



G20 NOTE: TECHNOLOGY AND JOBS IN THE DEVELOPING WORLD

Prepared by the Jobs Group of the World Bank



Technology and Jobs in the Developing World

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Abstract:

Digital technologies (robotics, ICT, artificial intelligence) will transform the world of work. The opportunities come alongside threats, as the virtuous circle of growth and productivity gains accompanies changes in the types of skills that employers demand, the relationships between employers and workers, and the trade flows between countries. What might be the effects on developing countries, and especially on the poorer segments of the population within them? They often do not have access to technology nor the skills or enabling environment to benefit from it, while at the same time bearing the brunt of the risks. This note discusses the risk of deepening inequality, across and within countries, due to technological change. It argues that reaching the twin goals of eradicating extreme poverty by 2030 and fostering (globally) shared prosperity will need developing countries to take maximum advantage of the opportunities technology offers. This would happen if they: (i) address bottlenecks in technology access; (ii) invest in skills; (iii) create the enabling business environment; (iv) while ensuring that the poorer and vulnerable groups are not excluded.

Introduction

Digital technologies (robotics, ICT, artificial intelligence) will transform the world of work. They bring opportunities for growth and prosperity by improving labor productivity, lowering transaction costs and reducing barriers to market entry. This will in turn accelerate innovation, inducing a virtuous circle of growth and productivity gains. Yet, technology also changes the types of skills that employers demand as well as the relationships between employers and workers, and the trade flows between countries.

Richer countries, and the better skilled and better connected within countries, stand to benefit most. But developing countries, and especially the poorer segments of the population within them, often do not have access to technology nor the skills or enabling environment to benefit from it, while at the same time bearing the brunt of the risks. Hence, there is a fundamental danger that inequality will deepen, across and within countries, undermining the prospect of globally shared prosperity itself. Much of it will depend on what will happen to the patterns of employment.

Most of the discussion so far has concentrated on the labor consequences for the developed world. This note reflects on the implications for developing countries. It concludes that to reach the twin goals of eradicating extreme poverty by 2030 and fostering (globally) shared prosperity developing countries will need to vigorously address bottlenecks in technology access and invest in building the skills and enabling business environments to take maximum advantage of the opportunities technology offers. This while ensuring that the poorer and vulnerable groups (the bottom 40 of the income distribution-B40) are not excluded from the process.

Threats and Opportunities

Digital technology directly and indirectly affects some of the key economic forces that shape the organization and location of production and exchange, and thus the world of work. This is because it facilitates automation, connectivity and market entry, as well as innovation.

Automation expands the range of tasks machines can cover and the precision with which they do so. And increasingly sophisticated technologies have become less expensive, making it easier to replace labor (e.g. robots taking over routine tasks), but also to augment it (e.g. robots assisting surgeons).^a ICT increases access to information, lowering transaction costs and increasing market scale and competition.^b Technology can also reduce the fixed cost of production (e.g. 3D printing), reducing economies of scale, and thus the barriers to market entry.^c These processes accelerate innovation, in business process and product development,^d instigating new opportunities and a virtuous circle of development.

Technology changes the parameters of these economic forces (the price of capital versus labor, the fixed cost of investment, the cost of transacting, and the speed of innovation). This fundamentally changes the organization and location of production, and exchange, and thus the quantity, quality, and distribution of jobs. The effects may be felt directly (substituting or complementing labor) or indirectly at another location (e.g. through trade). They can be positive or negative (Table 1), depending on the context, including the extent of technology diffusion, the demographic composition (aging versus youth bulges), the enabling business environment (skill mix, supportive infrastructure and institutions), the reigning labor market regulations, and the trading environment. As a result, the effects will differ between

^a For example, the global automotive industry installed 98,900 robots in 2014. IBM's Watson AI assists oncologists to diagnose lung cancer; automation causes middle-skill job creation to stagnate and drives down wages.

^b Mobile phones ease farmers' access to market information, improving earnings. 'Car sharing' services link riders with underutilized drivers but put traditional taxis out of work.

^c 3D printing helps manufacturers cut prototyping and testing costs.

^d Computer animation has created 80,000 jobs in India and 64,000 jobs in the U.S. but displaced traditional animator jobs.

developed and developing countries, and between the skilled and connected and the unskilled, poorer, and excluded populations within these countries.

Table 1: The dimensions of technology's impact on jobs		
	Positive effects	Negative effects
Quantity of jobs	<i>Access to markets and resources</i> , due to improved connectivity, helps firms grow and create jobs, or attract work to new markets that are more competitive.	<i>Susceptibility of today's jobs</i> due to automation, as machines can take on more tasks, or due to innovation reshaping industries and firms.
	<i>Product innovations</i> , created and distributed using various technologies, give rise to new industries, firms, and jobs.	<i>The nature of jobs change</i> , as technology reshapes and alters connections among workers, work, and employers.
Quality of jobs	<i>Productivity increases</i> due to the augmentation of workers' capabilities through automation; leads to related increases in wages, improvements in working conditions.	<i>Workers bear more risk</i> , as connectivity reorganizes where work is done and by whom, diffusing the traditional formal employer-worker relationship.
		<i>Wages stagnate or fall</i> , as technology allows employers to automate or trade more tasks; this could lead to wage polarization and inequalities depending on task content of jobs.
Distribution of jobs	<i>Inclusion of previously disconnected workers</i> , as connectivity and automation lowers search costs and helps workers overcome physical and social barriers; firms can overcome skills constraints to grow, creating jobs.	<i>Exclusion or lagging participation</i> means that workers, employers, and economies would suffer missed opportunities and from degrading competitiveness

Perhaps the most talked about effect today, especially in developed countries, is the displacement of labor, with technology *substituting for human effort* in some or most tasks, as the capital/labor price ratio drops. The starker of these predictions suggest that many occupations will be automated away, and job losses will be significant.^a The more nuanced suggest that some occupations might be entirely susceptible to automation, but that more might be transformed as some share of tasks are automated or traded. The process also bears on the labor markets in developing countries.^b

The decline in low and middle skilled occupations in developed countries due to outsourcing of labor intensive manufacturing (China) and more recently also routine services (India) from developed to developing countries following improved connectivity and market liberalization has been widely

^a Frey & Osborne

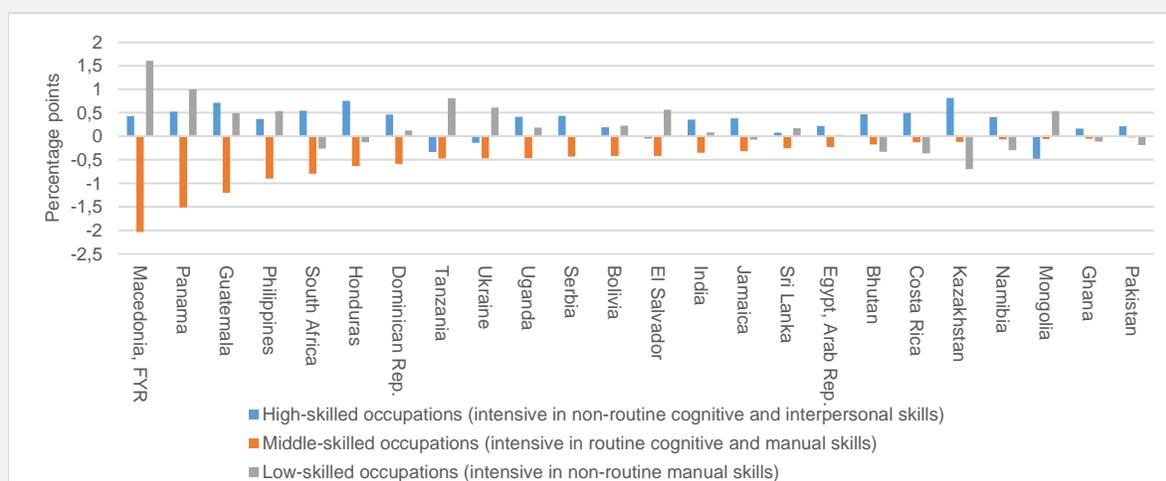
^b Arntz, M., T. Gregory and U. Zierahn (2016), "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis", OECD Social, Employment and Migration Working Papers, No. 189, OECD Publishing, Paris.

documented.^a It has underpinned the labor-intensive export led development model of many developing countries, especially in Asia. It has also helped East Asia's reduce extreme poverty.^b

Yet, following recent advances in automatization in the developed world, altering the capital/labor price ratios again, reshoring of these *tasks* (not necessarily jobs) has started.^c This threatens to close the door for labor intensive export led development as pathway out of poverty. This is especially problematic for low-income countries with a youth bulge, as in most African countries. In the absence of clear alternative development models, it also raises the specter of growing inequality between countries, increasing for migration. Gaps in mean incomes already account for more than 80 percent of global income differences, with unskilled workers' wages in rich and poor countries often differing by a factor of 10 to 1.^d

The direct effects of automation on the demand for low and routine medium skilled tasks in middle- and lower-income countries themselves may be limited for some time, as firms there are slower to adopt digital technologies. Yet, at least some workers and firms are using such technologies to be more productive, have better access to markets, and become more innovative.^e Combined with the reshoring of these tasks to developed countries (and further off-shoring to lower income countries), this is already introducing a decline in medium skilled occupations in many (lower) middle income countries and a polarization of their labor market, raising the specter of growing inequality within countries (**Figure 1**).

Figure 1: Labor markets might be polarizing (annual average change in employment share, circa 1995- circa 2012)



Source: World Bank, *World Development Report 2016*, page 121

But given high transaction costs, the broader economic payoffs from adopting the new digital technologies can also be large. It facilitates business and product development, also providing opportunities for employment generation. The adoption of mobile telephones and applications such as mobile money and e-agricultural services are commonly cited examples of such leapfrogging. Reduction in the fixed cost of investment and technology adoption (e.g. 3D printing) further reduces barriers to

^a Autor, David, H., David Dorn, and Gordon H. Hanson. "Untangling trade and technology: Evidence from local labor markets." *The Economic Journal* 125.584 (2015): 621-646.

^b See, for example, Quibria, M.G. (2002). *Growth and Poverty: Lessons from the East Asian Miracle Revisited*. Asia Development Bank Research Paper 33.

^c See Kapoor, R., *Technology, Jobs and Inequality: Evidence from India's Manufacturing Sector*, ICRIER, February 2016: http://icrier.org/pdf/Working_Paper_313.pdf

^d Branko Milanovic, 2012. "Global Inequality: From Class to Location, from Proletarians to Migrants," *Global Policy*, London School of Economics and Political Science, vol. 3(2), pages 125-134, 05.

^e See <http://www.theverge.com/2016/4/5/11367274/zipline-drone-delivery-rwanda-medicine-blood>; <http://www.digitaltrends.com/cool-tech/zipline-rural-medical-drone-delivery/>

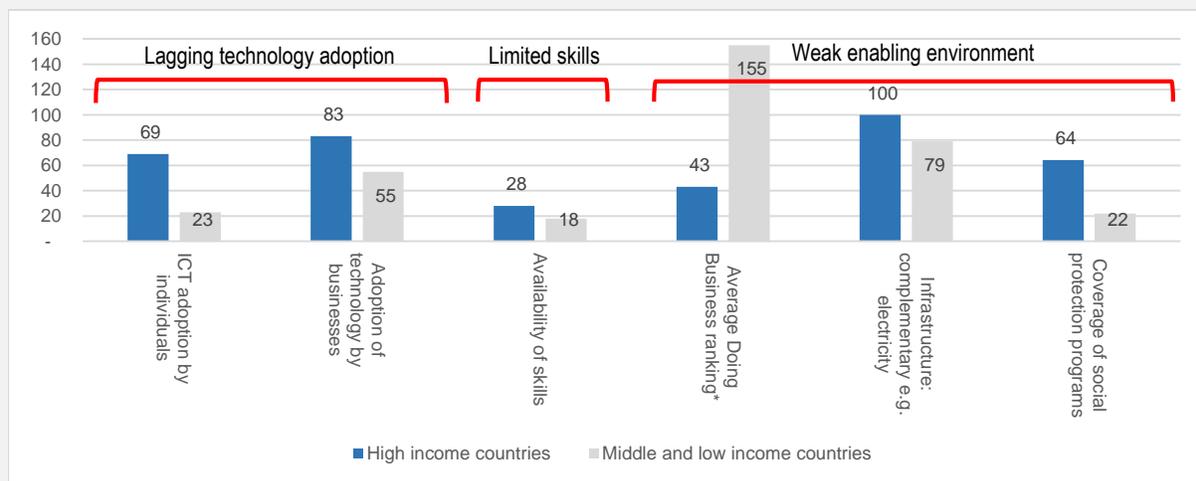
market entry, enabling also smaller firms to participate in production or distribution activities. This can increase labor productivity of skilled and unskilled individuals in urban and remote areas alike.

Digital technologies are also *disrupting the traditional employer-worker relationships*. They allow new forms of work (e.g. the ‘gig economy’) and delink workers from employers. With many social security benefits linked to traditional employment arrangements, workers may lose many benefits and protections. Given that informality is prevalent in the developing world, there is likely less of a concern about workers losing full time formal employment (and the attendant social protections). Indeed, the digital technologies that enable the ‘gig economy’ could also foster transparency in the labor market (e.g. about demand and wages), and create opportunities for workers to access markets far away. These technologies have at times even empowered informal workers in India and improved their ability to get wage raises.^a

Reinforcing and counteracting forces

While digital technologies thus present threats, they also hold opportunities for the employment agenda in developing countries. Yet, many countries lack the means to take full advantage of these opportunities (**Figure 2**), because of limited access to technology, a lack of skills as well as the absence of a broad enabling environment (“analog complements”).^b

Figure 2: Divides between advanced and emerging economies (c. 2014)



* Note that this number represents the average rank of countries, hence, a lower number is better.

Notes: Availability of skills: Labor force with tertiary education (% of total); Average Doing Business ranking: Average of rankings (all high income vs all low income countries); ICT adoption by individuals: Internet users (per 100 people); Infrastructure: Access to electricity (% of population); Adoption of technology by businesses: Percent of firms having their own Web site (OECD vs ECA); Coverage of social protection programs: Percentage of unemployed receiving unemployment benefits (Western Europe vs Central & Eastern Europe)

Technology access in the developing world often lags the developed world, and within countries, it is typically, major cities and towns that are online. Most rural or remote communities, which house four fifths of the poor^c are not, or they face higher prices or poorer quality services. Divisions also exist across different demographic groups. Women, people with disabilities, social and ethnic minorities, and older people lag behind in access to and use of digital technology.^d Many individuals and businesses will thus

^a Siddhartha Raja, Saori Imaizumi, Tim Kelly, Junko Narimatsu, and Cecilia Paradi-Guilford, *Connecting to Work*, World Bank, 2013, page 23; available at <http://documents.worldbank.org/curated/en/290301468340843514/pdf/809770WP0Conne00Box379814B00PUBLIC0.pdf>

^b See World Bank, *World Development Report 2016, Overview*.

^c *Taking on inequality*, 2016, World Bank Poverty and Shared Prosperity Report.

^d World Bank, *World Development Report 2016, Chapter 2*

be unable to take advantage of technology to improve productivity and incomes, simply because they do not have access to the “hardware.”^a

But even if the technology is available, *limited skills* imply that fewer countries, and businesses and individuals within countries, will be in a position to use those technologies in a productive manner. Skill gaps exist at two levels. First, many developing countries have limited pools of technically highly skilled workers, limiting innovation, technology transfer, or simply adoption and maintenance. Second, many workers in the developing world do not have the digital literacy—and in some cases, even more basic cognitive and technical skills—to use technology in their occupations (Figure 2). For example, in Africa, about 70 percent of people who do not use the Internet say it is because they do not know how to use it.^b They miss the opportunity of increasing productivity, while increasing the risk that they may be substituted by technology in the future.

Finally, other ‘*analog complements*’ of digital development—rules and institutions—are often also weaker in developing countries.^c These divergences are reflected in key socioeconomic development indicators, including access to finance (allowing workers to buy technology and firms to innovate), to core utilities (e.g. electricity), and social protection schemes (that would support displaced workers through transitions, prevent a deterioration in job quality).

This does not mean that developing countries, and groups within countries cannot benefit from technological change. Some have skipped over traditional methods and leapfrogged into adopting new technologies, taken advantage of their ‘greenfields’ to deploy systems such as biometric identification for social programs (e.g. India), or drones for medical deliveries rather than by road (e.g. Rwanda). About a third of the robots bought by Chinese firms are now manufactured in China, and countries such as India and the Philippines are world leaders in business process outsourcing and IT services. Yet, absent technology access, skills and good analog complements, such advances might be limited to a few businesses or individuals in the larger cities, exacerbating inequality.

Towards a more inclusive future of work

Public policies could position countries better to mitigate the threats and take maximal advantage of the opportunities. Key measures include:

Overcome existing divides by addressing bottlenecks in technology access. Focus on addressing regulatory and market failures that hold back the provision of affordable and reliable Internet access, access to electronic payment systems, and access to low cost devices. Public interventions may 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.

Building skills for the workforce of the future. Educational systems need significant reforms to impart the skills needed to allow the next generations to participate fully in a global digital economy. In cases where wholesale reform is difficult, ‘bridging’ from education to employment could help close some skills gaps. In some contexts, additional outreach to communities may be required to ensure that women and people with disabilities—who can gain from online work or learning opportunities—are not excluded. The World Bank has funded such training programs, focusing on connecting young people to jobs by improving access to IT certifications (in Mexico) or via online work platforms (in Kosovo).

^a OECD, Future of Productivity, 2015, available at: <http://www.oecd.org/eco/OECD-2015-The-future-of-productivity-book.pdf>; Marti, Ferrer ; Diego, Comin. (2013) If Technology Has Arrived Everywhere, Why has Income Diverged? Available at: <http://www.nber.org/papers/w19010>

^b World Bank, World Development Report 2016, page 123

^c See World Development Report 2016, Overview chapter

Invest in analog complements. Improving access to finance, to infrastructures such as electric power, to logistics, and to public services will be critical to unlock the full range of benefits from digital development. Social safety nets would need to reform to protect ‘gig’ workers and to support those who lose their jobs or need transition assistance. If the future is one of little work, cash transfers and universal basic income schemes—being piloted in the U.S. and Finland—may need to be developed.^a Technology can help deliver these complements – through digital financial services, renewable energy, mobile government services, and innovations such as drones to leapfrog weak logistics – and will be a critical driver of productivity and growth that will generate prosperity.

^a <http://www.economist.com/news/briefing/21699910-arguments-state-stipend-payable-all-citizens-are-being-heard-more-widely-sighing>