U.S. Metro Economies

Technology and the Future Labor Market

EXECUTIVE SUMMARY

The national unemployment rate has dipped below 4 percent for the first time in almost 20 years. While various sectors and regions of the country are confronting significant labor shortages, a longer-term issue may cause severe labor dislocations— a mismatch between required job skills in the context of disruptive technological changes and the available supply of those skills. This could cause unemployment rates to rise across broad classes of workers and lead to increased wage inequality over the next couple of decades.

The attached review of the literature does not provide an unambiguous profile of the nature of technological change and what changes the economy will confront in the future. The major issue relates to the nature of technology and its effect on the labor market. Some technologies—enabling technologies—will augment different types of labor, thus increasing the demand for labor and resulting in higher wages. However, other technologies—replacing technologies—can reduce the demand for labor, particularly low skill labor, and lead to reductions in wages. Those who have skills in high demand will benefit in terms of wage growth, while others will not.

While some economists point to market forces that have worked to reallocate resources and labor into occupations that require high skill capabilities, there is the risk that segments of the population will be left behind. This risk may increase if changes in technology outpace the availability of required skills in the labor force needed to accommodate these changes. What may happen, and this is specifically emphasized by economists, is heightened income inequality, as those with the necessary skill sets are able to command premium wages relative to those in the middle and lower income tiers. New technologies with job displacing impacts may even occur for occupations such as law, financial services, and medicine. However, it is also important to note that thanks to technological advancements, jobs such as Uber driver, data scientist, cloud services specialist, Youtube content creator, Twitter developer, Airbnb host, Instagram influencer, and social media managers have now come into existence. During the transition period, where the economy adjusts to the demise of one industry that gives rise to another, there are winners and losers. Policymakers need to be aware of this, and be prepared to offer viable solutions to displaced workers so that they acquire the necessary tools and training to adapt to new occupations and new industries.

There is an array of estimates in terms of labor replacements across various industries. For example, the Pew Research Center has estimated that at the high end, 42 percent of jobs in the hospitality sector will be replaced and 41 percent of restaurant jobs will be replaced. McKinsey has estimated that 45 percent of US workers are at risk of losing their jobs due to automation. Robotics in selected manufacturing sectors have been in place for decades and has clearly resulted in labor saving and a corresponding reduction in jobs. A prime example is in the automotive sector. One researcher from MIT has estimated that every new robot will place three workers. However, no forecast of additional robots in the workplace has been generated to date.

On the other hand, automation has occurred in some sectors such as banking where the conventional wisdom of dramatic loss of jobs did not materialize. For example, the advent of ATM machines did replace many of the tasks performed by bank tellers, but this allowed a change in roles in terms of providing more one-on-one services to customers. In fact, some banks have eliminated bank tellers altogether but significantly increased the number of loan officers and others providing financial advice. Thus, any discussion of labor displacement technologies must be weighed against the inevitable creation of new functions that can easily be handled by workers whose tasks have been displaced. Therefore, the net displacement of workers needs to be analyzed in assessing the future impact of technological changes.

The fear that has arisen from the rise in automation, robotics, artificial intelligence, and digitization of a number of processes is centered on jobs that involve backroom routinized tasks that can be more easily replaced by the new technologies. Furthermore, these jobs are typically low skill and low income in nature, often undertaken by individuals without a High School or GED diploma. The list of industries where jobs may be at risk includes the following:

- Manufacturing plants
- Warehousing
- Construction
- Machine operation
- Telemarketing
- Food preparation and serving
- Automotive sector
- Agricultural work
- Security services
- Transportation and delivery

It is true that historically the economy has undergone significant transformations. For example, from a primarily agricultural economy in the late 1800s, to an industrial economy by the 1930s. There was short-term pain not mitigated by any government policies. When technological change occurred, transitions were often difficult and it was impossible to know its impact on labor markets at the onset. A prominent example is the invention of automobiles, which displaced many workers in the equine industry. An untold number of carriage and wagon makers, carriage drivers, blacksmiths, harness/saddle makers, footmen, hay growers, equine veterinarians, horse trainers, and stable keeps lost their livelihoods. However, new jobs came into being as drivers, valets, car salespersons, auto mechanics and engineers, metalworkers, automotive instructors, car detailers, and tire technicians. There was a long and difficult transition to remove horses from urban life and rural farms, which took more than 50 years.

While we must tread with care in reaching any firm conclusions on the pace of technological progress, and the rate at which jobs are displaced, there are some strategies that policymakers may adopt to provide a "hedge" against the possibility of job dislocations due to automation. These could include the following:

- Generic types of adaptive training that facilitate occupational mobility.

- More emphasis on the provision of science, technology, engineering, and mathematics (STEM) type courses in school curricula. Incentives with regard to this type of training at the Postsecondary level, possibly even at the Associate degree level.

- Informational outreach efforts designed to provide opportunities for those in the workforce to improve technical skills even before any issues arise with respect to job displacing technologies.

- Other initiatives that provide more basic training and support for individuals who have worked in jobs that only require a series of repetitive tasks that may be replaced by computer assisted technologies in the future. This could include "soft skills" such as communication, teamwork, and punctuality.

- Barriers for entrepreneurs, such as bureaucratic and time-consuming licensing requirements, could be eased to facilitate job creation. For example, contractors and plumbers in some states need to comply with more than 20 licensing requirements in order to conduct business. If, for instance, states located within the same region were to agree on a standard set of licensing requirements, this would ease the burden of small business entrepreneurs.

Policies to address these future workforce issues will confront challenges—they will need to be flexible in order to meet unanticipated changes in the market that may require course corrections. Further, those policies will need to address job displacement not only at the lower end of the income distribution, but very much in the middle, where some technologies may end up replacing middle managers and other job functions with compensation residing in the median tier of the income distribution.

THE IMPACT OF TECHNOLOGY ON LABOR MARKETS

Technology – can't live with it; can't live without it. It has enabled humankind to achieve a vast array of marvelous feats such as landing on the moon and performing complex surgeries, to the more mundane aspects of life such as swiping on Tinder. Great strides have been made, for example, in the telecommunication sector, where prior to the inventions of faster networks and smart phones, "Apple" was just a fruit, and "going viral" likely meant a trip to the doctor's office. Technology has enriched our lives in ways that were inconceivable a few decades ago – but what cost have we paid as a society?

The battle between man and machines goes back centuries. Are they taking our jobs, or are they merely easing our workload? IHS Markit analyzed the impact technology has had on the labor market in the United States. Economists do not agree on technology's impact on employment rates. A few decades ago, some stated that technology enabled labor

(labor saving technologies), thereby increasing the value of both labor and machines. More recently, others have ominously predicted that jobs lost to computers and robots are never coming back (labor replacing technologies). Another school of thought posits that while computers have replaced humans in some occupations, they have given rise to completely new industries and occupations that were nonexistent a few decades ago. This last group argues that the impact on total employment has been negligible or even net positive.

LITERATURE REVIEW

A study conducted by Carl Benedikt Frey and Michael Osborne of Oxford University in 2013 studied how easily 702 occupations in the US could be automated – aided by a machine-learning algorithm. They concluded that approximately 47 percent could be completely executed by machines over the next decade or two. A working paper by the Organization for Economic Cooperation and Development (OECD) assesses the "automatability" of each task in a given job, based on a survey of skills in 2015. The study finds that 14 percent of jobs across 32 countries are highly vulnerable (70 percent chance of automation), and a further 32 percent were slightly less imperiled (probability of automation between 50 and 70 percent). At current employment rates, that is 210 million jobs at risk across the 32 countries in the study.

A recent report by McKinsey applies Frey and Osborne's methodology somewhat differently but arrives at similar conclusions: 45 percent of US workers are at risk of losing their jobs in the face of automation in the 2020s. They focus on 46 countries representing about 80 percent of the global workforce, and have examined more than 2,000 work activities and quantified the technical feasibility of automating each of them. The proportion of jobs that can be fully automated by adapting currently demonstrated technology is less than 5 percent—although for middle-skill categories that share could rise to 15 to 20 percent. An additional important finding is that even if whole jobs are not automated, partial automation (where only some activities that make up a job are automated) will impact almost all jobs to a greater or lesser degree, not just factory workers and clerks, but landscape gardeners, dental lab technicians, fashion designers, insurance sales representatives, and also CEOs. They find that about 60 percent of all jobs have at least 30 percent of activities that are technically automatable, based on technologies available today.

Probability of automation	Occupation
0.0035	Healthcare Social Workers
0.017	Chemical Engineers
0.027	Chiropractors
0.035	Computer and Information Systems Managers
0.16	General and Operations Managers
0.21	Information Security Analysts, Web Developers, and Computer Network Architects
0.3	Medical Assistants
0.4	Judges, Magistrate Judges, and Magistrates
0.48	Computer Programmers
0.52	Architectural and Civil Drafters
0.63	Construction and Building Inspectors
0.72	Carpenters
0.82	Engine and Other Machine Assemblers
0.87	Food Preparation Workers
0.93	Industrial Truck and Tractor Operators
0.94	Accountants and Auditors
0.96	Receptionists and Information Clerks
0.96	Compensation and Benefits Managers
0.98	Loan Officers
0.99	Data Entry Keyers

Source: Frey and Osborne (2013), probability of automation for select occupations

A feasibility study by the World Bank which goes even further, finds that 57 percent of jobs in OECD countries could be automated, and wither away over the course of the next two decades. However, there are reasons to be wary of these conclusions. First, it is extremely difficult to estimate which jobs can be fully automated. Another study utilizing the same broad methodology, Arntz, Gregory, and Zierahn (2016), reaches a very different conclusion because it maintains that within an occupation, many workers specialize in tasks that cannot be automated easily. Their conclusion is that once this type of specialization is taken into account only about 9 percent of jobs in OECD countries are at risk.

Estimated share of occupations displaced by automation in the United States
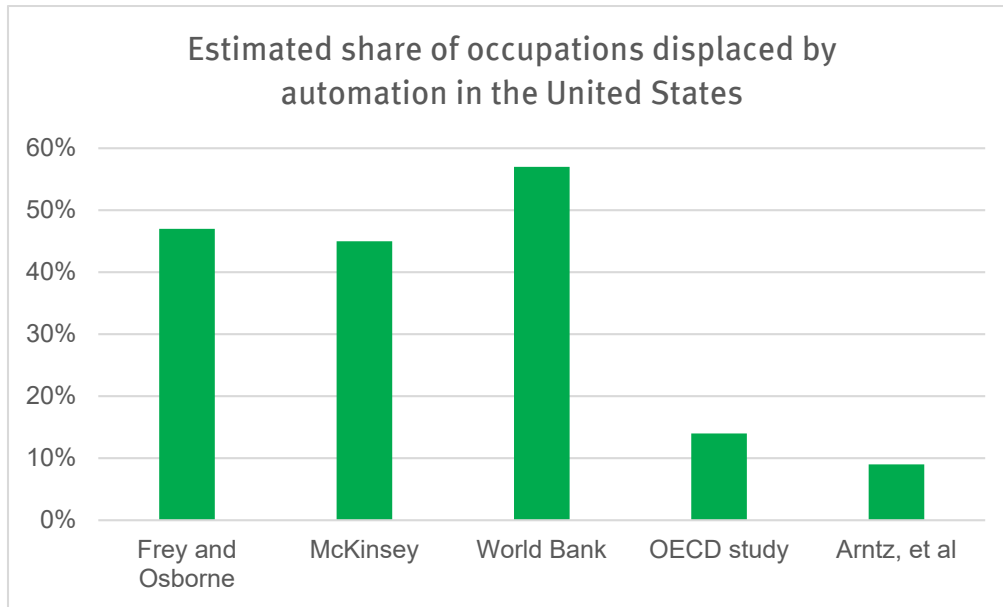
ACADEMIC LITERATURE

Daron Acemoglu, a professor of economics at MIT, posits that there are some critical limitations of current frameworks used to estimate the impact of automation on wages and inequality. Under what he calls the "enabling technology view", new technologies will help certain types of workers more than others, and thus could impact inequality. An important implication of this framework is that the productivity of and the demand for high-skill workers rather than low-skill workers increases more rapidly over time, increasing the wage premium of high-skill workers. This tendency is then counterbalanced by an increase in the supply of high-skill workers. Consequently, skill premia and wage inequality increase when technology changes faster than the supply of skills, and contracts when supply outpaces technology.

Acemoglu posits that while this framework has been useful in interpreting broad trends in the labor market, it has at least three limitations. First, despite its early success in accounting for changes in the college premium (average earnings of college-graduate workers relative to high school graduates), this framework has done much less well in recent times. Second, it implies that any improvement in technology should lead to higher wages for all types of workers. However, wage declines for low-education workers have been the norm, not the exception, over the past 30 years in the US. The inability of this conical framework to account for the pervasive phenomenon of declining real wages of certain groups of workers is one of its most jarring shortcomings. Thirdly, a more detailed look at the distribution of wages shows that there are richer dynamics that are not explained by this framework where inequality is created by the changing rewards to a single, well-defined type of skill. Wages at the bottom, median, and the top move differently over time. Most notably, we do not see an opening of the gap between median and bottom wages. Rather, following a period of sharp falls at the bottom of the wage distribution, there is an extended period from the mid-1980s to the mid-1990s where

wages at the bottom increased more rapidly than wages in the middle of the distribution. Moreover, this phenomenon is not just isolated to the US. The middle-paying occupations have contracted in every European country between 1993 and 2006, strongly suggesting that the employment patterns are due to common technological trends rather than idiosyncratic factors in the US.

Acemoglu suggests an alternative framework where new technologies explicitly replace labor in some tasks. In practice, some technologies will enable humans, such as computer-assisted design technologies, while others will replace workers. According to Acemoglu, many of the new technologies transforming the labor market are not of the enabling type but clearly replacing and displacing labor, and this has far-reaching consequences. Various computer-based automation technologies such as automated teller machines, computerized inventory control, and mail sorting machines are examples of replacing technologies. Most major replacing technologies that have already started spreading in the economy are industrial robots, which take over tasks previously performed by semi-skilled industrial workers (such as in the automotive sector), and artificial intelligence, which will most likely replace workers in many skilled occupations ranging from paralegals to accountants and even some middle managers.

Enabling technologies, which augment different types of labor, increase the demand for both factors of production, while replacing technologies can reduce wages. If new technologies replace tasks in the middle of the pay distribution, they will cause a polarization in employment. Intuitively, these new technologies will take away the middle paying occupations, and thus the overall wage distribution will have a smaller, 'hollowed' middle, causing wage polarization. As workers dislocated by technology from the middle of the pay distribution will compete with others, changes in employment structure may be divorced from wage growth patterns.

David Rotman from the MIT Technology Review, concurs with Acemoglu that while many workers in middle-paying occupations have now been replaced by computers, they have also aided high-paying jobs that require creativity and problem-solving skills. He notes that, interestingly, employment of low-skill occupations also proliferated during the same period. Demand has increased for restaurant workers, janitors, home health aides, and others doing work that is nearly impossible to automate. Economists have observed this phenomenon in almost all industrialized countries over the past few decades. This is not to say that technology has contracted the total number of jobs—rather, the composition of occupations has simply changed without significant changes in employment rates.

In a 2016 study, Brynjolfsson and McAfee from MIT posit that computer technology—from industrial robotics to automated translation services—are largely the cause of sluggish employment growth. The authors foresee dismal prospects for many types of jobs as technologies are increasingly adopted not only in manufacturing, clerical, and retail work, but also in professions such as law, financial services, education, and medicine. They believe that rapid technological change has been destroying jobs faster than it is creating them, contributing to the stagnation of median income and the growth of inequality in the

US and other industrialized nations. Their strongest evidence is the "decoupling" between productivity and total employment in the US.

DECOUPLING AND THE AUTONOMOUS ECONOMY

Productivity—defined as the amount of economic value created for a given unit of input, such as an hour of labor—is a crucial indicator of growth and wealth creation. Brynjolfsson and McAfee show that in the years after World War II, the two lines closely tracked each other, with increases in jobs corresponding to increases in productivity. As businesses generated more value from their workers, the country as a whole became richer, resulting in a virtuous cycle where more economic activity created even more jobs. Then, beginning in 2000, the lines diverge; productivity continues to rise robustly, but employment suddenly wilts. By 2011, a significant gap appears between the two lines, showing economic growth with no parallel increase in job creation. The authors call it the "great decoupling," and are confident that technology is behind both the healthy growth in productivity and the weak growth in jobs. It should be noted though that economists do not agree on the measurement of productivity, and many argue that productivity growth has slowed down considerably since 2010-11.

US Productivity and Employment

Source: Bureau of Labor Statistics, Office of Productivity and Technology
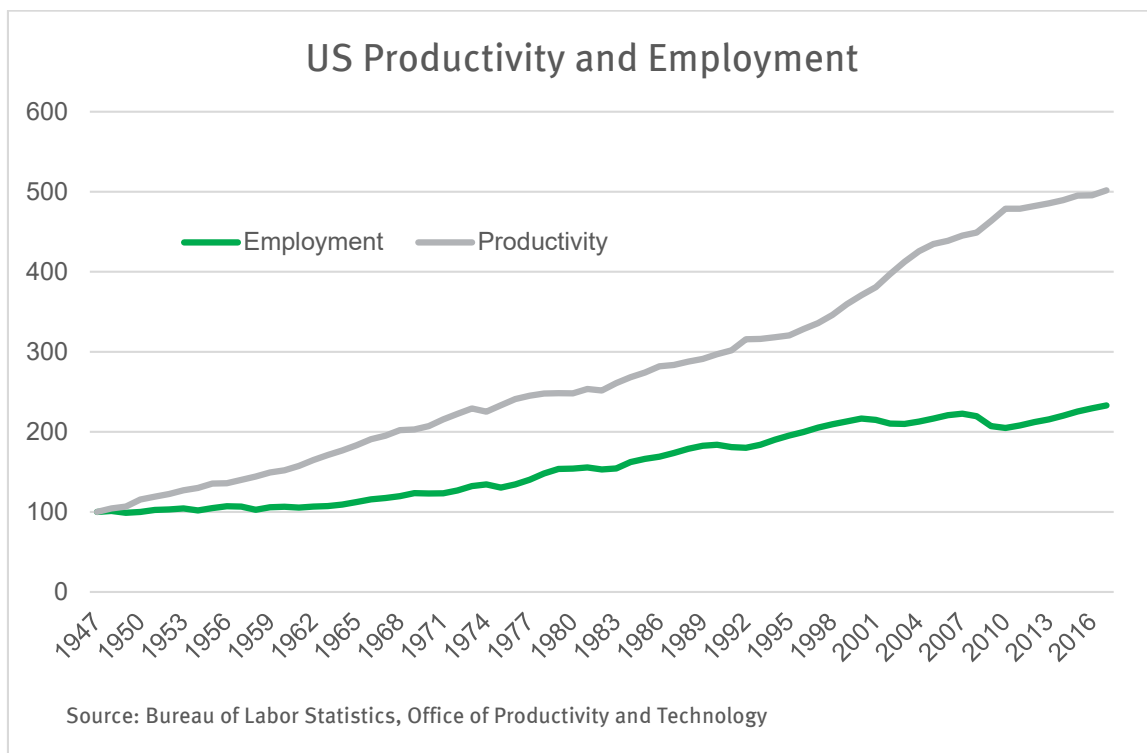
Brynjolfsson and McAfee point to additional evidence that median income is failing to rise even as the gross domestic product soars. It is a great paradox where innovation has never been faster, and simultaneously median income is falling, and we have fewer jobs. People are falling behind because technology is advancing so fast and our skills and organizations are not keeping up. Anecdotal evidence is plenty. Robots and advanced

automation have been common in many types of manufacturing for decades. In the United States and China—the world's manufacturing powerhouses—fewer people work in manufacturing today than in 1997, thanks in part to automation. The website of a Silicon Valley startup called Industrial Perception features a video of a robot it has designed for use in warehouses to pick up and throw boxes. Google's driverless car suggests what automation might be able to accomplish someday in the near future.

Brynjolfsson and McAfee point out that a less dramatic change, but one with a potentially far larger impact on employment, is taking place in clerical work and professional services. Technologies like the Web, artificial intelligence, big data, and improved analytics—all made possible by the ever-increasing availability of cheap computing power and storage capacity—are automating many routine tasks. Countless traditional white-collar jobs, such as many in the post office and in customer service, have disappeared. W. Brian Arthur, a visiting researcher at the Xerox Palo Alto Research Center's intelligence systems lab and a former economics professor at Stanford University, calls it the "autonomous economy." It is far more subtle than the idea of robots and automation doing human jobs. He states that it involves "digital processes talking to other digital processes and creating new processes," enabling us to do many things with fewer people and making human jobs obsolete. According to Arthur, this onslaught of digital processes primarily explains how productivity has grown without a significant increase in human labor. He warns, "It will change every profession in ways we have barely seen yet."

ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) refers to machines that respond to simulation consistent with traditional responses from humans, given the human capacity for contemplation, judgment, and intention (West, 2018). When particular conditions are met, the algorithm takes actions given possibilities set up by software developers. Artificial intelligence is now being incorporated into finance, transportation, defense, resource management, and elsewhere.

Artificial intelligence plays a substantial role in national defense. The military deploys AI to sift through massive troves of data and video captured by surveillance and then alert human analysts of patterns or when there is suspicious activity. Other public sector agencies are also using AI to improve service delivery. For example, the Cincinnati Fire Department is using data analytics to optimize medical emergency responses. The analytics system recommends to the dispatcher an appropriate response to a medical emergency call by taking into account factors such as the type of call, location, and weather. Rather than address service issues in an ad hoc manner, authorities are being proactive in how they provide urban services.

A Chicago-based Baker and Hostetler law firm has announced its first AI-based bankruptcy legal assistant. It uses IBM's Watson computer to read and understand language, postulate hypotheses, when asked questions, research, and then generate responses,

along with references and citations, to back up conclusions. This capability will undoubtedly have an impact on the jobs of paralegals in the near future.

The part of machine learning that is concerned with broader data representation rather than with specific tasks is known as deep learning. Deep learning systems are being applied in areas such as transportation, agriculture, genetics, and healthcare. One area that is seeing considerable growth is in financial technology. Decisions about loans are now being made by software than can take into account a variety of finely parsed data about a borrower, rather than just a credit score and a background check. This has led some experts to predict large job losses in the financial services industry. Antony Jenkins, a former CEO of Barclays, states, "The number of branches and people employed in the financial services sector may decline by as much as 50 percent." Rishi Ganti of Orthogon Partners Investment Management who uses automated trading software believes that "about 2 percent to 7 percent of the hedge fund industry's $3 trillion of assets will jump every year from predominantly human oversight to computers." This will have far-reaching consequences in the financial services sector, which currently employs more than 8 million workers.

In stock exchanges, high frequency trading machines have replaced much of 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 on a very small scale and execute trades that make money according to investor instructions. In addition, some specialized applications are used in arbitrage trading, where algorithms are activated based on slight differences in market values. Humans are not very efficient at spotting these types of price differentials but computers are able to use complex mathematical formulas to identify trading opportunities.

Merantix is a German company that applies deep learning to medical issues. It has an application in medical imaging that detects lymph nodes in the human body in Computer Tomography images. Humans can perform these tasks but radiologists charge upwards of $100 per hour and may be able to read about four images an hour. Deep learning can train computers on data sets to identify lymph nodes with irregularities. It is only a matter of time before this practice would be adopted in the US as well.

In the transportation sector, autonomous drones are currently being tested for home delivery. For example, 80 to 90 percent of packages delivered by Amazon weigh 5 pounds or less, making drones an ideal mode of delivery. The e-commerce giant envisions flying drones below 400 feet to bring lightweight items to a customer's front door or backyard. It is already using drone delivery in the UK and plans to expand this service to other countries. This will have enormous implications for those involved in the transportation and delivery of goods.

A NEW ERA?

At least since the Industrial Revolution began in the 1700s, improvements in technology have changed the nature of work and destroyed some types of jobs in the process. In 1900, 41 percent of Americans worked in agriculture; by 2000, it was only 2 percent. Likewise, the proportion of Americans employed in manufacturing has dropped from 30 percent in the post–World War II years to around 10 percent today. While such changes can be painful for workers whose skills no longer match the needs of employers, Lawrence Katz, a Harvard economist, says that no historical pattern shows these shifts leading to a net decrease in jobs over an extended period.

Katz has done extensive research on how technological advances have affected jobs over the last few centuries—describing, for example, how highly skilled artisans in the mid-19th century were displaced by lower-skilled workers in factories. While it can take decades for workers to acquire the expertise needed for new types of employment, he says, "we never have run out of jobs. There is no long-term trend of eliminating work for people. Over the long term, employment rates are fairly stable. People have always been able to create new jobs. People come up with new things to do." Still, Katz does not dismiss the notion that there is something different about today's digital technologies— something that could affect an even broader range of work. The question, he says, is whether economic history will serve as a useful guide.

A recent study by Deloitte seeks to shed new light on the relationship between jobs and the rise of technology by trawling through Census data for England and Wales going back to 1871. Their conclusion is unremittingly cheerful: rather than destroying jobs, technology has been a "great job-creating machine." Their findings such as a fourfold rise in bar staff since the 1950s or a surge in the number of hairdressers this century suggest that technology has increased spending power, thereby creating new demand and new jobs.

FACING EMPLOYMENT CHALLENGES OF THE FUTURE

Brynjolfsson himself says he is not ready to conclude that economic progress and employment have diverged for good. He suggests, the outcome will depend on recognizing the problem and taking steps such as investing more in the training and education of workers. "I used to say that if we took care of productivity, everything else would take care of itself; it was the single most important economic statistic. But that's no longer true." He adds, "It's one of the dirty secrets of economics: technology progress does grow the economy and create wealth, but there is no economic law that says everyone will benefit." In the race against the machine, some are likely to win while others lose. The question then is, what can workers do to keep their skills from becoming obsolete in the workplace?

Educational systems have not kept pace with the changing nature of work, resulting in many employers saying they cannot find enough workers with the skills they need.

In a McKinsey survey of young people and employers in nine countries, 40 percent of employers said lack of skills was the main reason for entry-level job vacancies. Sixty percent said that new graduates were not adequately prepared for the world of work. There were gaps in technical skills such as STEM (science, technology, engineering, and mathematics) subject degrees, but also soft skills such as communication, teamwork, and punctuality. Conversely, even those in work may not be realizing their potential. In a recent global survey of job seekers conducted by LinkedIn, 37 percent of respondents said their current job does not fully utilize their skills or provide sufficient challenge.

Darrell West, an economist at the Brookings Institution, questions that if companies need fewer workers as a result of automation and robotics, but most societal benefits are delivered through full-time jobs, how are people outside the workforce for a lengthy period of time going to get income, healthcare, and retirement pensions? It is important to rethink work and move toward lifetime learning so that people are trained for a world of dislocation. Unless there are innovative service delivery models, there may arise a large and permanent underclass that does not receive job benefits that is trapped in poverty.

WORLD ECONOMIC FORUM'S INITIATIVE

The World Economic Forum (WEF) has embarked on a *Closing the Skills Gap* project as a part of their *Shaping the Future of Education, Gender and Work System* initiative. Their goal is to serve as a platform to gather business commitments that address future-oriented skills development, while at the same time supporting constructive public-private dialogue on urgent and fundamental reform of education systems and labor policies to prepare workforces for the future of jobs. The project aims to gather commitments from these leading businesses resulting in skilling, upskilling and reskilling for at least 5 million by January 2020.
WEF defines upskilling as "short-term, targeted training typically provided following initial education or training, and aimed at supplementing, improving or updating knowledge, skills and/or competences acquired during previous training." Reskilling involves training workers to acquire new skills that give access either to a new occupation or to new professional activities.

They are executing a three-pronged approach to create global and national platforms:

1. Country implementation deep-dives: Various task forces bring together leaders from business, government, civil society, and education and training sectors to accelerate reskilling and upskilling efforts in the current workforce and the "future-proofing" of national education and training systems.

2. Global and regional knowledge exchange: An informal alliance provides an exclusive global platform for leaders and experts from business, government, civil society, and the education and training sectors to build consensus, share ideas, and identify preferred models and best practices.

3. Global business commitments: As a first step, a Forum is consolidating global business commitments with the goal to reach 10 million people by January 2020.

One example of the WEF's involvement in the higher education arena is the *JP Morgan Chase New Skills for Youth* program, which focuses on the development and implementation of career-focused education programs that increase the number of students who earn meaningful postsecondary credentials that are tied to high-wage, high-demand jobs. Another example geared toward adults is the *HP Learning Initiative for Entrepreneurs* (HP LIFE). It is a free online training program that enables students, teachers and entrepreneurs to gain business and IT skills. Twenty-five courses are available in seven languages, covering the key business areas of finance, marketing, operations, communication, and special topics such as social entrepreneurship, energy efficiency, effective leadership and strategic planning.

APPALACHIAN REGIONAL COMMISSION'S INITIATIVE

TechHire Eastern Kentucky (TEKY) is a great example of a public-private venture which reskills unemployed coal miners in Eastern Kentucky with computer coding skills so that they may find meaningful work. This venture funded by the Appalachian Regional Commission (ARC) has created or retained 100,000 new jobs in the past five years. One of the successes of the partnership was Louisville-based tech firm, Interapt, started by native Kentuckian, Ankur Gopal. TEKY teaches people in rural Kentucky tech skills, such as how to code, so that they can stay in their towns and still have future-proof jobs. "We've seen people already move off of food stamps because of this program," Gopal said in an interview. "We've seen people improve their health, improve their lifestyle. So we're seeing a ripple effect occur by the work we're doing."

OTHER FINDINGS

McKinsey also expounds the benefit of digital talent platforms that have the potential to improve matching workers and jobs, creating transparency and efficiency in labor markets. With their powerful search capabilities and sophisticated screening algorithms, online talent platforms such as LinkedIn, Indeed, and Monster can speed the hiring process and cut the time individuals spend searching between jobs, reducing unemployment. By aggregating data on candidates and job openings across entire countries or regions, they may address some geographic mismatches and enable matches that otherwise would not occur.

In emerging economies, self-employment is still the predominant form of work. The modern 9-to-5 job that dates back to the Industrial Revolution is being challenged by technology-enabled independent work (such as Uber and Etsy). McKinsey reports that 20 to 30 percent of the working age population in the United States and the European Union is engaged in independent work. Just over half of these workers supplement their income and have traditional jobs, or are students, retirees, or caregivers. While those who pursue

independent work (digitally enabled or not) out of preference are generally satisfied; those who pursue it out of necessity are unsatisfied with the income variability and the lack of benefits typically associated with traditional work. Policy makers and innovators will need to grapple with solutions to these challenges.

One recommendation from the McKinsey report is for policy makers to create incentives for private sector investments to treat human capital as they treat other types of capital. Through tax benefits and other incentives, companies could be encouraged to invest in workers. In addition, as work evolves at higher rates of change between sectors, activities, and skill requirements, many will need assistance in adjusting and adapting their skills to meet new demands.

Among workers, the least educated face the highest risk of losing their jobs to automation—especially those with High School degrees (or GEDs) or less. The OECD reports that automation is found to mainly affect jobs in the manufacturing industry and agriculture, although a number of service sectors, such as postal and courier services, land transport, and food services are also found to be highly automatable. Occupations with the highest estimated automatability typically only require basic to low level of education. At the other end of the spectrum, the least automatable occupations almost all require professional training and/or tertiary education. However, the answer to increased employability does not necessarily lie in obtaining a four-year college degree.

The benefits of obtaining a traditional four-year degree have arguably decreased, thus reducing the college premium in wages. In recent years, a number of vocational training, technical colleges, adult learning centers, and training institutes have sprung up in response. However, the benefits of such programs are not created equally—many programs do not have any type of accreditation. The vast majority of these institutions operate for-profit, and are accountable to their investors, rather than the students. There have been countless reports of students taking out thousands of dollars in loans to obtain a degree from these institutions, only to learn that their diplomas are almost worthless in the labor market. Policymakers have an opportunity to not only regulate these for-profit institutions, but partner with the private sector to make consumers, i.e. the students, more aware of their choices when selecting a higher education program.

CONCLUSION

Technological change is here to stay, and it continues to introduce structural changes to economies worldwide. In order to remain competitive in an ever-changing labor market, workers need to continually invest in their career in order to make them "future-proof." A few decades ago, it was sufficient to master a skill or trade and continue to practice that industry throughout one's career. However, the quickened pace of technological progress observed in many industries today, requires workers to continually update their skills and knowledge in order to ensure that their skills remain marketable.

A study conducted by Carl Benedikt Frey and Michael Osborne of Oxford University in 2013 studied how easily 702 occupations in the US could be automated. They concluded that approximately 47 percent of jobs could be completely executed by machines "over the next decade or two." A recent report by McKinsey applies Frey and Osborne's methodology somewhat differently but arrives at similar conclusions: 45 percent of US workers are at risk of losing their jobs in the face of automation. A few occupations that were found to be "highly automatable" were –

- Paralegals
- Accountants
- Contract and patent lawyers
- Machine operators
- Warehouse workers
- Automotive repair workers
- Taxi and truck drivers, and other delivery personnel
- Food preparation and service workers

While large-scale government intervention is not required, policymakers at the state and local level are in a better position to provide short-term assistance to those whose skills have become obsolete or are on the verge of obsolescence. Generic types of adaptive training could be offered, similar to programs offered by the World Economic Forum, which facilitates occupational mobility. Barriers for entrepreneurs, such as bureaucratic licensing requirements, could be eased to facilitate job creation.

Jobs in the STEM (science, technology, engineering, and mathematics) fields are in high demand and employers are facing shortages. Policymakers could offer incentives for schools at the Postsecondary level to offer curricula geared toward occupations in these sectors. In addition, outreach efforts are needed for those in the workforce or in-between jobs to improve their technical skills before their skills become obsolete. There could be additional incentives for those who train for STEM jobs. Many times, those outside the workforce are simply unaware of opportunities that exist outside their area of expertise. Obtaining the right information is all that is keeping them from gaining meaningful employment in their communities.

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