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# The Demographics of Innovation in the United States

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## EXECUTIVE SUMMARY

Behind every technological innovation is an individual or a team of individuals responsible for the hard scientific or engineering work. And behind each of them is an education and a set of experiences that impart the requisite knowledge, expertise, and opportunity. These scientists and engineers drive technological progress by creating innovative new products and services that raise incomes and improve quality of life for everyone.

But who are these individuals? How old are they? Were they born in the United States or abroad? Are they male or female? What are their races and ethnicities? What kind of education do they have? Identifying the characteristics of the individuals who create successful, meaningful innovation in America can shed important light on how to broaden and deepen the country's pool of potential innovators through STEM education (science, technology, engineering and math), immigration, and overall innovation policies.

This study surveys people who are responsible for some of the most important innovations in America. These include people who have won national awards for their inventions, people who have filed for international, triadic patents for their innovative ideas in three technology areas (information technology, life sciences, and materials sciences), and innovators who have filed triadic patents for large advanced-technology companies. In total, 6,418 innovators were contacted for this report, and 923 provided viable responses. This diverse, yet focused sampling approach enables a broad, yet nuanced examination of individuals driving innovation in the United States.

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## Who Innovates

The survey results show that the demographics of U.S. innovation are different not only from the demographics of the United States as a whole, but also from the demographics of college-educated Americans—even those with Ph.Ds. in science or engineering.

Immigrants comprise a large and vital component of U.S. innovation:

- More than one-third (35.5 percent) of U.S. innovators were born outside the United States, even though this population makes up just 13.5 percent of all U.S. residents.
- Another 10 percent of innovators were born in the United States but have at least one parent born abroad.
- More than 17 percent of innovators are not U.S. citizens, yet they are making invaluable contributions to U.S. innovation.
- Immigrants born in Europe or Asia are more than five times as likely as the average native-born U.S. citizen to have created an innovation in America.
- Immigrant innovators also are better educated on average than native-born innovators, with over two-thirds holding doctorates in STEM subjects (science, technology, engineering, and mathematics).

There is a striking gender split among innovators:

- Women represent only 12 percent of U.S. innovators.
- This constitutes a smaller percentage than the female share of undergraduate degree recipients in STEM fields, STEM Ph.D. students, and working scientists and engineers.
- The share of women was 5 percent larger among foreign-born innovators than among U.S.-born innovators.

Minorities born in the United States are significantly underrepresented:

- U.S.-born minorities (including Asians, African Americans, Hispanics, Native Americans, and other ethnicities) make up just 8 percent of U.S.-born innovators. These groups constitute 32 percent of the total U.S.-born population.
- Despite comprising 13 percent of the native-born population of the United States, African Americans comprise just half a percent of U.S.-born innovators.

Innovators in the United States are experienced and highly educated, and most hold advanced degrees in science and technology fields:

- Four-fifths of innovators possess at least one advanced degree, and 55 percent have attained a Ph.D. in a STEM subject.
- Half of innovators majored in some form of engineering as an undergraduate, and more than 90 percent majored in a STEM subject as an undergraduate.

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- STEM graduates from private undergraduate colleges and universities are more likely to become innovators. However, innovators are more likely to hold graduate degrees from public universities than private ones.
- While the Massachusetts Institute of Technology (MIT) educated more innovators than any other single graduate university, large public universities, including the University of Illinois at Urbana-Champaign, the University of California at Berkeley, and the University of Texas at Austin followed as the top educators of innovators.
- Contrary to popular narratives about young, technology-savvy entrepreneurs dropping out of college to found companies in Silicon Valley, the median age for innovators is 47.

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### Where and How Innovation Occurs

In addition to exploring the demography of innovators, this study sheds light on the innovations themselves and the organizations that produce them. The sample of meaningful and marketable innovations includes both fully commercialized innovations and innovations still in development.

- More than two-fifths of innovations in the sample are available on the market, and one-quarter have generated over \$25 million in total revenue.
- Innovators cite insufficient funds, market factors, and government regulatory constraints as barriers that slow or prevent commercialization.
- Twenty percent of innovations were collaborations between multiple institutions, and half of these were public-private partnerships between private companies and universities or government research labs.
- Public research labs were involved in 13 percent of innovations, and universities accounted for another 7 percent, showing the importance of federal funding for research in supporting the creation of market-ready innovations.

In contrast to the popular narrative that large firms are copiers and small firms the innovators, this study finds that large companies are the most important contributors to U.S. innovation:

- Approximately 60 percent of private-sector innovations originate from businesses with more than 500 employees; with 16 percent originate from firms with fewer than 25 employees.
- Reinforcing the critical role of the federal government in supporting innovation, more than half of companies with fewer than 25 employees received assistance from public sources, including grants from the departments of Defense and Energy and the National Institutes of Health, and awards from the Small Business Innovation Research program.

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Innovation occurs across the United States, but concentrates in the Northeast, in California, and near sources of public research spending.

- California had the most innovations of any state, with innovations concentrated in Silicon Valley, the San Francisco Bay Area, and San Diego.
- Controlling for population, the mid-Atlantic and New England states tended to produce the most international patents in life sciences, materials sciences, and information technology, with Massachusetts, Connecticut, Delaware, New Jersey, and Rhode Island leading.
- Innovation winning awards clustered around public laboratories and prominent research universities, such as Sandia and Los Alamos National Labs in New Mexico, Oak Ridge National Lab in Tennessee, and universities in Berkeley, California, and Cambridge, Massachusetts.

### **Policy Recommendations**

The findings here suggest two important policy implications related to STEM talent in the U.S. economy.

The first is to do a better job enabling women and minorities to gain STEM degrees. This will require more effort at the K-8 level, and, particularly, as ITIF has noted in the past, at the high school and college levels. Policymakers should consider expanding STEM high schools, particularly in disadvantaged communities, and expanding and improving computer science and engineering education in all American high schools. The country also needs stronger incentives for colleges and universities to do a better job of retaining students with an interest in STEM, as well as more funding for Ph.D. fellowships.

Second, given the importance of foreign-born STEM workers to American innovation success, we need policies to strengthen and expand the immigration pipeline that allows highly trained STEM workers to innovate in the United States, including foreign STEM graduates of U.S. colleges and universities who often have a hard time staying legally.

The results of this survey show that different segments of the population innovate at vastly different rates; that in-depth, specialized knowledge and experience in science, technology, engineering, and mathematics is the cornerstone of innovation; and that government has an important role to play in supporting education, STEM immigration, research funding, and technology transfer.

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## ABOUT ITIF

The Information Technology and Innovation Foundation (ITIF) is a nonprofit, nonpartisan research and educational institute focusing on the intersection of technological innovation and public policy. Recognized as one of the world's leading science and technology think tanks, ITIF's mission is to formulate and promote policy solutions that accelerate innovation and boost productivity to spur growth, opportunity, and progress.

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