



The Effects of Technology on Employment and Implications for Public Employment Services

The World Bank Group

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1 Introduction

Technology is changing the world of work and reshaping labor markets. This paper focuses specifically on the effect of ICT-enabled smart machines, smart devices, and smart techniques on employment. There is considerable scope for policies to shape these effects on employment – as well as how ICT itself will affect how some of these policies will be delivered. The focus here is on public employment services and ways they can support the opportunities ICT can provide to workers and the self-employed.

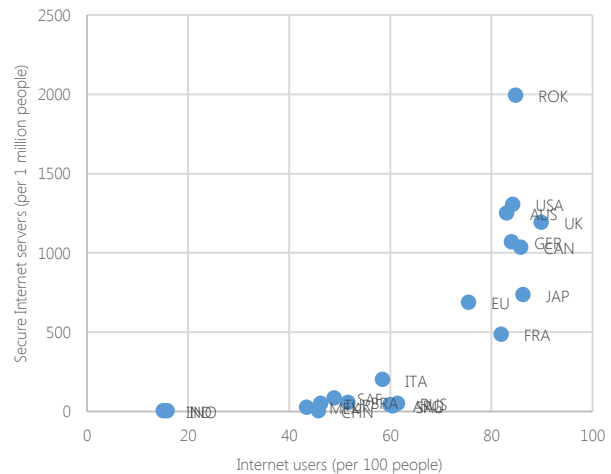
There are clear opportunities from digital jobs and the wider use of digital tools. As Section 2 discusses, governments, businesses, and individuals can benefit today from new ‘digital jobs’ and from the use of digital tools. However, technology also brings risks. Some jobs might also be digitized to varying extents, with some workers or part of their functions being replaced by technology. The ability to take advantage of opportunities will also vary among individuals; workers with higher levels of skills more likely to benefit, while those with lower skills might be less prepared and hence more exposed to risks of lower job quality and of job loss. Technology is also changing the nature of employment relationships, with implications for the risks individuals face. And there is the even larger risk of being left behind altogether. Section 3 discusses these risks.

Realizing the gains to be had from the use of new technologies, as in the past, will need investments and appropriate policies to create more digital jobs and increase access to digital tools. Governments will need to consider specific actions to expand the opportunities that technologies bring. This will help to a great extent to address the challenges due to employers’ adoption of technology, although not completely, so governments will have to consider additional actions to ensure that people realize the benefits of a good job, or are assisted during the transformation wrought by technology. Critically, outcomes are not preordained and much will depend on the choices governments will make today. Some policies and programs for governments to consider are discussed in Section 4. Finally, Section 5 discusses how public employment services could anticipate and respond to these changes – including through their own improved use of technology.

2 Opportunities

Technologies such as smart machines (advanced robots, machine learning), smart devices (personal computers, laptops, mobile networking, and smart phones), and smart techniques (cloud computing, big data, data analytics) have seen major advancements in the past two decades,¹ and promise to have even greater

Figure 1: Spread of ICT across G20 member countries

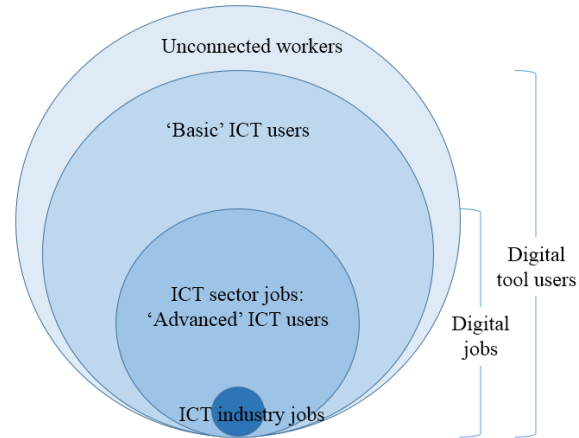


economic and social impact in the coming decade (see Figure 1).²

These changes have also had a significant implications for employment. The technology industry has created millions of “digital jobs” directly, for people involved in ICT production and for advanced users, who use specific software and tools as a main element of their work, irrespective of the industry.³

But the larger impact has been, and could be through the use of digital tools. Everything from the simple mobile telephone to online work platforms has allowed more people to connect to work. This means that the number of possible beneficiaries from digital tools could surpass 3.6 billion, the number of people who subscribe to mobile telephone services globally. Figure 2 shows the relative scale of impact of digital jobs versus the use of digital tools by workers.

Figure 2: Relative scale of possible impact of technology on work



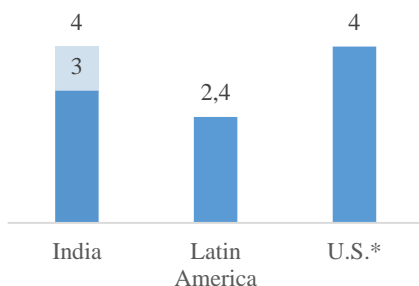
Digital jobs

The ICT industry has directly created millions of jobs in the advanced and the emerging economies. In the OECD countries, for example, the ICT sector employment was 5.74 percent of total business sector employment. For the G20 member countries among this, the range was between 4.66 and 6.45 percent.⁴ Some emerging economies have also benefited. Brazil’s IT industry was responsible for 16 percent of jobs created between 2010 and 2013,⁵ and had employed over 1.3 million people by 2014.⁶ India’s IT-BPO industry has over 3.5 million workers; a third are women.⁷

The spillover effects of the industry are also significant. Various studies show that digital jobs generate between two and four times the employment in other sectors of the economy (Figure 3). These jobs also often pay higher-than-average wages and see them grow faster than other sectors. Indicative data from 2004-2005 for a set of G20 countries suggests that on average, computer programmers earn gross wages that are about a third higher than the national averages.⁸

As businesses and government begin to integrate technologies even further in their processes and activities, and individuals adopt these technologies across various spheres of their lives, there is expected to be a growing demand for digital workers. Workers who have these (high-level) skills and are able to access these jobs will benefit from the opportunity.

Figure 3: Estimated number of jobs in other sectors for every digital job (note: U.S. is for high-technology)



However, many countries are facing a shortfall in the number of qualified professionals even as they might have people who are unemployed.⁹ Hence, having more people working in digital jobs will need both the appropriate enabling environment for businesses and individuals to adopt technology, innovate, and grow, and

the appropriate workforce development strategies in place.

Digital tools

The proliferation of cheaper and more capable technology globally has allowed more people to gain access to digital tools that allow them to connect better to resources and markets including labor markets. Three categories of these digital tools have emerged as important enablers of labor markets.

Transactional tools. A range of digital tools enable buyers and sellers of various goods and services to transact their business with greater efficiency and transparency. This includes the mobile telephone, which is well documented as allowing various workers to find information on prices better (e.g. farmers or fisher folk).¹⁰ This also includes electronic payment services, for example, that improves the reliability of financial transactions irrespective of location of the buyer or seller. E-Commerce has also begun to have significant impact. In China, village economies have changed and begun to create jobs outside of agriculture because SMEs could sell other products such as furniture or handicrafts through Taobao, the consumer-to-consumer arm of Alibaba.¹¹ eBay, an online marketplace originally started in the U.S., now has over 25 million sellers—many of them SMEs—and 155 million buyers, and works in 190 countries.¹² Now, 90 percent of commercial sellers on eBay export to other countries; the share is less than 25 percent among traditional small businesses.¹³ And in India, these marketplaces have created thousands of jobs for delivery personnel.¹⁴

Complementary tools. These tools include the various software and hardware that many organizations and workers now use, including business software, factory robots, personal computers, and smart phones. The McKinsey Global Institute finds that “companies that have fully integrated [the Internet] and use it extensively create more than twice as many jobs as the average, while the Internet has a neutral to slightly negative effect on companies using it only sparingly or not at all.”¹⁵ And it is likely that the sophistication of these technologies is set to exponentially grow. Advanced robots or artificial intelligence-based computers are able to do many tasks today that were previously considered impossible to automate. Robots are beginning to complement surgeons and could be used to perform remote surgeries. As 3D printing becomes cheaper and less complex, it is possible it could transform manufacturing, reducing the need for factory workers but increasing jobs for designers and 3D print managers.

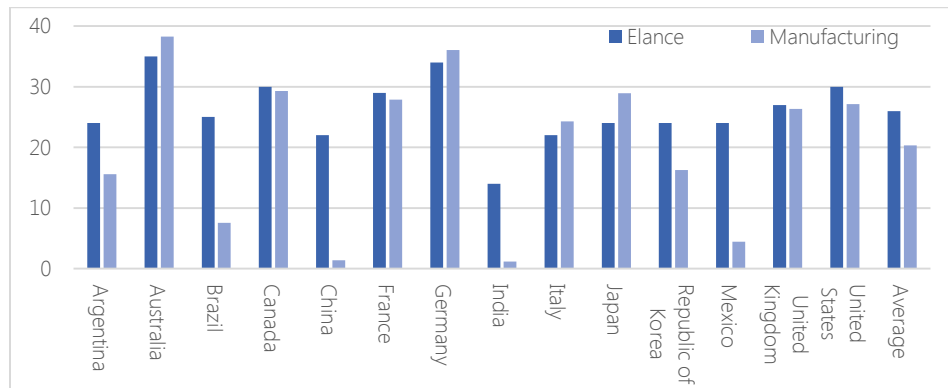
Matching tools. As the Internet and mobile networks have become widespread, they have become a medium to match workers with jobs or tasks at different geographic levels. At the city level, these matching services have helped to unlock unused rooms in homes (e.g. Airbnb), connected car-drivers with customers (e.g. Uber), and created markets for “gigs,” where a person undertakes specific and time limited tasks that are typically non-tradable (e.g. picking up groceries or delivering packages). At the national and global levels, matching platforms have emerged that help employers and workers connect with each other. In some cases, these platforms focus on jobs (e.g. Monster.com or SoukTel Jobmatch),¹⁶ while in other cases, they focus on tasks.

Platforms such as oDesk-Elance and Amazon Mechanical Turk allow people to work online. In the case of oDesk-Elance, and similar online contracting platforms, online workers connect with employers who set up a one-to-one relationship for a particular task, and where the supervision

of and payment for that task is completed through the platform. As workers and employers connect on the Internet, and the work is virtual, it is possible for employers to tap into global talent pools, and for workers to seek tasks globally as well, overcoming limited local demand. The result in many cases is that workers in countries that have globally relevant skills can potentially earn more per hour than average wages in their country (see Figure 4, which compares average hourly rates earned on one online work platform with direct wages in manufacturing).

Crowdsourcing platforms such as Amazon Mechanical Turk (AMT), allow employers to define a task that is then automatically disaggregated into “microtasks” and performed by a number of anonymous microworkers. Again, payments are processed through the AMT platform. These are two of the more well-known platforms, and many others exist. A third model combines elements of these; the employer hires an intermediary party who has hired and trained workers to do specific tasks. Many of such services are known for ‘impact sourcing,’ that is they aim to merge the crowdsourcing model with social impact as these services often aim to hire and train (and graduate) workers from socially vulnerable or marginalized groups, e.g. the poor, women, or people with disabilities.

Figure 4: Average hourly online work rates compared with direct wages in manufacturing¹⁷



3 Emerging challenges

The emerging consensus is that technology will complement workers in every job of the future, and some of today’s jobs will likely be substituted by technology. This means that the jobs of the future will be either digital jobs or jobs that use digital tools. There is, however, little consensus on when these changes might take hold, at what pace they might appear, and how the gains and losses from these changes will be distributed.

Hence, there are growing concerns about whether the adoption of improved and lower-cost technology by businesses and governments could have negative impacts on employment or lead to inequality, allowing some part of the population to benefit greatly, while others might find themselves with limited economic opportunities. Four key themes being debated in the literature are: (i) the extent to which jobs are susceptible to be replaced by technology or face massive reductions in wages; (ii) the concern of growing inequality in the quality and remuneration of jobs, and that if technology contributes to wage and wealth polarization, there is a risk of hollowing out of the middle class and increased tensions in society; (iii) the evolving nature of

employment relationships themselves and the implications for risks individuals face; and (iv) growing divides of those who do not even have access to digital opportunities and whether they can even catch up.

Job susceptibility

As technology becomes smarter, it is likely that entire jobs or a subset of the skills embedded in a job might be digitized. For example, advances in office technology since the 1980s have meant that few businesses hire typists any more. The responsibilities of clerical staff have had to shift, often along with their wages.

It is possible that jobs and tasks previously thought of as un-automatable could become digitized in the future. One widely cited study on this trend suggests that “about 47 percent of total US employment is at risk” from computerization. They divide jobs into “high, medium and low risk occupations, depending on their probability of computerization.” Notably, they “focus on potential job automatability over some unspecified number of years.”¹⁸ This echoes other studies that suggest that some share of occupations of today will not exist in the future.¹⁹

It is critical to note that the elimination of specific types of occupations does not mean that those many people will be out of work. This is because some of those who were working in those occupations will transition successfully to other jobs. It is also because new occupations will exist in the future that might not exist today. For example, online work platform Elance has a ranking of job categories most in demand. As of April 2015, some of these in-demand jobs included Internet marketing, blogs, and e-commerce jobs, and there were about 26,000 open jobs, paying hourly rates of between US\$16 to 22 on average.²⁰ These jobs did not exist until very recently.

Polarization of job quality

Various studies have shown that technological change is typically skill-biased, in that its adoption by employers would benefit workers with higher skills rather than those who might be unskilled.²¹ Recent research has added nuance to this discussion, suggesting that such skills-biased technological change is not monotonous in its outcomes.

Research is now showing that technology has begun to polarize the labor market. They raise demand for workers that have the skills that are either needed to manipulate technology or are creative—hence, cannot be substituted easily by technology—or that are non-routine and are currently performed better by humans and hence cannot be substituted easily. However, machines substitute for workers doing routine jobs that have typically been codifiable and hence can be automated to a larger extent even with today’s technology.

Polarization of the labor market has been well studied in a number of developed countries especially in the U.S. and in some European countries. The trend there has been that middle-class jobs have been automated to a great extent, causing a falling demand for those workers. For example there is a decline in jobs associated with the middle class in many countries, such as “sales; office and administrative support; production, craft and repair; and operator, fabricator and laborer.”²² And one study on the effect of robots—using data from the U.S., 14 European

countries, the Republic of Korea, and Australia—finds that while they did not have a significant effect on the total hours worked, they did reduce the hours of low- and middle-skilled workers.²³

However, there is little research yet done on the possibility or existence of labor market polarization in the emerging economies. Anecdotal evidence suggests that in countries such as India or China, technology might actually be creating middle class jobs either directly through the rise of the IT enabled services sector and other digital jobs, or through the ability of previously unconnected individuals or firms to use digital tools (e.g. the growth of SMEs in rural China). Hence, there might be divergent experiences of countries, but this is not yet studied in depth, and could be a productive area of research considered by the G20 member countries.

This trend of polarization has led to concerns about the possible impact of technology on both wages and job quality. Some workers would have jobs with higher wages (and have higher levels of skills specialization and creativity, and do many non-routine tasks) while others might be stuck with lower wages, and could face increasing pressure on wages as these jobs do not need a mix of skills that is scarce. As one, more provocative, rendering of this debate suggests, the world of work will polarize into “lovely” jobs and “lousy” jobs.²⁴

The nature of employment itself is changing, shifting more risks to individuals

Technology is changing the nature of work more broadly. These changes have implications not only for job quality and earnings, but also for the types of risks individuals bear.

The links between workers and employers is shifting. Microtasks and much online work involves short-term work. Workers can perform tasks for many people that they never meet. Contracts, if they exist, are short. Workers have flexibility in the hours they work, but no guarantees the desired hours of work will be there. Work requestors can offer any amount of payment for a task, in some cases higher than local wages, but there is no “minimum wage” and little protection for workers in the case of disputes. There are concerns about the “virtual sweatshop” created by technology platforms that are largely unregulated. Workers also do not have the possibility of organizing effectively to demand or protect their rights as these types of platforms are anonymous, and there might be social stigma attached to identifying oneself as a participant on these platforms.²⁵

These digital tools are creating a new informal “gig economy,” where workers can combine a number of disconnected tasks to earn their incomes. In many cases, these gig economy platforms have disrupted traditional markets in the ‘real world’ as well; for example, Uber has confronted taxi unions and regulators in a number of countries, while Airbnb (which allows someone to rent out their residence partly or in entirety) has challenged the hotel industry. Concerns about these platforms include the lack of price floors, little social safety nets, and difficulties in regulating the entry and behavior of workers, customers, and the platforms themselves. Regulating these platforms has proven to be challenging.

There are significant implications for social safety nets. For example, as the returns to jobs of high quality increase over time, and the possibility of falling wages for lower-skilled jobs looms large, it might be necessary to think about minimum wage levels to ensure that individuals do not find themselves falling into poverty. There may also be a need to think about the consequences of individuals’ movement across categories of jobs, towards multi-tasking, or towards informal

work for their ability to access social insurance program (e.g. health insurance or pensions) that remain tied to employment status in many countries.

Being left behind?

Lastly, there is a whole additional level of cost when individuals cannot even access the opportunities of technology. As the digital divide expands, there is a concern that catching up may become harder rather than easier as the supporting environment for successful technology adoption become more demanding. Internet access is varied across countries. McKinsey & Company estimates that “between 1.1 billion and 2.8 billion individuals cannot get online via the mobile network because they do not live within sufficient mobile network coverage.”²⁶ Moreover, they estimate that there are about 4.4 billion people not on the Internet worldwide, of which about 75 percent are in twenty countries (see Figure 5).

There are similar differences within countries. In many G20 member countries, for example, major cities and towns are very well penetrated by Internet and even high-speed broadband services. But with few exceptions, a significant share of rural or remote communities and in some cases, smaller towns are poorly connected to even basic Internet services. Divisions also appear within communities across different demographic groups. For example, women, older people, and the poor are less likely to be online, and people with disabilities also face various barriers. These are also the groups that would likely benefit the most from being able to access these tools.

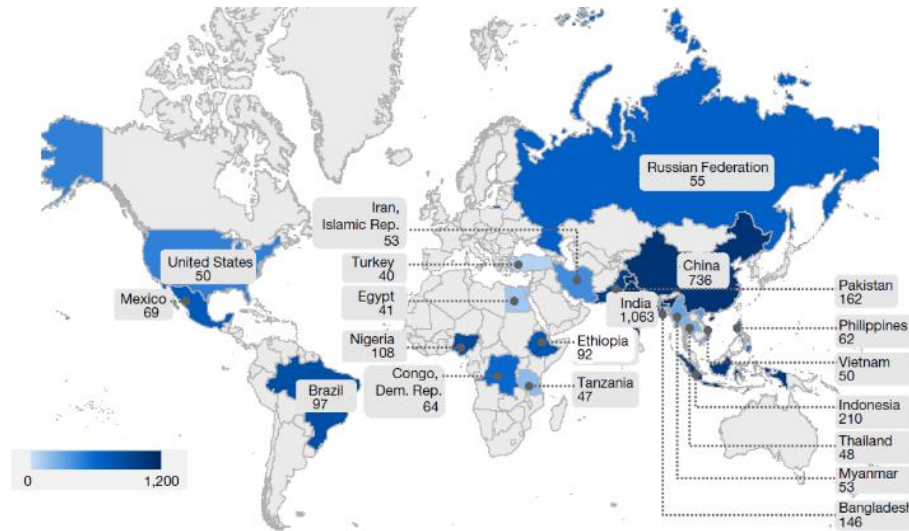


Figure 5: Size of offline population in 2013. Source: McKinsey & Company.²⁷

This implies a divide in the ability of workers’ access to digital tools. Unconnected workers are unable to access the various e-payment systems, online work platforms, or even e-commerce services that workers (and businesses) in connected areas might take for granted. This creates a risk that the effects of earlier divides might be exacerbated.

4 Policies and programs to leverage the potential of technology

Businesses, individuals, and governments have time to prepare. But they cannot afford to be complacent. The children who started school in 2015 will be working by 2030: Will they be ready for the world of work they will enter? Similarly, the young people who have started working now will retire in about 2050. Do they have the skills and the opportunities to prosper even as technology may fundamentally change their occupations? What might be the impact if their economies do not create enough good jobs or if technological adoption increases polarization or increases risks for workers? These questions concern both advanced and emerging economies (**Box A**).

Governments will need to consider specific actions to expand the opportunities that technologies bring. This will help to address the challenges, although not completely, so governments will have to consider additional actions. Four strategic sets of policies and programs that a government could consider to maximize the positive effects of technology on employment, while

Box A: The risks to emerging and advanced economies

The advanced economies, and those emerging economies that have invested in infrastructure, skills, and reforms, will likely see continued benefits from improved access to technology. At the same time, these might be the countries that are at the greatest risk of technological shifts due to prevalence of technology in their economies.

The emerging economies that have “bet” on technological progress as a means to economic growth face risks to those gains, now that technology might take away these jobs or relocate them back to the advanced economies. They will need to innovate and find new sources of demand and growth to maintain momentum. Advanced countries will need to ensure that legacy infrastructure and systems do not hold back innovation, even as technology might increase susceptibility of some jobs and increase risks of polarization.

Those that have not yet invested or have limited investments might not see a diffusion of technology to the extent that technological change is influencing employment. Yet they might suffer the consequences as they might not be able to use either technology-enabled manufacturing or services as a pathway towards prosperity. And they will face competition from countries that do use such technologies in global markets. They might need to start now to accelerate the likelihood that they can develop or secure sources of growth in the future.

mitigating the negative effects:

- Enable the creation of more digital jobs
- Increase access to digital tools
- Empower the workforce in a digital age
- Assist workers during the transition.

The underlying theme for these actions is to boost participation in technology-enabled employment, while preparing the workforce for possible disruptions. Creating more digital jobs and increasing access digital tools, while empowering the workforce will help expand opportunities and the ability of more people to move into positions where they are reaping the benefits of technology. This will address susceptibility of jobs to digitization and can help to mitigate polarization. An empowered workforce will also be able to manage better the new risks they face. However, these actions are not necessarily enough. Governments will need to address the challenge of some workers who are displaced by technology or are not being able to adapt quickly enough to the new world of work. These workers will need assistance, and a larger

review of labor policies and social protection policies may be needed as the nature of work and employment relationships change.

Enable the creation of more digital jobs

Digital jobs—which include both the direct technology jobs and the jobs where technology is a key tool for workers—have a number of positive characteristics. Even if the number of these jobs is relatively small, they are critical, as they create a capacity for technological innovation and adoption in an economy. No economy might be able to remain competitive if they do not invest some effort in developing this workforce.

These digital jobs will be created by private sector firms (and to some extent by public organizations) that innovate and grow. Hence, the focus for governments here are to create the conditions where these firms can start up, grow, and flourish. Governments can thus enable the creation of more of these digital jobs by:

- Creating the enabling policy and regulatory environment for entrepreneurship and innovation;²⁸
- Appropriate financing to support innovative startups and enterprises;²⁹
- Investing in the national innovation infrastructure, including telecommunications and cybersecurity and ensuring services are available and appropriately priced to ensure widespread access;
- Positioning the public sector as a demand-driver or ‘anchor tenant’ in adopting technology to catalyze private investment and innovation;³⁰
- Investing in the complementary infrastructures to ensure reliable electricity supplies, efficient logistics and safe transportation for workers;³¹ and
- Connecting educators with employers to reduce the lag in educational systems’ and skills development programs’ responsiveness to changing industry needs to ensure these digital jobs are filled.

Increase access to digital tools

The various digital tools that now exist create an opportunity for workers to use technology in ways that are complementary, allow for efficient transactions, and link them to markets and resources. Given emerging concerns about if and how governments should regulate these tools, especially matching tools, such regulation might be calibrated to ensure that workers’ rights are protected but that new opportunities are not precluded (**Box B**).

Affordable and reliable Internet access. For workers to benefit from these tools, however, they inevitably require at least reliable and affordable access to the Internet. Expanding access to the Internet has become a priority for most G20 member countries, and some of the members are among the leading Internet economies in the world. Yet, gaps remain, and it would be necessary to identify reforms and strategic, targeted investments that can help connect more people to these digital tools and the accompanying work opportunities.³²

Box B: Regulation of digital tools

Even as governments can support expanding access to the Internet and financial services, there is growing concern among some governments and in civil society that the use of these digital tools might lead to greater informalization of the workforce, might contravene labor laws and rules (e.g. minimum wage or licensing requirements, tax filing), and leave workers without the means to organize or seek meaningful dispute resolution. As recent decisions by various governments show, services such as Uber and Airbnb are coming under increasing pressure to adhere to the rules that are applicable to traditional service providers in those fields. Recognizing the need to balance the opportunity created for workers from access to digital tools,* with the need to protect workers (and consumers) from these risks, governments could consider taking a calibrated approach to regulation, while ensuring that both workers and consumers understand their rights and responsibilities.

* For a discussion on how platforms such as AMT create opportunities and risks for workers, see <http://www.newyorker.com/culture/culture-desk/video-turking-for-respect>.

Access to electronic payment systems. Such systems are essential for workers to be able to pay for resources and to be paid for their work. Payment systems that are global, and allow low cost and secure transactions, while ensuring compliance with international standards, are critical for online workers and those using digital tools in their businesses. Again, most G20 member countries have been leaders in innovating and adopting these systems, while being sensitive to the need to ensure user protection and security, and minimizing the risks from money laundering, for example.

Empower the workforce

Empowering the workforce to be both well-skilled and aware of their rights and responsibilities will prepare workers so that technology becomes a complement to them, as opposed to a substitute for them. For this, countries will need to build their human capital, ensure that their social safety nets evolve, and consider the mechanisms through which the rights of multi-tasking workers might be protected in a manner similar to single-job workers. Throughout these efforts, the role of public employment systems (PESs) would be critical. **Hata! Başvuru kaynağı bulunamadi.** discusses some of the possible ways in which PESs could both use technology and respond to it.

Human capital development. Perhaps the most important set of interventions relate to skills development. There are many programs worldwide focusing on bridging the gaps between formal education and employable skills and competencies.³³ Such bridging programs typically include the technical skills that employers seek, and the “soft” skills that help workers become more creative and better communicators, managers, and team-members.

The most effective programs to bridge education to employment focus on developing skills aligned with industry requirements. Those skills include technology- or industry-specific skills, but could also include broader skills, e.g. management, communication, language, critical thinking, and creative skills. Recognizing the global nature of digital jobs and the use of digital tools, an important part of some programs is language training. Widely available digital literacy

programs, including some programs targeted to the most vulnerable to falling behind in the digital age,³⁴ will also ensure that a larger group of people will be able to use digital tools.

Evolving social safety nets. As workers face the possibility of not having a traditional job, but doing a collection of tasks, the mechanisms of the social safety nets may also need to change. Programs such as health insurance schemes, pension programs, or other benefits (e.g. paid maternity leave, temporary disability benefits) have often been linked with a job. It might be necessary to consider new mechanisms to permit workers to access similar types of programs and benefits even if they are no longer working in a traditional environment. Examples of such programs could emerge from the private sector. Online work marketplace oDesk has both a health insurance program and retirement plan available for North American freelancers working on its site for at least 30 hours a week for one month.³⁵ Even in emerging economies that might have less extensive social safety nets, it will still be critical for governments to consider how to develop programs that are not based on a traditional employment relationship for eligibility or funding.

Protecting workers' rights. Given the relatively recent experience with online platforms, it is yet unclear what mechanisms workers have available to them that could provide them both a voice and means to protect their rights, either with their employers or their end-customers. In many cases, these platforms do offer some alternative dispute resolution mechanisms and tools, but in the case where workers might be earning small amounts of money from a large number of tasks, it might not be worthwhile for them to pursue claims. This matter is complicated by the global nature of these tasks, that is, that a worker (or employer) might have a claim against someone in another country that connected with them through a platform that operates from a third country. At some point, the costs of these claims could be substantial. Discussion will be needed to identify ways in which protections might extend to these workers and if and how they might differ from protections offered to other informal workers (also see **Box B**).

Assist workers during the transition

Some workers might not be able to adapt to technological change quickly enough for a range of reasons. Specific programs to assist these workers through this transition might be necessary to ensure that they do not bear an inappropriate burden, even as society prospers as a whole. This might need an inclusive dialogue on how the benefits of technological progress might be shared across society.

Create targeted assistance programs. Some workers might not have the means to learn new skills that avoid keeping them from slipping in terms of their incomes or job quality. For example, older workers,³⁶ or workers with disabilities³⁷ might face specific social, technical, or physical barriers to being able to adapt to new systems or techniques, and hence bear an additional burden. Governments could consider working closely with businesses and training organizations to ensure that such workers can be assisted through this transition.

Specific training programs aimed at vulnerable populations might be considered. Such programs would need to identify possible opportunities to ensure that these workers are trained for work that has a lower risk of digitization, to reduce longer-term risks. Specific assistive technology or accommodations might be necessary for workers with disabilities or older workers, to ensure that they have access to digital tools, along with the knowledge to use them.³⁸

Safety nets in terms of income support during such a transition might also be considered. In these cases, however, incentives should be structured to ensure that these workers get back to work in the shortest time possible. Better protections could empower more people to seek out new opportunities, reinforcing the potential for better outcomes.

Fostering an inclusive dialogue. Finally, given the concerns about the risk of concentration of the benefits of technological advancement in the hands of a few—evidenced by labor’s falling share of income—it might be necessary to engage meaningfully across civil society, governments, and businesses to ensure that workers and businesses both benefit from the abundance that will be created through higher productivity and resulting growth.³⁹

5 The implications for public employment services

Public employment services (PESs) could anticipate and respond to the opportunities and challenges created by how employers and workers use technology. They could also use these same tools, increasing their ability to collect and process information, and in expanding the reach of their services to jobseekers and workers.

Use smart techniques to improve understanding of how labor markets are functioning. Using the same smart techniques, e.g. big data or analytics, they could collect more information on which businesses are hiring, and where. Close collaboration between PESs, employers, and statistical agencies will ensure collection of timely and adequate data.

Use smart techniques to improve matching of employees with employers. Private services are already using big data and analytics to help improve matching of resumes with job openings. Online testing and evaluation methods to identify candidates with appropriate mixes of skills (e.g. cognitive, non-cognitive, and technical) are also evolving. PESs could also use similar tools to improve matching of potential employees with their jobs or employers.

Raising awareness about digital opportunities. PESs could play an important role in helping employers and workers realize the benefits of technological advancement, while themselves using technology to improve their functioning. For this, PES staff need to be trained and made aware of the opportunities (and challenges) arising from wider use of technology.

Improve links between educators and employers. Noting that the links between employers and educators are often weak, PESs could improve skills development programs by creating stronger links, especially to identify what skills are most in demand in the market and thus prepare jobseekers get better jobs, while reducing the delays businesses face in securing human resources. PESs could provide appropriate skills development advice and implement targeted programs to address the challenge. This could be a significant opportunity to quickly address existing youth unemployment, for example, while closing skills gaps.

Facilitating access to digital tools. PESs could consider ways in which they facilitate access to various digital tools to help beneficiaries, especially those who might not otherwise have access to them. A specific focus could be to provide technical support and training to workers on these digital tools, including matching services. The business model of PESs could include working more closely with various private online services and technology providers.

Strengthen networks of digital workers. PESs can also provide the platform for the creation of support groups, networks of workers, and other social networking opportunities to allow individuals to learn from each other's experiences. This is critical given the relatively limited opportunities for online workers to interact among themselves. A PES could also take a more active role in informing people on their social obligations (e.g. paying taxes) and rights (e.g. insurance, pension) given the changing nature of the employer-employee relationship.

Assisting workers to understand risks. PES staff could play a critical role in ensuring that workers who face either job or wage losses can both pre-empt but also respond quickly to these developments. This includes building awareness about PESs for workers who face new risks to their jobs and might not have otherwise been aware of the services PESs offer. Forward-looking analysis—also using smart techniques—of potentially susceptible occupations, and outreach activities to workers in identified occupation could be one strategy.

Assist workers facing a transition. As noted earlier (see page 12), PESs will play a critical role in delivering training, tools, and support to those workers that might find their jobs at risk of digitization, or already digitized. They might need a specific focus on those at greatest risk of being left behind in the digital economy.

G20 member countries have rich experience on many of these possibilities. Knowledge exchange among government agencies and PESs would be an important mechanism to identify actions that maximize the opportunity of digital jobs and tools while empowering and assisting workers.

Notes and references

¹ See World Bank, Information & Communication for Development (IC4D) 2009, and World Bank, IC4D 2012. Available at: <http://go.worldbank.org/0J2CTQTYPO>

² McKinsey Global Institute, Disruptive technologies: Advances that will transform life, business, and the global economy, May 2013m available at: http://www.mckinsey.com/insights/business_technology/disruptive_technologies

³ See OECD, New perspectives on ICT skills and employment, 2005, available at: <http://www.oecd.org/internet/ieconomy/34769393.pdf>

⁴ OECD estimates, based on national sources; STAN and National Accounts databases, February 2012

⁵ Angelica Mari, IT sector creates majority of jobs in Brazil, July 3, 2013, available at: <http://www.zdnet.com/article/it-sector-creates-majority-of-jobs-in-brazil/>

⁶ Nelson Vasconcelos, Ainda há vagas, April 7, 2015, available at: <http://brasileconomico.ig.com.br/tecnologia/coluna-nelson/2015-04-07/ainda-ha-vagas.html>

⁷ NASSCOM, Impact on India's Growth, available at: <http://www.nasscom.in/impact-indias-growth>

⁸ Analysis based on data from <http://www.worldsalaries.org/computerprogrammer.shtml>

⁹ A survey by the McKinsey Global Institute found that in 2011, a quarter of surveyed employers in Europe had reported difficulty “filling jobs for lack of qualified talent, particularly technicians and engineers.” These concerns extend to emerging economies as well. India's NASSCOM projected that the country face a shortfall of half a million skilled workers in 2010.

¹⁰ See, for example: http://sites.tufts.edu/jennyaker/files/2010/09/aker_nigercell.pdf; <http://www.economist.com/node/9149142>

¹¹ See, for example: <http://www.economist.com/news/china/21602755-one-small-hamlet-teaching-people-how-sell-online-cash-cow-taobao>; <http://www.npr.org/blogs/goatsandsoda/2014/09/11/347481629/alibaba-and-taobao-how-china-s-ebay-transformed-a-rural-village>

¹² Ebay, Marketplaces Fast Facts at a Glance Q4 2014, available at:

<http://www.ebayinc.com/sites/default/files/MP%20Factsheet%20Q4%202014.pdf>

¹³ McKinsey Global Institute, Global flows in a digital world, 2014, p. iii, available at:

http://www.mckinsey.com/insights/globalization/global_flows_in_a_digital_age

¹⁴ Economic Times (India), E-commerce transforms lives of blue-collar workers, earning as much as their white-collar counterparts, January 28, 2015, available at: http://articles.economictimes.indiatimes.com/2015-01-28/news/58546987_1_driver-partners-delivery-boys-bhavik-rathod

¹⁵ McKinsey Global Institute, Internet matters: The Net's sweeping impact on growth, jobs, and prosperity, p. 21, available at:

http://www.mckinsey.com/insights/high_tech_telecoms_internet_matters

¹⁶ Jobs listing tools such as Monster.com link job seekers and employers across 40 countries. Every minute, Monster.com sees 7,900 jobs searched and 29 resumes uploaded. In some countries of the Middle East and Africa, SoukTel's JobMatch matches job-seekers with employers via the Internet and on mobile devices.

¹⁷ Source: Elance.com; ILO KILM 8th Edition

¹⁸ Carl Benedikt Frey and Michael A. Osborne, *The Future of Employment: How Susceptible Are Jobs to Computerisation?* 2013, p. 44, available at: http://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

¹⁹ See, for example: <http://www.washingtonpost.com/posteverything/wp/2015/01/05/in-10-years-the-job-market-will-look-totally-different-heres-how-to-make-sure-youre-ready/>; <http://www.futuristspeaker.com/2011/11/55-jobs-of-the-future/>

²⁰ Elance, available at: <https://www.elance.com/trends/skills-in-demand>

²¹ See, for example, David Autor, *The Polarization of Job Opportunities in the U.S. Labor Market: Implications for Employment and Earnings* (Washington DC: The Center for American Progress and The Hamilton Project, April 2010); McKinsey Global Institute, *Help wanted: The future of work in advanced economies*, (New York: McKinsey & Company, Inc., March 2012):

http://www.mckinsey.com/insights/employment_and_growth/future_of_work_in_advanced_economies; Autor, David H., and David Dorn.

2013a. “The Growth of Low Skill Service Jobs and the Polarization of the US Labor Market.” *American Economic Review*, 103(5): 1553–1597;

Autor, David H., Frank Levy, and Richard J. Murnane. (2003). “The Skill Content of Recent Technological Change: An Empirical Exploration.”

Quarterly Journal of Economics, 118(4): 1279–1333; Brynjolfsson, Erik, and Andrew McAfee. 2011. *Race Against the Machine*. Digital Frontier Press;

Michaels, Guy, Ashwini Natraj, and John Van Reenen. 2014. “Has ICT Polarized Skill Demand? Evidence from Eleven Countries over 25 Years.” *Review of Economics and Statistics*, 96(1): 60–77.

²² David Autor, Polanyi’s Paradox and the Shape of Employment Growth, NBER Working Paper No. 20485, 2014, p. 13, available at:

<http://www.nber.org/papers/w20485>

²³ Georg Graets and Michaels Guy, *Robots and Work*, 2015, CEPR Discussion Paper No. DP10477, available at:

<http://ssrn.com/abstract=2575781>

²⁴ Maarten Goos and Alan Manning, *Lousy and Lovely Jobs: the Rising Polarization of Work in Britain*, *The Review of Economics and Statistics*, MIT Press, vol. 89(1), pages 118–133, available at: <https://ideas.repec.org/a/tpo/restat/v89y2007i1p118-133.html>

²⁵ Sarah Kessler, *Pixel & dined: On (not) getting by in the gig economy*, *Fastcompany*, March 18, 2014, available at:

<http://www.fastcompany.com/3027355/pixel-and-dined-on-not-getting-by-in-the-gig-economy>

²⁶ McKinsey & Company, *Offline & falling behind: Barriers to Internet adoption*, 2014, available at:

http://www.mckinsey.com/insights/high_tech_telecoms_internet/offline_and_falling_behind_barriers_to_internet_adoption

²⁷ McKinsey & Company, *Offline & falling behind: Barriers to Internet adoption*, 2014, p. 3

²⁸ World Bank, *Innovation Policy for the Developing World*, 2010, available at:

<https://openknowledge.worldbank.org/bitstream/handle/10986/2460/548930PUB0EPI11C10Dislosed061312010.pdf?sequence=1>

²⁹ World Bank, *Fostering Innovation for Productivity and Competitiveness*, 2013, available at:

<https://openknowledge.worldbank.org/handle/10986/16580>

³⁰ Yongsoo Kim, Tim Kelly & Siddhartha Raja, *Building Broadband: Strategies and policies for the developing world*, 2010, World Bank, available at: http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/282822-1208273252769/Building_broadband.pdf

³¹ Siddhartha Raja, Saori Imaizumi, Tim Kelly, Junko Narimatsu, and Cecilia Paradi-Guilford, *Connecting to Work : How Information and Communication Technologies Could Help Expand Employment Opportunities*, 2013, World Bank, available at:

<https://openknowledge.worldbank.org/handle/10986/16243>

³² See the World Bank Group, *Broadband Strategies Toolkit*, available at: <http://broadbandtoolkit.org/en/home>

³³ For a detailed examination of some programs that bridge the gap between education and employment, see McKinsey Center for Government. *Education to Employment: Designing a System that Works*, 2013:

http://www.mckinsey.com/client_service/public_sector/mckinsey_center_for_government/education_to_employment

³⁴ See, for example, the Republic of Korea’s “Ten Million People Internet Education Project (2000–2002),” details at: Myung Oh, James Larson, *Digital Development in Korea: Building an Information Society*, 2011, p. 134

³⁵ oDesk: https://www.odesk.com/info/odeskpayroll_contractor/

³⁶ See, for example: Chin Chin Lee, Sara J. Czaja, and Joseph Sharit, “Training older workers for technology-based employment,” *Educational gerontology* Vol. 35 Issue 1, 2009, pp. 15–31 available at: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2846373/>

³⁷ See for example: http://www.mcass.gov.on.ca/en/mcass/programs/accessibility/understanding_accessibility/understanding_barriers.aspx

³⁸ See for example: <http://www.mdod.maryland.gov/mtap.aspx?id=180>; http://www.cael.org/pdfs/tmt_new_approaches_awi_grantees

³⁹ For such a call, see Andrew McAfee, *What will future jobs look like?* Available at:

http://www.ted.com/talks/andrew_mcafee_what_will_future_jobs_look_like?language=en