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Tech Opportunity for Minorities and Women: A Good News, Bad News Story

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EXECUTIVE SUMMARY

Can tech jobs be a source of economic opportunity and upward mobility for an increasingly diverse American population?

Yes—consider two key facts about the labor market recovery, both of which show the potential for tech jobs to empower communities and bring shared prosperity.

First, since the recovery began in 2009, tech has created almost as many jobs for college graduates as healthcare. Tech jobs, here defined as all computer and mathematical occupations across industries, include computer systems analysts, network architects, and statisticians. Over 2009-2014, these tech jobs added about 730,000 college-educated workers. By comparison, healthcare occupations—which include everything from doctors and nurses to lab technicians and therapists—added 787,000 workers with a college degree.

This near parity in tech and healthcare job creation is significant given healthcare has long been regarded as the most dependable force for job creation. A growing and aging U.S. population, alongside rising medical costs, are widely seen as keeping healthcare jobs in high demand.

Second, we find that college-educated blacks and Hispanics have benefited enormously from the tech jobs boom. From 2009 to 2014, blacks with a college degree gained slightly more tech jobs than healthcare jobs—employment rose by 79,000 in computer and mathematical occupations (a 58% increase), compared to 76,000 gain in healthcare occupations (an 18% increase). The number of Hispanics with a bachelor's degree increased by 104,000 in the healthcare occupations (a 40% increase), not so far ahead of the 81,000 gain in computer and mathematical occupations (an impressive 103% increase).

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Indeed, the opportunity tech jobs are creating for non-Asian minorities defies conventional stereotypes. That's because the tech/info jobs boom is much broader than in Silicon Valley. Tech jobs are increasingly found across all industries and the country. Tech jobs are in finance, education, and government, and urban tech clusters are forming in U.S. cities such as New Orleans, New York, and Denver.

Unfortunately, the widespread belief that tech jobs are elitist threatens good policymaking. Many skeptics of tech opportunity are dismissive of the number of jobs being created by tech, unable to see beyond Silicon Valley. Reports on diversity from tech giants like Google and Facebook seemingly confirm such suspicions, with Google admitting that "we're not where we want to be when it comes to diversity."

> Since the recovery began in 2009, tech has created almost as many jobs for college graduates as healthcare.

The profound misunderstanding of the tech labor market could well have serious long-lasting consequences for struggling middle-class Americans. Universities and colleges, for example, are failing to adequately adjust to the labor market's signals. They are pushing too many science-minded people into healthcare jobs, leaving vast numbers of high-wage tech jobs unfilled.[1]

Our analysis also highlights some other bad news: women are not equally sharing in the tech jobs boom, accounting for just 26 percent of the college-educated tech job growth over 2009-2014. Science-minded women are disproportionately choosing healthcare-related majors, such as biology and health sciences, over computer and information sciences (CIS). Too little has been done to address the long-standing cultural biases against women in Science, Technology, Engineering and Mathematics (STEM).

A large projected growth in tech jobs, particularly for college graduates, suggests much is at stake. We must do more to maintain the good news story for blacks and Hispanics, while improving tech employment prospects for women.

Specifically, policies at the federal, state, and local level must encourage more women and minorities to pursue tech careers. For example, policies that promote both more CIS majors and more STEM majors should be an integral part of higher-education reform. We also need more viable alternative pathways into the tech workforce after high school.

Recent efforts by the Obama Administration, in collaboration with private companies, to engage more minorities and women in tech are a step in the right direction. But given the scale of the problem, particularly for women, this should only be seen as a starting point. Exposure and access to training for the new wave of middle-skill tech jobs must be a top national priority.

Still, the power of tech opportunity is only as strong as the policies that enable the tech jobs boom to prosper. That means policymakers should avoid taking actions that impose impractical restrictions or regulatory constraints, which choke off tech job creation or hinder private investment. For creating a new path for middle-class prosperity in a data-driven economy, such pro-growth policies are essential.

LABOR MARKET FACTS: TECH VERSUS HEALTHCARE

Our analysis challenges the conventional narrative that technology destroys more jobs than it creates. Accusations abound that today's tech jobs, and the innovations that inspired them, are a curse and not a blessing. Technology luddites loudly worry that automation is killing the middle-class and all hopes for shared prosperity. One recent commentator went as far as to write a piece titled "Silicon Valley to Millennials: Drop Dead."[2]

FIGURE 1: CHANGE IN EMPLOYMENT FOR COLLEGE-EDUCATED WORKERS IN TECH AND HEALTHCARE OCCUPATIONS, 2007-2014

	Change 2007-2009			Change 2009-2014		
	Number (in thousands)	Percent	Annual Growth Rate	Number (in thousands)	Percent	Annual Growth Rate
Computer and Mathematical Occupations	-4,000	-0.2%	-0.1%	730,000	31.7%	5.7%
Healthcare Practitioner, Technical, and Support Occupations	211,000	4.6%	2.3%	787,000	16.5%	3.1%

Includes employed with a Bachelor's degree or higher.
Source: Census Bureau, PPI

Indeed, after the dot-com bust of the early 2000s, tech employment was in shambles. In the years that immediately followed, relatively few of the jobs created were tech jobs, and relatively little of the subsequent economic growth came from the tech sector.

While tech job growth in the early 2000s was weak, healthcare jobs more than filled the gap. Healthcare jobs such as lab technicians, registered nurses, dieticians, and occupational therapists, filled mostly by college graduates, saw their ranks rise while tech jobs stumbled. As shown in Figure 1, employment for college-educated healthcare jobs even grew during the recession, by 211,000, compared to a small drop in college-educated tech jobs.

> Tech employment consists of much more than the Internet publishing and web search industry clustered in a small part of Northern California.

Such robust growth made healthcare jobs the gold standard of job creation. News media and policymakers alike praise healthcare jobs for their staying power, prioritizing them accordingly. For tech jobs to be seen as worthy of similar accolades, therefore, they must hold up to healthcare jobs.

Yet something happened during the recession that turned the tide in favor of tech jobs. The advent of the smart device, coupled with enormous investment in high-speed broadband, brought our economy into a new era. This transition into a data-driven economy created a major demand for tech and data analytics skills, as more people switched to digital trade and communication, and new technology was embraced across industries seeking to boost productivity.

Since the recovery began in 2009, the enormous benefits of the tech jobs boom have been especially apparent for college graduates. For example, almost 90 percent of all tech jobs created over 2009-2014 were filled by those with at least a college degree. Here we consider tech jobs to be the many computer and mathematical occupations found across industries – for example, computer systems analysts, programmers, software engineers, and statisticians and data scientists. As such, we focus on jobs filled by those with at least a bachelor's degree for most of the analysis in this paper, although we note a similar trend for total occupational employment.

Our research shows that over 2009-2014, tech jobs filled by those with at least a college degree grew almost as much as healthcare jobs, 730,000 compared to 787,000.[3] That puts the ratio of new healthcare jobs to tech jobs filled by those with at least a college degree at just 1.1, a far more even match than in the preceding years.

Moreover, the annual growth rate for college-educated tech jobs since the recovery began well

outpaces that of healthcare jobs, 5.7 percent compared to 3.1 percent.

BATTLING THE TECH STEREOTYPE

There are many common misperceptions about the tech/info sector, and about the rise in tech jobs. Indeed, tech jobs have become a lightning rod of controversy in the economic recovery. Media outlets of all shapes and sizes are eager to point out that, in addition to destroying other jobs, tech jobs are highly discriminatory. Only a select few benefit. Non-Ivy League graduates need not apply. It has become ingrained in society that these occupations, which range from software developer to web designer to network work technician, are so selective that they could not possibly be the solution for a shrinking middle-class.

A spate of news stories covering the public confessions by Google, Facebook, and Twitter on their lack of diversity only adds to the conventional wisdom of tech elitism.[4] The recent report from Google was matched by a similar declaration from Facebook that "as these numbers show, we have more work to do—a lot more."[5] Google, Facebook, and Twitter reported a workforce that was 60 percent white and 30 percent Asian, with 6 percent or less combined black and Hispanic. Adding insult, all three companies showed a large gender gap, with women comprising just 30 percent of employees.[6]

Not surprisingly, tech critics who believe the conventional narrative cite these data points as concrete evidence that tech jobs could hardly be less welcoming. News coverage of the reports on the industry's lack of diversity stirred outrage among prominent civil advocates with Jesse Jackson proclaiming, "There's no talent shortage. There's an opportunity shortage."[7] Some tech journalists blame inherent laziness on the part of tech company executives for not making an effort to be more inclusive.[8]

Yet these supposedly common "truths" about tech jobs do not match the facts. To get a true picture of the breadth of tech jobs, you have to look outside Silicon Valley. Tech employment consists of much more than the Internet publishing and web search

industry clustered in a small part of Northern California. Certainly, looking at this small subset of tech jobs, it seems tech could not possibly create opportunity on a large scale. For example, the Internet publishing and web search industry added a less than impressive 20,000 jobs in 2014, a figure that hardly calls for unrestrained enthusiasm.

> Tech jobs have created tremendous opportunity for blacks and Hispanics during the recovery.

In reality, the truth about tech is far from the conventional wisdom. We are shifting into a new era of tech-driven job growth that defies popular stereotypes. It turns out that tech is not just a small elitist sector that offers few jobs and hires only white and Asian supernerds.[9] Tech is becoming much more widespread, from finance to energy, and from New York to Texas. In its report on the "Top 100 Jobs of 2014," U.S. News ranked software developer and computer systems analyst as the top two jobs.[10]

In fact, as the data-driven economy takes hold, computer and mathematical jobs are being created across virtually all industries. According to official data, while it is true that many tech jobs are found in the "Internet" industry symbolized by Silicon Valley, tech jobs are also found in government, finance, manufacturing, and education.[11] The financial sector is among the highest paying for tech workers. It is hard to think of large companies that aren't investing heavily in mathematical workers who specialize in big data analytics, or employing computer workers to build and maintain secure computer networks during a time when cybersecurity threats are serious and constant.

Geographically, tech jobs are also becoming more widespread. Most of the top metropolitan areas for tech employment are not in California, but rather span the country. They include New York City, Washington D.C., Chicago, Dallas, and Atlanta.[12] And previous PPI research shows that tech clusters

are sprouting up across all corridors of the country, in the West, Northeast and South, in cities such as New Orleans, New York, and Madison, Alabama.[13]

Since the recovery began, tech jobs have accounted for about one million of all new jobs created, an impressive figure given total tech occupation employment is just 4.3 million. And demand for tech workers continues to be strong, with employers struggling to find qualified workers. The March 2015 data from the Conference Board shows that there are currently 600,000 vacancies for computer and mathematical occupations, with a ratio of supply to demand for computer and mathematical occupations standing at just 0.17.[14] In other words, there is less than one worker available for every tech job posting. It seems the real story of tech jobs is one of enormous opportunity.

USING HEALTHCARE AS A BENCHMARK

If the conventional stereotypes find tech jobs to be elitist and unwelcoming, then healthcare jobs have the opposite reputation. Healthcare jobs grew rapidly in the decade before the recession, especially for women and minorities. These jobs are important, because there are many of them: in 2014, 8.5 million people were employed as healthcare practitioners or technicians.

Looking at the official statistics, healthcare jobs on the surface seem more welcoming than tech jobs. In 2014, women comprised almost three-quarters of all healthcare practitioner and technical occupations. And more than twice as many blacks and Hispanics were employed as healthcare practitioners or technicians than in computer and mathematical occupations in 2014.

What's more, the unquestioned vitality of healthcare employment has, for all intents and purposes, become second nature. Everyone needs health care, and now, for longer: Average life expectancy has increased by 10 years since 1950,[15] and the average age of the population is fast approaching 40.[16]

In contrast to the misguided perception of tech jobs being mostly in Silicon Valley, the healthcare sector is also widely viewed as geographically ubiquitous. Opportunities exist everywhere there are people, because remote healthcare is not yet mainstream. Private sector healthcare jobs are being added all across the country, from San Antonio, to La Crosse, and St. Louis.[17] Healthcare employment is growing even in cities like Pittsburgh, which has had a hard time building a major tech presence. A recent *New York Times* article, for example, proclaimed tech start-ups "have neither a strong lifestyle reason nor a strong economic reason to stay in Pittsburgh once they succeed."[18]

Indeed, some have even gone so far as labeling healthcare "recession-proof."[19] If healthcare employment could withstand the worst recession in recent history, it could withstand anything. A 2013 Brookings report described healthcare jobs as a driving force of the labor market recovery, finding that across the top 100 metro areas healthcare accounted for one out of every 10 jobs.[20]

That's why we use healthcare job creation since the recovery began in 2009 as a yardstick or measuring the surge of tech jobs. Since tech employment is shrouded in misperceptions, it's useful to compare it to healthcare employment, which is generally not seen as tilted toward elites. This will tell us if tech jobs truly offer a promising new channel for upward mobility into the middle class.

GOOD NEWS: A TECH JOBS BOOM FOR MINORITIES

As it turns out, tech jobs have created tremendous opportunity for blacks and Hispanics during the recovery. Segments of the population previously left behind by finance and housing boom of early 2000s are finally participating in a growing economy.

In particular, we find college-educated blacks and Hispanics have enjoyed significant benefits from the tech jobs boom. This is especially true when considering the job growth for college-educated blacks and Hispanics in tech compared to healthcare jobs.

FIGURE 2: INCREASE IN EMPLOYMENT OF COLLEGE EDUCATED WORKERS, 2009-2014
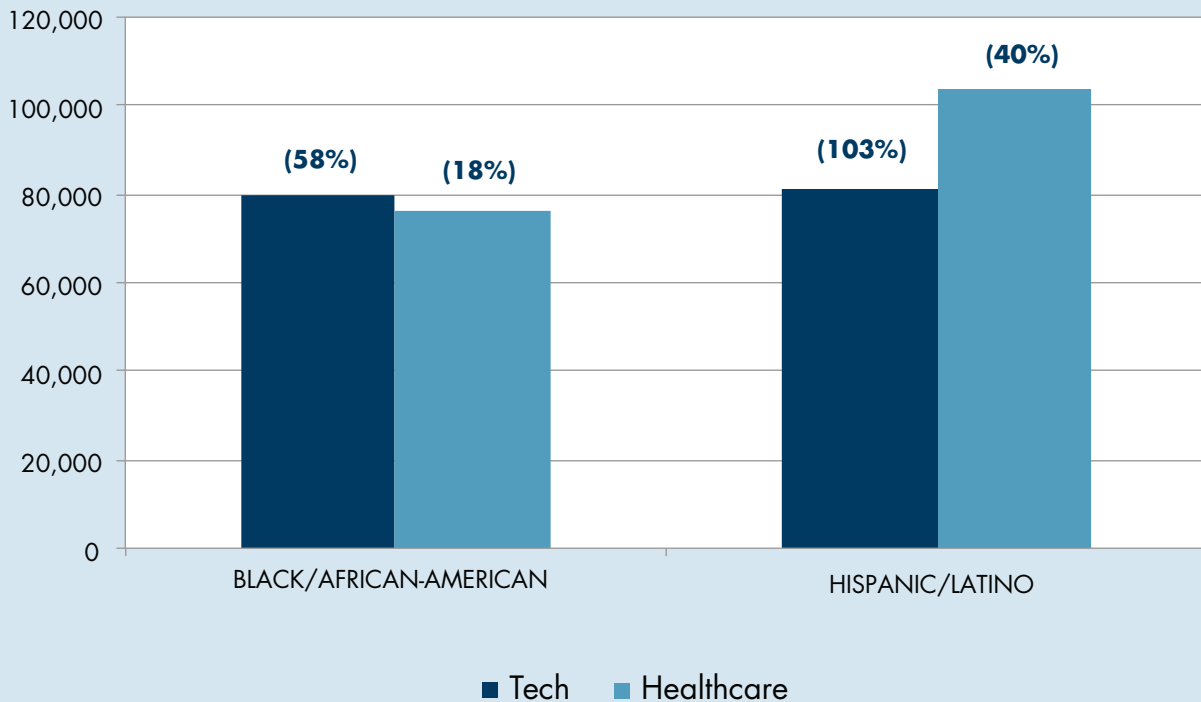
Tech jobs defined as Computer and Mathematical occupations;
Healthcare jobs defined as Healthcare Practitioners, Technical, and Support occupations.
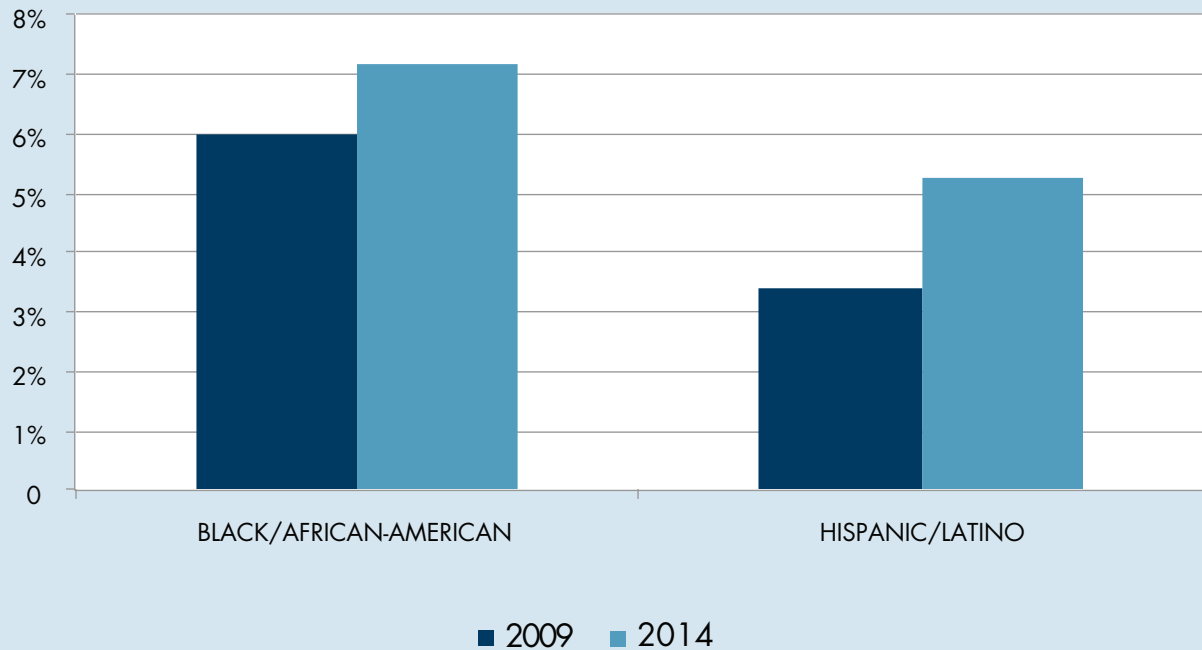*Source: Current Population Survey, PPI*

For example, our research shows tech jobs for college-educated blacks actually grew slightly more than healthcare jobs over 2009-2014. Black college graduates employed in tech occupations grew by 79,000 during this time, or 58 percent, while healthcare jobs rose by 76,000, or 18 percent. We find that blacks saw sizeable gains in employment share in computer programmers, software developers, database administrators, and network and computer systems analysts.

As Figure 2 shows, Hispanics have also enjoyed huge gains in tech jobs over 2009-2014. Since the recovery, Hispanics gained 81,000 jobs (an increase of 103 percent) compared to 104,000 for healthcare occupations (an increase of 40 percent).

Moreover, as the Figure 3 shows, the share of black and Hispanic employment in tech occupations requiring a college degree actually *increased* from 2009-2014.

That the share of tech employment has increased for blacks and Hispanics is itself indicative of the large magnitude of their employment gains. That's because both blacks and Hispanics started from a very low base, so that to increase their employment share, the growth in employment would have to be much greater than overall employment growth. This is evidenced by the 58 percent growth rate in tech employment for blacks, and the 103 percent growth in tech employment for ispanics over 2009-2014.

FIGURE 3: MINORITIES INCREASE SHARE OF TECH OCCUPATION EMPLOYMENT

Tech jobs defined as Computer and Mathematical occupations.
Source: Current Population Survey, PPI

What's more, the rising share of minorities in tech occupations can also be seen throughout all computer and mathematical occupations, regardless of educational attainment. In 2009, blacks comprised 6.7 percent of computer and mathematical occupational employment,[21] rising to 8.3 percent in 2014.[22] Meanwhile, their share of healthcare jobs remained flat. Hispanics too saw their share of tech occupational employment rise from 5.4 percent to 6.6 percent.

Finally, our research also shows blacks and Hispanics comprise a higher than average share of tech employment across several industries. As Figure 4 shows, it is clear blacks and Hispanics are increasingly represented in tech jobs within sectors such as public administration and healthcare.

In part, the rise in the Hispanic share is due to the increase in the total college-educated Hispanic employment population. Over 2009-2014, college-educated Hispanic workers grew by 38 percent, compared to 12 percent for all college-educated workers. Still, the 103 percent gain in college-educated Hispanics in tech jobs far outstripped the increase in total college-educated Hispanic workers, showing the relative shift to tech jobs.[23]

HOW TECH CREATES OPPORTUNITY

The ongoing tech employment boom extends far beyond the borders of Silicon Valley, both in terms of industry and geography. That is why tech jobs are creating enormous opportunity for minority populations, in spite of charges of elitism. And it is why limiting the potential of tech opportunity to Silicon Valley would be a disservice.

FIGURE 4. RACIAL COMPOSITION OF COMPUTER
AND MATHEMATICAL WORKERS BY INDUSTRY, 2014

	Total Occupational Employment, all races (in thousands)	Share of computer and mathematical workers	
		Black/ African-American	Hispanic/ Latino
Total	4,400	8.3%	6.7%
Professional and technical services*	1,715	7.9%	5.5%
Information and computer manufacturing**	519	8.4%	6.7%
Finance and insurance	513	6.2%	4.6%
Education, healthcare, and social assistance	472	6.5%	8.3%
Manufacturing, except computer	308	5.9%	4.2%
Public administration	305	17.1%	10.9%
Everything else	615	9.4%	10.1%

*Includes accounting, legal, computer systems design, engineering, consulting, and R&D services.
**Information and computer manufacturing includes the information sector (publishing, motion picture, broadcasting, telecommunications & Internet service providers) and computer and electronic manufacturing.
Figures based on both employed and unemployed workers.
Figures based on black alone and hispanic-designated categories.
Figures include all levels of educational attainment.
Source: Current Population Survey, PPI

In fact, tech jobs are fast becoming an important vehicle for social and economic empowerment. Through their ability to boost incomes, they have the potential to relieve some of the most pressing socio-economic problems facing our nation.

For example, many tech jobs are being created through the rise of tech-driven start-ups, which requires little more than a high-speed Internet connection and a novel idea. It does not require the large capital investments many other start-ups require early on that would otherwise make it prohibitively expensive.

Moreover, many of these tech start-ups cluster together in high-density urban hubs, creating inner-city jobs and positive local economic spillovers. Indeed, few of today's tech entrepreneurs want to put their start-ups out somewhere in a suburban office park. Instead, they place their new firms in places that are attractive to young tech workers. This has enormous potential benefits for high poverty urban populations, by promoting better education and social infrastructure.

Certainly, more can and should be done in Silicon Valley, but our findings highlight a positive forward momentum. Prominent Silicon Valley companies, such as Google and Facebook, have already acknowledged their lack of diversity and are taking concrete steps to address it.[24]

Of course, we also recognize that even the best efforts to employ greater numbers of under-represented populations may have limited results. That's because the ability for these populations to gain employment share in tech jobs is dependent on several outside factors, including a dearth in the number of qualified applicants.

BAD NEWS: WHY AREN'T MORE WOMEN IN TECH JOBS?
So far, the story about tech opportunity has been a good news story. However, along with the good news comes bad news that must be acknowledged and addressed.

Although minorities have enjoyed large gains from the tech jobs boom, it turns out that not everyone is sharing equally in the potential benefits. In particular, women have not been seen comparable gains in tech employment.

As Figure 5 shows, women accounted for just 26 percent of the employment gain over 2009-2014 for tech jobs held by people with at least a bachelor's degree. It is clear women, who make up 47 percent of the workforce but just 25 percent of college-educated tech employment, are substantially underrepresented relative to other occupations.

FIGURE 5. MEN DOMINATE GAINS IN TECH JOBS HELD BY
COLLEGE-EDUCATED WORKERS

	2009	2014	# Change	% Contribution to Total 2009-2014 Change
Total	**2,298,000**	**3,028,000**	**730,000**	
Men	1,722,000	2,259,000	537,000	74%
Women	576,000	769,000	192,000	26%

*Tech jobs defined as Computer and Mathematical occupations.
Source: Current Population Survey, PPI*

Why aren't women included more in the tech jobs boom? We believe the answer to this question has deep social and cultural roots.

To start, women can't be hired for jobs they aren't qualified to fill. If the recent reports from major tech companies like Google, Facebook, and Yahoo are indicative, there are too few women in the talent pipeline to close the gender gap in tech jobs.

One obvious bottleneck for women in obtaining a high-skill tech job is in the distribution of college degrees. Looking at 2013 bachelor's degree attainment, the latest year available, it becomes very clear that women are vastly under-represented in tech disciplines. In particular, we find that more science-minded women are being channeled into health-related majors over tech degrees, by a ratio of more than 23 to one. As shown in Figure 6, 215,600 received health-related degrees in 2013, compared to just 9,200 in tech.

Here, we define "tech-related" majors as all computer and information sciences (CIS) majors, and "health-related" majors as health professions plus biological and biomedical sciences. These classifications are based on individual majors as identified by the National Center for Education Statistics (NCES).

The gap between health-related degrees and CIS degrees may only worsen over time. More women are entering college than men, accounting for 56

percent of total four-year college enrollment.[25] This trend is expected to continue.

Data from the Department of Education already shows how the healthcare-tech degree gap has grown over the last decade. In 2000, three students were awarded degrees in health-related fields for every degree awarded in CIS. By 2013, 5.6 health-related degrees were awarded for every one degree in CIS, a gap entirely attributed to women.[26]

> Tech jobs are fast becoming an important vehicle for social and economic empowerment.

This is despite the fact that there are more bachelor's degree-granting institutions offering a CIS degree than health-related degrees. According to NCES, in the 2011-12 academic year 1,514 institutions awarded Bachelor's degrees in CIS compared to 1,383 in health professions and 1,338 in biological and biomedical sciences.[27]

Closing the gap in choice of college major must start by engaging young women in tech early. A recent study by Google, which surveyed 1,000 women and 600 men seeking to understand why more women aren't interested in tech jobs, found that "most of the decision-making to pursue Computer Science occurs before a young woman begins college."[28]

Specifically, the study identified four key indicators that explain why fewer women pursue tech studies. These are: (1) Social encouragement, (2) Self-perception, (3) Academic exposure, and (4) Career perception. In other words, it all comes down to introducing the world of tech early on, showing the relevance of tech in everyday life, and having family and peer systems in place that encourage tech exploration. Interestingly, these results held regardless of the method by which women were exposed to tech; early tech engagement of any kind

FIGURE 6. BACHELOR'S DEGREE ATTAINMENT, 2013

	Healthcare	CIS	Ratio
Total			
Men	71,100	42,300	1.7
Women	215,600	9,200	23.4
Blacks			
Men	5,100	4,000	1.3
Women	22,800	1,500	15.3
Hispanics			
Men	7,100	3,800	1.9
Women	20,000	910	21.9

Source: NCES, PPI

had a notable impact over no exposure at all. Such findings are encouraging, as the study also concludes, because it provides a realistic hope that the tech gender gap can be reversed in a politically viable way. The key is to engage women on the promise of tech earlier in their academic and social environments.

For women who do enter tech professions, there is also the issue of retention. New research from the American Institutes of Research shows a worrisome trend, where women are much more likely than men to permanently leave tech careers after they've entered them. Further, the study found a disconcerting gender gap in promotion potential among women with doctorate degrees in STEM disciplines.[29]

Some of this gets back into the cultural reputation of tech jobs as elitist. One recent high-profile discrimination lawsuit certainly added to this sentiment, and though it was overturned, the matter is far from settled. Out of this lawsuit emerged two additional corporate discrimination lawsuits, which remain ongoing.[30] The barrage of media coverage on sexism in tech also reinforces this reputation, much of which is filled with unflattering allegations of blatant gender discrimination.[31]

Fortunately, not everything is working against women interested in pursuing tech. There has been some progress at top universities in getting more science-minded women to successfully study computer science. For example, Carnegie Mellon University has started a mentorship program for female computer majors, and the University of Washington restructured its introductory computer science course to emphasis the real world practically of the major.[32] Georgetown University established a group "GU Women Who Code" to form a female coding community on campus.[33]

> Although minorities have enjoyed large gains…women have not been seen comparable gains in tech employment.

WHAT'S AT STAKE FOR WOMEN AND MINORITIES
Tech may be a driving force of job creation now, but is there reason to think the tech job boom will continue? It is an important question that must be considered as policymakers debate next steps in prioritizing workforce initiatives, especially as it compares to growth in healthcare occupations.

It is possible that the ongoing tech jobs boom is temporary. This theory suggests that over time, as broadband adoption stabilizes while the population rises, healthcare occupations will re-emerge as the relatively dominating source of job creation. In this scenario, the overwhelming number of college graduates studying health-related disciplines over computer and information sciences is less concerning, as tomorrow's graduates will be prepared for and in line with tomorrow's jobs.

Our view, however, is that the tech jobs boom still has a long way to go, and the next decade will continue to see enormous opportunity for college graduates pursing tech careers. A recent PPI report on the so-called "Internet of Things" (IoT) – the natural extension of Internet-type connectivity to physical objects – argues that we

are only beginning to enter the next phase of smart design and delivery of everyday goods and services. Indeed, the report foresees a progression toward a completely interconnected society, concluding that "the Internet of Everything has the potential to help revive the high-growth economy."[34] The reality of the IoT means it is more important than ever to have strong digital skills, in order to be adequately prepared for tomorrow's high-wage jobs.

Further, a deeper analysis of official employment projections supports the notion that the tech job boom is here to stay. The number of new and replacement tech jobs over the next decade requiring a four-year degree is not projected to be substantially less than healthcare practitioner, technical, and support jobs. Specifically, we estimate that there will be 1.35 million new and replacement tech jobs requiring at least a bachelor's degree, compared to 3.0 million healthcare jobs. That puts the projected college-educated healthcare to tech jobs ratio at just 2.2.[35]

For these calculations, we used the Bureau of Labor Statistics' (BLS) 2012-22 occupational employment projections. Specifically, we took the 2012 share of workers with a bachelor's degree or higher for each detailed occupation and applied those shares to each occupation's projected new and replacement jobs over 2012-2022. We then summed up the total projected jobs requiring at least a bachelor's degree across both occupational categories.

As surprising as these estimates are, they are actually more conservative than the official ratio of tech to healthcare practitioner jobs created. The Bureau of Labor Statistics gives its own estimates for each occupational category by educational attainment. For healthcare practitioners, BLS estimates about 506,000 jobs will be created that require at least a bachelor's degree, compared to 534,000 tech jobs.[36]

Moreover, there is reason to believe future growth in healthcare employment will not be as large as BLS projections suggest. That's because the strong employment gains over the last decade were in part due to falling labor

productivity. As PPI has demonstrated elsewhere, the number of healthcare workers per potential patient rose over the last decade.[37]

> A deeper analysis of official employment projections supports the notion that the tech job boom is here to stay.

Containing healthcare costs therefore means incorporating productivity enhancing—or cost-cutting—technology into the sector. Our proxy for healthcare productivity, which we call 'Gross Medical Productivity,' suggests healthcare costs rise when workers are less productive. That means that to increase productivity and reduce costs long-term, the rate of increase of healthcare employment needs to slow. This may put downward pressure on future healthcare employment.

EMBRACING TECH THROUGH POLICY
The ongoing tech jobs boom provides a platform for enormous economic and social opportunity. While some blame technology for increasing economic inequality, and others eschew tech jobs as exclusive and elitist, the rapid growth of minority employment in tech jobs shows that tech-driven investment and innovation is a potent force for narrowing wealth and income gaps. As entrepreneurs flock to cities to launch start-ups, tech jobs can also help to reduce urban poverty.

Yet significant obstacles remain; in particular, the tech gender gap. Years of conventional wisdom have convinced women that health degrees are a safer career bet, with more practical application.

That means an important part of addressing the gender imbalance must be to encourage more women to pursue STEM degrees and tech careers. If postsecondary institutions continue to stand by outdated notions of the importance of tech

degrees, colleges will continue to push too many science-minded female students into health-related fields of study over tech fields.

Narrowing the gender gap in tech also requires a complete shift in our current cultural mindset in and out of the classroom. Engaging more women in tech must include a supportive family and peer system for encouragement. In addition, it must also include early academic exposure and integration of tech into learning across all subjects. This will help show just how important tech is across all areas of life, and with the emergence of the Internet of Things, the need to be digitally trained will no longer be isolated to one type of profession.

The private sector also plays an important role in steering young people, including minorities, toward tech careers. Examples include efforts by industry to engage students in math and science at a young age, and by companies such as Google[38] and Verizon[39] that host tech-driven contests for high school students, and programs aimed at increasing the number of young girls who can code. Governments at all levels must ensure that our education and workforce development systems can support robust economic and technological innovation.

Indeed, much is at stake in adequately addressing the women shortfall in tech. Over the short-term, women will be at a disadvantage relative to men who are better qualified for tech careers, perhaps perpetuating a reinforcing cycle of tech as elitist and unwelcoming. Over the long-term, this could undermine prospects for economic growth, depress productivity and wage gains, and make our workforce less globally competitive. The impact would fall disproportionately on young college graduates, who struggle with mounting debt burdens and underemployment.

The power of tech opportunity therefore lies in getting the right mix of policies to ensure all segments of the population are able to enjoy the benefits of the tech jobs boom. Already there

has been some movement at the federal level in this regard. For example, President Obama's ConnectEd Initiative, which calls for 99 percent of U.S. students to have high-speed broadband in the classroom by 2017, is a great way to ensure all young Americans have access to an Internet connection.[40] In July 2014, the White House also released a report on "Job-Driven Training and American Opportunity," where several initiatives focus explicitly on equipping more Americans with the skills they need to fill tech jobs.[41] And in December 2014, the White House announced during its Computer Science Education Week more than $20 million in philanthropic contributions to increase the number of computer science teachers by 2016, mainly in elementary schools.[42]

Finally, in March 2015 President Obama announced a new "TechHire" initiative supported by 300 employers and 21 local governments.[43] The initiative will work to correct the large mismatch in unfilled tech vacancies, by working with community colleges and coding boot camps to train tech workers. It marks an important step forward in getting more traditionally under-represented populations engaged in tech careers, because it addresses the need for viable alternative pathways into the workforce for middle-skill jobs that don't need a four-year college degree. Yet, such initiatives should only be considered as the beginning, and should be a subject of further exploration and experimentation.

Perhaps most importantly, the power of tech opportunity can only be realized as long as policymakers encourage the tech jobs boom. Policymakers must resist the temptation to overly regulate the Internet, understanding that investment and innovation across the entire data ecosystem is necessary to sustain the strong tech jobs creation that is lifting America's middle-class. Only when the right policies are in place will we be able to fully embrace the potential of the data-driven economy, and the tech opportunity for everyone that comes with it.

ENDNOTES

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