published and cited by others – regulators with potentially no experience in the issue area now attempt to judge the quality of the articles themselves.¹⁵⁰ "They're asking these scholars to prove their worth almost beyond a criminal standard of doubt," Gallini says, "The process feels insane."¹⁵¹

Curiously, having a patent also isn't a great help in the fight to get an ability visa. Kathy Grzegorek, an immigration lawyer in Los Angeles, says that only patents that have already been licensed or commercialized hold major sway in extraordinary or exceptional ability applications – something she says makes little sense considering the pattern of American research. "At a large research university like Caltech, a lot of fundamental, basic research is going on," she explains, "so it might be 15 or 20 years before even the best patents start making money."¹⁵² And because the average patent application can take anywhere from four to eight years to approve,¹⁵³ many immigrants often want to apply for visas before their patents are even awarded.

Both lawyers say all those factors mean that recent PhD graduates are increasingly getting passed over in favor of mid-career professionals with more of a track record of success.¹⁵⁴ This comes after years when the inconsistent standards used to judge such talent visas have resulted in the EB1 "extraordinary abilities" and "outstanding professors and researchers" subcategories being drastically underutilized.¹⁵⁵ Although the US makes 40,000 visas available each year to



PATENT #8,084,889

Electricity Without Wires

A Croatian professor and a Greek engineering graduate student at MIT invented a way to transmit electricity wirelessly between magnetic coils so that devices like cell phones, electric cars, and even medical defibrillators can be charged without using a wall socket. A startup commercializing the technology has already entered into partnerships with Toyota, Audi, and a medical device company to explore incorporating it into products.

“priority immigrants,” as the category including extraordinary researchers is known, that target is almost never met.¹⁵⁶ ¹⁵⁷ In fact, over the last 19 years, the US has admitted on average fewer than 5,000 extraordinary ability immigrants and outstanding professors and researchers per year.¹⁵⁸

Given the extraordinarily high standards set for EB1, most advanced degree holders must apply for one of the 40,000 EB-2 visas. But in 2011, 39,680 foreign-students graduated from US universities earning masters degrees or PhDs in STEM.¹⁵⁹ The green cards would be just enough, if these visas were not also used by foreign-educated professionals and family members.

Even the way the green card system is structured places a low priority on the highly-talented immigrants who often create American jobs: The 40,000 visas available to “priority workers” annually represent fewer visas than the 50,000 visas the US awards to random applicants via the annual visa “lottery” category.¹⁶⁰ More generally, over 688,000 green cards were awarded to immigrants for family reunification reasons in fiscal year 2011, while just over 139,000 were awarded to immigrants coming for employment – the group more likely to contribute to US job creation.¹⁶¹ In fact, the US grants about 1 million green cards annually, but just 15 percent are given for economic reasons to workers and their family members – and if you take out those that go to spouses and children, the number is closer to seven percent. In contrast, over 60 percent of permanent visas in countries such as Canada, UK, and Australia, are distributed based on economic reasons to employees and their families.

University officials say all those problems and more have resulted in a system that impedes innovation – or worse yet, prevents it from happening at all. Paul DeLuca, the University of Wisconsin provost, says every year his school has at least one student or researcher delayed from beginning an academic post because of unexpected complications getting their student or researcher visas.¹⁶² In a university setting, where research projects are often funded by grants with firm time horizons, those delays can stall research and result in wasted funds. “In my supervisory role, I see frustration, anxiety, and lost opportunities – not to mention technology laying fallow

for years – because of the real, legitimate problems with our immigration system,” DeLuca says.¹⁶³

Most of the innovators we spoke to faced major challenges and frustrations with the US visa system – hurdles that could have easily discouraged less determined candidates. Of the more than a dozen inventors we spoke to during our research, two asked members of Congress to intervene on their behalf to help them obtain green cards or resolve immigration issues.¹⁶⁴ And many described wait times for permanent residency that stretched from months to years, offering little certainty for themselves or their families.

The cost alone of applying for a green card was daunting for many student innovators and researchers. That’s because without a large company or university to sponsor their visas, many immigrants must pay thousands of dollars out of pocket for the legal assistance they need compiling extensive documentation of their work and responding to any government requests for additional information. And it’s no wonder the fees are high: To get a visa to stay in the US as an immigrant with “extraordinary ability,” Koralach says he submitted a four-inch-thick packet filled with letters of recommendation and highly detailed information on his work and career.¹⁶⁵ It was so big, it wouldn’t fit though the drop slot at the embassy where he was supposed to submit it.¹⁶⁶

Ankit Agarwal, a former postdoctoral researcher at the University of Wisconsin–Madison, says the passion that motivates him every day is “growing” his business and “adding more high-skilled clones of myself” to his startup company.¹⁶⁷ A biochemical engineer by training, Agarwal originally moved to the US in 2002 to pursue his PhD. While doing his postdoctoral work at Wisconsin, Agarwal became concerned about the millions of patients who seek hospital treatment in America each year for chronic wounds or slow-healing ulcers. Knowing that about one in five of those patients develop dangerous infections each year, Agarwal worked with other scientists at the university to develop a thin film of silver nanoparticles that could be used to make the artificial skin used in their treatment resistant to bacteria. The technology was considered so promising that in 2009 Agarwal

“OF ALL THE CRAZY RULES IN OUR GOVERNMENT, THE CRAZIEST BAR NONE IS THAT WE TAKE THE SMARTEST PEOPLE IN THE WORLD, WE BRING THEM TO AMERICA, WE GIVE THEM PHDS IN TECHNICAL SCIENCES, AND WE KICK THEM OUT TO GO FOUND GREAT COMPANIES OUTSIDE OF AMERICA. THIS IS MADNESS.”

ERIC SCHMIDT
FORMER CEO, EXEC. CHAIRMAN
GOOGLE

was one of 13 postdocs awarded a prestigious fellowship from the Kauffman Foundation for researchers working on technologies that could turn into high-potential startups within the next five years.¹⁶⁸

But accolades and training funds did not make things easier for Agarwal to solidify his immigration status. After launching his company, Imbed Biosciences in 2010, Agarwal needed a green card to work at his startup full time. He considered applying for an EB2 “exceptional ability” visa, which is often within the reach of someone at his tenure level, but the wait for an Indian national to get such a green card was five years or longer.¹⁶⁹ “In an industry like biotechnology that moves rather quickly,” Agarwal says, “waiting that long was out of the question.”¹⁷⁰

So Agarwal decided to apply for the much more difficult-to-obtain “extraordinary ability” visa, which would allow him to bypass the backlog. But he was repeatedly advised against it. The first three lawyers Agarwal consulted either refused to take his case or told him they were pessimistic about its success. Once he found a lawyer eager to work with him, Agarwal says he and his wife had to make major sacrifices just to pay the “overwhelming” legal and application fees that accompany such applications – an expense that set them back about \$12,000. To pay, the Agarwals drained their savings and took out high-interest credit card loans.¹⁷¹

But in the end, Agarwal was among the lucky ones: His green card application was approved, and it didn’t take years to get it. Many other immigrants – even ones clearly contributing to the US economy – have faced similarly large obstacles and aggravations. In some cases, the problems are enough to cause foreign students and scientists to head back home, creating a situation that many in the US business community find highly frustrating. Eric Schmidt, the former CEO and current executive chairman of Google, tackled the topic in one recent interview on CNN. “Of all the crazy rules in our government, the craziest bar none is that we take the smartest people in the world, we bring them to America, we give them PhDs in technical sciences, and we kick them out to go found great companies outside of America,” Schmidt said,

“This is madness.”¹⁷²

Surajit Sinha, an organic chemist in Jadavpur, India, is one example of promising talent that got away. Sinha, who was raised by an impoverished widow in the tiny village of Saripa, India, came to the United States in 2000 to do a postdoctoral research fellowship. While at Stanford University, he focused on drug design, and patented a promising technology that could be used to disable some of the genes involved in cancer – an invention that earned his mentor a prestigious award from the National Institutes of Health in 2008. “I worked incredibly hard,” Sinha recalls of those years, “often spending all night at my lab.”¹⁷³

But despite his achievements, Sinha faced major obstacles when he began looking for a more permanent position in America. He interviewed at pharmaceutical companies, but couldn’t find a position that he and his academic advisor believed truly fit his desire to do ambitious research. Smaller more innovative startup companies he met with told him securing his H-1B visa would be a major issue: In 2006, the year Sinha was applying for jobs, so many high-skilled immigrants applied for H-1B visas that the cap was reached within two months.¹⁷⁴

Sinha longed for a green card, which he knew would make it easier for him to secure a job and also provide him with more flexibility to take on new projects or start his own laboratory. As an Indian national, however, the wait time for the green card he was eligible for was daunting. “I realized it would take me about 10 years to get my green card and do what I really wanted,” Sinha says, “and by then, much of my life would be over.”

So later that year Sinha returned to India and took a position as an assistant professor at one of the country’s top research institutes. Today his contributions to his home country are substantial: He currently employs nine graduate students and researchers in his lab, and recently had representatives from the pharmaceutical giant Eli Lilly and Company visit to talk about sponsoring some of his future work. Among other things, Sinha is trying to develop a cancer drug, and working on a compound he believes could represent



The artificial skin Ankit Agarwal invented at the University of Wisconsin-Madison has advanced the treatment of chronic wounds and slow healing ulcers, but almost didn’t get commercialized in the US because three different lawyers told him he was unlikely to get a visa.

an alternative to the painkiller morphine.

Sinha says he'd still rather be in the United States, where he would have easier access to the sort of state-of-the-art supplies and lab space that could accelerate his research and make it more competitive globally. The complexities and frustrations of the American immigration system, however, still perplex him. "If someone really wants to contribute to America," he says, "they should have more support within the country to stay there."¹⁷⁵

Sinha was probably right to worry about the emotional and professional costs he would have paid if he had chosen to wait years and years for an American green card. Nikolaj Wolfson, a former visiting scientist at the California Institute of Technology, uses the word "agony" to describe his three-year wait for a green card – a wait he thought would take only about a year given his Canadian citizenship. "You can never fully relax as a human," Wolfson says, describing that period. "It's hard to function at your full capacity never knowing what might happen tomorrow."¹⁷⁶

The lack of a dedicated visa for immigrant entrepreneurs is also a major hindrance to foreign innovators – as well as a major drag on the US economy. In 2010 immigrants were twice as likely to found startups as native born Americans,¹⁷⁷ and many foreign-born scholars we spoke to said their desire to try their luck in the world's entrepreneurship capital was one of the things that drew them to America in the first place.¹⁷⁸ But unfortunately, under today's laws, many relatively recent foreign residents who don't have green cards – or substantial personal wealth – don't have any way to work at their own company after graduation while remaining in the United States legally.¹⁷⁹ And that is true even when a US venture capital firm is willing to back the enterprise.

That issue proved to be an insurmountable problem for Demijan Klinc, a Slovenian citizen who earned a PhD in electrical and computer engineering from the Georgia Institute of Technology. While working on his degree, Klinc developed a promising so-called "cone of silence" technology that made it easier for credit-card companies to transmit sensitive customer information over wireless networks without risk of interception.

In 2009, while still in school, Klinc partnered with one of his professors and another Georgia Tech contact to turn his technology into the Atlanta-based startup Whisper Communications. Klinc says founding Whisper was "super exciting," and the company was promising, earning a competitive grant from the National Science Foundation. But two years into his venture, as he was preparing to graduate and lose his student visa, Klinc began to worry about whether he'd be able to get the H-1B high-skilled visa he'd need to continue working at Whisper

for the next several years. Given the high costs and legal paperwork associated with sponsoring such a visa, Klinc says, "There was a lot of uncertainty about whether it would even be feasible for a company just getting started like Whisper to sponsor me." And that difficulty affected not only Klinc but his longtime girlfriend as well. She hoped he'd be offered a position that would put him more squarely on the path to getting a green card; as long as Klinc held the H-1B visa, she would be ineligible to work as his domestic partner and dependent.¹⁸⁰

So when Klinc was offered a position as a videoconferencing engineer at Apple, he walked away from his startup – essentially depriving the company of half its research staff. "Visa-wise, going to Apple solved every single problem that I had," Klinc explains. And while it wasn't the only factor, that pushed him, he said it was a particularly compelling one. "It's a fact of life," he says, "that visa considerations often prevail."

Unfortunately, while the US makes it overly difficult for the talented STEM graduates we need to stay in America, other countries are eagerly putting out the welcome mat. Under a Canadian program created last year, international students who have completed just two years of a STEM PhD program can be accepted into the country as permanent residents while they are still enrolled in school¹⁸¹ – a far cry from the US system that requires students to finish their degrees before beginning a lengthy and uncertain visa process.¹⁸² Ireland, Singapore, and the United Kingdom are among the countries with special visas available to foreign entrepreneurs.¹⁸³ And while many Chinese nationals endure their decade-long wait to get a green card in America, their home country is actively

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*MICHAEL R. BLOOMBERG,
MAYOR OF NEW YORK CITY AND
CO-CHAIR OF THE PARTNERSHIP
FOR A NEW AMERICAN
ECONOMY*

recruiting them to return: Under a government talent program, Chinese scientists who move home from abroad can get free housing, a one-million Yuan bonus (more than \$157,000) and in some cases, a prestigious academic title attached to their name.^{184 185 186}

Many leaders are beginning to see the steps other countries are taking to recruit top talent as a direct challenge to America's economic prosperity. New York City Mayor Michael Bloomberg, who has previously compared our immigration policy to "national suicide," said that "America needs to think about immigration policy as part of our national economic strategy. Every day we let our antiquated immigration policies stand is a day we send new innovations, new companies, and new jobs abroad."

Many university officials agree, and say that they believe that the recruitment strategies other countries are adopting are already working. At Caltech, Farina says he's seen a real change in the number of students from China and India who opt to return home and take highly-attractive positions. "Twenty years ago, you never heard of a Chinese PhD student getting a degree here and wanting to go back," Farina explains. "But today they get offered amazing jobs back home, while we make it very difficult for them to stay here. All the incentives push them to leave."¹⁸⁷

Paulo Fontoura, a neurologist, certainly found he could more easily settle abroad in Switzerland – just one of many countries competing with the US for top talent. Fontoura, a native of Lisbon, Portugal, originally came to America in 2000 to study neuroimmunology as a postdoctoral researcher at Stanford University. While there, he helped develop a DNA-based vaccine that his team thought could help strengthen immune systems compromised by multiple sclerosis, with fewer side effects than the typical treatments – a product so promising it became the basis for a startup put together by several of his lab colleagues. Fontoura estimates that the company, Bayhill Therapeutics, employed about 70 people during its most successful period.¹⁸⁸ It also raised more than \$50 million in venture capital financing and in 2009 secured a deal worth up to \$325 million to further develop a potential treatment for type 1 diabetes with the pharmaceutical giant Genentech.^{189 190}

But even these successes did not allow Fontoura to bypass the most basic visa headaches. He ran into problems even before he arrived in America: it took longer than expected to receive his J-1 visa and he missed his Stanford start-date by two months, potentially jeopardizing his position. And once he got to America, his visa had to be renewed every year, a

process that came with its own cumbersome hassles. "Is the visa system conducive to helping people stay and work in the US?" Fontoura asks, "I would definitely say it isn't." Three years after landing at Stanford, Fontoura returned home. He says such issues were one of the factors driving that move.¹⁹¹

Fontoura quickly regretted his decision. He attempted to continue the same sort of cutting edge clinical research in Portuga, but says, with sparse funding available for such work, the climate there was "very, very difficult." So two years later, he returned to Stanford for several months as a visiting professor, once again joining the university's state-of-the-art multiple sclerosis lab. That work led to his being approached by Roche Pharmaceuticals about a job conducting research in their Palo Alto office. Although conversations were going well, Fontoura says the firm cut his interviews short when officials there realized he didn't have an H-1B visa, which would have made it hard for him to start the job within the time-frame they needed. Fontoura says that running up against the US immigration barrier at that phase in his career was a "major disappointment."¹⁹²

Things didn't all turn out badly in the end, though. A year and half later, Roche approached Fontoura and offered him a position in their office in Basel, Switzerland. He now heads the company's translational research division, or clinical research arm, overseeing a staff of 30 scientists. His team is working on nine early stage chemical compounds, which Fontoura believes could develop into drugs used for a variety of diseases, including schizophrenia, Alzheimer's disease, and autism.¹⁹³ As a citizen of the European Union, Fontoura says that settling in his new home was incredibly simple. All he had to do was register with the local authorities, a process that took less than an hour. "It couldn't have been more different than what I'd faced in America," he says.¹⁹⁴

For potential immigrants like Fontoura, there could be some positive changes on the horizon. Congress is currently considering several bills that address some of the visa problems that are most harmful to the promising foreign innovators and entrepreneurs of tomorrow. A bill is expected to be introduced by leaders in the House of Representatives this summer that would secure green cards for foreigners who earn advanced degrees in STEM fields from accredited US universities and then get a job offer.¹⁹⁵ Another bill, The Startup Visa Act of 2011, would grant special two-year visas to foreign entrepreneurs and students who can prove that US investors are willing to back their businesses.¹⁹⁶

But excerpts in academia say that as long as our immigration



policy remains unchanged, they will continue to watch some promising students experience disappointing immigration outcomes. Steven W. McLaughlin, of Georgia Tech, says that most of the foreign students he sees would prefer to stay if it were a realistic option. “These are some of our best and brightest minds, who want to contribute,” McLaughlin says. “There’s something truly wrong with a system that fails them.”¹⁹⁷

There are several budget-neutral steps Congress could take immediately to remedy the problems outlined in this report.

- First, Congress should provide green cards to STEM grads, especially those with advanced degrees from US universities, so that they have a clear and viable path to remain in this country and invent products here.
- Second, Congress should enact a visa for entrepreneurs, as countries around the world from the UK to Canada to Chile to Singapore already have done or are doing. This would allow more of the inventions coming out of our universities to be translated into US companies and US jobs.
- Third, Congress should remove, or at least raise, the caps on temporary high-skilled work visas. Temporary high-skilled workers fill gaps in our economy and help our companies grow. The arbitrary caps currently set at 65,000 annually are exhausted almost every year. They caps should be removed or at least raised to levels that allow companies to recruit and retain the innovators they need.

ENDNOTES

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