GLOBAL TRENDS

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EMERGING OR EVOLVING DYNAMICS

STATE AND SOCIETAL LEVEL

Technology and the Future of Work

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During the next two decades, technological innovations—including automation, online collaboration tools, artificial intelligence, and additive manufacturing—will reshape some fundamental aspects of how and where people work. The future workplace is likely to be increasingly flexible but also increasingly insecure as companies demand new skill sets while no longer providing employees with traditional benefits. A key uncertainty is whether the labor force will adjust quickly enough to meet the demands of the new working world. Scholars agree that although technological innovations will eliminate many jobs, they will also create new ones as firms shift labor into complementary tasks. However, the skills required and the locations of these jobs may not match the capabilities of the labor force—putting pressure on already stretched governments to help labor markets manage these new conditions.

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TECHNOLOGY DRIVING WORKPLACE CHANGES

New technologies are reshaping the workplace through automation, online collaboration tools, artificial intelligence, and additive manufacturing. Tasks that once seemed uniquely suited to human abilities, such as driving a car or diagnosing a disease, are already automated or potentially amenable to automation in the next decade. Emerging technologies are also making possible virtual labor mobility through Internet-based freelance platforms that match customers with self-employed service providers, as well as speed-of-light commercial data and software transmission.

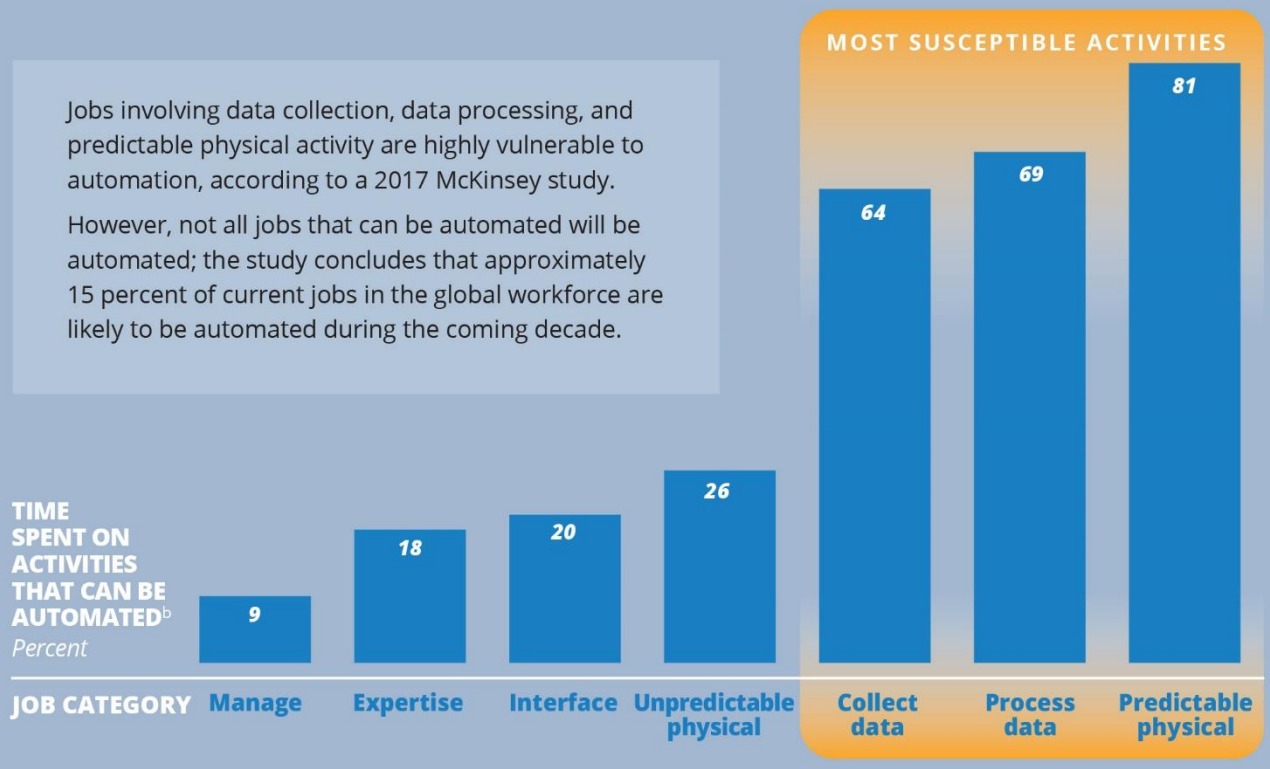
Automation Continuing To Replace Some Jobs

In advanced economies, robots are increasingly supplanting humans for routine tasks and may take on more complex tasks in the coming decades as progress is made in artificial intelligence (AI). Companies probably will apply AI breakthroughs in object recognition, machine translation, robotic controls, and natural language processing as a labor-saving measure in white-collar professions.

GRAPHIC 1
WORK ACTIVITIES WITH HIGHER AUTOMATION POTENTIAL[a]

Jobs involving data collection, data processing, and predictable physical activity are highly vulnerable to automation, according to a 2017 McKinsey study.

However, not all jobs that can be automated will be automated; the study concludes that approximately 15 percent of current jobs in the global workforce are likely to be automated during the coming decade.

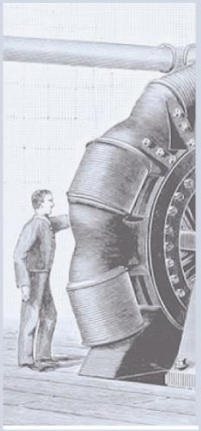


[a] Based on a study of US occupations.
[b] Automated by adapting currently demonstrated technology.
Source: McKinsey & Company.

PREVIOUS WAVES OF WORKPLACE DISRUPTION

Changes to work in the coming two decades will probably reflect aspects of previous waves of job market change, from the 19th century Industrial Revolution to the automation and trade globalization of recent decades. In those episodes, shifts in technology and the workforce created winners and losers, with worker skills, retraining opportunities, and the government role in labor market adjustments showing up as common denominators.

- **Industrial Revolution.** Beginning in the late 18th century, as the European population boomed, Western economies underwent massive shifts in the workforce out of agriculture and into industrial jobs. New technologies drove productivity in the agriculture, iron, and textile sectors. The adaptation of coal-powered steam engines to railroads and shipping boosted international trade. Over a period of several decades, the Industrial Revolution was especially difficult for low-skill-worker households, as wages failed to keep up with the cost of living. Many poor households lived in unhealthy conditions, with inadequate food, housing, education, and social services.



- **Rising Labor Share.** Technology and workforce changes can lead to improvements for workers, too. In the wake of World War II, several factors common to most advanced economies combined to shift firm profits away from business owners and to workers, thereby reducing income inequality. These included widespread education, worker unionization and other types of political power, demands from aging workers for retirement benefits, factory mechanization that improved the productivity of low-skill workers, and a cultural shift that emphasized the social benefits of lower income inequality.

- **Outsourced Manufacturing.** When China joined the global trading system in the early 2000s, it was home to almost one-quarter of the world's total working-age population. Chinese manufacturing wages were as low as 3 percent of those in the United States, giving China a labor cost advantage that helped drive its rapid increase in global market share, in combination with effective use of imported technology. Western manufacturers took advantage of the cost savings and moved many factories overseas, leading to significant job losses in certain regions of advanced economies, disrupting local communities.

- Automation is most widespread in jobs with midlevel technical skill requirements. However, employees with nonroutine skills that complement automated processes are in high demand and have seen rising wages. These nonroutine skills include emotional intelligence and teamwork, as well as critical thinking and problem solving skills.

- In the coming years, AI is likely to be applied to higher skill tasks, eliminating some jobs while significantly increasing the productivity of those workers who remain. Affected fields include law, medicine, finance, and software development. Lab technicians, chemical engineers, and optometrists are examples of professions particularly vulnerable to future AI applications.

An automation wave is likely to hit some developing economies during the next two decades, although their current automation levels are lower than those of advanced economies. The cost of automation and digital technology continues to decline globally, reducing barriers to new investment in robots. Developing economies with workforces that probably are vulnerable to disruptive automation include Brazil, Costa Rica, Malaysia, Romania, and Russia because their working populations are older and they earn relatively high wages.

- Some developing economies will struggle to industrialize as automation reduces the cost of manufacturing elsewhere. For example, as Asian manufacturers adopt automation and other innovative technologies, they will gain cost advantages derived from producing large volumes of goods. Exports of these products will drive down the prices of competing goods globally, making it difficult for small-scale manufacturers in Latin America and Sub-Saharan Africa to compete in the marketplace and reducing the number of industrial jobs in those regions. Instead, employment in those regions has been gravitating toward the lower paying services sector.

A key uncertainty about automation during the next few decades will be the degree of its disruptive effect on labor markets. Automation could create such efficiency that the number of well-paid jobs created is less than the number lost. Whether workers and companies will be able to meet retraining and education needs is unclear, given the pace of change. One 2013 study concluded that up to half of all US jobs were susceptible to being overtaken by the new forms of automation. More recent studies have looked closely at which job subtasks are automatable and found a smaller percentage of jobs at risk. The newer results concluded that 9 percent to 15 percent of jobs on average could be displaced—still highly disruptive, but on a scale that may permit workers, companies, and governments time to adapt without being overwhelmed.

FROM FACTORY-FREE PRODUCTION TO OFFICE-FREE SERVICES?

How far could the disruption of services sector employment by international digitalized services platforms spread? The path charted by some manufacturers over the past two decades suggests that the answer is "very far." Some manufacturers went to the logical extreme of outsourcing all production in what became known as "factory-free production"—for example, Apple-designed iPhones are assembled in Asia, and Dyson designs vacuum cleaners but subcontracts out the production.

This development could point the way to a large-scale "office-free services" model, with major corporations operating with no in-house human resources staff or international financial services firms with no physical headquarters.

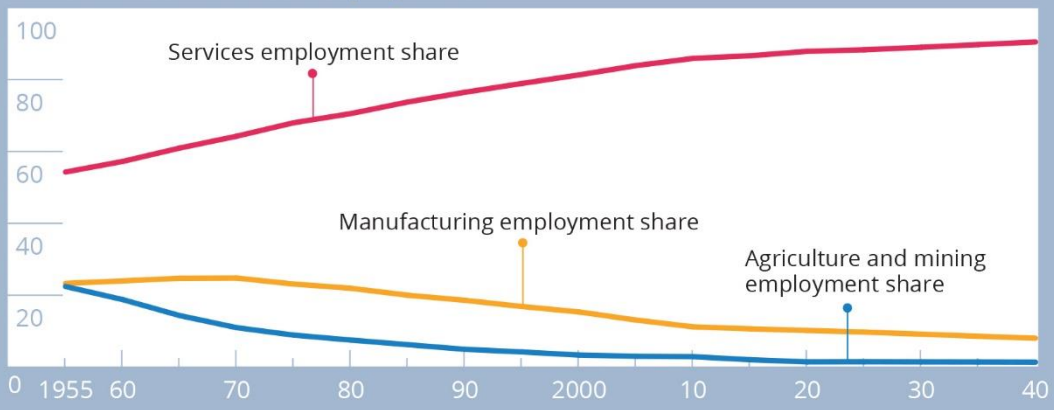
GRAPHIC 2

THE FUTURE OF WORK IS IN SERVICES

As automation reduces the number of jobs on farms and in factories, the labor force is shifting into services. In advanced economies (see top chart), this transition began before World War II and services employment is on track to reach a 90 percent share by 2040, based on projections by Oxford Economics. In large emerging markets (see bottom chart), the services sector already employs more workers than the manufacturing sector does, too, and could reach nearly 60 percent of total employment by 2040.

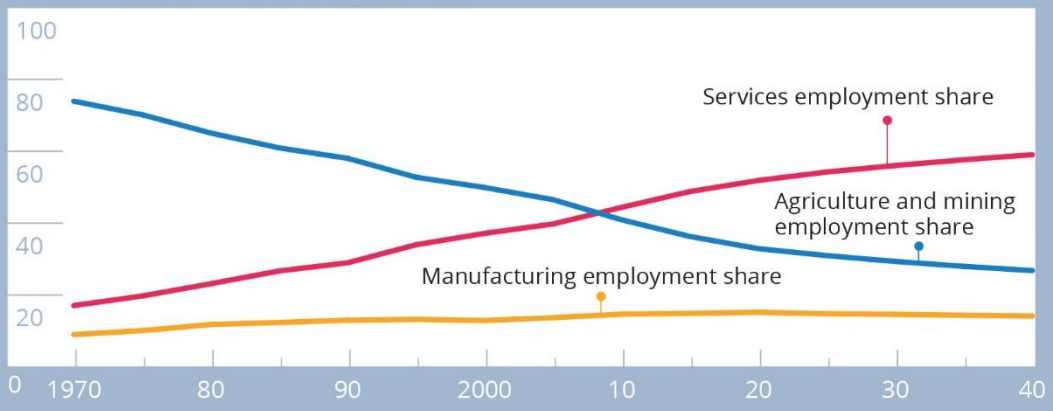
ADVANCED ECONOMIES: EMPLOYMENT BY SECTOR 1955-2040[a]

Percent share of total employment



LARGE EMERGING MARKETS: EMPLOYMENT BY SECTOR 1970-2040[b]

Percent share of total employment



[a] Advanced economies with available labor data: France, Italy, Japan, United Kingdom, United States of America.
[b] Large emerging markets with available labor data: Argentina, Brazil, Chile, China, Colombia, Egypt, Ethiopia, India, Indonesia, Kenya, Mexico, Morroco, Malaysia, Nigeria, Peru, Philippines, South Africa, Thailand.

Source: Historical data through 2010: calculations based on Groningen Growth and Development Center, 10-Sector Database, https://www.rug.nl/ggdc/productivity/10-sector/?lang=en. Estimated and projected data through 2040: calculations based on Oxford Economics, Global Economic Databank, employment by sector, https://www.oxfordeconomics.com/.

Technologies Changing Where Jobs Are Performed

Companies are increasingly dividing jobs into discrete tasks that can be completed by teleworking employees or outsourced to sometimes geographically distant freelancers, further disconnecting work tasks from where those tasks are performed. Digitalization and Internet connectivity have facilitated this trend with innovations such as online document sharing, cloud storage, wireless connectivity, videoconferencing, and AI-augmented process management. During the next 20 years, advances in telepresence technologies, such as virtual reality, will allow more physical tasks to be completed remotely, expanding this trend beyond traditional office jobs.

- Long before we began to experience the workplace disruptions caused by the COVID-19 pandemic, more than 2 million additional US workers had begun working from home at least part-time, bringing the total to 8 million US workers, according to US Census Bureau estimates, or more than 5 percent of the US workforce. Similar percentages of workers have reported working from home in Europe and Japan.
- Freelancing or "gig economy" web platforms facilitate outsourcing of office tasks, such as web development, writing and translation, design and multimedia, and administrative support, as well as consumer services such as ride-sharing, delivery, and household microtasks.

GRAPHIC 3
HELP WANTED: EMPLOYMENT IN CROSS-BORDER SERVICES

Workers in developed and developing countries are accessing new markets for their labor through trade in cross-border services, such as writing software code or providing translation services through online platforms.

The service exports of several small countries are heavily focused on digitally deliverable services, as are those of some larger countries, including some developing economies.

TOP 10 ECONOMIES BY SHARE OF DIGITALLY DELIVERABLE SERVICES IN TOTAL SERVICES EXPORTS

[a] 2016 data.
Source: UNCTADStat.

- Technological advances almost certainly will reshape more traditionally physical jobs as well, in industries such as mining, forestry, and oil and gas. Automated techniques allow for operations control or infrastructure inspection by remote workers who could "visit" multiple geographically distant sites in one day. Self-driving vehicles, drones, and other robotics are likely to accelerate this trend.

Parallel with the rise of offsite work within countries, companies in advanced economies are increasingly sourcing services to workers in emerging economies, particularly those in East and South Asia and Sub-Saharan Africa. International trade in digitally deliverable services—including financial and business services and computer programming—has grown at almost twice the rate of the global economy during the past 15 years and in 2018, contributed more than 3.5 percent of global economic output, double the value of international tourism that year.

- Workers in developing Asian countries are benefiting from new employment in cross-border freelanced services, such as software development and IT systems integration, but these freelancers receive relatively low average wages and have poor labor bargaining power.
- Three developing countries are among the top 10 countries with the largest share of digitally deliverable services in their total service exports: Sierra Leone (76 percent), Ghana (73 percent), and India (66 percent).
- Freelancers in Kenya are among the leading suppliers of writing and translation services globally, and in Nigeria, South Africa, Tanzania, and Zimbabwe, freelancers are among the most active in supplying software development services.

Additive manufacturing—known as 3D printing—is also changing the location and composition of jobs as companies "reshore," or localize, production plants. Additive manufacturing offers companies several advantages, such as the ability to make lighter weight parts, avoid wasting material, and save on shipping costs. The widespread adoption of this technology could eliminate manufacturing jobs in some emerging economies while creating new jobs in advanced economies in product design, customer relations, and computer programming.

- Many jobs associated with additive manufacturing offer higher pay and demand greater skill than traditional manufacturing jobs, but such jobs are also scarcer. For instance, software engineers are needed to modify the 3D printer computer code when a product is customized.
- The medical device industry has already widely adopted additive manufacturing, a trend probably accelerated by the COVID-19 pandemic because the health care industry has worked to quickly leverage 3D printing for ventilator valve and personal protective equipment production. The automotive and aerospace manufacturing sectors are among those likely to generate the greatest number of 3D printing tasks.

DEMOGRAPHICS, PANDEMIC ACCELERATING NEW WORK PRACTICES

Aging Workforces Spurring Automation

During the next two decades, the workforces of most of today's largest economies will shrink as aging workers retire, increasing the need for automated processes. South Korea will lose 23 percent of its working-age population (ages 15-64), Japan 19 percent, Germany 13 percent, and China 11 percent, according to UN projections. Southern Europe's advanced economies—such as Italy, Portugal, and Spain—make up the world's most rapidly aging region; together their working-age populations will decline by more than 17 percent during the next 20 years.

Automation—traditional industrial robots and AI-powered task automation—almost certainly will spread quickly as companies look for ways to replace and augment an aging workforce. Companies with large

cohorts of workers 55 and older are more likely to adopt robotics and other forms of automation as they anticipate the potential for declining workforce productivity. Industrial robots are currently concentrated in the United States, China, Germany, Japan, and South Korea, only one of which—the United States—does not have a shrinking workforce.

- Southern and East European economies probably will adopt more workplace automation, given the anticipated high rates of worker retirements. In particular, Italy, Russia, and Spain have lower-than-average rates of industrial robot adoption, suggesting that increased automation could spread to those countries.
- Automation and AI will also be adapted for aging workers in white-collar workplaces. For example, networked and smart hearing aids could enhance communication, and robotic exoskeletons could increase personal mobility.

Pandemic Response Leading to New Ways, Locations for Working

In response to the coronavirus pandemic, companies worldwide have quickly expanded technology-driven workplace changes. Some companies have encouraged employees to work remotely rather than commute to worksites, and many businesses have shifted to digitally connected virtual teams, eliminating the need for business travel. Although some of these changes are likely to remain after the pandemic ends, others may be discontinued if companies and workers decide in-person engagement is critical to performance.

- Videoconferencing is replacing daily commutes to an office and periodic travel for conferences. As quarantine measures were widely implemented in March 2020, office videoconferencing apps saw record downloads by users in Italy and Spain—countries that previously had below-EU-average rates of work from home. Traffic on one videoconferencing app rose from 10 million daily meeting participants in December 2019 to more than 300 million in April 2020.
- For office workers already struggling with the high cost of housing in urban centers, temporary remote work protocols have raised interest in permanently working remotely from lower cost locations. When the COVID-19 crisis has ended, employers are likely to maintain larger percentages of remote and freelance workers, even while potentially facing questions related to adjusted pay scales, and mechanisms for employee monitoring and feedback.

Technology is also filling and creating new roles in the services sector, in particular where the public is demanding a shift to low contact or automated options. For example, online streaming of entertainment is eliminating jobs in movie theaters and live performance venues while digital platforms are creating new job opportunities in shopping and delivery services.

- Many countries are testing robots and drones—including the United States, Chile, China, Ghana, Israel, and South Korea—to replace humans in high-contact tasks, such as medical testing, surface sterilization, and package delivery.
- Even in industries where telework is not an option—such as manufacturing, farming, and food processing—companies probably will pursue technological fixes to keep their businesses operating with fewer workers. As in previous crises, companies have been making capital investments in automation, which is likely to accelerate the trend in some industries.

BROADER IMPLICATIONS

The changing landscape of work raises broader implications, especially for advanced economies, concerning social stability and the role of governments on issues of inequality, social identity, and regulation.

Increasing Inequality

The hollowing out of the middle-income workforce in advanced economies—a process under way for the past two decades—almost certainly will continue, with profits disproportionately going to some high-skill workers and the corporations that hold the new technologies. Automation has replaced mostly middle-skill jobs even as employers add workers at both the bottom and top of the pay scale—a trend known as "job polarization."

For example, across Western Europe and the United States, the employment share for traditional middle-income jobs, such as machine operators, metalworkers, and office clerks is decreasing. At the same time, low-paying services-sector jobs, such as sales representatives, as well as high-income jobs for doctors, engineers, and other professionals are increasing.

Overall compensation for workers relative to economic output probably will also shrink during the coming two decades. Automation has decreased the overall share of worker take-home pay relative to corporate shareholder profits because decreases in wages and jobs displacement have not been fully offset by the potential of automation to produce more goods and drive new employment in related industries.

- Although many new high paying, high-skill jobs have been created in the past 20 years, the total wages and benefits those workers earn do not surpass the lost wages and benefits of the displaced workers.
- In the years ahead, some higher skill professionals are likely to face declining wages as new technologies begin to supplant the routine tasks they perform—a development that will further contribute to downward pressure on worker pay.

Digital freelance, or "gig economy," platforms are contributing to declining aggregate worker earnings and benefits in advanced economies, since most freelancers work part-time and have lower-than-average overall take-home pay. As remote work becomes more common, companies may increasingly substitute freelancing for work performed offsite by employees as a cost-saving measure.

- Freelancers, who do not receive employer-provided benefits, are more vulnerable to employment loss during a business downturn. Payment is also more at risk for freelancers. At some point, about 90 percent of freelancers have been denied payment after completing a task based on what the customer claims—often unfairly, according to freelancers—is subpar work.

Even though aggregate wages probably will fall in advanced economies, a small portion of workers will see rising wages and profits. Technology innovators and workers who perform nonroutine and cognitive work that is enhanced—not replaced—by automation almost certainly will continue to see their wages increase relative to those of other workers. Overall worker compensation will further concentrate in key digital domains affected by automation, such as online search, electronic communication, and online shopping.

- A handful of companies enjoy near-monopolies in these domains, benefiting from network effects inherent in digital services. That is, the larger the user base of these digital services grows, the more desirable these companies' services are to consumers, even though the marginal cost of expanding their services is close to zero. Consequently, workers in jobs with access to these monopoly profits will see higher wage growth.

The pandemic is accelerating this trend as consumers avoid brick-and-mortar stores and companies shift to e-commerce and work-from-home arrangements, giving online platforms additional market share. Although consumers probably will revert to their pre-pandemic lifestyles after the pandemic, surging shares of e-commerce companies in China, Europe, India, and the United States suggest that investors judge a substantial portion of the behavioral shift is likely to stick.

The need for retraining, particularly among lower and middle-income workers, could exacerbate income inequality, particularly if workers bear the burden individually. Low-income workers are likely to be unable to afford the certification necessary to obtain higher paid employment and thus be relegated to low-skill jobs. In addition, workers who are retraining could lack information on which training programs will pay off with future work assignments, exacerbating the skills mismatch that already leaves higher skilled positions unfilled.

Reshaping Social Identities

Changes to the nature, location, and compensation structure of work in advanced economies during the next two decades will further reshape white-collar workers' social identities. Many people gain self-worth from their work and tend to identify closely with their workplace goals. Physical workplaces provide social cohesion and help build institutional trust in modern society. Changes and dislocations that many blue-collar and manufacturing workers in advanced economies experienced in the late 1990s will increasingly affect white-collar and service workers as companies begin disaggregating, outsourcing, and automating knowledge-worker jobs.

- At the same time, many younger workers in advanced economies are eager to adopt more flexible and creative employment opportunities offered by workplace changes. Technology is enabling work to be more about tasks and less about job positions, allowing workers more choice on how and where to complete the tasks. Research shows that those who choose flexible working arrangements out of preference, not necessity, are positive about future changes to the workplace.
- Polling in advanced economies during the past decade has shown that rising generations are less attached to institutional corporate structures and more eager to control their work. Similarly, younger business owners and hiring managers are more likely to allow nontraditional workplace practices, according to a survey of US firms.
- Even so, many younger workers also experience anxiety and depression because of the less stable nature of gig or freelance work. A 2018 survey of Canadian millennials found that those with precarious employment—defined as permanent part-time work without traditional benefits—experienced a significantly higher prevalence of mental health concerns.

With automation poised to command a larger share of routine physical and cognitive tasks, workers will be expected to innovate, facilitate teamwork, and apply skills across different classes of tasks. Solutions to problems will be more readily crowdsourced—a method that is often more effective than relying on deep expertise alone.

- To succeed, workers will need to continually acquire new skills, including using insights from real-time data analytics that artificial intelligence can generate from increasingly digitized homes and workplaces.

New Issues for Governments To Manage

As these trends unfold, the public is likely to increasingly demand that governments manage the dislocations caused by new technologies. Governments probably will have an incentive to play a role in managing and smoothing labor market disruptions, but many governments may not have the capacity to manage these issues when faced with a host of other challenges.

- Governments most likely will face tough choices between investing in the current workforce and providing benefits to displaced and aging workers. Record levels of government debt in both advanced and developing economies, along with the rising overall costs of aging populations, could limit new programs for reskilling, healthcare, and retirement. Even in Sub-Saharan countries on the verge of a youth bulge, large older worker cohorts nearing retirement probably will strain the minimal elder care programs in place. In the long term, if governments neglect education and infrastructure, growth probably will slow.
- Governments will have a regulatory and legal role in defining relations between workers and employers. The new work landscape may include today's problems of bad business practices, gender and race discrimination, and fraud, as well as new types of bias in online "gig worker" employment platforms.
- The growing trend of cross-border freelancing may require new regulatory frameworks, within and among states. Online freelancers may be vulnerable to cyber fraud, cyber attacks, and outages that have the potential to damage their livelihoods and, in aggregate, the broader economy. For instance, cryptocurrencies could become digital services workers' preferred channel for payment, but in the event of financial system stress, cryptocurrencies may not have the backing of central banks, leaving online workers at greater risk.
- The current era of deceptive digital material—including manipulated images—and cyber hacking will challenge freelance employment platforms to maintain credibility with their remote workforces. The problems could range from digital reputation manipulation and large-scale theft of other employees' work to the possible macroeconomic disruption of core digital-economy platforms being taken offline through malice or natural disaster. These types of potential market failures in the nonvirtual economy are often the subject of government regulation.