

What happens if robots take the jobs? The impact of emerging technologies on employment and public policy

By Darrell M. West

INTRODUCTION



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I realized something dramatic was happening when my assistant Hillary came to me with an unusual experience. I had asked her to reschedule an appointment and she had emailed Amy, the personal assistant of the individual on my calendar. Amy was amazingly prompt in her follow-up. Hillary was on vacation and when Amy didn't get an immediate response, she emailed my assistant multiple times over the weekend trying to find a date that would work.¹

It was only at this point that Hillary noticed Amy was a "virtual assistant." Working for an artificial intelligence firm that schedules meetings, Amy performed the tasks of a human assistant who read emails, discerned intent, and came up with a relevant response. Other than the artificial intelligence title on her signature line, and her extraordinary persistence and follow-through on weekends, there was nothing in the exchange that would have led anyone to conclude the correspondent was not human.

In reflecting on this experience, I realized that a virtual assistant trained in intelligent response is not a futuristic vision. Rather, it is a current reality that performs quite well. This and other automated tools are no longer at the cutting edge of new technology. Rather, robots, artificial intelligence, computerized algorithms, mobile sensors,

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3-D printing, and unmanned vehicles are here and transforming human life. People can decry these developments and worry about their “dehumanizing impact,” but we need to determine how emerging technologies are affecting employment and public policy.

In this paper, I explore the impact of robots, artificial intelligence, and machine learning. In particular, I study the impact of these emerging technologies on the workforce and the provision of health benefits, pensions, and social insurance. If society needs fewer workers due to automation and robotics, and many social benefits are delivered through jobs, how are people outside the workforce for a lengthy period of time going to get health care and pensions? There are profound questions for public policy based on emerging technologies, the changing nature of the workforce, and the differential impact on various demographic groups. We need to reconfigure the social contract and figure out how to deliver social benefits in the new economy that is unfolding.

Current approaches linked to full-time jobs will be insufficient if employment patterns change and society needs fewer workers to perform basic tasks. We already have seen the impact of automation on blue-collar jobs and are starting to see its impact spread to white-collar jobs. As computers become more sophisticated, creative, and versatile, more jobs will be affected by technology and more positions made obsolete.

In this situation, there have to be ways for people to get health care, pension, disability, and income supplements outside of full-time employment. Offering a basic income, revamping the earned income tax credit, providing activity accounts for lifetime education and retraining, expanding corporate profit-sharing, and providing benefit credits for worthy volunteerism represent ways to do this. We also need to reform school curricula so students aren’t being trained for jobs that no longer exist and encourage continuing education and access to arts and culture for adults so they can expand their horizons throughout their lives. Advanced economies need to determine ways to avoid a permanent underclass with limited financial prospects or employment possibilities.

EMERGING TECHNOLOGIES

The list of new technologies grows every day. Robots, augmented reality, algorithms, machine-to-machine communications, 3-D printing, and autonomous vehicles help people with a range of different tasks.² These technologies are broad-based in their scope and significant in their ability to transform existing businesses and personal lives. They have the potential to ease people’s lives and improve their personal and business dealings.³ In his book, “Pax Technica,” political scientist Philip Howard outlines an “empire of bits” that is transforming how people interact with one another.⁴ Technology is becoming much more sophisticated and this is having a substantial impact on the workforce.

ROBOTS

Robots are expanding in magnitude around the developed world. Figure 1 shows the numbers of industrial robots in operation globally and there has been a substantial increase in the past few years. In 2013, for example, there were an estimated 1.2 million robots in use. This total rose to around 1.5 million in 2014 and is projected to increase to about 1.9 million in 2017.⁵ Japan has the largest number with 306,700, followed by North America (237,400), China (182,300), South Korea (175,600), and Germany (175,200). Overall, robotics is expected to rise from a \$15 billion sector now to \$67 billion by 2025.⁶

According to an RBC Global Asset Management study, the costs of robots and automation have fallen substantially. It used to be that the “high costs of industrial robots restricted their use to few high-wage industries like the auto industry. However, in recent years, the average costs of robots have fallen, and in a number of key industries in Asia, the cost of robots and the unit costs of low-wage labor are converging ... Robots now represent a viable alternative to labor.”⁷

The Defense Advanced Research Projects Agency held a competition for a robot that could perform in hazardous environments. Robots were given eight tasks such as “driving a vehicle, opening a door, operating a portable drill, turning a valve and climbing stairs.”⁸ The goal was

to have equipment that could operate in damaged nuclear reactors or disaster scenes too dangerous for humans to operate. A Korean team won the competition (with a \$2 million first prize) for completing these tasks.

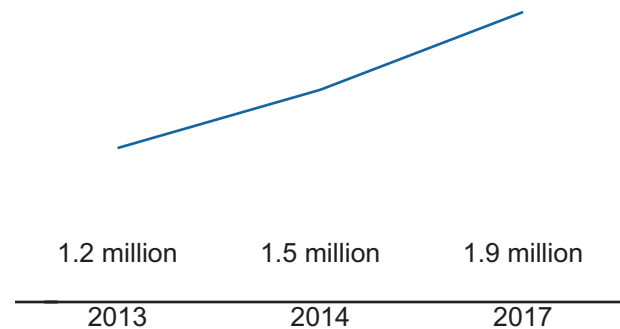
In the contemporary world, there are many robots that perform complex functions. According to a presentation on robots, “the early 21st century saw the first wave of companionable social robots. They were small cute pets like AIBO, Pleo, and Paro. As robotics become more sophisticated, thanks largely to the smart phone, a new wave of social robots has started, with humanoids Pepper and Jimmy and the mirror-like Jibo, as well as Geppetto Avatars’ software robot, Sophie. A key factor in a robot’s ability to be social is their ability to correctly understand and respond to people’s speech and the underlying context or emotion.”⁹

These machines are capable of creative actions. Anthropologist Eitan Wilf of Hebrew University of Jerusalem says that sociable robots represent “a cultural resource for negotiating problems of intentionality.”¹⁰ He describes a “jazz-improvising humanoid robot marimba player” that can interpret music context and respond creatively to improvisations on the part of other performers. Designers can put it with a jazz band, and the robot will ad lib seamlessly with the rest of the group. If someone were listening to the music, that person could not discern the human from the robot performer.

In Japan, there is a new hotel called Henn-na that uses robots to check people in and escort guests to their rooms. The robotic receptionist speaks Japanese or English, depending on the preferences of the guest. It can set up the reservations for people, take them to their rooms, and adjust the accommodation’s temperature. Within the room, guests can use voice commands to alter the lighting and ask questions regarding the time or weather.¹¹

Amazon has organized a “picking challenge” designed to see if robots can “autonomously grab items from a shelf and place them in a tub.” The firm has around 50,000 people working in its warehouses and it wants to see if robots can perform the tasks of selecting items and moving them around the warehouse. During the competition, a Berlin robot successfully completed ten of the twelve tasks. To move goods around the facility, the company already uses 15,000 robots and it expects to purchase additional ones in the future.¹²

Figure 1: Number of Industrial Robots Around the World



In the restaurant industry, firms are using technology to remove humans from parts of food delivery. Some places, for example, are using tablets that allow customers to order directly from the kitchen with no requirement of talking to a waiter or waitress. Others enable people to pay directly, obviating the need for cashiers. Still others tell chefs how much of an ingredient to add to a dish, which cuts down on food expenses.¹³

Other experimentalists are using a robot known as Nao to help people deal with stress. In a pilot project called “Stress Game,” Thi-Hai-Ha Dang and Adriana Tapus subject people to a board game where they have to collect as many hand objects as they can. During the test, stress is altered through game difficulty and noises when errors are made. The individuals are wired to a heart monitor so that Nao can help people deal with stress. When the robot feels human stress levels increasing, it provides coaching designed to decrease the tension. Depending on the situation, it can respond in empathetic, encouraging, or challenging ways. In this way, the “robot with personality” is able to provide dynamic feedback to the experimental subjects and help them deal with tense activities.¹⁴

COMPUTERIZED ALGORITHMS

There are computerized algorithms that have taken the place of human transactions. We see this in the stock exchanges, where high-frequency trading by machines has replaced human decision-making. People submit, buy, and sell orders, and computers match them in the blink of an eye without human intervention. Machines can spot trading inefficiencies or market differentials at a very small scale and execute trades that make money for people.¹⁵

Some individuals specialize in arbitrage trading, whereby the algorithms see the same stocks having different market values. Humans are not very efficient at spotting price differentials but computers can use complex mathematical formulas to determine where there are trading opportunities. Fortunes have been made by mathematicians who excel in this type of analysis.¹⁶

ARTIFICIAL INTELLIGENCE

Long considered a visionary advance, AI now is here and being incorporated in a variety of different areas. It is being used in finance, transportation, aviation, and telecommunications.

Artificial intelligence refers to “machines that respond to stimulation consistent with traditional responses from humans, given the human capacity for contemplation, judgment and intention.”¹⁷ It incorporates critical reasoning and judgment into response decisions. Long considered a visionary advance, AI now is here and being incorporated in a variety of different areas. It is being used in finance, transportation, aviation, and telecommunications. Expert systems “make decisions which normally require human level of expertise.”¹⁸ These systems help humans

anticipate problems or deal with difficulties as they come up.

There is growing applicability of artificial intelligence in many industries.¹⁹ It is being used to take the place of humans in a variety of areas. For example, it is being used in space exploration, advanced manufacturing, transportation, energy development, and health care. By tapping into the extraordinary processing power of computers, humans can supplement their own skills and improve productivity through artificial intelligence.

AUGMENTED REALITY

Augmented reality is bringing 3-D technologies and graphic displays to human existence. For example, Facebook's Oculus, Google's Magic Leap, and Microsoft's HoloLens represent consumer examples of this development. They enable people to supplement the usual senses with computer-generated graphics, video, sounds, or geo-location information. These images can be mapped to the physical world and made interactive for the user.

People can mount displays on their heads or stand in a digital lab where images are projected onto the wall. Using handheld devices or sensors, they can move through buildings, simulate battle conditions, role play disaster responses, or immerse themselves in virtual reality.

Some of the most advanced applications have come from the military. Its planners use augmented reality to train recruits for street patrols and battle conditions. Supervisors can alter virtual conditions and see how the soldiers respond. This allows them to "experience" a wide range of circumstances from the safety of the lab.²⁰ That helps them navigate actual battlefields once they are sent abroad.

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MEDICAL SENSORS AND MACHINE-TO-MACHINE COMMUNICATIONS

Machine-to-machine communications and remote monitoring sensors that remove humans from the equation and substitute automated processes have become popular in the health care area. There are sensors that record vital signs and electronically transmit them to medical doctors. For example, heart patients have monitors that compile blood pressure, blood oxygen levels, and heart rates. Readings are sent to a doctor, who adjusts medications as the readings come in. According to medical professionals, "we've been able to show significant reduction" in hospital admissions through these and other kinds of wireless devices.²¹

There also are devices that measure "biological, chemical, or physical processes" and deliver "a drug or intervention based on the sensor data obtained."²² They help people maintain an independent lifestyle as they age and keep them in close touch with medical personnel. "Point-of-care" technologies keep people out of hospitals and emergency rooms, while still providing access to the latest therapies.

Implantable monitors enable regular management of symptoms and treatment. For example, "the use of pulmonary artery pressure measurement systems has been shown to significantly reduce the risk of heart failure hospitalization."²³ Doctors place these devices inside heart failure patients and rely upon machine-to-machine communications to alert them to potential problems. They can track heart arrhythmia and take adaptive moves as signals spot troublesome warning signs.

Automated machines are being integrated into health care in several different respects. Some people are relying upon "rehabilitation robots" to aid people with specific tasks. Service robots meanwhile help people personalize their treatment and deal with health, safety, and mobility issues. Companion robots attempt to improve quality of life

through interactivity and socialability.²⁴ In conjunction with wired “smart homes”, it is possible integrate robots into the day-to-day lives of senior citizens and improve their medical treatment.

3-D PRINTING

Additive printing is a way for software to send design plans to specialty printers and have those devices make exact copies of those goods or products. Used in the manufacturing area for things composed of a single material, this has transformed product manufacturing and delivery, and altered global supply chains. Companies that used to make something in one place and ship it thousands of miles to another location now can reduce shipping logistics dramatically. They can email the specifications anywhere around the globe and have machines make a copy for the customer and have the product immediately available to that person or organization.

Right now, this technology is limited to simple items made of a single material such as plastic or metal. However, in the future, 3-D's impact will grow as design specifications become more multi-faceted and companies are able to print things composed of more than one material. That will exponentially expand the market for additive printing and make it much easier to transform production. Fewer design people and factory workers will be needed in this situation.

AUTONOMOUS VEHICLES

Unmanned vehicles and autonomous drones are creating new markets for machines and performing functions that used to require human intervention. Driverless cars represent one of the latest examples. Google has driven its cars almost 500,000 miles and found a remarkable level of performance. Manufacturers such as Tesla, Audi, and General Motors have found that autonomous cars experience fewer accidents and obtain better mileage than vehicles driven by people.²⁵

Unmanned drones are being used for a variety of purposes. In India, for example, authorities are using them for crowd control. Whenever there is extensive violence or mob attacks, police deploy drones armed with pepper spray and cameras, and use them to disperse crowds and round up troublemakers.²⁶ Law enforcement officials claim these devices have been very effective at helping to restore order.

They also are being used in real estate, agriculture, entertainment, and wildlife management. People employ them to photograph property, monitor pest infestations in crops, and manage wildlife sanctuaries.²⁷ This helps officials get to hard-to-reach areas and track problems autonomously without humans having to be in particular geographic spots.

IMPACT ON THE WORKFORCE

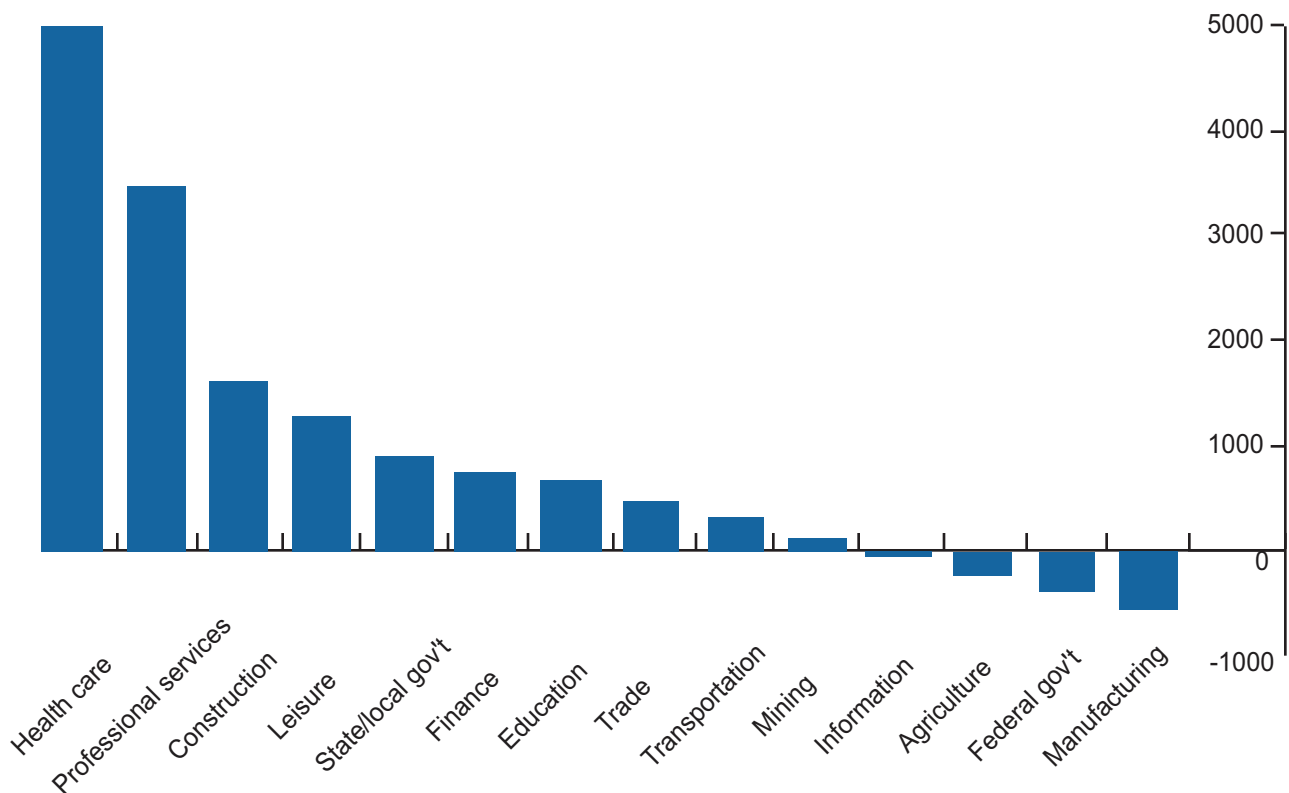
The rapid increase in emerging technologies suggests that they are having a substantial impact on the workforce. Many of the large tech firms have achieved broad economic scale without a large number of employees. For example, Derek Thompson writes that “Google is worth \$370 billion but has only about 55,000 employees – less than a tenth the size of AT&T’s workforce in its heyday [in the 1960s].”²⁸ According to economist Andrew McAfee, “we are facing a time when machines will replace people for most of the jobs in the current economy, and I believe it will come not in the crazy distant future.”²⁹

In a number of fields, technology is substituting for labor, and this has dramatic consequences for middle class jobs and incomes. Cornell University engineer Hod Lipson argues that “for a long time the common understanding was that technology was destroying jobs but also creating new and better ones. Now the evidence is that technology is destroying jobs and indeed creating new and better ones but also fewer ones.”³⁰

Martin Ford issues an equally strong warning. In his book, “The Lights in the Tunnel,” he argues that “as technology accelerates, machine automation may ultimately penetrate the economy to the extent that wages no longer provide the bulk of consumers with adequate discretionary income and confidence in the future. If this issue is not addressed, the result will be a downward economic spiral.”³¹ Continuing, he warns that “at some point in the future—it might be many years or decades from now—machines will be able to do the jobs of a large percentage of the ‘average’ people in our population, and these people will *not* be able to find new jobs.”

Firms have discovered that robotics, machine learning, and artificial intelligence can replace humans and improve accuracy, productivity, and efficiency of operations. During the Great Recession, many businesses were forced to downsize their workforce for budgetary reasons. They had to find ways to maintain operations through leaner workforces. One business leader I know had 500 workers for his \$100 million business and now has the same size workforce even though the company has grown to \$250 million in revenues. He did this by automating certain functions and using robots and advanced manufacturing techniques to operate the firm.

Figure 2: Future employment projections by sector, 2012-2022 (in millions)



The U.S. Bureau of Labor Statistics (BLS) compiles future employment projections. In its most recent analysis, the agency predicts that 15.6 million new positions will be created between 2012 and 2022. This amounts to growth of about 0.5 percent per year in the labor force.

Figure 2 shows the distribution by sector for that period. The health care and social assistance sector is expected to grow the most with an annual rate of 2.6 percent. This will add around 5 million new jobs over that decade. That is about one-third of all the new jobs expected to be created.³² Other areas that are likely to experience growth include professional services (3.5 million), construction (1.6 million), leisure and hospitality (1.3 million), state and local government (929,000), finance (751,000), and education (675,000).

Interestingly, in light of technology advances, the information sector is one of the areas expected to *shrink* in jobs. BLS projections anticipate that about 65,000 jobs will be lost there over the coming decade. Even though technology is revolutionizing many businesses, it is doing this by transforming operations, not increasing the number of jobs. Technology can boost productivity and improve efficiency, but do so by reducing the number of employees needed to generate the same or even higher levels of production.

Manufacturing is another area thought to lose jobs. The BLS expects the U.S. to lose 550,000 jobs, while the federal government will shed 407,000 positions, and agriculture, forestry, fishing, and hunting will drop 223,000 jobs.³³ These sectors are the ones thought to be least likely to generate new positions in the coming decade.

Since BLS projections make few assumptions about emerging technologies, it is likely that their numbers underestimate the disruptive impact of these developments. It is hard to quantify the way that robots, artificial intelligence, and sensors will affect the workforce because we are in the early stages of the technology revolution. It is hard to be definitive about emerging trends because it is not clear how new technologies will affect various jobs.

But there are estimates of the likely impact of computerization on many occupations. Oxford University researchers Carl Frey and Michael Osborn claim that technology will transform many sectors of life. They studied 702 occupational groupings and found that “47 percent of U.S. workers have a high probability of seeing their jobs automated over the next 20 years.”³⁴

According to their analysis, telemarketers, title examiners, hand sewers, mathematical technicians, insurance underwriters, watch repairers, cargo agents, tax preparers, photographic process workers, new accounts clerks, library technicians, and data-entry specialists have a 99 percent of having their jobs computerized. At the other end of the spectrum, recreational therapists, mechanic supervisors, emergency management directors, mental health social workers, audiologists, occupational therapists, health care social workers, oral surgeons, supervisors of fire fighters, and dieticians have less than a one percent chance of having their tasks computerized. They base their analysis of improving levels of computerization, wage levels, and education required in different fields.³⁵

In addition, we know that fields such as health care and education have been slow to embrace the technology revolution, but are starting to embrace new models. Innovations in personalized learning and mobile health mean that many schools and hospitals are shifting from traditional to computerized service delivery. Educators are using massive, open, online courses (MOOCs) and tablet-based instruction, while health care providers are relying on medical sensors, electronic medical records, and machine learning to diagnose and evaluate health treatments.

Hospitals used to be staffed with people who personally delivered the bulk of medical treatment. But health providers now are storing information in electronic medical records and data sharing networks are connecting lab tests, clinical data, and administration information in order to promote greater efficiency. Patients surf the web for medical information and supplement professional advice with online resources. Both education and health care sectors are seeing the disruption that previously has transformed other fields.

Given the uncertainties surrounding job projections, it is not surprising that experts disagree over the impact of emerging technologies. For example, in their highly acclaimed book, “The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies,” economists Erik Brynjolfsson and Andrew McAfee argue that technology is producing major changes in the workforce. According to them, “technological progress is going to leave behind some people, perhaps even a lot of people, as it races ahead. As we’ll demonstrate, there’s never been a better time to be a worker with special skills or the right education because these people can use technology to create and capture value. However, there’s never been a worse time to be a worker with only ‘ordinary’ skills and abilities to offer, because computers, robots, and other digital technologies are acquiring these skills and abilities at an extraordinary rate.”³⁶

“[I]f current trends continue, it could well be that a generation from now a quarter of middle-aged men will be out of work at any given moment.” — Former U.S. Treasury Secretary Lawrence Summers

Former U.S. Treasury Secretary Lawrence Summers is equally pessimistic about the employment impact. He argues that “if current trends continue, it could well be that a generation from now a quarter of middle-aged men will be out of work at any given moment.” From his standpoint, “providing enough work” will be the major economic challenge facing the world.³⁷

However, some economists dispute these claims. They recognize that many jobs will be lost through technology improvements, but say that new ones will be created. There may be fewer people sorting items in a warehouse because machines can do that better than humans. But jobs analyzing big data, mining information, and managing data sharing networks will be created. According to those individuals, the job gains and losses will even out over the long run. In future decades, work will be transformed but humans still will be needed to manage the digital world.

For example, MIT economist David Autor has analyzed data on jobs and technology but “doubts that technology could account for such an abrupt change in total employment...The sudden slowdown in job creation is a big puzzle, but there’s not a lot of evidence it’s linked to computers.”³⁸ In the same vein, Harvard economist Richard Freeman is “skeptical that technology would change a wide range of business sectors fast enough to explain recent job numbers.”³⁹

Northwestern economist Robert Gordon takes an even stronger stance. He argues that “recent progress in computing and automation is less transformative than electrification, cars, and wireless communication, and perhaps even indoor plumbing. Previous advances that enabled people to communicate and travel rapidly over long distances may end up being more significant to society’s advancement than anything to come in the twenty-first century.”⁴⁰ Based on this reasoning, he does not anticipate dramatic workforce effects from emerging technologies, even though many other experts already see the substitution of technology for labor.

A Pew Research Center study asked 1,896 experts about the impact of emerging technologies. Its researchers found that “half of these experts (48 percent) envision a future in which robots and digital agents have displaced significant numbers of both blue- and white-collar workers—with many expressing concern that this will lead to vast increases in income inequality, masses of people who are effectively unemployable, and breakdowns in the social order.”⁴¹

Another Pew project looked at public opinion on technology and found considerable unease about emerging trends. Its national public opinion survey revealed that “65 percent think it would be a change for the worse if lifelike robots become the primary caregivers for the elderly and people in poor health.”⁴² In addition, people were sharply divided on the emerging technology of driverless cars. When asked whether they would ride in a driverless car, 48 percent said they would while 50 answered that they would not.

THE EFFECT ON VARIOUS DEMOGRAPHIC GROUPS

The technology trends discussed here do not play out equally across all demographic groups. There are differential impacts based on age, gender, income, race, and ethnicity. Certain individuals are more at risk than others from emerging technologies and their ramifications for the workforce. It is quite clear that those with few technical skills or specialty trades will face rough going in the future.⁴³

Young people, for example, face particular risks since they are at the beginning of their careers.⁴⁴ They are the ones whose job experiences almost certainly will be affected by robotics, machine learning, and artificial intelligence. Even though many of them have time to acquire relevant expertise, few are getting training in science, technology, engineering, and math (STEM) fields. This limits their ability to withstand employment alterations through the acquisition of scientific training. According to the U.S. Department of Education, there will be a 14 percent increase in STEM jobs between 2010 and 2020. However, “only 16 percent of American high school seniors are proficient in mathematics and interested in a STEM career.”⁴⁵

But job complications are not limited to young people. Women traditionally have entered positions that focus on caregiving. With the aging population and the shift of jobs towards health care, that would appear to insulate people employed in those areas from technological change. Yet digital technology is changing caregiving. Sensors and remote monitoring devices record vital signs and electronically transmit them to health care providers. Wearable technologies keep people in touch with friends and family members. The sick and infirm no longer require a human being to measure certain conditions, but can do so through “intelligent family care assistants” that track their health.⁴⁶

One study calculated that 11 million seniors live by themselves in America. A number of these individuals use “an emergency alert system for the elderly based on monitoring of their heart rates, breathing activities, and room temperature measurements. The device also allows the dependents to make on demand request for assistance.”⁴⁷

Racial minorities face dismal job opportunities even in the best of times. Owing to discrimination, prejudice, and lack of training, minorities and poor people already have high unemployment rates. And without high-skill training, it will be difficult for them to adapt to the new economy where advanced machines take their jobs.

In addition, their ability to get training in digital technology is limited by uneven access to computers and high-speed connectivity. An analysis of digital inequality shows that many of these individuals lack access to high-speed Internet, and this creates difficulties for them in education and employment.⁴⁸ They are less likely to own smartphones, have

access to the Internet at home, and get detailed instruction in computing and software. That limits their ability to adapt to the emerging realities of the 21st century workforce.

IMPLICATIONS FOR PUBLIC POLICY

In the classic Edward Bellamy book, “Looking Backwards,” protagonist Julian West wakes up from a 113 year slumber and finds that the United States in 2000 is completely different from 1887. People stop working at age 45 and devote their lives to mentoring other people and contributing to the overall sense of community.⁴⁹ There are shorter workweeks for ordinary people and everyone receives full benefits, food, and housing.

Similar to our time period, new technologies at that time enabled people to be very productive in a short period of time. Society did not need a large number of workers so people could devote much of their lives to education, volunteerism, and community development. In conjunction with these employment trends, public policy shifted to encourage new lifestyles and ways of living.

In flash forwarding to the current era, we may be on the verge of a similar technology transition. Robotics and machine learning have improved productivity and enhanced the overall economy of developed nations. Countries that have invested in innovation have seen tremendous growth in overall economic performance. In the future, it may be possible that society will not need as many workers as seen today.

Yet unlike Bellamy’s utopia, there has been little public discussion regarding the economic or policy impact of emerging technologies.

Observers worry that knowledge societies are destroying industrial and manufacturing jobs, and exacerbating social and economic divisions. In its most pointed form, skeptics fear that technology will eliminate jobs, reduce incomes, and create a permanent underclass of unemployable people. As argued by Nicolas Colin and Bruno Palier, “employment is becoming less routine, less steady, and generally less well remunerated. Social policy will therefore have to cover the needs of not just outside the labor market but even many inside it.”⁵⁰

If technology innovation allows businesses to provide goods and services with far fewer employees, what will that mean for workers? A significant increase in the number of people without full-time jobs would exacerbate divisions within society and complicate the distribution of benefits such as pensions, health care and insurance. Most benefits are tied to employment so if the economy requires fewer workers due to technological advancement, we need to consider how this will affect social benefit delivery.

In this section, I review short and long-term steps we should consider to deal with emerging technologies. This includes thinking about how to deliver benefits outside of jobs, considering a basic income guarantee, revamping the earned income tax credit, providing activity accounts for lifetime learning and job retraining, encouraging corporate profit-sharing, providing benefit credits for volunteerism, making curricular reforms to assure that students have

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the skills they need for a 21st century economy, encouraging adult education and continuing learning, expanding arts and culture for leisure time, and avoiding a permanent underclass suffering the ill effects of income inequality.

BENEFITS OUTSIDE OF JOBS

If we end up in a situation with many people are unemployed or underemployed for significant periods of time, we need a way to provide health care, disability, and pension benefits outside of employment. Called “flexicurity” or flexible security, this idea “separate(s) the provision of benefits from jobs.”⁵¹ It offers health care, education, and housing assistance on a universal basis.

Currently, people must work 60 percent of the time (around 24 hours a week) in order to qualify for fulltime benefits. When they are fully employed, they are eligible for company-sponsored health care plans and pensions. During the period since World War II, jobs have been a primary distribution system for social benefits. Except for the poor and elderly, this keeps benefits outside of the public sector and places the onus on private companies.

That approach worked well in an era when most of the people who wanted jobs were able to get them. People with limited skills were able to get well-paying jobs with benefits in factories, warehouses, and production facilities. They could educate their children, achieve a reasonable standard of living, and guard against disabling illnesses.

The complication came when the economy shifted, wages stagnated, and technology made it possible for companies to get by with fewer workers. The advent of robotics, machine learning, artificial intelligence, and machine-to-machine communications eliminated a number of jobs and put a number of people outside the typical workforce.

For health care, people need access to quality care through plans outside of employment. It is possible through commercial insurers to purchase catastrophic insurance for extraordinary health claims. Or if people are poor or elderly, there are government programs that guarantee access to medical care. The recent expansion of health insurance through the Affordable Care Act has extended insurance to millions of people who previously lacked coverage.

In regard to retirement planning, many employers have moved to 401-style pension plans. Employees contribute to their own funds and sometimes get a match from the employer. But this does not help those outside the workforce who need retirement assistance. Even Social Security is tied to employment. People who haven’t worked are not eligible for retirement benefits so we need to figure out ways to take care of those people in the newly emerging economy.

CONSIDERING A BASIC INCOME GUARANTEE

Given the possibility of persistent unemployment or underemployment, some have suggested it is time for a basic income guarantee. Economist Philippe Van Parijs proposes that we should “pay each citizen a basic income that would guarantee access to basic necessary goods.”⁵² That would help those with few employment prospects obtain basic subsistence without worry about homelessness or abject poverty.

Writer Ben Schiller argues that “a universal basic income is the bipartisan solution to poverty we’ve been waiting for.” He claims that with jobs disappearing to robotics and worker wages stagnating, governments should provide “a single payment that would give someone the chance to live reasonably.” He cites a Swiss referendum (that ultimately was rejected by voters) setting the amount at \$2,800 per month.⁵³

British economist Robert Skidelsky says it is time for a basic income guarantee. He argues that “as robots increasingly replace human labor, humans will need incomes to replace wages from work.” He claims that raising the minimum wage will not be effective because it will lower the cost differentials of labor versus machines, and therefore speed automation.⁵⁴

Critics of a basic income generally emphasize two reasons. First, they point out the value that work adds to human worth. Many people define a significant part of their self-esteem through their employment. Even though a large number report they are unhappy in their current position, jobs are vital to many people. Second, people worry about a lack of work incentives in an income guarantee. Proposals must be structured in a way that balances payments with work encouragement. Otherwise, people may stop working and do little to contribute to community goals.

Yet evidence from abroad shows that giving people basic money does not create dependency. According to Charles Kenny of the Center for Global Development, providing a social safety net “may help lift people up and out of poverty. Give poor people cash without conditions attached, and it turns out they use it to buy goods and services that improve their lives and increase their future earnings potential.”⁵⁵

To deal with dependency questions, a basic income could be tied to volunteer activities or work requirements. Derek Thompson cites the Works Progress Administration example from the 1930s of having “the government to pay people to do something, rather than nothing.”⁵⁶ He suggests the creation of a “national online marketplace of work” in which people could engage in projects that help the community. This could include tutoring, eldercare, childcare, disaster response, or arts and culture work. That would enable individuals to contribute to the broader society while earning a minimum income from the government.

REVAMPING THE EARNED INCOME TAX CREDIT (EITC)

In their book “The Second Machine Age,” Brynjolfsson and McAfee propose an expansion of the earned income tax credit as a way to provide income support while also giving people incentives to work.⁵⁷ As of 2014, the current policy offers a tax credit of up to \$6,143 for families with three or more children. As people make more money, the size of the credit drops and gets phased out completely at income levels ranging from \$40,000 to \$55,000, depending on marital status and number of children.⁵⁸

The goal of this proposal is to encourage people to work but make sure they have basic support for very low incomes. According to the Urban-Brookings Tax Policy Center, around 26 million households receive around \$60 billion in tax refunds or reduced taxes. Data suggest that this policy made it possible for 6.5 million people to rise out of poverty.⁵⁹

Law Professor Cass Sunstein supports the EITC. He claims if properly devised that it would “reduce poverty, boost employment, improve the health of infants and mothers, and increase the likelihood that people would graduate from college.”⁶⁰ Raising this credit by around eight percent would yield major returns, he says.

For the EITC to be effective during a time of high unemployment, it needs to be revamped. Right now, most are not eligible due to low-income limits. In addition, income transfers take place only once a year, at the time of tax filing and refunds. If large numbers of people have no jobs and little income, the EITC would need to be configured and applied to broader groups of people. Raising the income limit and making refunds and/or credits available on a monthly basis would be required for it to address large-scale employment dislocations.

PROVIDE ACTIVITY ACCOUNTS FOR LIFETIME LEARNING AND JOB RETRAINING

We should consider the establishment of activity accounts for lifetime learning and job retraining. In an era of fast technology innovation and job displacement, there needs to be a means for people to gain new skills throughout their adulthood. When people are employed, their companies could contribute a set amount to an individual's fund. This account could be augmented by contributions from the person him or herself as well as the government. Similar to a retirement account, money in the fund could be invested tax-free in investment options including cash reserves, stocks, and bonds. The owner of the account could draw on it to finance lifetime learning and job retraining expenses. It would be portable, meaning that if the person moved or switched jobs, the account would migrate with that individual.

The goal of this account is to provide incentives for continuing education. Under virtually any scenario, people are going to have to continue their education beyond the first 20 years of their lives. Emerging jobs are going to require different skills than what people gain in school. There will be new jobs created that may not exist today. As pointed out by Brookings Institution scholar Kemal Dervis, it will be crucial as technology innovation continues in the future to provide people with a means to upgrade their skills and knowledge levels.⁶¹ He notes that France has established "individual activity accounts" that provide social benefits.

With the expected increase in leisure time, adults need time and financial support for continued learning. We shouldn't envision education merely as a time for young people to learn new skills or pursue areas of interest. Instead, we need to think about education as a continuing activity that broadens people's horizons over the course of their entire lives. Education is an enrichment activity and we need to view it as a general benefit for the individual as well as the society as a whole.

INCENTIVES FOR VOLUNTEERISM

The trends cited in this analysis suggest that we need to consider income supplements or benefit eligibility through vehicles other than fulltime jobs. The workforce ramifications of emerging technologies means that many people in the future may not be able to provide for their families through regular employment.

One possibility comes through volunteer activities. Even if people have limited employment options, many participate in a wide range of public-minded organizations. They help other people, train the next generation, or provide assistance for the less fortunate in society.

A variety of survey evidence demonstrates that young people are particularly interested in volunteerism. In general, they have different attitudes towards work and leisure time, and many say they want time to pursue outside activities. For example, a survey of American students found that they want "a job that focuses on helping others and improving society." In addition, they value quality of life considerations, not just financial well-being.⁶²

A number of them value volunteer activities outside of their work experience. They have varied interests and want extra-curricular activities that fulfill them. This may involve tutoring in after-school programs, helping English as a second language pupils, stopping domestic violence, protecting the environment, or encouraging entrepreneurship. According to a Deloitte study, "63 percent of Millennials donate to charities and 43 percent actively volunteer or are a member of a community organization."⁶³

In a digital world where there may be less work and more leisure time, it makes sense to think about incentives and work credits for volunteerism. This could include credits towards social benefits or public rewards that acknowledge community contributions. In the United Kingdom, for example, volunteers get reimbursed for expenses or earn credits for job training programs through participation in worthy causes. In addition, volunteering counts as “looking for work” so people can use those activities to qualify for national insurance credits.⁶⁴

Going forward, the United States should consider those types of incentives. In the future, people are likely to have more time outside of employment so it makes sense to encourage them towards community engagement and give them incentives to volunteer for non-profit organizations or charitable causes. This will benefit the overall community and give people purposeful activities in which to engage.

ENCOURAGE CORPORATE PROFIT-SHARING

In an analysis of the American economy, Brookings scholars William Galston and Elaine Kamarck note several problems that have harmed working wages and overall prosperity. This includes rising inequality, a shrinking middle class, a wedge between productivity and compensation, business investment, and what they call the “excessive financialization of the U.S. economy.”⁶⁵ They also note problems related to stock buybacks, executive compensation, the fixation on quarterly earnings, and the rise of activist investors.

Their critique dovetails with the concern of this paper over the impact of emerging technologies on employment possibilities. If robotics and machine learning are going to take many existing jobs and create employment difficulties for people without advanced technical skills, there is a looming crisis for society as a whole. The combination of short- and long-term economic problems suggests that we need to think about how to deliver social benefits and make sure large numbers of people are not left behind permanently.

One longer-term option is to encourage corporate profit-sharing, both for full and part-time people. A challenge of the current situation is how to provide financial support for people if few workers are needed to provide necessary goods and services. Profit-sharing represents a way to spread the benefits of improved productivity to a broader group of people. According to certain formulations, companies could provide up to \$5,000 in shared profits for employees making at least \$50,000/year.⁶⁶ This would improve worker wages and share more corporate profits. It won't address the problems of people without jobs, but it would encourage greater equity among a larger cross-section of the population.

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CURRICULAR REFORM

In today's world, it is important that schools don't train students for jobs that won't exist in the future. Economist Andrew McAfee argues that “our education system is in need of an overhaul. It is frustrating that our primary education

system is doing a pretty good job at turning out the kinds of workers we needed 50 years ago. Basic skills, the ability to follow instructions, execute defined tasks with some level of consistency and reliability.”⁶⁷

What is needed, he said, are people who can do “things like negotiate, provide loving and compassionate care, motivate a team of people, design a great experience, realize what people want or need, [and] figure out the next problem to work on and how to solve it.”⁶⁸

A study of the future of work in the United Kingdom found that there is a “shrinking middle” in the workforce that requires retraining. “People moving in and out of learning will continue. In particular, when people develop portfolio careers, they need to be able to convert their qualifications or build upon the ones they have. Education has to come up with the right package to solve these new demands.”⁶⁹

With the fast pace of technological change and the development of new kinds of positions in data analytics or software coding, educational institutions that focus on traditional curricula are not providing young people with the skills needed in the 21st century economy. There has to be a close alignment of curricula and skills needed in the workforce.

Vocational education and training systems are bringing students closer to the current needs of the labor market. This will help young people have a smooth transition to jobs. They will show up with the particular skills that are needed and be in a position to make contributions right away.

Many programs are focusing on collaboration and teamwork, not competition. Many contemporary positions involve working together as part of teams so it is vital that people learn those skills. In addition, it is crucial that people understand how to think critically and communicate their ideas to other people. If educational programs provide these types of skills, it will help students in an era of extensive digital innovation.

EXPANDING ARTS AND CULTURE FOR LEISURE TIME

The so-called “end of work” may create a new kind of economy. According to Harvard economist Lawrence Katz, “it’s possible that information technology and robots [will] eliminate traditional jobs and make possible a new artisanal economy ... an economy geared around self-expression, where people would do artistic things with their time.”⁷⁰ From his standpoint, this transition would move the world from one of consumption to creativity.

People will use their leisure time to pursue interests in arts and culture, or special areas that they follow. This could include reading, poetry, music, or woodworking. Depending on their background, they could have more time for family and friends. A study of family time found that macroeconomic conditions affect how much time people spend together. When employment problems rise, “fathers spend more time engaging in enriching childcare activities” and “mothers are less likely to work standard hours.”⁷¹ As long as there are opportunities for people to pursue broader interests, reduction in work does not have to eliminate chances for cultural pursuits.

NEXT STEPS

To summarize, advanced societies are at a major turning point in terms of how we think about work, leisure, and social benefit delivery. If advanced economies need fewer workers to complete needed tasks, and benefits are

delivered mainly through full-time jobs, there is a danger that many people will have difficulties getting health care, pensions, and the income maintenance they need to sustain their lives. This is of particular concern at a time of large income inequality and highly skewed economic distributions.⁷²

The contrast between the age of scarcity in which we have lived and the upcoming age of abundance through new technologies means that we need to pay attention to the social contract. We need to rewrite it in keeping with the dramatic shifts in employment and leisure time that are taking place. People have to understand we are witnessing a fundamental interruption of the current cycle where people are paid for their work and spend their money on goods and services. When a considerable portion of human labor no longer is necessary to run the economy, we have to rethink income generation, employment, and public policy. Our emerging economic system means we will not need all the workers that we have. New technologies will make these individuals obsolete and unemployable.

There needs to be ways for people to live fulfilling lives even if society needs relatively few workers. We need to think about ways to address these issues before we have a permanent underclass of unemployed individuals.

In this situation, it is important to address the policy and leisure time issues raised by persistent unemployment or underemployment. There is a danger of disruptions and unrest from large group of people who are not working. That creates poverty and social dissatisfaction and runs the risk of instability for the society as a whole. Stability cannot be enforced through a police presence or having wealthy individuals live in gated communities.

There needs to be ways for people to live fulfilling lives even if society needs relatively few workers. We need to think about ways to address these issues before we have a permanent underclass of unemployed individuals. This includes a series of next steps for society. There needs to be continuous learning avenues, opportunities for arts and culture, and mechanisms to supplement incomes and benefits other than through fulltime jobs. Policies that encourage volunteerism and reward those who contribute to worthy causes make sense from the standpoint of society as a whole. Adoption of these steps will help people adapt to the new economic realities.

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