Untapped Innovation?

The Racial and Gender Divides That Hinder the U.S. Knowledge Economy

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THE ISSUE

The United States’ innovative spirit rests on a complex network of economic rules favoring market-based competition, predictable legal arrangements for patenting and securing intellectual property, and incentives for investors. It also relies on a robust university system that provides the requisite educational training and facilities to carry out research and development (R&D). Maintaining this network fundamentally requires a focus on early education, especially in science, technology, engineering, and mathematics (STEM). A more inclusive innovation economy also demands greater attention to communities of color, who are often poorly connected to the innovation economy; women, who are underrepresented in the innovation economy; and those in regions that do not yet share in the prosperity of the United States’ innovation clusters. To build a more inclusive innovation-based economy, policymakers should foster equitable access to early childhood STEM education. They should encourage the expansion of technology transfer programs across universities and colleges, including historically Black colleges and universities (HBCUs), and connect them to their regions’ economic growth. Policymakers, academia, and industry leaders should also encourage minorities and women to participate in the patenting and venture systems that support the innovation economy. Renewing American innovation means making opportunity as universal as the talent that seeks it.

To continue to be leaders in innovation and creativity, we need to make full use of the tremendous amount of talent found in our country. If we lose the brain power, skills, and talents of practically half of our population, we are really shooting ourselves in the foot.

— SENATOR MAZIE HIRONO (D-HI)

INTRODUCTION

The growth of the U.S. knowledge-based economy, combined with the efficiencies of globalized networks of research, development, and production, have contributed to the remarkable rise of numerous world-leading innovation clusters over the past three decades. Over that period, these regions, including the Bay Area in California and the Route 128 corridor in Massachusetts, have witnessed sustained job creation, rising incomes and property values, and growing populations. Meanwhile, former manufacturing centers such as Cleveland, Ohio, have suffered from a prolonged period of decline as production moved offshore. The result is a divergence across American society between those who participate in the innovation economy and those who find it increasingly difficult to connect to it, threatening the United States’ brand as the “land of opportunity” as well as a sense of shared purpose.

When it comes to balancing these trends and demographics, access to a quality education is a fundamental concern. Data from the U.S. Department of Education’s Office for Civil Rights show that this
lack of even access to quality education particularly disenfranchises women, people of color, and low-income communities. In turn, these populations are less likely to be exposed to job opportunities in STEM fields or seek careers in technology entrepreneurship.

One indication of this disparity can be seen in the underrepresentation of women, Black, Hispanic, and Native American inventors in patent applications in the United States. Recent studies show that this disparity is reinforced by the limited availability of financial capital, fewer networking and mentoring opportunities, and less formal education within some social and economic networks. The demographic result is a start-up and innovation ecosystem that is mostly male, white, well educated, and coastally located—reinforcing the perception that the innovation system and knowledge-based economy works only for some. This growing disparity between those who benefit from the knowledge economy and those who are not able to connect to it is a concern for the nation’s future economic vitality as well as for its security. In disenfranchising such a significant sector of the nation’s population, everyone fails to benefit from their intellect and civic participation.

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**THE STEM DIVIDE AND ITS IMPACTS**

The innovation divide begins with differential access to STEM education. STEM education not only prepares children for jobs of the future, but also nurtures positive attitudes about science and technology that underpins an “innovation nation.” Since the 1980s, however, the data show that STEM proficiency is declining throughout the United States. Analysts predict that this decline will negatively impact future U.S. economic and scientific leadership.

Uneven STEM access is a critical equity issue, primarily in urban and rural areas. For example, more than half of high schools in the United States do not offer a course in calculus. More than 4 in 10 high schools do not offer courses in physics, more than one in four do not offer courses in chemistry, and more than one in five do not offer Algebra II (considered essential to later STEM success at the college level). Analysts point out that this lack of access further exacerbates gender and racial stereotypes, limits opportunities for minorities, inhibits the growth of diverse role models, and negatively impacts young girls’ confidence in their math skills.

**Figure 1: NAEP Long-Term Assessment Results: Mathematics**

One effect of this lack of equity in educational opportunity can be seen in long-term assessments of students, as compared by race. As Figure 1 shows, since 2004, white students have scored significantly higher than Black or Hispanic students in each National Assessment of Educational Progress (NAEP), a test offered to a representative sample of nine-year-olds to measure long-term trends in academic knowledge and skills. These race and gender disparities in STEM extend into college education. Only 22 percent of bachelor’s degrees and 9 percent of doctorates in science and engineering are awarded to students from underrepresented minority groups.

The impact of this disparity is stark when looking at the United States’ participation in emerging technologies such as artificial intelligence (AI) and quantum computing. According to Stanford University’s 2022 AI Index Report, the percentage of new Black or African American and Hispanic students enrolling in computing doctoral programs dropped significantly over the past decade, only accounting for an average of 1.5 percent and 2.9 percent of the U.S. total, respectively, between 2010 and 2020.

These trends reveal a large demographic gulf in educational access to the knowledge-based economy. Barriers that exist across the country discourage talented American children from seeking the training and exposure needed to fully contribute to the knowledge economy as researchers and entrepreneurs.
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THE PATENT DIVIDE AND ITS IMPACTS
Patents are a leading measure of how research ideas are converted into new products and services for the market. Demographic data on those who apply for patents further reveal the impact of the STEM divide.

LIMITED MINORITY PARTICIPATION
A study published in The Quarterly Journal of Economics in 2018 found that patent holders in the United States today are primarily white, male, and wealthy.11 Another study found that “from 1970 to 2006, African American inventors were awarded just six patents per million people, compared to over 40 patents per million for women and 235 patents per million for all U.S. inventors.”12 Additional data on patenting among minorities show that Black inventors file patents at about one-third the rate of white inventors, while Hispanic inventors file for patents at less than half the rate of Black inventors.13 Furthermore, only about 1 percent of Black and Hispanic college graduates apply for patents, compared to 2.7 percent of white graduates.14 While this is not surprising considering that science and engineering fields are dominated by white men, significantly lower participation in the patenting process by minorities contributes to lower participation in the system altogether and hinders progress in diversifying STEM fields.

THE PATENTING GENDER GAP
Data on patenting show there is also a gender gap. As of 2020, women hold nearly half of all full-time jobs in the United States, but only about 21.9 percent of U.S. patents list women as inventors, and women make up only 12.8 percent of all patentees throughout the country.15 Worldwide, the statistics are not much better, with 16.5 percent of patent applicants in 2020 identifying as female; at their current rate of increase in patenting worldwide, women will not file as many patents as men in a single calendar year until 2058.16 A major barrier to broader participation in the innovation economy more generally is the limited training available on the patenting process.17 Given the complexity of the patent system, many potential entrepreneurs do not have the requisite background or knowledge to succeed. While a lack of exposure to the patent system prior to undergraduate or graduate studies keeps many Americans from patenting, the lack of training opportunities especially disadvantages women and minority entrepreneurs from low-income communities, who also often have limited access to peer and mentoring networks. This is a second hurdle for groups who are also less likely to be exposed to STEM fields at a young age.

LIMITED DIVERSITY IN THE PATENT LAW COMMUNITY
As a report from the American Bar Association points out, the legal community supporting the patenting system is also not diverse, with white lawyers vastly outnumbering Black and Hispanic lawyers, in every career position across the country. About 81.69 percent of registered U.S. lawyers are white, 3.45 percent are Black, 7.70 percent are Asian American, and 2.02 percent are multiracial; in sum, only 17.48 percent of registered lawyers across the United States identify as racial minorities.19 Women in general only make up 36.16 percent of registered lawyers.20 Looking just at those who make their careers in patent law, the report finds that women make up 21.8 percent of all registered attorneys and agents at the U.S. Patent and Trademark Office (USPTO). Moreover, only 1.7 percent of registered patent attorneys and agents are non-white women, and “there are more patent attorneys and agents named ‘Michael’ in the United States than there are racially diverse women.”21 Between 2000 and 2020, the number of new USPTO registrants who are racially diverse has been about 6.5 percent per year, up from about 1.7 percent per year in the 1970s. Overall, this means less than 6 percent of all U.S. patent practitioners since 1950 have been racially diverse.22 When looking at these statistics from a policy perspective, it is important to recognize the early barriers that preclude many Americans from participating in the patent industry. Factors such as socioeconomic status, educational background, and location are all significant in determining who becomes a patent lawyer.
THE VENTURE CAPITAL INDUSTRY AND THE INNOVATION DIVIDE

The venture capital (VC) industry, which plays a key role in the innovation system, also reflects a lack of diversity in its ranks that affects the inclusivity of the innovation economy. A 2016 study by the National Venture Capital Association (NVCA) shows that in 2016, 89 percent of venture capitalists were male and 74 percent were white. Research conducted by Richard Kerby, co-founder and partner at Equal Ventures, found that out of 200 firms composed of roughly 2,000 investors, only 1.5 percent of full-time employees identified as racially diverse, with 58 percent of investors being white men. Furthermore, based on visible funds (from visible investors at venture funds with a fund size of $100 million or more), only 1 percent of investors were African American—only one of whom was a woman. In general, only 7 percent of partners at the top 100 venture capital firms are women.

NVCA data show there are substantially fewer Black investors than white investors. According to a 2019 report by the John S. and James L. Knight Foundation, only 1 percent of the wealth management industry, which amasses $70 trillion, is controlled by women or minorities. The statistics on how many minority and female-led businesses receive venture capital funding are even more striking. The NVCA study found that less than 1 percent of funding went to businesses founded by African American women, while only 10 percent went to women-founded businesses in general. In the past year alone, U.S. firms set a record VC high by investing almost $130 billion in start-up companies, only 2.3 percent of which went to start-ups led by women. It is far more difficult for female founders to raise funding, as well as for female capitalists to raise capital. Moreover, a national survey on access to capital among minority business enterprises found that 71 percent of minority business enterprises have never had an outside investor.

THE OPPORTUNITY COST OF RACIAL AND GENDER INEQUALITY

Inclusivity is necessary for a more productive economy and connected society. Conversely, the opportunity costs of not drawing on the talents of all Americans and of not connecting them to the innovation economy are significant. While CSIS has not evaluated the methodologies used, three studies, referenced below, suggest that greater inclusion can create significant new wealth.

The McKinsey Global Institute found in 2015 that over $12 trillion could be added to GDP by 2025, simply by advancing women’s equality. In a potential scenario where women play a fully identical role in labor markets to that of men, McKinsey estimated that as much as $28 trillion (26 percent) could be added to the global annual GDP by 2025. The opportunity costs of not drawing on the talents of all Americans and of not connecting them to the innovation economy are significant.

Meanwhile, a 2020 Citigroup report estimated that including more women and Black Americans in the initial stages of innovation could increase U.S. GDP by as much as $640 billion. The authors of the report argued that the United States’ aggregate economic output would have been $16 trillion higher today if identified racial gaps had been closed in 2000. For context, the GDP of the United States in 2019 was $21.4 trillion. If these racial gaps were closed today, the authors believe the United States “could see $5 trillion of additional GDP over the next 5 years, or an average add of 0.35 percentage point to U.S. GDP growth per year and 0.09 percentage point to global growth per year.”

Finally, the National Bureau of Economic Research posits that eliminating the patent gap for women with science and engineering degrees alone could increase the U.S. GDP by over $500 billion a year.

A March 2022 report by the National Science Foundation (NSF) on innovation intensity offers further insight into the innovation inclusion gap. Overall, it finds that innovation by white-owned firms disproportionally drives the national innovation rate of 27 percent, which is calculated based on the number of new products of processes a firm introduces; this rate varies considerably among industries, with the highest-performing software publishing industry and the communication technology industry both operating at 66 percent. NSF data also show that, as of 2018, there was a male-to-female ratio of 19:1 for CEOs in the United States and 6.5:1 for chief financial officers. These metrics are the result of decades of gender and racial groups having unequal opportunities, an issue the United States needs to address to meet the demands of tomorrow’s economy.

Even so, there are signs of positive change. The NSF report also shows that “women and underrepresented minorities are making marginally more frequent contributions to innovation in business than male and white firm owners, respectively,” with firms that were majority female-owned having an innovation intensity of 27.5 percent between...
2015 and 2017, compared to majority male-owned firms at 26.2 percent. Yet, this difference has almost no overall effect on innovation because majority female-owned firms only make up 21 percent of the total.

In addition, the NSF and the National Center for Science and Engineering Statistics (NCSES) reported in 2010 that the number of female STEM graduates had grown 30 percent faster in the previous two decades than the number of male graduates. On top of this, firms have begun to respond to calls for investing in reskilling and lifelong learning opportunities, and Fortune 500 CEOs now frequently speak on their firms’ efforts to address the opportunity imbalance and its effects of the United States’ notable skills gap.

These trends indicate a slow change underway that could be accelerated by greater access to opportunity. Lasting action on this issue will require a more determined and consistent response by public and private stakeholders to invest in and realize the gains from a more inclusive innovation economy.

**RECOMMENDATIONS**

Reflecting on how a lack of opportunities in these areas translates into a lack of diversity overall, there are several key steps that policymakers and academic and business leaders can take to begin to address the issue:

1. **Support early STEM learning opportunities.**

Providing students across the country with access to hands-on learning opportunities in STEM subjects can draw them to future careers in STEM research and innovation-based entrepreneurship.

Accordingly, state and local governments in the United States should fully fund a STEM curriculum for elementary schools, especially in rural and urban areas. Bills such as the Supporting STEM Learning Opportunities Act, which is aimed at providing opportunities for STEM education and experiential learning programs, could further reinforce workforce pathways for young women and students of color.

2. **Expand university technology transfer programs to better reach women and minorities.**

Expanding the infrastructure for university technology transfers is necessary to better reach and include women and minority students and faculty. Today, many smaller universities and HBCUs lack such programs, which connect university faculty with innovative concepts and the creation of high-value start-ups, therefore increasing diverse participation in the innovation economy.

Congress should amend the U.S. Innovation and Competitiveness Act (USICA) of 2021 to add back in Section 2109, which originally outlined a Focused Action Supporting Technology and Economic Response (FASTER) agenda. This proposal aimed to broaden and diversify the institutions offering technology transfer resources to its innovators.

3. **Combine college preparatory academic training with technical and workplace training.**

The United States can focus on closing its skills gap by helping create and illuminate state and local pathways into certain industries. It can point underserved students toward well-paid and dignified careers in the knowledge economy while responding to the needs of employers looking for highly specific skillsets. The skilled technical workforce, comprised of workers in occupations that require significant STEM knowledge and expertise but not a bachelor’s degree, represented 13 percent of overall U.S. employment in 2017. The skilled technical workforce contributes to all parts of the economy and accounts for more than half of all employees in advanced R&D industries.

Originally authorized in 2006, the Carl D. Perkins Career and Technical Education Act aims to further develop the U.S. skilled technical workforce by integrating career and technical education (CTE) skills into secondary and postsecondary education. By advancing CTE and furthering policies to accelerate employer engagement with this program, the legislation provides a stronger foundation for students to build careers in STEM without a bachelor’s degree. Beginning such training for students early on and providing more funding to better link secondary/postsecondary and workforce data is crucial in lessening the skills gap. In 2018, this legislation was reauthorized through 2024, continuing congressional commitment to providing nearly $1.3 billion annually for CTE programs across the nation.

4. **Prioritize data collection on inventor demographics.**

Proper data collection about demographic participation in the patent system is important for measuring and monitoring gender, racial, and regional disparities in the innovation economy. The USPTO does not request demographic information from patent applicants, meaning that the federal government does not have a clear picture of the racial and gender skew in patenting.
The bipartisan Inventor Diversity for Economic Advancement (IDEA) Act of 2021—which was passed by the Senate Judiciary Committee in April 2021—seeks to rectify this by requiring the USPTO to include demographic questions on patent applications and report on applicants’ voluntary disclosures.49

5. Leverage existing federal and state programs to improve diversity in venture capital.

The Small Business Innovation Research (SBIR) program already offers a proven model for how the federal agencies can help draw venture capital to promising start-ups beyond Silicon Valley by highlighting firms’ technological promise and commercial potential while lowering risk and attracting follow-on investment from VC firms.50

State development agencies should complement and bolster the SBIR program and further guide venture capital to new regions and demographic communities.

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ENDNOTES


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