

Technology, jobs, and the future of work

By James Manyika

Automation, digital platforms, and other innovations are changing the fundamental nature of work. Understanding these shifts can help policy makers, business leaders, and workers move forward.

The world of work is in a state of flux, which is causing considerable anxiety—and with good reason. There is growing polarization of labor-market opportunities between high- and low-skill jobs, unemployment and underemployment especially among young people, stagnating incomes for a large proportion of households, and income inequality. Migration and its effects on jobs has become a sensitive political issue in many advanced economies. And from Mumbai to Manchester, public debate rages about the future of work and whether there will be enough jobs to gainfully employ everyone.

The development of automation enabled by technologies including robotics and artificial intelligence brings the promise of higher productivity (and with productivity, economic growth), increased efficiencies, safety, and convenience. But these technologies also raise difficult questions about the broader impact of automation on jobs, skills, wages, and the nature of work itself.

Many activities that workers carry out today have the potential to be automated. At the same time, job-matching sites such as LinkedIn and Monster are changing and expanding the way individuals look for work and companies identify and recruit talent. Independent workers

are increasingly choosing to offer their services on digital platforms including Upwork, Uber, and Etsy and, in the process, challenging conventional ideas about how and where work is undertaken.

For policy makers, business leaders, and workers themselves, these shifts create considerable uncertainty, alongside the potential benefits. This briefing note aims to provide a fact base on the multiple trends and forces buffeting the world of work drawing on recent research by the McKinsey Global Institute and others.

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Developments in employment, income, and skills

Challenges in labor markets are growing, household incomes in advanced economies have been stagnating, and there are increasing skill gaps among workers.

Labor markets are under strain, and talent is underutilized

[Unemployment and underemployment](#) are high around the world. In the United States and the 15 core European Union countries (EU-15), there are 285 million adults who are not in the labor force—and at least 100 million of them would like to work more. Some 30 to 45

percent of the working-age population around the world is underutilized—that is, unemployed, inactive, or underemployed. This translates into some 850 million people in the United States, the United Kingdom, Germany, Japan, Brazil, China, and India alone. Most attention is paid to the unemployed portion of this number, and not enough to the underemployed and the inactive portions, which make up the majority of untapped human potential.

Almost 75 million youth are officially unemployed. **Women represent one of the largest pools of untapped labor:** globally, 655 million fewer women are economically active than men. In a “best-in-region” scenario in which all countries match the rate of improvement in gender gaps (in labor force participation, hours worked, and sector mix of employment) of the best-performing country in their region, **\$12 trillion more of annual GDP would be realized in 2025**, equivalent in size to the current GDP of Japan, Germany, and the United Kingdom combined.

Exhibit 1

If every country matched the progress toward gender parity of its fastest-improving neighbor, global GDP could increase by up to \$12 trillion in 2025.

Incremental 2025 global GDP over business-as-usual scenario, ¹ %	Incremental GDP, \$ trillion
India	16% 0.7
Latin America	14% 1.1
China	12% 2.5
Sub-Saharan Africa	12% 0.3
North America and Oceania	11% 3.1
World	11% 11.8
Middle East and North Africa	11% 0.6
South Asia (excl. India)	11% 0.1
Western Europe	9% 2.1
Eastern Europe and Central Asia	9% 0.4
East and Southeast Asia (excl. China)	8% 0.9

¹Sample = 95 countries.

Source: IHS; ILO; Oxford Economics; World Input-Output Database; national statistical agencies; McKinsey Global Growth Model; McKinsey Global Institute analysis

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Household incomes in advanced economies have stagnated or fallen, fueling public disgruntlement

The vast majority of people derive incomes from jobs. In the United States, Western Europe, and across advanced economies, [market incomes \(from wages and capital\) stagnated or fell](#) for about two-thirds of households in 2005–14, a period marked by deep recession and slow recovery after the 2008 financial crisis. This was the first time incomes stopped advancing on such a scale since the stagflation era of the 1970s, and it may have helped stir popular opposition to globalization. The recession was a leading cause of the abrupt end to income advancement, but other longer-run factors also contributed, including a decline in the share of national income that is paid to workers, the so-called wage share. This has fallen across advanced economies despite rising productivity, suggesting a decoupling between productivity and incomes.

The decline is due in part to the growth of corporate profits as a share of national income, rising capital returns to technology investments, lower returns to labor from increased trade, rising rent incomes from home ownership, and increased depreciation on capital. Policy makers in the affected countries took action during the downturn to compensate for the income squeeze, in the former of lower taxes and higher transfers, but these were largely one-off measures to buoy disposable income in response to the recession, and not sustainable.

Globalization has brought numerous benefits, including lifting millions of people in emerging economies into the consuming class. But it also has had an impact in some sectors like manufacturing in advanced economies, with some jobs moving offshore. Better support could have been provided to help affected workers build new skills and transition into new sectors or occupations.

A survey we conducted in France, the United Kingdom, and the United States showed a significant proportion of those whose incomes stagnated are worried about their children's economic prospects—a sharp departure after many decades in which it was an article of faith that every generation would enjoy higher living standards than their parents. Middle-income households have been the most affected, and young and less educated people are especially vulnerable. Across all age groups, medium- and low-skill workers have done worse than those with a college education. Many blame governments, global institutions, corporations, and establishment “elites” around the world, and the principles of free trade and open borders are under attack.

Skills, jobs, and locations do not always match, limiting income-earning opportunities for many

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 subject degrees but also in 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 enough challenge.

Some of the mismatching is locational: where there is demand for work, there may not be available and qualified workers to be found. This geographic mismatch can be seen across regions within countries, and between countries.

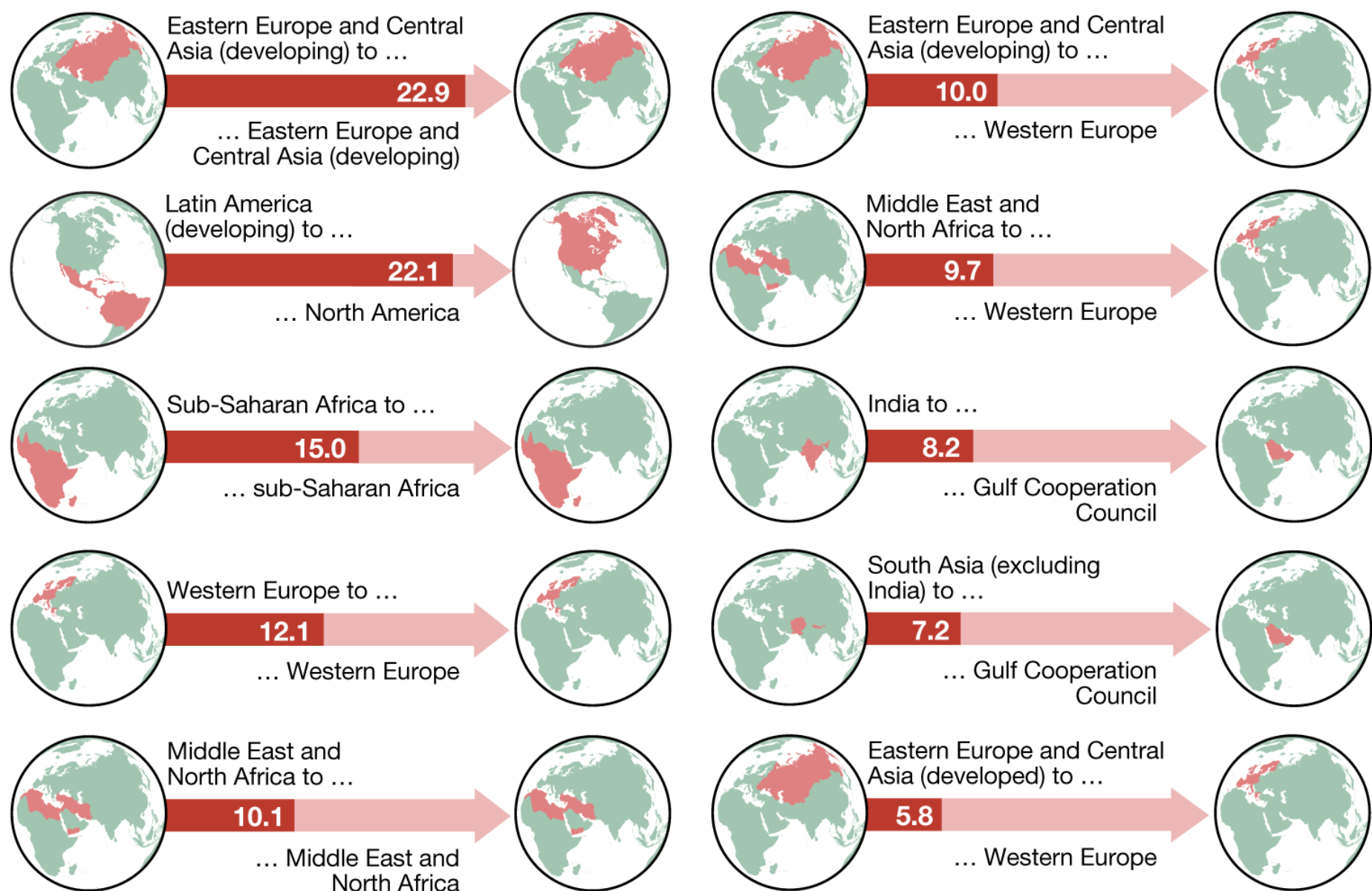
Cross-border migration fills some skill gaps but can create tensions

Cross-border migration has been a natural consequence of a world in which people do not find attractive work opportunities in their country of origin, at a time when other economies are not adequately filling their skills gaps. [Migration boosts global productivity](#), but its consequences are often feared by native workers, who face labor market disconnects and a lack of well-paid jobs.

In 2015, approximately 247 million people lived in a country not of their birth—a number that has almost tripled in the past 50 years. Most have gravitated to places where [they believe they will find better jobs](#). More than 90 percent have moved voluntarily, and about half have moved from developing to developed countries. In the period 2000 to 2014, migration has provided about 40 percent of labor force growth in Canada, Spain, the United Kingdom, and the United States.

Most migration consists of people moving to another country in the same part of the world.

Top 10 regional movements,¹ total migrant population in millions, 2015



¹Includes movement both between and within regions.

Source: United Nations Department of Economic and Social Affairs; World Bank; McKinsey Global Institute analysis

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Migrants made an absolute contribution to global output of roughly \$6.7 trillion, or 9.4 percent of global GDP in 2015. However, migrant workers, on average, earn wages that are 20 to 30 percent lower than those of comparable native-born workers. [More effective](#)

[Integration approaches](#) could lay the groundwork for economic gains of up to \$1 trillion globally, benefiting both economies and individuals.

In the context of challenging labor market conditions, popular sentiment has moved against immigration. [Surveys conducted by MGI](#) suggest that a significant proportion of middle- and low-income groups in advanced economies who are experiencing flat or falling real incomes are pessimistic about the future and likely to hold particularly negative views about immigrants.

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How automation and technology are affecting work

New technologies have the potential to upend much of what we know about the way people work. But disruption is an opportunity as well as a challenge—given the promise of digital talent platforms and new options for independent work, for example.

Many activities that workers carry out today have the potential to be automated

Technological change has reshaped the workplace continually over the past two centuries since the Industrial Revolution, but the speed with which automation technologies are developing today, and the scale at which they could disrupt the world of work, are largely without precedent.

MGI research on the [automation potential](#) of the global economy, focusing on 46 countries representing about 80 percent of the global workforce, has examined more than 2,000 work activities and quantified the technical feasibility of automating each of them. The proportion of occupations that can be fully automated using currently demonstrated technology is actually small—less than 5 percent. An additional important finding is that even if whole occupations are not automated, partial automation (where only some activities that make up an occupation are automated) will affect almost all occupations to a greater or lesser degree. The impact will be felt not just by factory workers and clerks but also by landscape gardeners and dental lab technicians, fashion designers, insurance sales representatives, and even CEOs.

We find that about 60 percent of all occupations have at least 30 percent of activities that are [technically automatable](#), based on currently demonstrated technologies. This means that most occupations will change, and more people will have to work with technology. Highly skilled workers working with technology will benefit. While low-skilled workers working with technology will be able to achieve more in terms of output and productivity, these workers may experience wage pressure, given the potentially larger supply of similarly low-skilled workers, unless demand for the occupation grows more than the expansion in labor supply.

On a global scale, we calculate that the adaptation of currently demonstrated automation technologies [could affect 50 percent of the world economy](#), or 1.2 billion employees and \$14.6 trillion in wages. Just four countries—China, India, Japan, and the United States—account for just over half of these totals. There are sizable differences in automation potential between countries, based mainly on the structure of their economies, the relative level of wages, and the size and dynamics of the workforce.

As machines evolve and acquire more advanced performance capabilities that match or exceed human capabilities, the adoption of automation will pick up. However, the technical feasibility to automate does not automatically translate into the deployment of automation in the workplace and the automation of jobs. Technical potential is only the first of several elements that must be considered. A second element is the cost of developing and deploying both the hardware and the software for automation. The supply-and-demand dynamics of labor are a third factor: if workers with sufficient skills for the given occupation are in abundant supply and significantly less expensive than automation, this could slow the rate of adoption. A fourth to be considered are the benefits of automation beyond labor substitution—including higher levels of output, better quality and fewer errors, and capabilities that surpass human ability.

Finally, regulatory and social issues, such as the degree to which machines are acceptable in any particular setting, must also be weighed. It is for these various reasons that go beyond purely technical feasibility of automation that our estimates for “whole-job” automation are lower than other estimates. Our scenarios suggest that it may take at least two decades before [automation reaches 50 percent](#) of all of today’s work activities, taking into account regions where wages are relatively low.

Productivity growth from the **steam engine**

0.3%

1850–1910



Source: McKinsey Global Institute analysis

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#Automation

Technology can help labor markets: Digital talent platforms improve matching between workers and jobs

Digital talent platforms have the potential to improve the ways workers and jobs are matched, creating transparency and efficiency in labor markets, and potentially raising GDP. They can raise labor participation and working hours; evidence from around the world suggests that some people would work more hours if they could. A US survey, for example, reports that three-quarters of stay-at-home mothers would be likely to work if they had flexible options. Even if a small fraction of inactive youth and adults use these platforms to work a few hours per week, the economic impact would be significant.

With their powerful search capabilities and sophisticated screening algorithms, online talent platforms can also 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 have come about.

Finally, online talent platforms help put the right people in the right jobs, thereby increasing their productivity along with their job satisfaction. They can draw people who are engaged in informal work into formal employment, especially in emerging economies. Both of these effects could increase output per worker, raising global GDP.

Digitally-enabled independent work is on the rise

While independent work is nothing new (and self-employment is still the predominant form of work in emerging economies), the digital enablement of it is. MGI research finds 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 70 percent choose this type of work, 30 percent use it out of necessity because they cannot find a traditional job at all, or one that meets their income and flexibility needs. The proportion of independent work that is conducted on digital platforms, while only about 15 percent of independent work overall, is growing rapidly, driven by the scale, efficiency, and ease of use for workers and customers that these platforms enable. Such platforms include Uber, Etsy, Didi, and others. 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.

Not to be forgotten—technology creates new jobs and income possibilities

Even while technologies replace some jobs, they are creating new work in industries that most of us cannot even imagine, and new ways to generate income. One-third of new jobs created in the United States in the past 25 years were types that did not exist, or barely existed, in areas including IT development, hardware manufacturing, app creation, and IT systems management. The net impact of new technologies on employment can be strongly positive. A 2011 study by [McKinsey's Paris office](#) found that the Internet had destroyed 500,000 jobs in France in the previous 15 years—but at the same time had created 1.2 million others, a net addition of 700,000, or 2.4 jobs created for every job destroyed. The growing role of big data in the economy and business will create a significant need for statisticians and data analysts; [we estimate a shortfall of up to 250,000 data scientists in the United States](#) alone in a decade.

Digital technology also can enable new forms of entrepreneurial activity. Workers in small businesses and self-employed occupations can benefit from higher income earning opportunities. A new category of knowledge-enabled jobs will become possible as machines embed intelligence and knowledge that less-skilled workers can access with a little training. In India, for example, Google is rolling out the Internet Saathi (Friends of the Internet) program in which rural women are trained to use the Internet, and then become local agents who provide services in their villages through Internet-enabled devices. The services include working as local distributors for telecom products (phones, SIM cards, and data packs), field data collectors for research agencies, financial-services agents, and paratechnicians who help local people access government schemes and benefits through an Internet-based device.

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The challenges of digitization—and possible solutions

We have yet to reach the full potential of digitization across the global economy. Making sure that digital gains are accessible to all could provide significant value. And though other challenges, too, remain, they could be addressed by exploring several solution spaces—for instance, through evolving education systems or by pursuing public-private partnerships to stimulate investment in enabling infrastructure.

We are only starting to capture the opportunities from digitizing economies at the sector and company level

Digital technologies are creating major new opportunities for workers and companies, in both advanced and developing economies, but there are significant variations within and across countries and sectors. Our use of the term digitization (and our measurement of it), encompasses:

1. Digitization of assets, including infrastructure, connected machines, data, and data platforms;
2. Digitization of operations, including processes, payments and business models, and customer and supply chain interactions; and
3. Digitization of the workforce, including worker use of digital tools, digitally skilled workers, and new digital jobs and roles.

In measuring each of these various aspects of digitization, we find relatively large disparities even among big companies. Based on these measures, a few sectors are highly digitized—for example, financial services, media, and the tech sector itself. These tend to be among the sectors with the highest productivity growth and wage growth. Many others are much less digitized, including healthcare, education, and even retail. These tend to be the largest share of the economy in terms of GDP and the lowest-productivity sectors. Similarly, companies are digitizing unevenly.

Companies that are digital leaders in their sectors have faster revenue growth and higher productivity than their less-digitized peers. Their profits and margins can increase three times as fast, and workers within these companies enjoy double the wage growth.

Digitization will continue to change how companies organize work, as well as the mix of work in any given sector. All this will require ongoing adaptation and transition by workers in terms of skills, activities, companies, and even the sectors they work in.

Clearly, we are still in the early stages of how sectors and companies use digital technologies, and there is considerable unevenness. From country to country, too, there are significant divergences. Overall, for example, we estimate that the United States has captured only 18 percent of its potential from digital technologies, while [Europe has captured only 12 percent](#). Emerging economies are even further behind, with countries in the Middle East and Brazil capturing less than 10 percent of their digital potential.

More than half the world's population is still offline, limiting the potential to benefit from digital

Rapid technology adoption can unlock huge economic value, even as it implies major need for retraining and redeployment of labor. [In India, for example, digital technologies](#) provide the foundation for many innovations that could contribute \$550 billion to \$1 trillion of economic impact per year in 2025. However, the value of digitization that is captured depends on how many people and businesses have access to it.

More than four billion people, or [over half of the world's population, is still offline](#). About 75 percent of this offline population is concentrated in 20 countries, including Bangladesh, Ethiopia, Nigeria, Pakistan, and Tanzania, and is disproportionately rural, low income, elderly, illiterate, and female. The value of connecting these people is significant, and as they enter the global digital economy, the world of work will transform in fundamental ways and at an unprecedented pace. Access to the technology alone is not enough; even in countries where a large majority of the population has access, the literacy and skills needed to capture digital gains are sometimes limited.

How to positively affect the future of work: Solution spaces

The disruptions to the world of work that digital technologies are likely to bring about could pose significant challenges to policy makers and business leaders, as well as workers. There are several solution spaces to consider:

- *Evolve education systems and learning for a changed workplace.* Policy makers working with education providers (traditional and nontraditional) could do more to improve basic STEM skills through the school systems, put a new emphasis on creativity as well as critical and systems thinking, and foster adaptive and life-long learning.

- *Determine how the private sector can drive training.* Companies face gaps in skills they need in a more technology-enabled workplace. They could benefit from playing a more active role in education and training, including providing better information about needs to learners and the education and training ecosystem, and providing better learning opportunities themselves.
- *Create incentives for private-sector investment to treat human capital like other capital.* Through tax benefits and other incentives, policy makers can encourage companies to invest in human capital, including job creation, learning and capability building, and wage growth.
- *Explore public-private partnerships to stimulate investment in enabling infrastructure.* The lack of digital infrastructure is holding back digital benefits in many economies, both developing and developed; public-private partnerships could help address market failures.
- *Rethink incomes.* If automation (full or partial) does result in a significant reduction in employment or greater pressure on wages, some ideas such as universal basic income, conditional transfers, and adapted social safety nets could be considered and tested.
- *Rethink transition support and safety nets for workers affected.* As work evolves at higher rates of change between sectors, locations, activities, and skill requirements, many workers will need assistance adjusting. Many best-practice approaches to transition safety nets are available and should be adopted and adapted, and new approaches considered and tested.
- *Embrace technology-enabled solutions.* Such solutions, including richer information signals, can be used in the labor market to improve matching and access and bridge skills gaps. Policy makers will need to address issues such as benefits and variability that these digital platforms can raise.

- *Focus on job creation.* Accelerate the creation of jobs in general through stimulating investment in businesses, and accelerate the creation of digital jobs in particular—and digitally enabled opportunities to earn income—including through new forms of entrepreneurship.
- *Innovate how humans work alongside machines.* Greater interaction will raise productivity but require different and often higher skills, new technology interfaces, different wage models in some cases, and different types of investments by businesses and workers to acquire skills.
- *Capture the productivity benefits of technology.* These can be harnessed to create the economic growth, surpluses, and demand for work that create room for creative solutions and ultimately benefit all.

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