Technological change is a key driver of economic development. Increasing productivity and national income almost always requires successful adoption of more advanced technology, and change can be disruptive. As a consequence of technological change, some jobs may shrink or disappear entirely, while the jobs that expand may require different skills than those they replace. OECD countries are not alone in experiencing the labor market shifts associated with technological improvement. Later developers catching up to the technological frontier may experience more rapid change, and there is a perception that the pace of technological change itself is increasing at unprecedented rates. As a result, some believe that jobs, and the skills needed to do them, will change more quickly than ever before.1

Recent technological progress holds promise for businesses and consumers, while presenting new challenges for labor markets. While research

on the impacts of technology on labor demand has yielded mixed results,\textsuperscript{2,3} the skill-biased nature of technological change suggests that higher-skilled workers, and richer countries, stand to benefit most. As a result, the danger of increasing inequality within and across countries looms large, undermining the prospect of globally shared prosperity. Much of that prospect will depend on evolving patterns of employment within developed countries, but also, critically, on whether lower- and middle-income countries, and the poorer segments of society within them, can harness the job opportunities and benefits that technologies present.

**Fully harnessing the potential of technology, and minimizing the risks, will require a set of concerted actions.** These include 1) supporting individuals and firms in technology adoption to level the playing field; 2) building skills for the workforce of the future; and 3) rethinking social security systems in light of newly emerging modes of work. For countries, the relative importance of each of these areas in preparing for the new world of work will vary by their income status.\textsuperscript{4}

**Overall, this policy note asks four key questions relevant to the future of work debate, namely** 1) Will there be jobs?; 2) Will there be good jobs?; 3) Who will get the jobs?; and 4) What to do about it? This is followed by a brief overview of World Bank activities around the Future of Work, suggesting possible contributions that build on existing work. As an illustrative example, we spotlight STEP surveys that measure the skills of the working population of a country, including socio-emotional characteristics that are increasingly in demand in the digital age.

**WILL THERE BE JOBS?**

Digital technologies are changing the world of work through three key channels: automation, connectivity, and innovation. Automation most directly affects employment by changing the costs of labor relative to capital. Thus far, the effects of automation have been more pronounced in high-income countries, where studies have documented polarizing labor markets (Acemoglu and Autor, 2011; Autor and Dorn, 2013; Goos, Manning, and Salomons, 2014; Santos, 2016). While firms in middle- and lower-income countries are slower to adopt digital technologies, the World Development Report 2016 finds some signs of labor market polarization similar to OECD countries. Developing countries may face the indirect consequences of automation and reshoring. If labor-scarce industrialized countries continue developing and adopting labor-saving technologies, firms may find it more profitable to produce goods at home using machines rather than workers in low-wage countries. This reshoring of tasks could disrupt labor markets in the developing world, and prematurely close the door to formal-wage job creation in export-led manufacturing sectors.

**Connectivity changes the cost of transactions and the potential for economies of scale.** Access to markets and resources due to improved connectivity helps firms grow and create jobs, or attract work to new markets that are more competitive. These effects are especially pertinent in low- and middle-income countries where transaction costs are often prohibitively high, preventing farms and firms from expanding to supply domestic and external markets. Yet, while disruptive technologies often weaken the market power of long-standing incumbents, they can also create new oligopolies when there are significant economies of scale from increased use of services. The World Development Report 2016 shows that many

\textsuperscript{2} Frey and Osborne (2013) find that Information and Communication Technologies (ICTs) are capable of eliminating 47 percent of all jobs currently performed in OECD countries. On the other hand, Arntz, Gregory, and Zierahn (2016) use a task-based approach for 21 OECD countries, and find that 9 percent of jobs across these countries are automatable. See also, Autor and Handel, 2013; Acemoglu and Restrepo, 2017.

\textsuperscript{3} When evaluating this information, it is important to be aware of caveats. For example, existing measures of job tasks and automatability fail to capture many important variables affecting actual technology diffusion, and therefore lead to implausible predictions when applied too mechanically (Frey and Rahbari, 2016).

internet-based markets—such as web searches, mobile payments, or online bookstores—are dominated by a few firms. Given that most of these digital platforms are developed in high- or middle-income countries, developing countries could potentially face the risk of becoming increasingly subject to the market power of foreign companies.

Finally, technology has changed the speed of innovation, allowing more individuals to create and test new ideas and products faster, while minimizing attendant costs and risks associated with product development. Product innovations, created and distributed using various technologies, can give rise to new industries, firms, and jobs. This applies in developing countries too. For instance, computer animation has created 80,000 jobs in India, though it also displaced traditional animator jobs.

These three channels of technological change interact in complex ways to affect the economic forces that drive the organization and location of production work. What this means for individual countries will depend on the specific technology, industry, and occupation under consideration, and on the level of national income, which affects both the general wage level, and the affordability of sophisticated capital equipment. Production technologies can be divided into two broad types that affect different kinds of jobs: (a) Modern mechanical technologies, which frequently augment or substitute for physical labor, such as those involved in most agricultural and blue-collar work; and (b) ICTs, which tend to augment or substitute for skilled labor and assist in the performance of interpersonal tasks, which are typically performed by white-collar, office workers. ICTs may also affect blue-collar jobs through manufacturing automation and retail jobs through online platforms (e.g. e-commerce). However, the impact of ICTs in many middle and low income countries will be constrained by (1) the occupational and sectoral composition of employment, which is less white-collar than in OECD countries; (2) low wages and limited investment capital, which favor labor-intensive methods over high-tech automation; and (3) infrastructure limitations, which limit internet and other types of technological penetration.

**WILL THERE BE GOOD JOBS?**

Technology also changes labor conditions. Among the positive effects, automation can increase productivity and workers’ capabilities, thereby leading to increases in wages and improvements in working conditions. At the same time, workers bear more risk because wages can stagnate or fall as technology allows employers to automate or trade more tasks.

Digital technologies are also disrupting traditional employer-employee relationships by introducing new forms of work that delink workers from employers. An example is the ‘gig economy’, characterized by the prevalence of freelance arrangements and temporary positions. The short-term engagement of independent workers means more flexibility (both for the employee and the employer), but it can also mean that workers lose many social benefits and protections usually linked to traditional employment arrangements. In the developing world, where informality is prevalent, there is likely less of a concern about workers losing full-time formal jobs and the attendant social protections. In fact, the digital technologies that enable the ‘gig economy’ could also foster transparency in the labor market (e.g. labor demand and wages), and have at times even empowered informal workers to secure wage increases (Raja et al. 2013).

**WHO WILL GET THE JOBS?**

In addition to changing the number and quality of jobs, technology also impacts the distribution of jobs by altering the types of skills that employers demand. Across countries, workers with a lower level of education are at the highest risk of displacement. In OECD countries, 40 percent of workers with a lower secondary degree are in jobs with a high risk of job automation, while less than 5 percent of those with a tertiary education. Thus, automation could reinforce existing disadvantages faced by some workers (OECD 2016; Berger and Frey, 2016; Arntz, Gregory, and Zierahn, 2016).

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5 A related literature reviews the significant changes that technology has brought to service delivery. For example, drone technology has been used to deliver blood to remote hospitals in Rwanda. For more on this, see World Development Report 2016.
Technology can also alter the distribution of jobs across countries (i.e. the geography of jobs). For instance, ICT diffusion across the globe varies significantly by region and income level. According to available information, ownership of personal computers in low and even middle income countries remains quite low, as do the number of fixed broadband subscribers and secure internet servers used in e-commerce, in comparison to those currently present in OECD countries. Rates of computer ownership and internet subscriptions across countries follow a strong income gradient that aligns with the World Bank’s classification of countries into upper middle income, lower middle income, and low income.

Information on factory automation is much more limited, but existing evidence suggests that industrial robots are heavily concentrated by country and industry with higher income countries accounting for the largest share. According to the most recent data from the International Federation of Robotics, an industry trade association, the top five national markets (China, Republic of Korea, Japan, United States, and Germany) accounted for 75 percent of global robot sales in 2015. Together, all high-income countries accounted for nearly 64 percent of global industrial robot sales, while China, the world’s manufacturing powerhouse, accounted for another 27 percent. Together, all other middle and low income countries accounted for just 9 percent of global industrial robot sales, (China not included). Clearly, robot use in this less affluent group of countries remains fairly insignificant.

When barriers to technology are removed, new opportunities can empower the poorer segments of society. As an example, the Women in Online Work (WoW) program in Kosovo creates new job opportunities with higher earnings for women, by providing training on technical (IT) and soft skills. The Internet and ICTs also present opportunities for full participation of persons with disabilities. Conversely, if these technology gaps continue, there is a danger that inequality will deepen, within and across countries. Developing countries lack the means to take full advantage of these opportunities because of limited access to technology, a lack of technological skills, and the absence of a broad enabling environment or the so-called ‘analog’ complements.

WHAT CAN WE DO?

Although current data cannot resolve debates regarding the extent of ICTs’ impact on the labor market, there is no doubt that all countries face significant challenges in balancing the need to increase national income and maintain international competitiveness with that of creating well-paying jobs for equitable growth. Given the implications of technology for jobs, policy makers must ensure institutions and systems that:

...connect

Leave no one off-line. Technology access in developing countries often lags the developed world. Within countries, it is typically major cities and towns that are online. Many individuals and businesses will thus be unable to take advantage of technology to improve productivity and incomes, simply because they do not have access to the necessary tools. This is because regulatory and market failures often hold back the provision of affordable and reliable Internet access, access to electronic payment systems, and access to low-cost devices. Public interventions may further be necessary to overcome the divides that limit the participation of women, the poor, and rural communities in the digital economy. For example, a number of countries in South Asia and Africa have invested in public-private partnerships to extend Internet connectivity into rural areas (see Box 1).

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6 However, some access to the Internet is more common through use of public access points like cybercafes and mobile phones.
7 Regional rates are highest in Latin American and the Caribbean, Europe and Central Asia, and developing East Asia, lowest in South Asia and Sub-Saharan Africa, and intermediate in Middle East and North African countries (outside of the wealthy oil states). Interestingly, a sample of four African countries found that while over 60 percent of households had mobile phones, less than 2 percent had a computer and less than 1 percent had a household internet connection (Handel 2017).
8 Figures in this paragraph are from “Executive Summary World Robotics 2016 Industrial Robots,” International Federation of Robotics.
**BOX 1. DISTANCE TO THE TECHNOLOGY FRONTIER: POLICIES TO UNRAVEL THE IMPACT OF AUTOMATION, CONNECTIVITY, AND INNOVATION IN DEVELOPING COUNTRIES**

Technological change is a constant and unavoidable aspect of economic development and includes countries far from the technology frontier. Fostering greater use of digital technologies in low- and middle-income countries is a plausible way to mitigate threats and take maximum advantage of the new digital economy opportunities available. These technologies are changing the world of work through automation, connectivity and innovation. Moving towards a digital economy is likely to affect the number, quality, and distribution of jobs across and within countries.

But what actions can countries take to strengthen competition, capacity and connectedness?

- Design interventions during a child’s early years that build foundational skills and IT skills [i.e. the Early Years partnership].
- Establish a framework and tools to measure workforce skills and the extent to which they align with the new world of work [see Box 2]. For example, the Skills Towards Employability and Productivity (STEP) tool characterizes literacy as representing a range of skills, from the decoding of written words and sentences to the comprehension, interpretation, and evaluation of texts that are of varying complexity and fit different workplace, personal, society, and community contexts.
- Design adequate social security systems that enable portability of social security, including through the use of technology itself. A good example is the World Bank’s Identification for Development (ID4D) initiative.
...build institutions

Invest in ‘analog complements’ of digital development that are equally needed to take advantage of the opportunities which digital technologies create. Rules and institutions are often weaker in developing countries. Access to finance can also be a challenge. Electricity and other utilities to run technologies are often unreliable (or even absent). And administrative barriers and corruption often prevent entrepreneurs from setting up businesses. Improving access to finance, to infrastructure such as electric power, to logistics, and to public services will be critical to unlocking the full range of benefits from digital development.

...build the right skills

Invest in the early years. An increasingly digital economy places even greater premiums on an individual’s ability to reason, continually learn, effectively communicate and collaborate. Investments in the physical, cognitive, linguistic, social, and emotional development of young children, are critical to help them compete successfully in a rapidly changing economy. Grounded in increasing evidence of the high returns to early childhood interventions, the Early Learning Partnership, a multi-donor trust fund managed by the World Bank, funds country-level ECD programs and contributes to global analytical work making the investment case for early years interventions.

Build strong foundational skills, regardless of specific circumstances. Some skills are necessary for productive employment to emerge in the first place and they cannot be acquired on the job. Without numeracy and literacy skills, the prospects of improving employment opportunities and earnings, whether in agriculture or in urban settings, are thin. Today, more than one-tenth of 15 to 24 years olds worldwide are functionally illiterate, and that does not bode well for their future. The traditional literature on education and human capital has long considered that one of the main values of education is the ability to adapt to a changed economic environment. Socio-emotional skills that allow individuals to recognize and manage emotions, deal with conflict and change, are increasingly critical as the nature of learning and work are reshaped. Because learning is cumulative, poor foundations mean that all subsequent investments in learning or skills development will be less effective.

Build basic IT skills and digital literacy. Workers have the ability to use technology as the presence of ICTs increases in low and middle income countries (LMICs). Following the experience in high income countries we may anticipate that facility with technology will be increasingly necessary for certain labor activities in LMICs. In OECD countries, within a span of just 8 years (from 2006 to 2014), facility with technology passed from being an important and desirable skill, into a skill that “almost every occupation requires.” Policy makers must accordingly integrate basic IT skills and digital literacy into curricula to prepare future workers for a widening range of jobs will increasingly involve interacting with ICTs. Although countries that are not technologically dynamic may not experience large impacts on skills and employment, by remaining on the sidelines they will surely fall further behind other countries moving forward with ICT adoption.

Prepare individuals for a lifelong learning environment. Some are calling for a new set of skills “liquid skills” which would potentially allow workers (and students) to adapt to a fluid working landscape (Infosys, 2016). According to this view, career paths will tend to be more erratic—giving up the concept of a “job for life”—where workers will have to reskill in a routinely manner either to respond the skills requirements of their jobs or to move to a new type of job (Infosys, 2016). Under these circumstances, we will face at least two challenges. First, current and future students must prepare for a lifelong learning environment, i.e. learning to learn must become a core skill. Second, those already in the workforce or soon to be employees, together with employers must be prepared to re-skill in a constant manner.

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10. See McCrory et. al. (2014).
BOX 2. INTRODUCING A SKILLS TOWARDS EMPLOYABILITY AND PRODUCTIVITY (STEP) MEASUREMENT PROGRAM

The World Bank’s STEP Skills Measurement Program (STEP) is the first ever initiative to measure skills in low and middle-income countries. It provides policy-relevant data on skill requirements in the labor market, addressing backward linkages between skills acquisition and educational achievement, personality, and social background, and forward linkages between skills acquisition and living standards, reductions in inequality and poverty, social inclusion, and economic growth.

The STEP Program includes a household-based survey and an employer-based survey.

The household-based survey introduces three unique modules:

- a direct assessment of reading proficiency and related competencies scored on the same scale as the OECD’s PIAAC (International Assessment of Adult Competencies);
- self-reported information on personality, behavior, and time and risk preferences (e.g., Big Five, Grit, decision-making, and hostile attribution bias); and
- job-relevant skills that respondents possess or use in their job.

The employer-based survey is designed with five modules which aim to assess:

- the structure of the labor force;
- cognitive skills, behavior and personality traits, and job-relevant skills that are currently being used, as well as skills employers look for when hiring new workers;
- provision of training and compensation by employers;
- the level of satisfaction with the education and skills training available in the labor force.

The STEP collection currently hosts data collected between March 2012 and July 2014 in Armenia, Bolivia, Colombia, Georgia, Azerbaijan, Ghana, Lao PDR, Macedonia, Sri Lanka, Ukraine, Vietnam, and the Yunnan Province in China. In all countries, the target population is urban adults aged 15 to 64, whether employed or not. More countries will be added as data become available.
...rethink social security

Expand the coverage of health insurance and pensions, including by delinking them from formal labor market status. The standard coupling of social security provision to the employer-employee relationship will be challenged by an increasing number of independent contractors and more frequent transitions between jobs. Taxes on labor and other regulations can increase the relative cost of labor to capital, exacerbating the impact of innovations in automation. Countries should consider reducing them or at least not increasing them to finance social insurance obligations. Rich countries with mature social insurance schemes that depend on large payroll tax revenue streams are unlikely to phase them out significantly but may be able to make them less regressive over time. Middle income countries may have more scope to replace part of their financing and, in extreme cases where the link between contributions and benefits is no longer viable, may be able to make a complete break from the past. Finally, the best chance for avoiding the pitfalls of the payroll tax lies in those low-income countries that have either not introduced it already or where there is no significant liability. Here a combination of consumption taxes and targeted cash transfers and other redistributive programs could lead to higher coverage rates for basic pensions and health insurance with fewer labor market distortions. Coincidentally, these are also the countries poised to reap the benefits of emerging technologies that provide viable alternatives to the increasingly anachronistic models of the past.