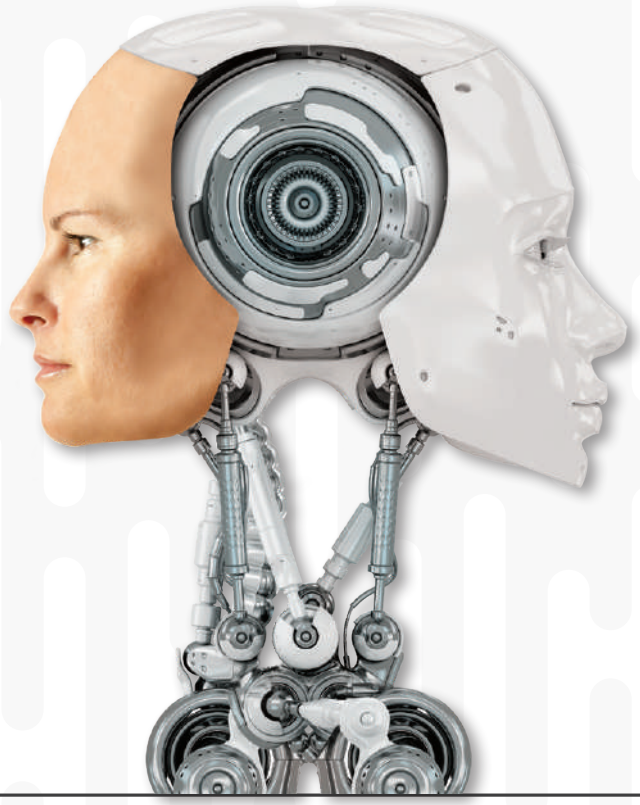
Book

The future of work : regional perspectives



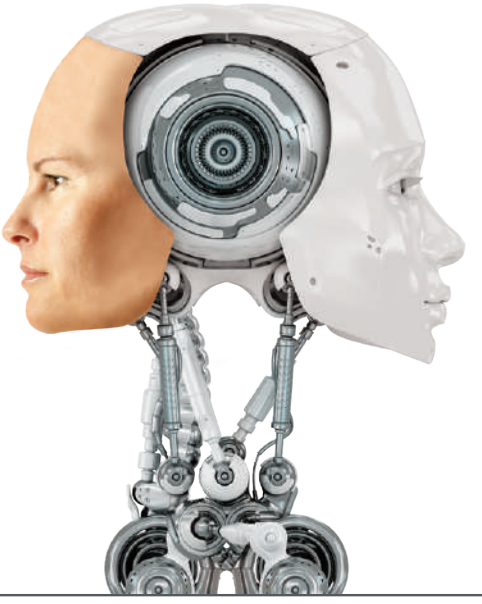
The Future of Work
Regional Perspectives

AFRICAN DEVELOPMENT BANK GROUP

ASIAN DEVELOPMENT BANK

European Bank
for Reconstruction and Development

IDB
Inter-American
Development Bank



The Future of Work
Regional Perspectives

African Development Bank
Asian Development Bank
European Bank for Reconstruction and Development
Inter-American Development Bank

The Future of Work
Regional Perspectives

AfDB, ADB, EBRD, IDB (African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, Inter-American Development Bank). 2018.
The Future of Work: Regional Perspectives.
Washington, DC.

Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library
The future of work: regional perspectives / African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, Inter-American Development Bank. p. cm. — (IDB Monograph; 605) Includes bibliographic references. 1. Work-Forecasting. 2. Labor market-Effect of technological innovations on. 3. Labor market-Effect of automation on. 4. Employment forecasting. I. African Development Bank. II. Asian Development Bank. III. European Bank for Reconstruction and Development. IV. Inter-American Development Bank. Labor Markets Division. V. Inter-American Development Bank. Office of Strategic Planning and Development Effectiveness. VI. Serie.IDB-MG-605

Terms, names boundaries, colors and denominations used in this report or any of its maps to refer to geographical or other territories, political and economic groupings and units, do not constitute and should not be construed as constituting an express or implied position, endorsement, acceptance or expression of opinion by the co-publishers or its members concerning the status of any country, territory, grouping and unit, or delimitation of its borders, or sovereignty. ADB recognizes “China” as the People’s Republic of China, “Korea” as the Republic of Korea, and “Vietnam” as Viet Nam. In addition, ADB recognizes “Russia” as the Russian Federation.

The opinions expressed in this publication are those of the authors and do not necessarily reflect the views of the Co-publishers, their Board of Directors, Board of Governors, or the countries they represent. ADB does not guarantee the accuracy of the data included in this publication and accepts no responsibility for any consequence of their use. The mention of specific companies or products of manufacturers does not imply that they are endorsed or recommended by ADB in preference to others of a similar nature that are not mentioned.

Photography

AFRICAN DEVELOPMENT BANK

© Photography: Shutterstock

ASIAN DEVELOPMENT BANK

© Photography: Asian Development Bank.

EUROPEAN BANK FOR
RECONSTRUCTION AND DEVELOPMENT

© Photography: European Bank for Reconstruction and Development, Dermot Doorly, iStock Photos.

INTER-AMERICAN DEVELOPMENT BANK

© Photography: iStock Photos

Acknowledgments

The Future of Work: Regional Perspectives is a joint effort of the African Development Bank (AfDB), the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (EBRD), and the Inter-American Development Bank (IDB), endorsed by their presidents.

The principal authors of each individual chapter are as follows:

Chapter 1: Nikola Milushev and Carmen Pagés

Chapter 2: Kapil Kapoor, Hassanatu Mansaray, Laura Sennett, Oscar Pitti Rivera, Antonio Ocana Marin, and the African Centre for Economic Transformation

Chapter 3: Bandini Chhichhia, Sergei Guriev, Alexia Latortue, Nikola Milushev, Alexander Plekhanov, and Valerijs Rezvijs

Chapter 4: Elisabetta Gentile, Rana Hasan, and Sameer Khatiwada

Chapter 5: Dulce Baptista, Mariano Bosch, Manuel García Huitron, Daniel Jaar Michea, Carlos Ospino, Carmen Pagés, Laura Ripani, and Graciana Rucci

This study was made possible by the leadership and general coordination of Kapil Kapoor (AfDB), Jiro Tominaga (ADB), Alexia Latortue (EBRD), Carmen Pagés (IDB), and Pablo Pereira Dos Santos (IDB). Editorial production of this volume was led by Andrés Gómez-Peña and Nancy Morrison. Graphic design and layout was led by Lina María Botero in collaboration with Carlos Bernal. Marcelo Cabrol, manager of the IDB's Social Sector, and Luis Miguel Castilla, manager of the IDB's Office of Strategic Planning and Development Effectiveness, provided valuable guidance and advice throughout the life of this project.

Contents

Foreword

The "Future of Work" is currently one of the most popular terms searched on Google. Many technological breakthroughs are rapidly shifting the frontier between activities performed by humans and the ones performed by machines, transforming the world of work.

Many studies and initiatives are examining what these changes mean for our work, our incomes, our children's futures, our companies, and our governments. Most of them do so from the perspective of advanced economies. Much less work has been done from the perspective of developing and emerging economies. Yet differences in the spread of technology, economic and demographic structures, education levels, and migration patterns greatly affect the way in which these changes might affect developing and emerging countries.

This study, ***The Future of Work: Regional Perspectives***, focuses on the likely repercussions of this major trend in developing and emerging economies in Africa; Asia; Eastern Europe, Central Asia, and Southern and Eastern Mediterranean; and Latin America and the Caribbean. It is a joint effort of the four main regional development banks: the African Development Bank, the Asian Development Bank, the European Bank for Reconstruction and Development, and the Inter-American Development Bank.

This study highlights the opportunities that changes in the dynamics of work might create for our regions. Technological progress could allow the countries we work with to grow faster and attain higher standards of living more rapidly than ever before. In fact, we argue that the biggest risk for many countries would be to miss out

on this revolution. What matters is how well countries prepare to take advantage of these changes to maximize the opportunities, while addressing the likely risks and challenges. Appropriate responses at the level of the individual, the enterprise, and the government are needed. This study explores some of these responses.

We are delighted to present this report to the policy makers, companies, and individuals of our member countries. We hope that, armed with the knowledge presented here, and with the support of our institutions, we can, together, foster a better future of work for all the peoples of our regions.

Kapil Kapoor
Director, Strategy and Operational Policies
AFRICAN DEVELOPMENT BANK

Yasuyuki Sawada
Chief Economist and Director, General Economic Research and Regional Cooperation Department
ASIAN DEVELOPMENT BANK

Alexia Latortue
Managing Director, Corporate Strategy
EUROPEAN BANK FOR RECONSTRUCTION AND DEVELOPMENT

Marcelo Cabrol
Manager, Social Sector
INTER-AMERICAN DEVELOPMENT BANK


PRODUCTION
Operation mode
Administration
Dashboard
Monitoring
Problems
Group and tag
Tactical views
System
Configuration
External
01
STATUS
02
DIAGRAM
03
SETUP
Home / Dashboard
Automatic mode
WORK MANAGER
DAILY TARGET
WEEKLY TARGET
MONTHLY TARGET
MACHINE PRODUCTION
TEMPERATURE CHART

Chapter 1

The Future of Work in Emerging and Developing Economies

Technological progress provides a golden opportunity for emerging and developing economies to grow faster and attain higher levels of prosperity in a shorter span of time. However, there are fears that technologies could potentially displace human labor, widen income inequality, and further increase the share of informal or contingent work. While anxiety about technological change has existed since the dawn of the industrial age, until recently new economic activities more than compensated for technology-induced unemployment. Current disruptive technology changes, however, raise concerns that this time could be different.

The impact of technological change on the future of work will differ across emerging markets and developing economies depending on demographic trends, patterns of international trade, the prevalence of the informal economy, and other conditions. Ultimately, how these changes play out and whether the benefits in terms of income, health, flexibility, or new jobs will outweigh the costs will depend on the policies that countries undertake to take advantage of these technologies, mitigate their adverse effects, and share benefits among the whole population. Fulfilling the promises of technological change while mitigating the associated risks calls for thorough public debate and collective action of governments, regulators, the private sector, and international organizations.

The Changing Nature of Work

Rapid technological progress increases the potential of boosting economic growth and raising prosperity across the world. The confluence and rapid development of a wide range of new technologies, such as artificial intelligence, robotics, 3D printing, the Internet of Things, biotechnology, and blockchain, is known as the Fourth Industrial Revolution (4IR) (see Box 1.1) Rapid technological progress can significantly boost economic growth at a time when productivity growth has slowed in many parts of the world (McKinsey Global Institute, 2018). It can yield important efficiency gains within companies. It can also accelerate the process of structural transformation by which countries grow by shifting labor from low-productivity activities, often in agriculture, to higher-productivity activities, mostly in the manufacturing and the service sectors. Such growth is essential to provide the resources to continue improving economic, social, and environmental outcomes, as well as to speed up the convergence of incomes of emerging economies with developed countries.

Box 1.1 The Fourth Industrial Revolution (4IR)

A number of recent technological breakthroughs—especially in artificial intelligence (AI), machine learning, and robotics—are unleashing new capabilities and fundamentally changing the nature of work. These new technologies are complementing as well as replacing workers. They hold the promise of higher productivity and greater safety. This technological revolution is being referred as the Fourth Industrial Revolution (4IR).

The 4IR technologies present challenges and opportunities. The key opportunities include improvements in productivity. Consumer surplus (savings) could increase as goods are delivered more cheaply. This surplus, in turn, could drive demand for new services and thus encourage entrepreneurship (and new jobs).

On the other hand, 4IR technologies are likely to eliminate many jobs, especially middle-income jobs, and further entrench inequality by disproportionately rewarding owners of capital and skills over owners of labor. The rapid changes that are being driven by these technologies are also increasing uncertainty and making it harder for businesses and policy makers to plan.

The impact of 4IR technologies has been a subject of study, particularly because of concerns about job losses. As noted, 4IR technologies are likely to alter society in various ways:

- 3D printing is pointing to the end of the factory model of production and may herald a return to a form of cottage industries seen in the past.
- Industry boundaries are becoming blurred as technologies allow companies to more easily venture into other industries. For instance, Google is developing autonomous cars while Tesla, a car company, sees itself as an energy company.
- Traditional notions of work are being rethought, particularly with work being increasingly defined by what people do rather than where they do it. For example, business will continue to connect and collaborate remotely with freelancers and independent professionals through digital talent platforms.
- The digital platform is upending assumptions that have underpinned economic policy. The sharing economy is moving from the concept of ownership to concept of buying a service. Car companies, for instance, are more unlikely to sell cars in the future but rather offer a transport service.[a]

a. One car in a sharing economy removes 22 cars from the road—a fact based on the current ownership model in which a car spends 93 percent of its lifetime idle.

However, there are fears that technologies could potentially displace human labor, widen income inequality, and further increase the share of informal or contingent work. News of fully automated stores, warehouses, or automobiles that do not require the intervention of humans have ignited fears that technology will create mass labor dislocation, increase technological unemployment, and continue widening inequality and polarizing the labor market into good jobs (stable jobs with benefits)—those that develop or adopt technology—and precarious jobs. This prospect might even be more worrisome for many emerging and developing countries where labor forces are rapidly growing in relation to the overall population, raising concerns that in the future not enough jobs will be created to employ these bulging working-age populations.

Historically, technological progress has not created technological unemployment. If history is any guide, new technologies have eliminated some jobs and substituted for some tasks formerly performed by humans, but they have also enabled the creation of many new jobs powered by growing incomes and the emergence of new occupations.

But many people are asking whether this time will be different. Because technology is encroaching on many tasks that were formerly though to be out of reach of machines, and because technological growth could itself be affecting the mechanisms by which income growth translates into increased demand for human work, history might not repeat itself (Brynjolfsonn and McAfee, 2014; Susskind and Susskind, 2015).

Another important question is the extent to which the effects of this wave of technological change will differ across different regions of the world, which enter this period with very different initial conditions. Differences in demography, access to broadband, workforce skill levels, or the availability of safety nets create important differences in the velocity at which technological progress spreads across regions as well as its effects on populations. While there is growing research about the future of work in developed economies, relatively less has been discussed from the perspective of developing and emerging countries (Chandy, 2017). This volume explores the benefits and risks brought by this new technological wave from the perspective of the member countries of the four multilateral development banks spanning Central, Eastern, and South-Eastern Europe, Central Asia, and the Southern and Eastern Mediterranean; Asia; Africa; and Latin America and the Caribbean. The chapters consider the specific interplay of technology, demographics, and economic and social policies in these regions, and focus on how these forces can shape the future of work.

The New World of Work in Historical Context

At least two developments characterize the new world of work. First, the confluence of new and rapidly evolving technological breakthroughs is increasing the potential for automation. Second, the way people are working is also rapidly evolving as technology is connecting people to jobs and income opportunities in new ways.

Anxiety about the impact of rapid technological progress on work and livelihoods has been a fact of life since the dawn of the industrial age. In the early nineteenth century, weaving craftsmen in England, the Luddites, set out to break machines taking over their jobs. About a decade later, in 1817, David

Ricardo wrote that the "discovery and use of machinery… will be injurious to the laboring class, as some of their number will be thrown out of employment, and population will become redundant…" His writings sound remarkably current nearly two centuries later (Ricardo, 1817).

A contemporary of Ricardo, Thomas Malthus, sounded the alarm on another trend: the demographic pressure on economic well-being (Malthus, 1798). Ever since the writings of Malthus and Ricardo, the interplay of technology and demography and their impact on employment, economic growth, and education have been at the forefront of the public debate.

Successive waves of technological and demographic change have led to large-scale, often painful disruptions. Yet new technology has always brought about new economic activities that more than compensated for the lost occupations, on balance (Acemoglu and Restrepo, 2017). Technological progress has boosted productivity and expanded incomes, which in turn have raised the demand for goods and services. This, in turn, has created entirely new industries and jobs, providing employment for a rapidly growing world population and raising average incomes. These trends were particularly pronounced and widely shared across the social spectrum in the twentieth century, when job creation was mostly concentrated in middle-class occupations.

Despite the evidence that in the past technological progress has never failed to generate new employment, many voice concerns that this time around could be different. The sheer pace of technological change allows less time for new jobs to emerge and could outpace the ability of large sections of the workforce to re-educate and retrain (McKinsey Global Institute, 2017a). A large proportion of the new jobs created could be in low-pay occupations with no benefits and unstable working conditions. In addition, technology itself may be affecting the way rising incomes create demand for human labor, as machines could increasingly produce the excess demand for goods and services caused by rising incomes (Susskind and Susskind, 2015).

Yet, while initial estimates suggested a large potential for automation, new estimates are less pessimistic. Initial estimates based on the potential of automating occupations indicated that a large percentage of jobs could be automated in the coming years, given current technologies. This methodology indicated that 47 percent of all persons employed in the United States were working in jobs that could be performed by computers and algorithms within the next 10 to 20 years (Frey and Osborne, 2017). Based on the same methodology, World Bank estimates suggest an even higher potential for automation in developing countries, on the order of 60 percent to 70 percent (World Bank, 2016). Recent studies however, indicate that such figures may overestimate the potential job losses due to automation because only certain tasks or activities within an occupation are at high risk of automation. Once this is accounted for, only a relatively small percentage of jobs (on the order of 5 percent to 10 percent) can be fully automated given current technologies. Nonetheless, at least 30 percent of the activities in another 60 percent of occupations could be automated with technologies currently available (McKinsey Global Institute, 2017b; Armtz, Gregory, and Zierahn, 2016). These figures suggest that while some occupations will disappear, many occupations will be largely transformed in the coming years. This is a process that has already been going on in the past few years.

The introduction of information and communications technologies (ICTs) in developed economies has been hollowing out middle-income jobs. Since the early 1990s, job creation has been concentrated at the two ends of the spectrum: among less-skilled occupations (catering, construction, cleaning) that are harder to automate and high-skilled occupations (including professional services and research & development) (Autor and Dorn, 2013). Highly paid skilled work in turn raises demand for employment in low-paid services, reinforcing the polarization of occupations into what Goos and Manning (2007) called "lovely" and "lousy" jobs.[1] In addition, in many cases technological change leads to deskilling of occupations long before the occupations themselves disappear. In the past, deskilling affected artisans such as smiths and tailors as mechanization split more complex tasks into a large number of relatively simple ones.[2] More recently, navigation systems have deskilled driving while warehouse automation have deskilled jobs in logistics. For instance, Amazon warehouses with a high degree of automation appear to require workers with less experience who are also paid lower wages (The Economist, 2018). There is a growing risk that people in basic occupations cannot rely on a single quality job with social security and other benefits, and will need to take on several small jobs to make ends meet, with accompanying anxiety and insecurity.

The new wave of automation could further raise inequality because one unit of labor backed by new technologies is scalable and can be simultaneously sold an increasingly

1. Also see Autor and Dorn (2013).

2. See, for instance, Goldin and Katz (1998).

Large differences in economic structures generate large differences in the way countries will be or are being affected by the Fourth Industrial Revolution.

large number of times (for example, a song downloaded or a piece of software). By contrast, units of labor in non-routine manual jobs such as cleaning or catering can be sold only once. As a result, pay inequality is expected to continue rising. Rising inequality and polarization of jobs creates fertile ground for the rise of populism, which could in turn undermine economic and democratic institutions, growth, and international peace.

Nonetheless, technology is also bringing countless benefits, which may be even larger in the context of emerging and developing economies. In addition to faster economic growth, rising computing power and the use of big data can deliver a tremendous boost to scientific and medical research, with the potential to resolve many currently intractable health or pollution problems. Related advances in biotechnology, health care, and long-term care may help mitigate the social and fiscal impact of rapid aging. New technologies reduce information asymmetries, which helps financial inclusion by providing access to finance for people without credit histories.

The development of new technologies can benefit workers with a preference or need for flexibility. Technology is making it increasingly feasible to decentralize tasks from companies directly to people, which they perform as freelancers. Unbundling of jobs into sets of smaller tasks creates opportunities for workers to enjoy the flexibility of freelancing and to top up their incomes. This trend has led to the flourishing of the "gig," "sharing," or more generally, the "platform" economy. Remarkably, Uber, the world's largest taxi company, owns no taxis, and Airbnb, the world's largest accommodation provider, owns no real estate (Brynjolfsson and McAfee, 2017).

New flexible ways of working could benefit groups that have been traditionally economically marginalized, such as women, young people, and the disabled (OECD, 2017). Young people, in particular, are early adopters of new technologies and may have a comparative advantage over mid-career workers in rapidly evolving technology-intensive industries.

At the same time, the spread of platform-enabled work may create important risks for the welfare state. To the extent that most workers in the on-demand and gig economy are considered self-employed, this limits their access to employer-provided health or pensions, a minimum wage, or other labor law protections or unions (Chandy, 2017).

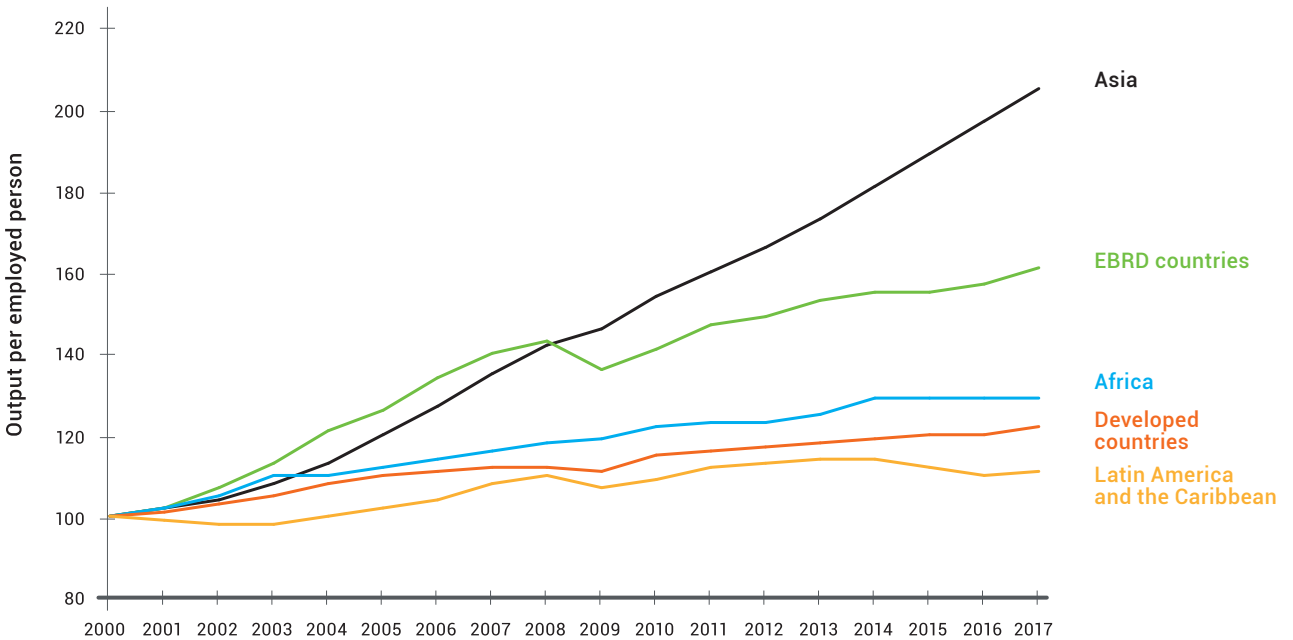
Ultimately, how these changes play out and whether the benefits in terms of incomes, health, flexibility, or new jobs will outweigh the costs will depend on the policies that countries undertake to take advantages of these technologies, attenuate their adverse effects, and share benefits among all. The discussion on the role of government regarding the future of work is continued in the final sections of this chapter.

The Future of Work: What Is Different in Emerging and Developing Countries?

Technological progress provides a golden opportunity for emerging and developing economies to grow faster and attain higher levels of prosperity in a shorter span of time. While productivity growth in emerging regions has been faster than in the developed world (see Figure 1.1), technologies to boost productivity are needed to speed up growth, particularly in Africa and in Latin America and the Caribbean, where productivity growth has been quite low, and where much of the growth has been driven by employing

Figure 1.1 Labor Productivity Growth across Regions

While productivity growth in emerging regions has been faster than in the developed world, it has been uneven across regions.



Source: The Conference Board (2017).

Note: The index of labor productivity per hour worked is measured in 2016 U.S. dollars (converted to the 2016 price level with updated 2011 purchasing power parity). The year 2000 is equal to 100. Developed countries include Canada, the high-income countries of Asia and the Pacific, the United States, and Western Europe. The other four regions include the developing member economies of each regional development bank: the African Development Bank, the Asian Development Bank, the European Bank for Reconstruction and Development (EBRD), and the Inter-American Development Bank.

a higher percentage of the labor force, rather than by increasing the productivity of each worker.

Large differences in economic structures generate large differences in the way countries are being affected by technological progress. Technological developments in agriculture, for example, could be particularly relevant in Developing Asia and Africa because agriculture accounts for a larger percentage of employment. In Africa, 51 percent of workers are in agriculture, while the share in Asia is 32 percent. In the other regions, the percentage of agriculture is much lower: only 16 percent in Latin America and the Caribbean and 10 percent in the developing member economies of the European Bank for Reconstruction and Development (EBRD). Developments in manufacturing, such as robotics and 3D printing, are more important for EBRD regions[3] because they have a large percentage of employment in manufacturing (30 percent). Finally, developments in the service sector will be particularly relevant for the EBRD regions and Latin America and the Caribbean, where these sectors account for close to 60 percent of total employment—not too far from the 70 percent share in the developed world.

Technological progress can deliver rapid growth if it accelerates structural transformation. While in developed economies the worst jobs are found in the low-productivity service sector, in many parts of the developing world the worst jobs are found in agriculture. Many agricultural workers live in subsistence conditions unable to make ends meet (see Chapter 3 on Developing Asia). New developments in precision agriculture, based on automation and the use of the Internet of Things, offer great potential for increasing productivity in agriculture and speeding up structural transformation in Africa and many countries in Asia. The deployment of sophisticated robots in manufacturing will increase productivity in the manufacturing sector, but it needs to go hand in hand with investments to increase the productivity of service sectors. Otherwise, there is risk of shifting workers to low-productivity service jobs, causing the reverse effect: a slowdown of overall productivity growth. Services enabled by digital technology, such as IT (information technology) services, can expand without being constrained by local income, but are typically skill intensive. As discussed later in this chapter, shifting a higher percentage of employment to these sectors will require complementary investments in education and training.

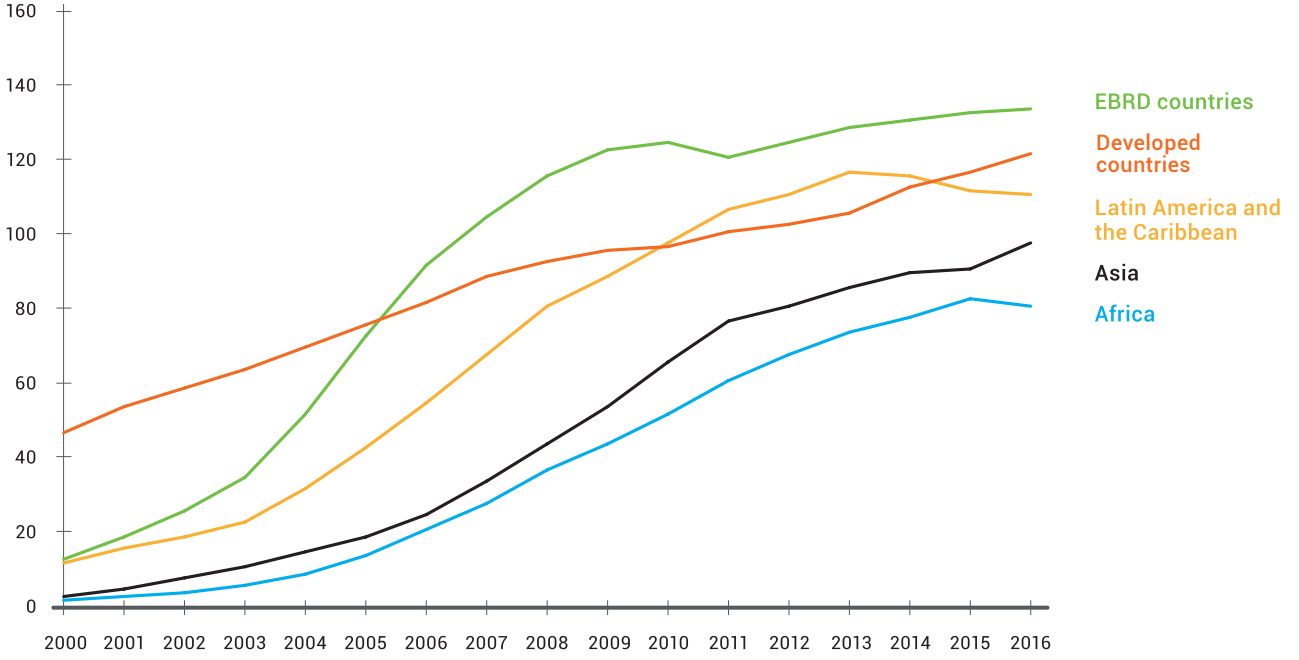
Broadband coverage—a prerequisite for the deployment of digital technologies—may constrain the pace of automation in developing and emerging countries. While there has been a rapid convergence in the spread of mobile phones lines across the world, there are still marked differences in broadband subscriptions (Figure 1.2). In 2016, the number of mobile cellular subscriptions per 100 people was at or above 100 in all regions except Africa, where it reached more than 80 subscriptions per 100 people, indicating the patterns of a mature technology. On the other hand, the spread of broadband is quite uneven and the differences between developed countries and the rest of the world are large. Moreover, so far there is no evidence that these gaps are closing. The EBRD countries have the highest number of subscriptions after the developed world, with more than 20 subscriptions per 100 people, followed by Latin America and

3. The regions where the EBRD works span Central, Eastern and South-Eastern Europe, the Southern and Eastern Mediterranean, Central Asia, and Mongolia.

Figure 1.2 Mobile and Fixed Broadband Subscriptions by Region

Despite a rapid convergence in the spread of mobile phones lines across the world, there are still marked differences in broadband subscriptions.

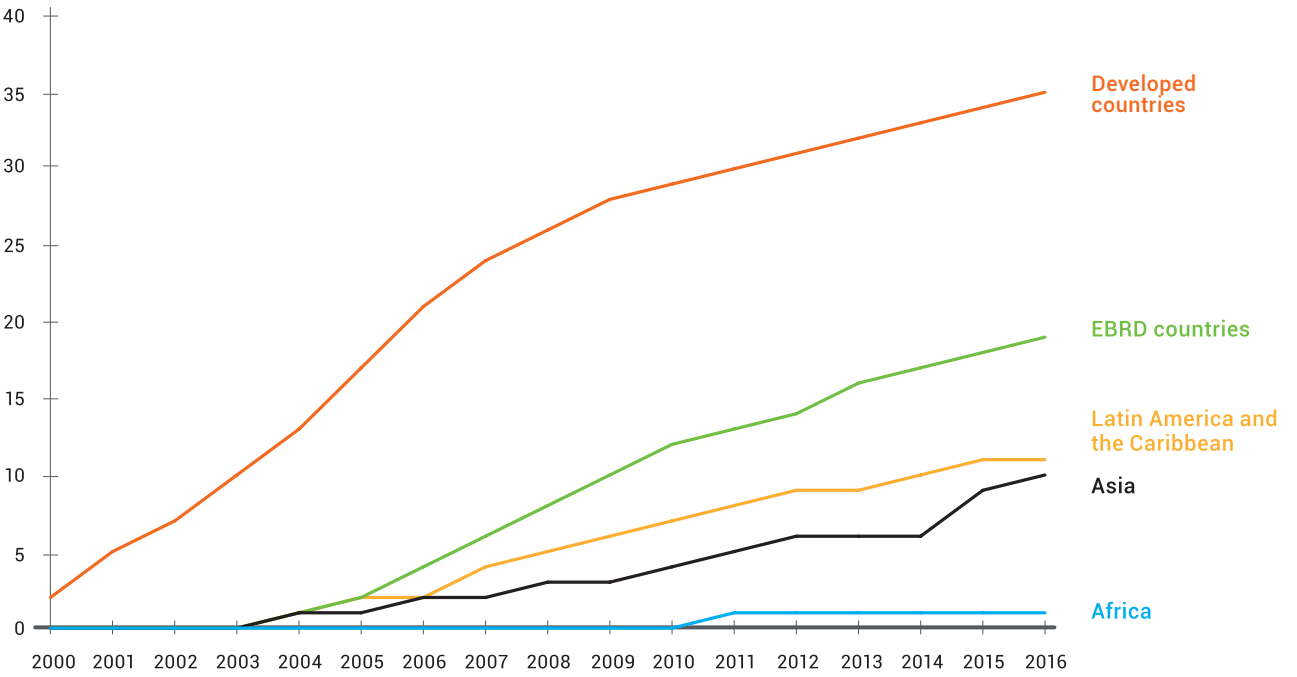
a. Mobile cellular subscriptions (per 100 people)



the Caribbean, with 10. Given this base, the consequences, positive and adverse, of technological progress are likely be felt first in many EBRD countries and in Latin America and the Caribbean, and later in Asia and Africa.

Initial estimates indicated a higher potential for automation in developing and emerging economies, but more recent estimates show smaller differences and no clear patterns by income level. Initial estimates of the potential for automation showed that developing economies have a higher potential of automation because they are more specialized in low-wage, low-skilled occupations, which given current technology are easier to automate. World Bank estimates showed the highest potential of automation in the Asian and African region, with 73 percent and 71 percent of the jobs susceptible to being automated, respectably (Table 1.1) (World Bank, 2016). New estimates

b. Fixed broadband subscriptions (per 100 people)



Source: World Bank (2018).

Note: Developed countries include Canada, the high-income countries of Asia and Pacific, the United States, and Western Europe. The other four regions include the developing member economies of each regional development bank: the African Development Bank, the Asian Development Bank, the European Bank for Reconstruction and Development (EBRD), and the Inter-American Development Bank.

however, indicate much smaller differences across regions, and no pattern based on income. For example, according to McKinsey (2017a), both developed economies and Africa have the same potential for automation. It should also be stressed that while some of the initial numbers showed that automation could potentially destroy more than half of existing jobs, new estimates based on tasks indicate that only 8 percent of the jobs in EBRD countries and 9 percent in developed economies can have more than 70 percent of their tasks automated.

Differences in the skill base across regions alter the incentives to automate and the potential to create new jobs and occupations. New technologies are increasing the demand for skills complementary to technology, including digital skills and high-level cognitive skills (such as creative thinking, the ability to learn, and problem resolution), as well

Table 1.1 The Risk of Automation by Region

While initial estimates predicted great risks of joblessness through automation, more recent estimates and a finer break-down by task and activity suggest that the risk has been overstated.

Region	Approach		
	Occupation	Task	Activities
Africa	0.71		0.48
Developing Asia	0.73		0.51
Developed countries	0.48	0.09	0.48
EBRD countries	0.60	0.08	0.50
Latin America and the Caribbean	0.67		0.51

Sources: For occupation, World Bank (2016); for task, Armtz, Gregory, and Ziehran (2016); for activities, McKinsey Global Institute (2018).

Note: EBRD = European Bank for Reconstruction and Development.

as soft skills. At the same time, technological progress is reducing the demand for routine-based work. This implies that limitations in the skill base of the population may constrain technology adoption or the creation of new jobs. There are significant differences in the skills base of the workforce. On average, the EBRD countries have the highest skills levels, followed by Developing Asia, while Latin America and the Caribbean and Africa have the lowest, according to the Human Capital Index of the World Economic Forum (WEF, 2017). The ranking is a little different if rather than using the aggregate Human Capital Index, skills are measured using the Human Capital Capacity Index, which measures the percentage of the workforce that has attained tertiary, secondary, and primary education, as well as the percentage that has literacy and numeracy skills (Figure 1.3).

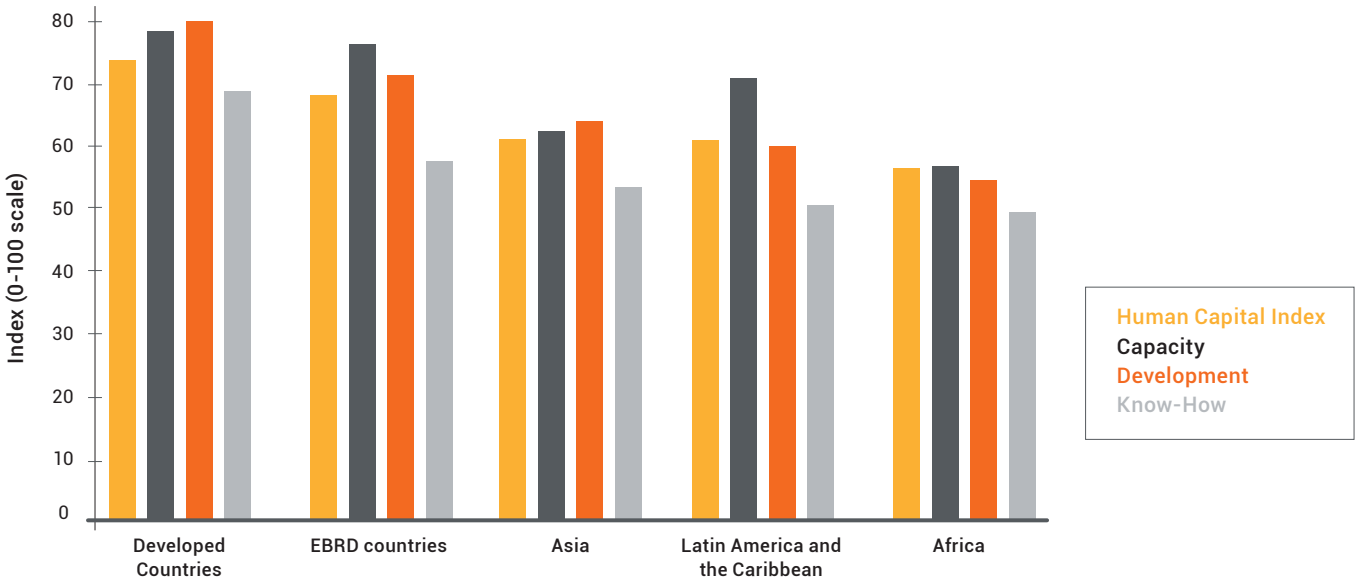
Cost pressures to automate also differ substantially across regions. Countries with faster wage growth and/or shrinking working-age populations in relation to the overall population will experience greater incentives to automate.[4] Developed and EBRD countries, on average, face rapid aging of their labor forces and declining shares of the working-age population (Figure 1.4). The share of

4. See, for example, Acemoglu and Restrepo (2017) and Acemoglu and Restrepo (forthcoming).

Figure 1.3 Investments in Human Capital by Region

EBDR countries and Developing Asia have the highest investments among developing countries.

Latin America and the Caribbean and Africa have the lowest.



Source: WEF (2017).

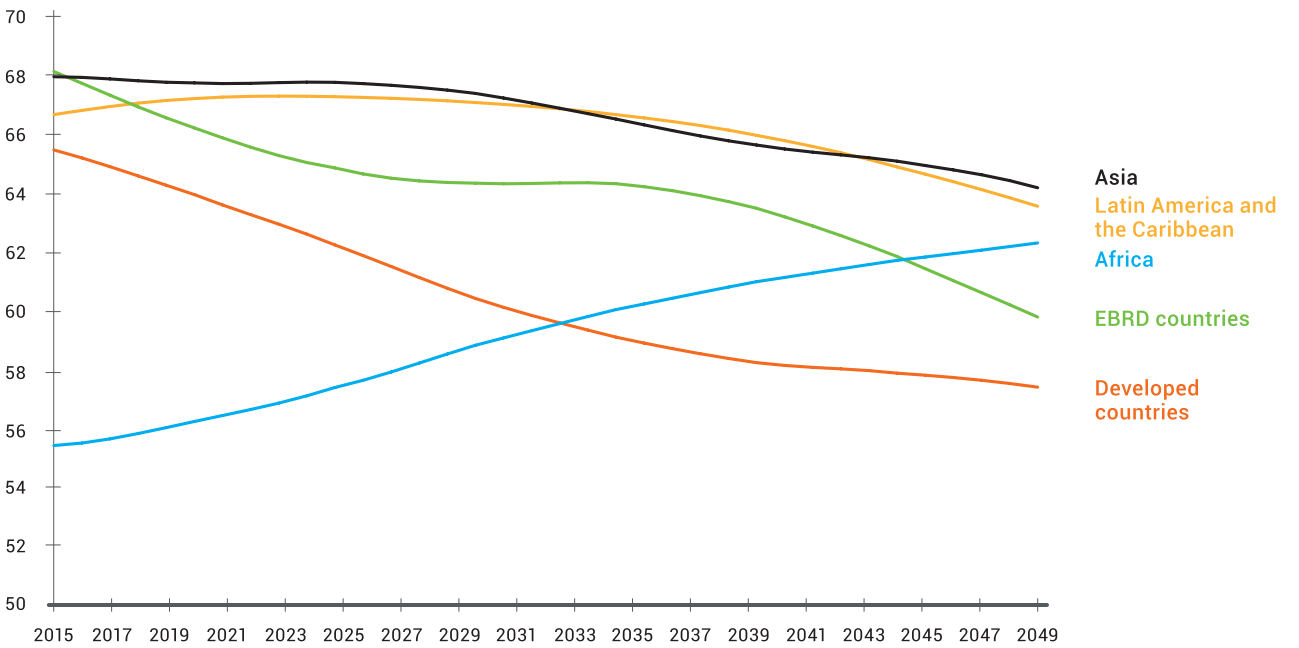
Note: Developed countries include Canada, the high-income countries of Asia and the Pacific, the United States, and Western Europe. The other four regions include the developing member economies of each regional development bank: the African Development Bank, the Asian Development Bank, the European Bank for Reconstruction and Development (EBRD), and the Inter-American Development Bank.

the working-age populations will decline slightly in Latin America and the Caribbean and Asia, starting in 2025 in Latin America and the Caribbean and a bit later in the average country of Developing Asia. By contrast, Africa will continue experiencing a demographic boon, with an increasing share of its population in the labor force, growing from 57 percent to 67 percent from 2015 to 2050. These figures may be altered by migration patterns.

While in developed countries the effects of automation will be driven by production costs, in developing and emerging countries they may result from changing international trade patterns. To the extent that automation can increase the

Figure 1.4 Evolution of the Working-Age Population as a Percentage of Total Population

The working-age population will decline slightly in Asia and Latin America and the Caribbean, decrease more sharply in EBRD countries, and increase in Africa.



Source: ILO (2017).

Note: Developed countries include Canada, the high-income countries of Asia and the Pacific, the United States, and Western Europe. The other four regions include the developing member economies of each regional development bank: the African Development Bank, the Asian Development Bank, the European Bank for Reconstruction and Development (EBRD), and the Inter-American Development Bank.

competitive advantage of producing in developed countries, the offshoring trend that has occurred since the 1980s may come to a halt and may even be reversed as a higher share of production takes place in developed countries. Such adverse effects could be potentially more important for Asia and EBRD countries because of their higher specialization in the production of industrial goods. The study for Developing Asia (Chapter 3 in this volume), shows that this effect is likely to be more than compensated by the growing demand for labor caused by rising income, leading to a net expansion in employment.

The welfare costs of automation may be higher in developing and emerging economies because their safety nets are less developed than in higher-income economies. The costs of job dislocation are higher for workers without access to unemployment insurance or unemployment assistance. While comparable data for unemployment protection across country income groups do not exist, unemployment is usually within the risks covered by social security. However, social security coverage is typically low in emerging and developing regions. Data from the International Labour Organization indicate that while more than 65 percent of people in the labor force are contributing to social security in developed countries, only between 36 percent and 48 percent do so in the EBRD regions, 30 percent in Latin America and the Caribbean, 17 percent in Asia and the Pacific, and 9.6 percent in Africa.[5]

The potential adverse effects of automation may be at least partially outweighed by the emergence of technology-enabled job intermediation platforms, which bring new opportunities to connect people to global digital labor markets and to opportunities to generate income. The McKinsey Global Institute (2015) estimates that by 2025 digital online platforms could increase global GDP by $2.7 trillion through three effects: improved productivity; greater employment; and higher labor market participation (through work performed both by currently inactive people and increased work hours of current part-time workers). Moreover, up to 540 million people could benefit from online platforms by 2025. The spread of platform work can bring substantive benefits if it allows people to tap into digital global labor markets, without the need to migrate to other countries. The growth of a myriad of platforms that offer work, per project or task, that can be developed remotely, even from home, increases opportunities for workers in locations where broadband connections are available but there are no jobs. For some time, participating in these global markets may substantially increase the returns to digital, creative, or other skills that can be sold remotely, vis-à-vis the local market. However, over the years, as the global competition for that type of work increases, wages may be auctioned down.

Platform technologies can raise the productivity of the large informal sectors. Self-employment accounts for more than 76 percent of employment in the developing world and 46 percent in emerging economies.[6] This employment is often characterized as low pay, low productivity, although

5. World Social Security Protection Report data, 2017–19. http://www.social-protection.org/gimi/gess/OldAge.action.

6. ILO (2018). Figures include own-account work and family workers.

there is a large dispersion of incomes within this sector.[7] Intermediation platforms such as Uber have the potential of increasing productivity in the own-account sector. Platforms allow workers to connect with demand more efficiently and reduce the time in which a person is searching for clients and is not generating income (Cramer and Krueger, 2016). They can also create economies of scale and scope that further boost productivity.

But platform-enabled work may further compromise access to social insurance. In many countries, self-employed workers are not required to contribute to social security and rarely do so voluntarily. In others, they are required to contribute by law, but the level of enforcement is minimal. To the extent that platforms increase labor decentralization and increase the ranks of self-employment, health and pensions coverage may decline for a growing number of people. The International Labor Organization estimates that the number of self-employed workers will increase in 2018 and 2019 by 17 million per year (ILO, 2018).

How Can Policy Shape the Future of Work in Emerging and Developing Countries?

Developing adequate policy responses to the challenges posed by the future of work requires a rational assessment of the related opportunities and risks, spirited public debate, and increased preparedness among policymakers and companies. Adaptation to past waves of technological progress has always depended on effective policy responses. Fulfilling the promises of technological change while mitigating the associated risks calls for thorough public debate and collective action of governments, regulators, the private sector, and international organizations, including the multilateral development banks (see Box 1.2 on the role multilateral development banks can play to help shape the future of work). The greatest risk that emerging and developing countries face is missing the opportunity presented by this technological revolution. Therefore, ways to enable and accelerate the adoption of technology while seeking to mitigate its potential adverse effects on people's jobs and incomes are needed.

Facilitating Workers' Transitions to New Jobs

As the wave of structural change gathers speed, many workers will have to find new jobs. Supporting workers in this transition will be essential to ensure that affected workers attain higher incomes and better jobs. To do so, countries can build on the enormous potential of digital technologies and platforms to connect workers and jobs. A growing number of global and local companies are already operating in this space, but often they are not catering to the most vulnerable workers. Countries can improve the supply of services by contracting out with private providers or improving public labor intermediation systems and platforms. This is particularly important because these services have the potential of reaching all workers independently of whether they work in the formal or the informal labor markets and because labor market intermediation services are the most cost-effective active labor market policies (Card, Kluve, and Weber, 2015).

7. See, for example, Binelli (2016) for Mexico; and Bargain and Kwenda (2011) for Mexico, Brazil, and South Africa.

Box 1.2 The Role of Multilateral Development Banks in Shaping the Future of Work

The multilateral development banks (MDBs) can play an important role to help shape the future of work. MDBs can support member countries' responses to demographic trends and changes in technology by being a repository for and a laboratory of initiatives that can help countries capitalize on new technologies and mitigate their adverse effects. The MDBs' geographic reach and their broad stakeholder base allow them to test and incubate novel ideas, thereby building up political capital and expertise that can be deployed for more difficult reforms. MDBs can also support steps to make pensions and universal basic income schemes more portable across borders (particularly in the case of integrated labor markets such as those in the European Union); increase access to globally competitive education or promote cross-border skills certification; and enable lower-income countries to benefit more fully from global technological advances in taxation, data management, cyber security, and data protection. One final area in which MDBs can also play an important role is facilitating regional and global coordination in areas such as tax and competition policy, where the changing nature of jobs makes such a response vital to take advantage of the new opportunities.

Therefore, they constitute a sensible first line of response in countries with high levels of informality and scarcity of resources. Transitions often involve people migrating from rural to urban areas or across borders. Providing migration assistance is an important component of this support.

Investing in Job-Readiness for a New World of Work

Returns on life-long learning are likely to rise. Throughout history, education and technological progress have been closely matched (Goldin and Katz, 2010). Electrification created demand for jobs with cognitive/computational skills, leading to longer years of education. Workers could often rely on the acquired skills accumulated through a one-off investment throughout their careers. In recent years, however, demand for basic cognitive skills has been declining even as the supply of education has continued to increase (Beaudry, Green, and Sand, 2016). Initially, automation focused primarily on routine cognitive tasks (such as clerical work, bookkeeping and basic paralegal work reporting). Tasks that appear to be harder to automate broadly fall into three categories: perception and manipulation tasks, creative intelligence tasks, and social intelligence tasks (Frey and Osborne, 2017). Yet even in these domains, artificial intelligence (AI) has been making rapid advances (Brynjolfsson and McAfee, 2017). The exact path of AI development is notoriously hard to predict. But it is reasonable to assume that to stay ahead of the machines, humans will also need to keep continuously learning to solve new, increasingly complex problems, likely involving emotional intelligence, complex human interactions ("soft skills"), and creativity. The basic education qualifications need to be geared increasingly toward helping individuals learn how to learn and enhance their soft skills, rather than providing them with specific technical skills. Life-long learning will be required to keep up with change and acquire specialized skills.

The onus is on various stakeholders to maximize equality of opportunity in terms of access to education and labor markets, as well as promote continuous mid-career learning opportunities to those seeking them. In addition, special programs for youth and adults with insufficient foundational skills will be required so they are not left behind. Solutions may involve greater use of publicly backed education and training, with employers playing a leading role in the curriculum design of training and retraining programs. MDBs have a role to play in strengthening partnerships between policymakers and employers to jointly identify and address challenges in the area of education in life-long learning. The increased funding required to run such programs could partly come in the form of contributions from companies or loans with income-contingent repayment over the long term. Advances in technology should reduce the cost and complexity of administering such schemes. Quality assurance mechanisms will need to be strengthened in many countries so better results in terms of learning can be achieved. Finally, educational and training systems will need to develop pathways to ensure flexible and continuous life-long learning trajectories. Retraining and upskilling for adults will need to be flexible and compatible with full-time work. Technology can be part of the solution. Online learning, possibly enhanced by artificial intelligence, offers the promise of providing custom-tailored, flexible courses. In addition, better information and monitoring mechanisms

can create stronger incentives to raise the quality of training programs through transparent systems of evaluation and program ratings. Moreover, skills development systems can build on big data to detect the skills requirements of markets and provide instant feedback information to build relevant curricula.

Strengthening Social Protection

The rise of the "gig economy" may require rethinking the provision of health care, pensions, and social protection, as saving for old age has traditionally been viewed as the responsibility of employers (Tyson and Mendonca, 2015). While new platforms give workers greater flexibility and foster versatility in terms of skills, in the absence of strong social safety nets they also create anxiety and may take a toll on individuals' subjective well-being.

Elements of the solution could include full portability of pensions across employers and self-employment, expansion of health care coverage, policies to support greater labor force participation among older workers, steps to ensure that gig-economy jobs are created in the formal sector, and introduction of some form of universal basic income as a means of counteracting the impact of more flexible labor markets and reduced job security on individual income paths.[8]

Creating Additional Fiscal Space and Redistributing Income

New technologies can be used to help create additional fiscal space for these policies, for instance through greater transparency of (cashless) payments (Rogoff, 2016), strengthened tax administration, and seamless exchange of information to fight tax evasion.

In addition, tax policies should seek to find effective and efficient ways to redistribute income. Taxes on robots have been proposed as one solution to the problem. While they may create inefficiencies in the production of goods and services, having a positive tax on robots may be an optimal way to redistribute incomes under certain scenarios (Guerreiro, Rebelo, and Teles, 2018). More broadly, tax policy has traditionally favored innovation and investment. This has helped governments promote economies' competitiveness and boost productivity growth, but has also provided an implicit subsidy for job automation. Equality and fairness considerations may call for the opposite approach—phasing out subsidies for investment and implicit or explicit subsidization of jobs at risk of automation through lower taxes on labor and tax incentives for schemes enhancing human capital. The right policy mix, however, will strongly depend on country characteristics and preferences on growth and redistribution.

8. See Van Parijs and Vanderborght (2017) and OECD (2017).

Two other important redistributive tools to be assessed in this context are negative income taxes (NIT) and universal lump-sum transfers to all individuals financed through progressive income tax, also often called universal basic income (UBI).[9]

Conclusion

Technology affects the workplace in a profound way, which necessitates suitable policy responses. The previous wave of technological change catalysed the creation of modern education systems, anti-trust regulation, and the welfare state. Today, technological change automates jobs, gives rise to the platform economy, and erodes medium-skilled occupations created by the earlier wave of technological change. This puts pressure on education, competition policy, and social safety nets. As before, economic and social policy need to respond.

The policy responses depend on a country's individual circumstances. On the other hand, such policy responses need to be more global and more coordinated than before—and here MDBs have a unique role to play, along with policymakers and the private sector, together shaping the future of work.

9. In a tax-benefit scheme with a progressive tax system, NIT and UBI can yield the same distributive outcomes and the same marginal and average tax rates (Tondani, 2009, 248).

Fulfilling the promises of technological change while mitigating the associated risks calls for thorough public debate and collective action of governments, regulators, the private sector, and international organizations, including the multilateral development banks.

References

Acemoglu, D., and P. Restrepo. 2017. *Secular Stagnation? The Effect of Aging on Economic Growth in the Age of Automation. American Economic Review* 107 (5): 174–79.

———— Forthcoming. *The Race between Man and Machine: Implications of Technology for Growth, Factor Shares and Employment. American Economic Review.*

Autor, D. H., and D. Dorn. 2013. *The Growth of Low-Skill Service Jobs and the Polarization of the US Labor Market. American Economic Review* 103 (5): 1553–97.

Bargain, O., and P. Kwenda. 2011. "Earning Structures, Informal Employment, and Self-Employment: New Evidence from Brazil, Mexico and South Africa." *Review of Income and Wealth* 57 (Special Issue, May): S100–S122.

Beaudry, P., D. Green, and B. M. Sand. 2016. *The Great Reversal in the Demand for Skill and Cognitive Tasks. Journal of Labor Economics* 34 (S1, Part 2, January).

Binelli, C. 2016. *Wage Inequality and Informality: Evidence from Mexico.* IZA *Journal of Labor and Development* 5 (5): 1–18.

Brynjolfsson, E., and A. McAfee. 2014. *The Second Machine Age: Work, Progress and Prosperity in a Time of Brilliant Technologies*. New York: W. W. Norton Company.

Card, D., J. Kluve, and A. Weber. 2015. *What Works? A Meta-Analysis of Recent Active Labor Market Program Evaluations*. National Bureau of Economic Research, Cambridge, MA.

Chandy, L. 2017. *The Future of Work in the Developing World.* Brookings Institution, Washington, DC. https://www.brookings.edu/research/the-future-of-work-in-the-developing-world/

Conference Board, The. 2017. *The Conference Board Total Economy DatabaseTM (Adjusted Version)*, November.

Cramer, J., and A. Krueger. 2016. *Disruptive Change in the Taxi Business: The Case of Uber.* NBER Working Paper 22083, National Bureau of Economic Research, Cambridge, MA.

Economist, The. 2018. *What Amazon Does to Wages: Is the World's Largest Online Retailer Underpaying its Employees?* January 18.

Frey, C. B., and M. A. Osborne. 2017 *The Future of Employment: How Susceptible Are Jobs to Computerisation? Technological Forecasting and Social Change* 114 (C): 254–80.

Goldin, C., and L. F. Katz. 1998. *The Origins of Technology-Skill Complementarity. The Quarterly Journal of Economics* 113 (3, August 1): 693–732.

———— 2010. *The Race between Education and Technology.* Cambridge, MA: Harvard University Press.

Goos, M., and A. Manning. 2007. *Lousy and Lovely Jobs: The Rising Polarization of Work in Britain Review of Economics and Statistics* 89 (1, February): 118–133.

Guerreiro, J., S. Rebelo, and P. Teles. 2018. *Should Robots Be Taxed?* NBER Working Paper 23806 (issued September 2017, revised January 2018), National Bureau of Economic Research, Cambridge, MA.

ILO (International Labour Organization). 2017. Labour Force Estimates and Projections. ILOSTAT. www.ilo.org/ilostat. (accessed March 2018).

———— 2018. *World Employment Social Outlook: Trends 2018.* Geneva: International Labour Office.

Malthus, T. 1798. *An Essay on the Principle of Population*. London: J. Johnson.

McKinsey Global Institute. 2015. *A Labor Market that Works: Connecting Talent with Opportunity in the Digital Age*. McKinsey Global Institute, June.

_____ 2017a. *A Future that Works: Automation, Employment, and Productivity*. McKinsey Global Institute, January.

_____ 2017b. *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation*. McKinsey Global Institute, December.

_____ 2018. *Solving the Productivity Puzzle: The Role of Demand and the Promise of Digitalization*. McKinsey Global Institute, February.

OECD (Organisation for Economic Co-operation and Development). 2017. *Going Digital: The Future of Work for Women*. Paris: OECD.

Ricardo, D. 1817. *On the Principles of Political Economy and Taxation* (1st edition). London: John Murray.

Rogoff. K. 2016. *The Curse of Cash*. Princeton, New Jersey: Princeton University Press.

Susskind, R., and D. Susskind. 2015. *The Future of Professions: How Technology Will Transform the Work of Human Experts*. Oxford University Press.

Tondani, D. 2009. *Universal Basic Income and Negative Income Tax: Two Different Ways of Thinking Redistribution. The Journal of Socio-Economics* 38 (2): 246–55.

Tyson, L., and L. Mendonca. 2015. *Worker Protection in the Gig Economy*. https://www.project-syndicate.org/commentary/employee-protection-gig-economy-by-laura-tyson-and-lenny-mendonca-2015-11?barrier=accessreg (November 28).

Van Parijs Ph. and Y. Vanderborght. 2017. *Basic Income: A Radical Proposal for a Free Society and a Sane Economy*. Cambridge, MA: Harvard University Press.

WEF (World Economic Forum). 2017. *The Human Capital Report 2017: Preparing People for the Future of Work*. World Economic Forum.

World Bank. 2016. *Digital Dividends. World Development Report 2016*. Washington, DC: World Bank.

_____ 2018. World Development Indicators. http://databank.worldbank.org/ (accessed March 2018).

Chapter 2

The Future of Work in Africa

Economic transformation can increase productivity and unleash more dynamic sectors in Africa that can create and sustain jobs (absorb labor). Some transformation policies that show good promise in Africa are agriculture-driven transformation, local content and local participation, modernizing the services sector, export-oriented manufacturing, and enhancing infrastructure.

Fourth Industrial Revolution (4IR) technologies will play an increasingly important role in Africa's economic transformation in these areas. Africa is already the world's second-largest mobile phone market, and the pool of mostly young, successful entrepreneurs using these technologies is growing. Yet while Africa will surely face the disruptions—for better or worse—associated with 4IR, the region currently is ill-prepared to take advantage of the unique opportunities that will come with those challenges.

Across the region, employers identify inadequately skilled workers as a major constraint to their businesses.

Job creation and growth strategies need to be revisited so that they can address the opportunities and challenges presented by 4IR. Africa especially needs to address the problem of youth unemployment.

Background and Context

Providing decent jobs is the most assured pathway out of poverty. However, in Africa, job growth lags economic growth. Annual growth rates of 5.5 percent in GDP yielded 3.1 percent in job growth during 2000-08, and even less during 2009-14 (4.5 percent and 2.8 percent, respectively). Crucially, some 90 percent of the jobs created were in the low-productvity informal sector (Benjamin and Mbaye, 2014). Unnemployment is high and decent jobs are scarce. About 70 percent of workers are in highly vulnerable jobs and almost two-thirds are working poor (see Table 2.1).

Table 2.1 Labor Market Indicators (percent)

Africa is characterized by high levels of working poverty and vulnerable employment, while job creation lags behind economic growth.

Labor indicators	2000-07	2008-13	2014	2015	2016	2017
Labor force participation	69.8	69.9	70	70.2	70.3	70.4
Unemployment rate	8.1	7.6	7.3	7.4	7.5	7.5
Employment growth	3.0	3.0	3.4	3.0	3.0	3.1
Vulnerable employment	72.9	71.4	69.8	69.9	69.7	69.6
Extreme working poverty (less than $1.90 per day)	49.3	39	35.2	34.3	33.1	31.7
Working poverty (between $1.90 and $3.10 per day)	23.8	27.7	29.6	29.7	30	30.4
Productivity growth	2.9	1.8	1.5	0.5	1.2	1.7

Source: ILO (2018).

Note: Vulnerable employment refers to the sum of the employment status groups of own account workers and contributing family workers. They are less likely to have formal work arrangements and are therefore more likely to lack decent working conditions, adequate social security and "voice" through effective representation by trade unions and similar organizations. Vulnerable employment is often characterized by inadequate earnings, low productivity and difficult conditions of work that undermine workers' fundamental rights.

The key driver of this situation is the structure of Africa's economies. They are generally highly dependent on raw commodity exports, and thus growth may largely reflect the movement of commodity prices. African economies are also characterized by large informal sectors and a small formal sector. The informal sector is more dynamic in terms of employment, but productivity and wages are low. Inequality has also been growing, with the Gini coefficient rising from 0.52 in 1993 to 0.56 in 2008, underscoring that growth is not widely shared. Some key features of the employment landscape are:

- **Low employment elasticity.** The jobless growth phenomenon in Africa is reflected in very low employment elasticity. Every percentage point of economic growth during 2000-14 yielded employment growth of only 0.41 percentage point (AfDB, 2018).[1]

- **Preponderance of agricultural and informal jobs.** Jobs are largely agricultural and largely informal. Productivity and wages are low. Under-employment is high, ranging from 37 percent to 67 percent by country, resulting in a high proportion of working poor. Workers in the informal sector can earn up to six times less than workers in the formal sector (Bhorat and Tarp, 2016, cited in AfDB, 2017).

- **Gender and age discrimination.** The employment situation has a disproportionately negative impact on women and youth. Three-quarters of employed women in Sub-Saharan Africa are in informal employment, compared to 61 percent of men, the African Development Bank (2017) estimates. Underemployment is more common among women (AfDB, 2017). Gender differences tend to be more pronounced in countries with high levels of youth unemployment (AfDB, 2015).

The Youth Unemployment Challenge

Africa's employment challenge is essentially a youth employment challenge.[2] Of the 73 million jobs created between 2000 and 2008, only 22 percent were filled by youth (AfDB, 2017). The rate of unemployment among youth is estimated to be double that of adults in most African countries (AfDB, 2017).[3] About 40 percent of youth have no job security or any benefits whatsoever and about half are working poor. Lowering the youth unemployment rate to that of adults would lead to an increase in Africa's GDP of between 10 percent and 20 percent (AfDB, 2015).

The poor jobs situation for Africa's youth is due to three main factors. First, the pace of expansion in job growth in Africa's formal sector has not matched the pace of graduation from secondary and tertiary institutions. Each year, 10 million

1. The values range from 0.16 to 1.64 for 47 countries studied. Eighteen had elasticity below 0.41, twenty had values between 0.41 and 1.00, and nine had a value greater than 1.00 (AfDB, 2017).
2. Young people between the ages of 15 and 25 (the United Nations definition of youth) make up 19 percent of the population.
3. In 2016, youth unemployment in North Africa was more than three times higher than adult unemployment (AfDB, 2018).

to 12 million youths, mostly educated, enter the workforce, yet only 3 million formal jobs are created annually (AfDB, 2017).

Second, many youths are ill-prepared to fill the few openings because they often do not have the skills required by employers (AfDB, 2015) due either to the poor quality of their education or to specialization in subject areas (such as arts and humanities) other than those that employers demand (such as science, technology, and mathematics—STEM). Third, youth do not have the social capital, networks, and experience to compete with adults in the labor market (AfDB, 2015).

High youth unemployment is already creating new challenges at home and abroad. Forty percent of youths joining the ranks of rebel and terror groups cite the lack of economic opportunity as the key motivation (AfDB, 2017). Many youths are also leaving their home countries to search for jobs (see Box 2.1). Much of this immigration is illegal, aided by the emergence of criminal networks smuggling people, especially to Europe. This is a particularly dangerous option for the young people who suffer from predation and other dangers. Over 3,500 people, many of them young, died in the Mediterranean in 2015 while trying to make the perilous journey (AfDB, 2015).

The challenge will become even bigger; Africa's youth population is expected to double to over 830 million by 2050. This could be a population boon if these young people are equipped with appropriate education and training in the context of favorable economic policies (Bloom, Canning, and Sevilla, 2003). It can also be a population bomb. An estimated 15 million to 20 million increasingly well-educated young people are expected to join the African workforce every year for the next three decades (WEF, 2017). If youth unemployment rates remain unchanged, nearly 50 percent of those young people (excluding students) will be unemployed, discouraged, or economically inactive by 2025 (AfDB, 2016). It is instructive to note that the "Arab Spring" that started in Tunisia was due to a combination of highly educated and unemployed youths.[4] The emergence of associations of unemployed graduates points to coming agitation if softer means of engagement do not translate into results.[5]

The key to creating decent jobs is policies and strategies that increase productivity, increase labor elasticity, and increase the capacity of the economy to reallocate labor from traditional to modern jobs and sectors. However, these strategies are not "free" and may involve trade-offs, especially between labor elasticity and productivity growth, which have an inverse relationship.

The jobs challenge prompted the African Development Bank to develop a Ten-Year Strategy (TYS) that aims to equip young people with the right skills for both the formal and informal sectors, including the skills to create small businesses (AfDB, 2013). The AfDB has also launched the Jobs for Youth Initiative in Africa (JfYA) to complement the Ten-Year Strategy. The initiative aims to help African

4. In Tunisia, the 2007 unemployment rate for university graduates was 40 percent, almost twice the 24 percent rate for non-graduates (AfDB, 2015).

5. Observers have noted that high unemployment is not enough by itself to lead to an uprising; additional compounding factors tend to be present. For example, in North Africa's uprising, the compounding factors were a sense of social injustice and the need for dignity (UNESCO, 2011).

Box 2.1 The Africa–European Union Immigration Challenge: Shifting the Frontier to the Home Country

Illegal immigration has been one response to Africa's job crisis. Although most migration is within the region of origin, when migrants leave Africa, their destination tends to be their former colonizing country. This means that Europe bears the brunt of illegal immigration out of Africa. This has become a major political problem for European leaders because the public is increasingly hostile to immigration.

Indeed, creating economic opportunities for youth in Africa and immigration were two of the four agenda items tackled in the 5th Africa-EU summit (http://www.consilium.europa.eu/en/meetings/international-summit/2017/11/29-30/). At the summit, a new EU external investment plan was presented. It aims to trigger €44 billion of investments in Africa by 2020, thereby creating new job opportunities for young people across the African continent. A recent report commissioned by the Italian Agency for Development Cooperation, the AICS-ICID Report, calls for a coordinated set of actions to ensure that people do not choose to migrate in the first place. Proposed actions include support for policies to expand local employment opportunities, particularly by encouraging entrepreneurship, developing human capital (including vocational education and training), providing employment services, and subsidizing employment.

Sources: Frigenti and Rosati (2017); Ratha et al. (2011).

countries create 25 million jobs and benefit 50 million youth over the decade 2016-25 (AfDB, 2016).[6] Various approaches point to a number of broad strategies for growth and employment, as discussed next.

Economic Transformation Policies

Economic transformation can increase productivity and unleash more dynamic sectors that absorb labor. Several transformation policies are promising.

- **Agriculture-driven transformation.** An agricultural sector characterized by high productivity can support agro-processing. Manufacturers of high-quality products for local and export markets can create many jobs across value chains that include manufacturing, logistics, and retailing. The sector may also act as a stimulus for broader economic development through many potential linkages with other subsectors of the industry and services sectors (ACET, 2017; AfDB, 2018).

- **Local content and local participation.** The responsiveness of subsectors, especially extractives, that do not create many jobs can be improved by developing stronger linkages between these subsectors and the broader economy through increased local content and local participation (ACET, 2014).

- **Modernizing the services sector.** The key is to improve the productivity of this sector, particularly its large informal part. One way to do this is by using information and communications technologies (ICT), such as mobile payment systems and ordering systems.

- **Export-oriented manufacturing.** A policy priority is to encourage a shift toward more labor-absorbing growth paths, characterized by strong backward and forward linkages between firms. However, given small domestic markets, manufacturing in Africa is unlikely to experience dynamic growth and employment creation without a significant degree of export focus and export specialization, Bhorat, Steenkamp, and Rooney (2017) argue.

- **Enhancing infrastructure.** Rapid urbanization in Africa presents many opportunities for young entrepreneurs to develop businesses that serve an increasingly urban and connected population in an environment that provides higher returns to scale and agglomeration (AfDB, 2015). However, this opportunity can be unlocked only by providing infrastructure, especially for smaller cities. Building this infrastructure will also be a source of employment, Freire, Lall, and Leipziger (2014) note.

---

6. JfYA has three main objectives: to address demand challenges by creating greater economic opportunities for youth; to address supply challenges by equipping youth with skills that position them for the jobs of tomorrow; and to address linkage challenges and better connect youth to economic opportunities.

Facilitative Policies

Economic transformation polices should be complemented with other polices, especially those to enhance labor reallocation, stimulate entrepreneurship, and support companies in coping with difficulties. Some relevant polices are discussed next.

- **Push policies.** Pull policies need to be combined with push policies to be more effective. This is especially critical due to the dual nature of African economies, where a high-productivity modern formal sector operates side by side with a low-productivity informal sector. There is a need to facilitate the movement of workers from low-productivity activities to those with higher productivity. Even as opportunities are created through transformational policies, workers in traditional sectors may not know about the openings and/or they may be too poor to afford the job search cost and even the cost of moving when a better job awaits. Therefore, polices that facilitate movement of labor out of the traditional sector to modern sectors are key. One approach is to establish job centers that can create awareness of opportunities (such as job fairs); match potential employers with potential employees; provide training to close skills gaps; help job seekers write resumés and prepare for interviews; and provide cash support to cover search costs or transition to a new activity (such as temporary housing support).

- **Training and skills development.** Training and skills development programs are also important. In developing and executing the skills and training strategies, governments should work with the private sector and the academic community to decide on priorities and forms of intervention (AfDB, 2018).

- **Improved regulation.** A supportive regulatory environment for both the formal and informal economy is another key measure. For example, regulatory reforms in Rwanda led to a more than quadrupling of new firms from 700 to 3,000 per year (McKinsey Global Institute, 2012).

- **Wage subsidies.** Subsidies can allow employers to keep employees on their payroll rather than lay them off for economic reasons. Subsidies can also enable companies to hire young workers (or women, in specific instances) by paying part of their salary for a given period, allowing them to acquire or develop skills that can eventually provide long-term employment (AfDB, 2018). However, fiscal constraints are severe.

- **Improved data collection and dissemination.** While the preceding policies can play a role, the mix of polices that work in certain countries is highly dependent on context. This underscores the need for good data to design policies based on evidence. It is vital to invest in regular labor market data collection and ensure timely public access so that policy making can benefit from researchers' analysis.

The Fourth Industrial Revolution (4IR)

Efforts to address the jobs challenge are being complicated by recent technological breakthroughs that are unleashing new capabilities and fundamentally changing the nature of work (see Box 1.1 in Chapter 1). This technological revolution is being referred as the Fourth Industrial Revolution (4IR).

For Africa, 4IR is a double-edged sword. On the one hand, it can increase productivity, meaning that fewer people will be needed to perform the same tasks as automation complements humans. Forty-one percent of all work activities in South Africa are susceptible to automation—as are 44 percent in Ethiopia, 46 percent in Nigeria, and 52 percent in Kenya, the World Economic Forum finds (WEF, 2017). On the other hand, 4IR technologies can enable new types of activities. For instance, mobile phones are allowing people who did not have insurance to buy micro-insurance. Sharing platforms like Airbnb are allowing people to convert extra rooms into rental units that are attracting new types of tourists.

4IR and Economic Transformation

The key challenge for Africa is structural transformation. Economic transformation strategies can increase productivity while simultaneously increasing employment elasticity. Thus, the crucial question is whether 4IR can enable or hinder transformation. A closer look at some of the proposed employment and growth strategies in light of 4IR points to the need to rethink the strategies (see Table 2.2).

- **Agriculture-driven transformation.** Agriculture-driven transformation is likely to be more energized by 4IR. ICTs can play a major role in upgrading all stages of agricultural value chains. Precision agriculture can increase productivity at the farm level using "big data" and autonomous vehicles to optimize application of inputs. ICT platforms can help develop new business models that are particularly amenable to increased youth participation. Examples include delivering agricultural services by connecting farmers to service providers, such as "Trotro Tractor"[7] and "Hello Tractor," which allow farmers to buy mechanization services. The Esoko[8] platform is allowing farmers to connect to markets. Blockchain technologies are being used to guarantee food safety standards that are key to participating in lucrative international food markets. Big data and the Internet of Things (IoT) are making "telephone" farming a reality.[9] In this way, the middle class is increasingly able to farm their out-of-town holdings while working in town.

7. http://www.trotrotractor.com/.
8. https://www.esoko.com/.
9. IBM's EZ-Farm project is exploring how sophisticated data analytics can help farmers keep in touch with what is really happening on their out-of-town smallholdings. Sensors strategically placed around the farm monitor water tank levels, the amount of moisture in the soil, as well as the performance of irrigation equipment. Infrared cameras measure rates of photosynthesis, which can indicate whether crops are being watered too much or too little. All these data are streamed wirelessly to the IBM Cloud and accessed by the farmer via a smartphone app. http://www.bbc.com/news/business-33610593.

Table 2.2 The Fourth Industrial Revolution (4IR) and Transformation Strategies

4IR technologies will have a very varied impact on various economic transformation strategies for Africa.

	4IR technology		
Transformation strategy	**AI/Machine learning**	**Internet of Things (IoT)**	**Big data/data science**
Agricultural transformation	• Application in plant breeding to speed varietal selection • Intelligent robots are reducing applications of inputs by over 90 percent	• Use of drones to monitor crops • Internet- enabled irrigation systems	• Telephone farming • e-extension • Inputs-as-service[a] • Use of Big Data for credit scoring of farmers
Modernized services	• Driverless cars will eliminate jobs in transportation • Potentially many applications especially (e.g. credit scoring using non-standard data)	• Sale of solar power as utility/ service through internet-enabled cookers and solar panels (e.g. M-Kopa)	• Shared economy (e.g. AirBnB) • Financial inclusion (e.g. micro-insurance) • e-commerce (e.g. Jumia, iRoko)
Local content	• Potential for development of sophisticated machine-learning algorithms to interpret and/or explore data	• Drone-based services (e.g. facilities inspection, mapping)	• Geological data mining may create new opportunities
Export-led manufacturing	• Advanced robots will eliminate the advantage of cheap labor		Will enable very specific market segmentation and eliminate mass markets
Infrastructure		Alternative infrastructure (e.g. drones)	
Overall impact of 4IR technology	Will eliminate traditional paths of industrialization		The most dynamic of 4IR technology for Africa. Potential to create many jobs

	4IR technology		
Transformation strategy	**3D Printing**	**Blockchain technologies**	**Net impact on competitiveness**
Agricultural transformation	• Locally fabricated agricultural machines	• Food traceability system for international trade	• Very high. Agriculture has many potential entry points and little downside in terms of job losses.
Modernized services	• Toll/contract manufacturing • Community workshops	• Numerous trust-based applications (land registries, contracting) • Cryptocurrency-based transactions	• Very high. This sector is already very dynamic. An e-commerce company valued at $1 billion, M-Pesa, is already the biggest money transfer service in the world.
Local content	• Locally manufactured parts		• High to moderate. Much potential here, but will require much support to build new capability, especially in artificial intelligence, data science, and 3D printing.
Export-led manufacturing	• Will eliminate the factory manufacturing model		• Very low. This will not be a viable strategy in the 4IR world.
Infrastructure			• Neutral
Overall impact of 4IR technology	Presents great opportunity for leapfrogging into manufacturing	Potential to formalize the huge informal sector	

Note: An empty cell means that no meaningful application has been identified by the authors.

a. For instance, rather than buy an "input" say a herbicide, a farmer can buy a "weed killing" service i.e. the service provider comes in and spray the weeds saving the farmer the cost of buying spraying equipment and/or excess herbicide. Similarly a farmer can buy ploughing service rather than buy a tractor, for example TroTro Tractor Limited in Ghana offers ploughing services by connecting farmers and tractor operators using IoT and Big Data. So rather than buying the input (tractors) the farmer is buying an input service (ploughing).

- **Modernized services.** This is perhaps the most dynamic area. Internet and mobile phones have allowed many services to be developed and rolled out. For example, the Africa Internet Group (AIG) is involved in various kinds of e-commerce and has been able to leverage internet platforms to create the first billion-dollar internet business in Africa, the so-called "unicorns."[10] In Kenya, M-Pesa is now the biggest money transfer system in the world. The M-Pesa platform allows people to pay for all kinds of services and is rapidly formalizing the informal sector by bringing many transactions online. Mobile phones have also brought banking, insurance, and other financial services to many who had previously been excluded. Accra Metropolitan Authority (AMA) is exploring how it can leverage big data technologies to analyze mobile phone data to get to see how people move around within the city and thus optimize transportation systems.[11] In East Africa, M-Kopa is selling solar power as a service or utility to 500,000 poor households using an IoT platform that has solar panels and cooking stoves connected to the internet.[12]
- **Local content and local participation.** The enclave nature of extractive industries is more a reflection of the specialized nature of the sector, which makes it harder for local industries to supply equipment and parts. 3D printing will make it easier to develop local fabrication capacities to supply this sector.
- **Export-oriented manufacturing.** Automation is erasing the cheap labor advantage and is leading to relocation of operations from Asia back to Western industrialized countries as robots and AI change the economics of manufacturing. Africa's share in robots sold in 2015 (around 0.2 percent of world sales) is more than 15 times lower than its share in world GDP (around 3 percent). Indeed, the Overseas Development Institute (ODI) notes that as the cost of capital falls in developed countries, developed countries will find it more efficient to reshore manufacturing activities from Africa (and elsewhere) (Banga and te Velde, 2018). The recent evidence for the United States suggests that this leads to a loss of roughly 126 African jobs per company reshored.[13] Thus the prospect of Asian manufacturing moving to Africa as labor costs rise in Asia is no longer a viable strategy for

10. AIG businesses in Africa include Jumia (an e-commerce platform); Zando (shoes and clothing); Hellofood (a food delivery service); Kaymu (an online resale marketplace); Lamudi (a real estate classified platform); EasyTaxi (a cab-hailing service); Jovago (a hotel-booking portal); Everjobs (a jobs classified site); and Carmudi (a car-selling platform). Started in 2012, AIG now operates in 23 African countries.
11. http://www-03.ibm.com/press/us/en/pressrelease/40817.wss.
12. http://www.idgconnect.com/abstract/26156/how-iot-big-data-tackling-africa.
13. Between 2010 and 2015, 250,000 jobs were reshored to the United States, Banga and te Velde (2018).

transformation, or at best a very problematic one. The ODI report further notes that new goods emerging from the Fourth Industrial Revolution are based on a digital thread connecting tasks undertaken before and after manufacturing with the actual manufacturing stage. This requires advanced infrastructure, research and development (R&D) skills, and skilled labor along the whole value chain. Thus, it is unlikely that manufacturing will shift to Africa, given limited digitization. This trend could potentially lead to the concentration of manufacturing in other developing countries, limiting opportunities for technological diffusion and spillovers.

All the same, ODI argues that there is a window of opportunity for African countries to move into less automated sectors, where technology installation has been slow (Banga and te Velde, 2018). Automation varies greatly across sectors, with automotive and electronics sectors being at the forefront while food processing and furniture production lag. This provides an opportunity for manufacturing focused on local and regional markets. Further, even as these industries become susceptible to automation, ODI (2018) point that because of their lower labor costs, African countries will tend to have decade longer to adjust before cost of robots falls enough to replace human labor. This window can be used to build manufacturing capabilities, underscoring the need for continued focus on improvements in basic infrastructure—such as a reliable power supply, tele-communications, and roads—combined with a targeted approach to building industrial capabilities. Mastering traditional manufacturing makes it easier to jump to more complex digitized manufacturing.

Beyond automation, advances in 3D printing may totally disrupt this sector as small shops gain the capability to make sophisticated, customized products and yet still be competitive. Thus, an export-oriented manufacturing strategy is likely to be very problematic in light of 4IR developments.

Facilitative Policies

4IR technologies can be deployed to help make facilitative policies more effective.

- **Push policies.** By providing information, training, and links to employers and other resources, internet platforms can be leveraged to improve push policies. Many job platforms exist, such as Jobberman in Ghana, which advertises jobs, holds job fairs, and provides help with developing resumés.[14] The JobMatch program in Rwanda seeks to connect prospective employers and disadvantaged youth through a matching system using text messages (Dawes, Nema, and Zelezny-Green, 2014).

- **Training and skills development.** 4IR technologies provide opportunities for innovative delivery of training. Online courses are available from the best centers of learning in the world through Massive Online Open Courses (MOOCs).

14. https://thebftonline.com/business/jobberman-ghana-holds-instant-hire-job-fair/.

- **Improved regulation.** 4IR technologies can make business regulation smoother. In Kenya, the government runs ICT centers, called Huduma Centres, that serve as a one-stop shop for government services. Users can access many services, including quick registration of companies and payment of various licenses.

- **Wage subsidies.** Subsidies are susceptible to political problems, including patronage. For example, a powerful politician can direct funds to companies in return for jobs for his/her supporters. Big data and artificial intelligence (AI) algorithms can reduce this type of abuse by making payments purely driven by data, with little or no human input.

- **Improved data collection.** Data collection can also be greatly improved using new technologies. For example, data on locations and payments that can be collected from cell phones can provide interesting insights on where economic activity is taking place. Mobile platforms also provide the opportunity for doing surveys on employment.

Looking Ahead

One of the impacts of 4IR is increased productivity. For African countries, this probably means increased productivity of the modern sector. Growth driven by automation may create jobs to support new business lines that may be enabled by the 4IR technologies. On the other hand, growth may stem from more production of the same things the firm has been producing through efficiencies enabled by 4IR, and may thus eliminate some jobs. For now, the evidence seems to point to elimination of jobs through automation. However, 4IR offers many opportunities to support transformation strategies that are job-creating growth pathways. This is especially true for agriculture and services, where applications are numerous. Nascent areas of local content provision can also create many opportunities, though much capacity will need to be built.

Indeed, a major concern is the low level of preparedness of countries to take advantage of opportunities. Across the region, employers identify inadequately skilled workers as a major constraint to their businesses, including 41 percent of all firms in Tanzania, 30 percent in Kenya, 9 percent in South Africa, and 6 percent in Nigeria (WEF, 2017). The AfDB (2018) points out that too few scientists and engineers in Africa work in sectors that drive economic transformation. This pattern is likely to get worse—a point underscored by the fact that African college graduates with a science, technology, engineering, or mathematics (STEM) degree, represent only 2 percent of the continent's total university-age population. Yet these STEM skills are crucial requirements in a 4IR world.[15]

Thus, while Africa will surely face the disruptions associated with 4IR, the region currently is ill-prepared to

15. In 2010, for example, the share of college students in engineering, manufacturing, and construction programs was 7.3 percent in Burkina Faso, 3.0 percent in Burundi, 4.3 percent in Cameroon, 4.5 percent in Mozambique, 5.6 percent in Madagascar, 5.9 percent in Ghana, and 12.8 percent in Morocco. In 2014 the shares in Austria, Germany, Malaysia, and Mexico were all above 20 percent (AfDB, 2018).

take advantage of the unique opportunities that will come with those challenges. Yet there is no doubt that Africa has the potential to accelerate its development using 4IR platforms. In less than 15 years, the continent has grown to become the world's second-largest mobile phone market, offering millions of families access to financial services, public health information, and the internet (De Klerk, no date). Even more impressive is how young people have used this technology as a platform to unleash their entrepreneurial potential. This has led to the emergence of a growing pool of mostly young, successful entrepreneurs. With the right support, Africa's success with mobile platforms can be replicated on increasingly powerful 4IR platforms and can drive transformation of African economies.[16] This underscores the need to revisit job creation and growth strategies so that they can address the opportunities and challenges presented by 4IR.

16. To be sure, 4IR is happening within a broader socioeconomic and cultural context. In Sub-Saharan Africa, the basic concern for food and personal security remains crucial. On the global scale, however, concern for sustainability in the face of looming climate change and environmental degradation takes center stage. The fact that socioeconomic issues are highly specific to context means that the exact impact of 4IR will differ by country and by region.

A new EU investment plan aims to create new job opportunities for young people across the African continent.

References

ACET (African Centre for Economic Transformation). 2014. *Africa Transformation Report*. Accra: ACET.

———— 2017. *Africa Transformation Report 2017: Agriculture Powering Africa*. Accra: ACET.

AfDB (African Development Bank). 2013. *At the Center of Africa's Transformation: Strategy for 2013-2022*. Abidjan: African Development Bank Group.

———— 2015. *African Development Report 2015: Growth, Poverty and Inequality Nexus*. Abidjan: African Development Bank Group.

———— 2016. *Jobs for Youth in Africa—Strategy for Creating 25 Million Jobs and Equipping 50 Million Youth, 2016-2025*. Abidjan: African Development Bank Group.

———— 2017. *Growth and Job Creation: Policy Options for Pro-Employment Growth*. Background paper for the *African Economic Outlook 2018* report of the African Development Bank, African Development Bank Group, Abidjan.

———— 2018. *Africa Economic Outlook 2018*. Abidjan: African Development Bank Group.

Banga, K., and D. W. te Velde. 2018. *Digitalization and the Future of Manufacturing in Africa*. ODI (Overseas Development Institute) SET (Supporting Economic Transformation) Programme. Draft report, February.

Benjamin, N., and A. A. Mbaye. 2014. *Informality, Growth, and Development in Africa*. WIDER Working Paper 2014/052, United Nations University (UNU)-Wider.

Bhorat, H., F. Steenkamp, and C. Rooney. 2017. *Understanding the Determinants of Africa's Manufacturing Malaise*. In *Income Inequality Trends in Sub-Saharan Africa: Divergence, Determinants and Consequences,* edited by A. Odusola, G. A. Cornia, H. Bhorat, and P. Conceição, 103–28. New York: United Nations Development Programme.

Bhorat, H., and F. Tarp, eds. 2016. *Africa's Lions: Growth Traps and Opportunities for Six African Economies*. Washington, DC: Brookings Institution Press.

Bloom, D., D. Canning, and J. Sevilla. 2003. *The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change*. Santa Monica, CA: RAND.

de Klerk, Nico. No date. *Fourth Industrial Revolution: A Force for Stability or Volatility in Africa?* http://www.defenceweb.co.za/index.php?option=com_content&view=article&id=43192&Itemid=116&catid=.

Dawes, L., P. Nema, and R. Zelezny-Green. 2014. *Scaling Mobile Employment Services: A Stakeholder Perspective: Increasing Opportunities for Youth through Mobile*. GSMA Mobile for Employment, May 13. https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2014/05/Scaling-Mobile-Employment-Services-A-Stakeholder-Perspective.pdf.

Freire, M. E., S. Lall, and D. Leipziger. 2014. *Africa's Urbanization: Challenges and Opportunities*. Working Paper No. 7, The Growth Dialogue, Washington, DC.

Frigenti, F., and F. C. Rosati. 2017. *Moving Upstream the 'Relevant' Migration Frontier. Strategic Priorities to Turn the Migration Challenge into a Development Opportunity*. ICID blog, the Italian Centre for International Development. http://www.icid.info/icid-blog/9-69/moving-upstream-the-relevant-migration-frontier-strategic-priorities-to-turn-the-migration-challenge-into-a-development-opportunity#.WnwewK5l_IX.

ILO (International Labour Organization). 2018. ILOSTAT http://www.ilo.org/ilostat (accessed January 25, 20118)

McKinsey Global Institute. 2012. *Africa at Work: Job Creation and Inclusive Growth*. McKinsey Global Institute.

Ratha, D., S. Mohapatra, C. Özden, S. Plaza, W. Shaw, and A. Shimeles. 2011. *Leveraging Migration for Africa: Remittances, Skills, and Investments*. Washington, DC: World Bank.

UNESCO (United Nations Educational, Scientific, and Cultural Organization). 2011. *Arab Youth: Civic Engagement and Economic Participation*. Beirut: UNESCO Regional Bureau for Education in the Arab States.

WEF (World Economic Forum). 2017. *The Future of Jobs and Skills in Africa—Preparing the Region for the Fourth Industrial Revolution*. Davos-Klosters: World Economic Forum.


Celestica
Celestica

Chapter 3

The Future of Work in Developing Asia

Developing Asia has done remarkably well in creating jobs for its workers. Recent advances in technology will further fuel productivity gains. Yet there is concern that the high degree of automation made possible by some of these advances could cause widespread job losses.

However, there are good reasons to remain optimistic about Developing Asia's job prospects. First, job automation takes place only where it is both technically and economically feasible. This tends to be in capital-intensive manufacturing, where employment levels in the region are relatively low. Second, data covering 12 Developing Asian economies show that from 2005 to 2015 rising domestic demand more than compensated for jobs lost due to technological advances. This pattern is likely to continue as a growing middle class consumes more and better goods and services. Third, technological change and rising incomes will lead to new occupations and industries, further offsetting labor displacement due to automation.

Nonetheless, new technologies will alter the composition of skills needed by the workforce. It may also lead to more frequent unemployment, lower wage growth—especially for the less skilled—and widening income inequality. Governments should respond by ensuring that workers are protected from these negative effects. Ensuring that new technologies serve the broader development agenda also requires paying careful attention to using technologies in the delivery of public services and supporting their spread and further development.

Jobs in Asia

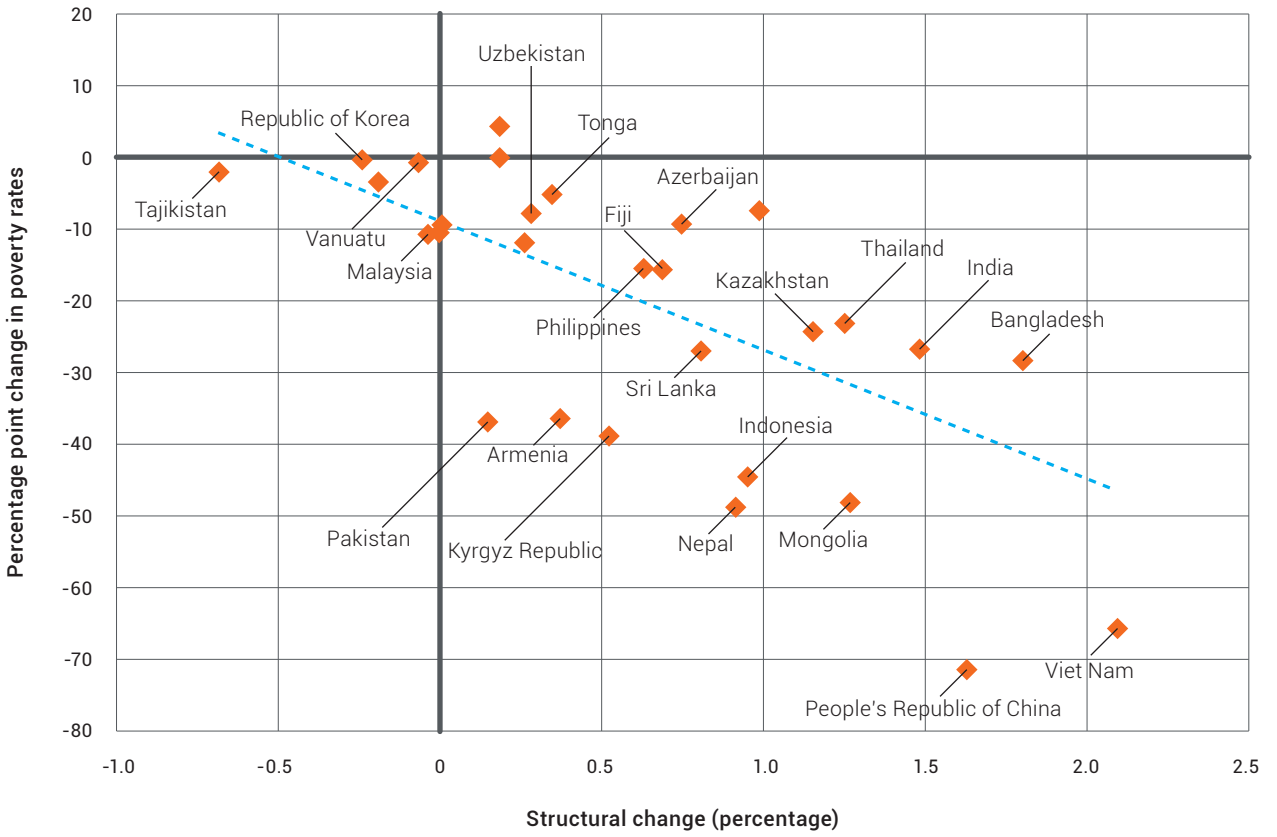
Developing Asia has done remarkably well in creating jobs for its workers.[1] Over the past 25 years, the region has created 30 million nonagricultural jobs annually. Job creation has been accompanied by improved productivity and rising earnings for workers, leading to large reductions in poverty. Shifts in employment from agriculture to industry and services, where pay and productivity are higher, have been important to the process (Figure 3.1, panel a). However, improved productivity within sectors has typically been the main driver of countrywide productivity growth (Figure 3.1, panel b). Technological advances, such as high-yielding varieties in farming, modern machine tools in manufacturing (like numerically controlled lathes), and information and communication technology (ICT) in services, have been central to productivity gains. International trade, foreign direct investment, and investments in education, infrastructure, and research and development have played key roles in promoting the development and adoption of new technologies. Macroeconomic stability and a business-friendly investment climate have also provided an environment conducive to sustained growth.

1. This chapter uses official country names as approved by the Board of Directors of the Asian Development Bank.

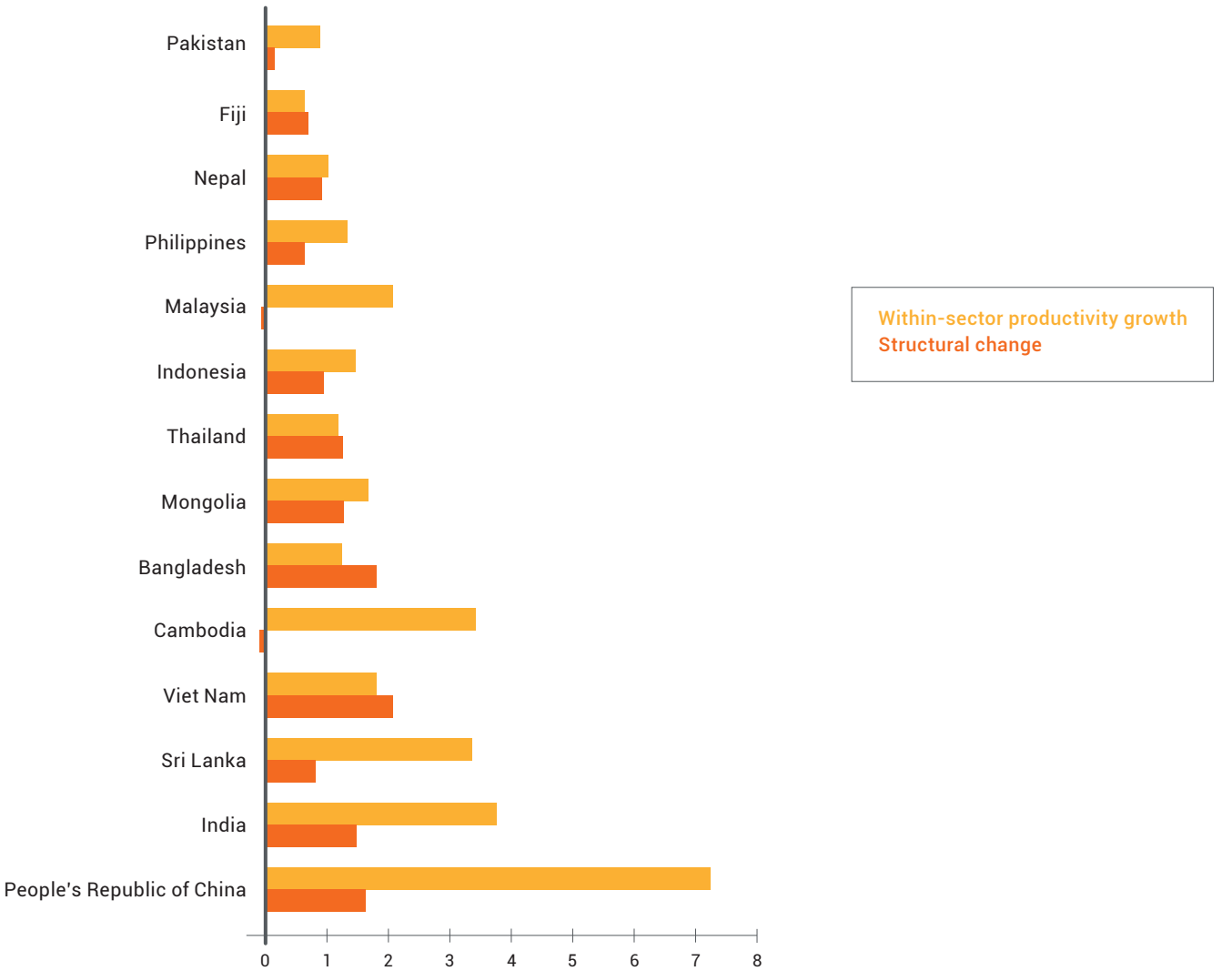
Figure 3.1 Poverty Reduction and the Components of Productivity Growth, Developing Asia, 1993-2013

Shifts in employment from agriculture to industry and services have led to a big drop in poverty, but improved productivity within sectors has also been important.

a. Structural change and change in poverty rates ($3.20/day), 1993-2013



b. Components of productivity growth, 1993-2013 (percentage)



Source: Adapted from ADB (2018).

Note: *Panel a* contains 31 countries classified as low- and middle-income countries in 1993; only developing Asian economies are labeled. A poverty line of $3.20/day in 2011 purchasing power parity terms is used. Following McMillan, Rodrik, and Verduzco-Gallo (2014), changes in economy-wide labor productivity have been decomposed into structural change—the gains in productivity from shifts of employment from lower- to higher-productivity sectors—and the contributions from improvements in sector-specific labor productivity.

Recent advances in technology will further fuel productivity gains. However, concerns have been raised about their potentially adverse impact on jobs. New technologies underlying the oft-cited Fourth Industrial Revolution (4IR)—such as robotics, three-dimensional printing, artificial intelligence, mobile internet, and the emerging Internet of Things—will help drive future prosperity. Yet, they also pose challenges for workers. In textiles and footwear, for example, experiments in completely automated production are now being conducted. Similarly, it is becoming technically feasible to automate more complex services such as customer support and financial analysis. This has raised concerns that automation could cause widespread job losses, slow wage growth, and worsen income inequality in developed and developing economies alike. Some studies of Asia's developing economies indicate that over half of today's jobs could be at risk (McKinsey Global Institute, 2017; Chang, Rynhart, and Huynh, 2016).

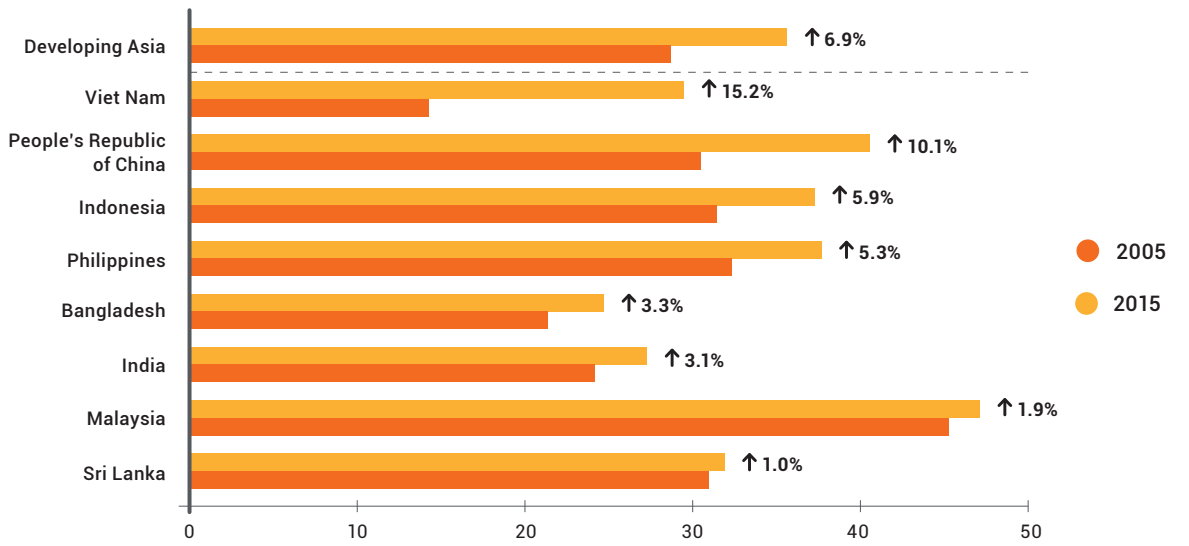
Is Automation Anxiety Justified?

There are several reasons why dire predictions of jobs lost will unlikely be borne out, especially in the context of Developing Asia. First, the typical job consists of several tasks, only some of which may be automated. Second, even if it is technically feasible to automate a task, doing so may not be economically viable. Third, especially in the context of low- and middle-income countries, where much growth potential remains (even through greater use of now standard technologies such as electricity and modern transport), rising demand for goods and services offers a countervailing force to automation-driven labor displacement. Finally, technological change and economic growth have always gone hand in hand with the creation of new industries and occupations; there is no reason this time must be different.

An analysis of employment changes in Developing Asia since the early 2000s provides insights into how new technologies and other forces have been affecting jobs and will shape their future. While technologies associated with "extreme" automation are only just starting to appear, modern machine tools and ICT have already been put to work in many factories and firms. Data on the use of industrial robots—defined as machines that can be programmed to perform production-related tasks without the need of a human controller—show that between 2010 and 2015, the stock of robots rose 70 percent to 887,400 units in nine developing Asian economies. Moreover, consistent with analytical work on the effects of automation on different types of jobs, labor force survey data reveal that the share of jobs intensive in nonroutine tasks is on the rise, while the share of jobs intensive in routine tasks has been declining (Figure 3.2). Therefore, analyzing employment changes over recent years offers insight on how technological change will affect jobs.

Figure 3.2 Nonroutine Employment Shares in Developing Asia and Selected Asian Economies, 2005-15

The share of jobs intensive in nonroutine tasks is increasing, while the share of jobs intensive in routine tasks has been decreasing.



Source: Decomposition result derived from ADB (2018).

Note: Classification into routine and nonroutine is based on Autor and Dorn (2013) and excludes agricultural occupations. Countries appear in ascending order of percentage point increase in nonroutine employment. Developing Asia includes 12 Asian developing member economies: Bangladesh; the People's Republic of China; India; Indonesia; the Republic of Korea; Malaysia; Mongolia; the Philippines; Sri Lanka; Taipei,China; Thailand; and Viet Nam.

Manufacturers will continue to rely on workers because of both technological and economic feasibility. For example, comparing the production of garments to automobiles, more technological sophistication is required for a robot to have the dexterity to work with cloth and carry out stitching operations than work with large metal parts; at the same time, average wages are relatively low in sectors such as apparel and footwear, making automation uneconomical. Accordingly, Developing Asia's growing use of industrial robots is concentrated in areas of capital-intensive manufacturing—which, significantly, have relatively low employment levels to begin with (Figure 3.3). Thus, while the electrical and electronics sector and automotive sector each accounted for 39 percent of total robot use in 2015, they accounted for only 9.2 percent and 4.2 percent of total manufacturing employment, respectively. In contrast,

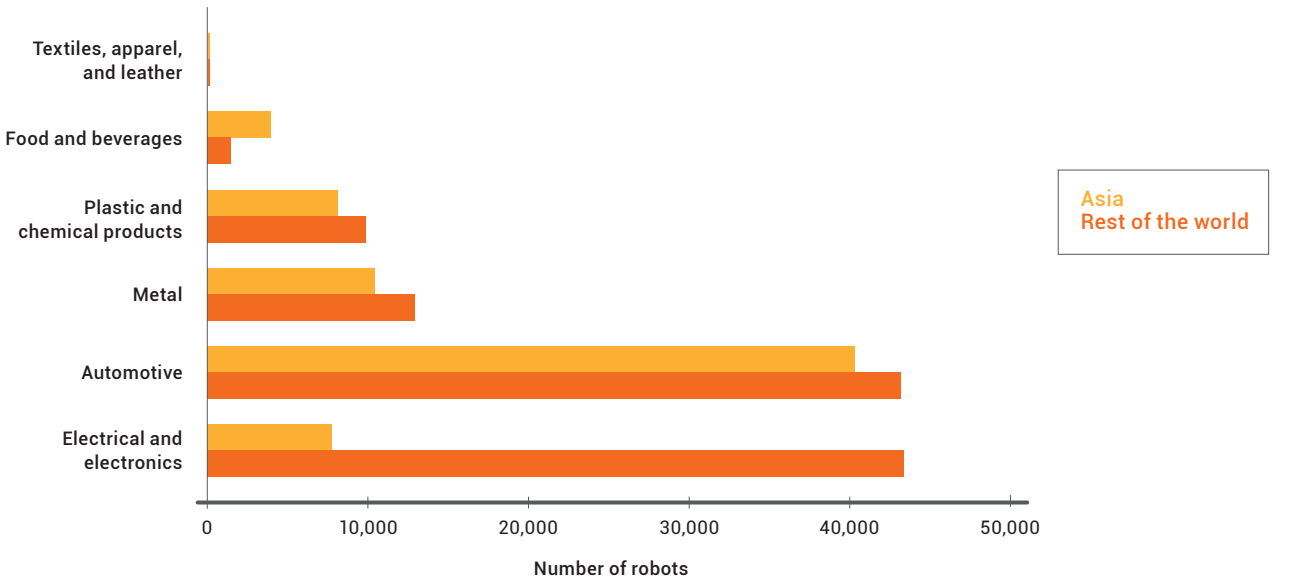
textiles, apparel and leather combined accounted for only 0.1 percent of robot usage in 2015, but 19.2 percent of total manufacturing employment. Given that robot usage is concentrated in sectors with relatively low employment, concerns about robots replacing workers may be overstated.

Even as robots become more sophisticated, they are not likely to take over production in labor-intensive sectors in the foreseeable future. Notwithstanding the growing sophistication of sewing robots in garment manufacturing, for example, current cost structures suggest that even over the next five to ten years, sewing machine operators—accounting for two-thirds of garment workers—will likely remain more cost effective than sewing robots. Moreover, technological transformation and innovation are being applied across the region's factories to raise operational efficiency and reduce time lags, not just to displace labor. Thus, factories relying on sewing machine operators rather than sewing robots will remain competitive in global markets. Finally, for middle-income countries with large domestic markets, there will be even less pressure to switch to sewing machine robots. In India, for example, the domestic market for apparel could well increase by 250 percent over the next 15 years, requiring an increase in garment workers even in the face of labor-saving technology.

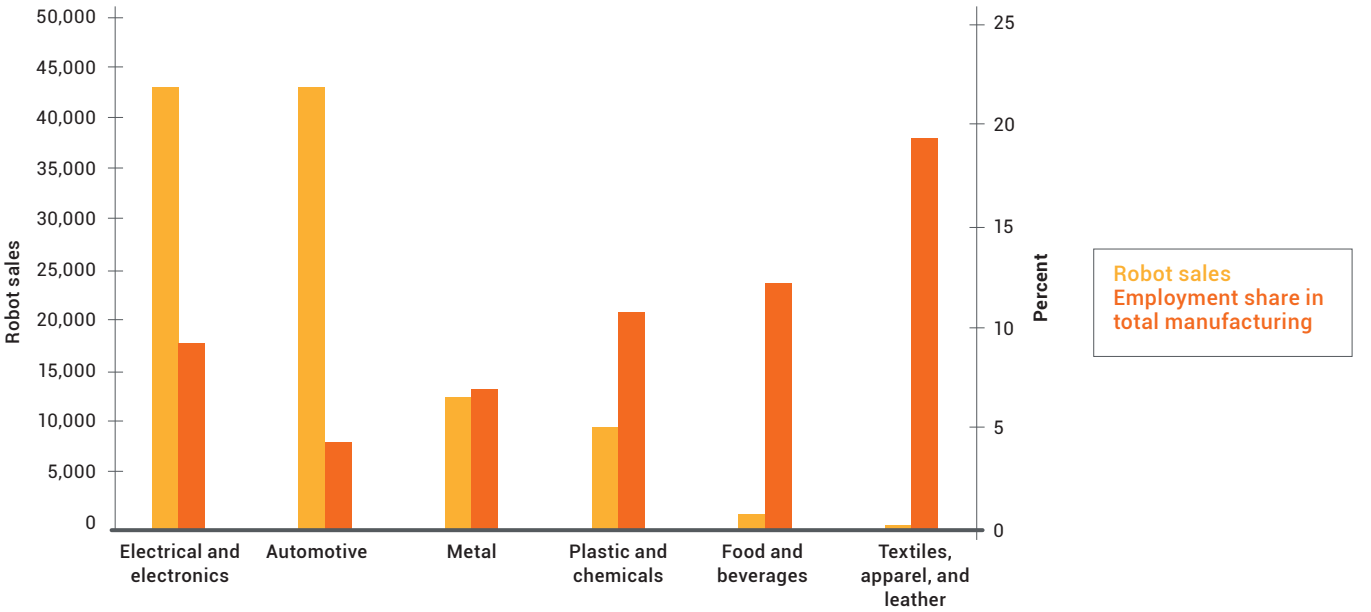
Figure 3.3 Annual Supply of Robots and Sectoral Employment, 2015

a. Robots by industry, Asia and the rest of the world, 2015

The use of robots remains highly concentrated in just a few sectors with relatively low employment.



b. Employment shares by sector, selected Asian economies



Source: Adapted from ADB (2018).

Note: Asia includes the People's Republic of China; India; Indonesia; the Republic of Korea; Malaysia; Singapore; Thailand; Taipei,China; and Viet Nam.

Rising demand provides a strong countervailing force to job displacement driven by automation. New technologies often allow a given level of output to be produced by fewer workers. While this leads to a displacement effect on employment, a "productivity" effect can result in a rise in demand as costs of production and product prices decline in response to improved productivity. In principle, a strong increase in demand may even lead to an expansion of jobs in factories that automate parts of their production process. More generally, the productivity benefits of new technology in one industry lower production costs in other industries through input-output channels, contributing to an increase in demand and employment across industries.

Because domestic demand is now the main growth driver in Developing Asia, "reshoring" production to advanced economies may not be a major threat to employment. In the 12 economies studied, only around 10 percent of total employment in 2015 depended directly and indirectly on final demand from advanced economies. Furthermore, while consumer markets in advanced economies are increasingly saturated, markets in Developing Asia and the rest of the world still have a high potential for growth. Therefore, even if automation in advanced economies caused some factories in the region to reshore, the employment impact will likely be muted.

Looking to the future, workers will continue to leave agriculture. But considerable scope remains to raise agricultural productivity and earnings in what will remain one of Asia's largest employers. In advanced economies, the lowest paid employment tends to be in services, such as restaurants and hotels, where prospects of raising productivity are limited. In contrast, the lowest paid employment in Developing Asia tends to be agricultural, where prospects for productivity gains remain large. Even as workers exit agriculture, adopting today's standard technologies—such as high-yielding varieties of staple grain crops and modern irrigation and farm machinery—hold much potential benefit for those who remain. The latest Fourth Industrial Revolution (4IR) technologies will expand productivity still further through bioinformatics and precision agriculture. While these advances will typically benefit larger farms, some applications using digital technology will help the typical farmer in the region working on relatively small plots of land with limited resources by lowering their information and transaction costs, connecting them with markets, and reducing the large gaps between farm gate and retail prices, helping them with production practices as well as with branding and marketing.

In sectors such as health care, technological advancement has been rapid, but it will not displace labor. Technologies such as magnetic resonance imaging (MRI) and precision medicine provide health care interventions that humans cannot. Rather than replace health care workers, they complement them in delivering medical care. Given that Asia and the Pacific is already experiencing a shortage of health care professionals (for example, there is less than 1 physician per 1,000 people in many Asian countries, while the Organisation for Economic Co-operation and Development [or OECD] average is 2.8), employment in the sector will expand, enabling remote knowledge support in underserved communities. Rising incomes in the region should also bring a significant increase in demand for health care services, including new jobs supporting "wellness."

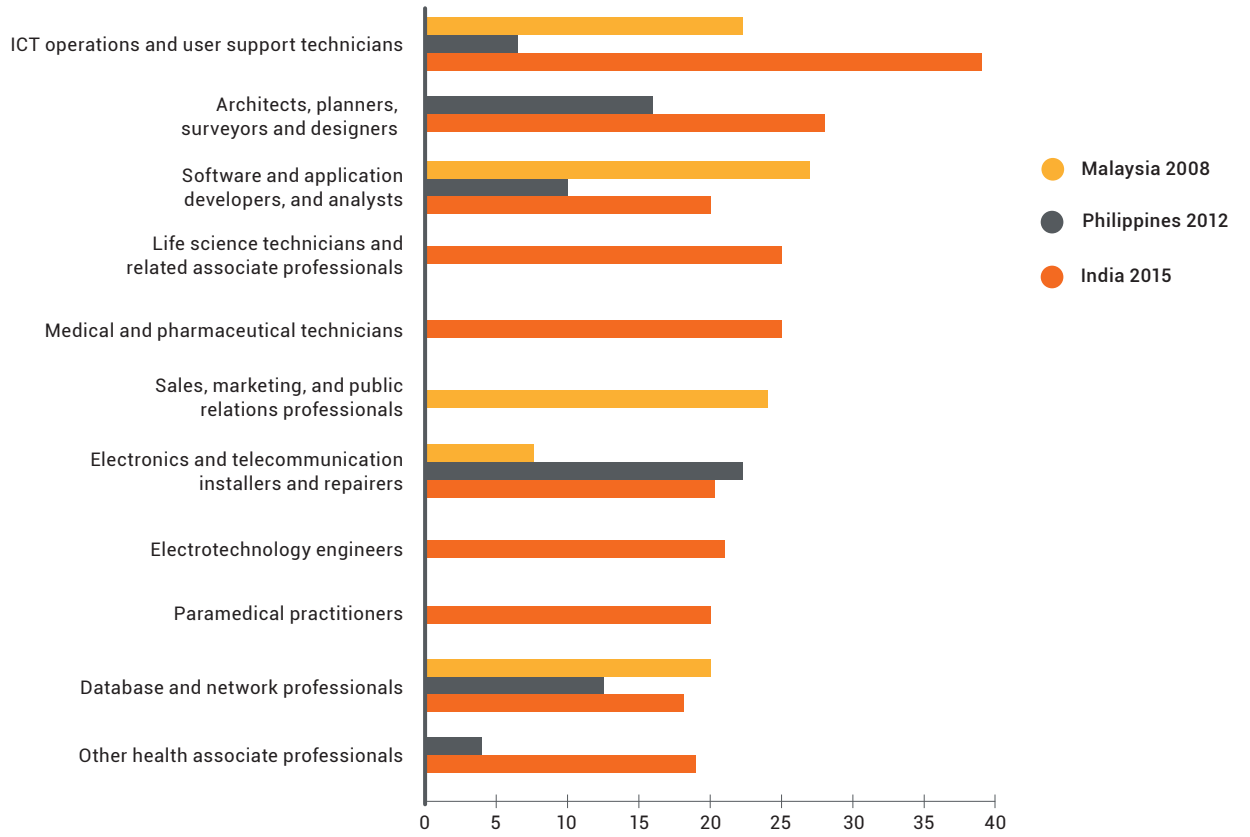
Technological change and economic growth lead to new occupations and industries. For example, auto repair workers and car salesmen were associated with the rise of the automobile industry in the early 1900s, just as jobs for "app developers," ICT technicians, and informal social media retailers are growing today (Box 3.1). The creation of new occupations and industries is a key countervailing force against the displacement effect of new technology. A detailed analysis of occupation titles in three Asian countries shows that new types of jobs have emerged to handle new technologies. In Malaysia, India, and the Philippines, between 43 percent and 57 percent of new job titles that have emerged in the last 10 years are related to ICT (Figure 3.4). Significant shares of new job titles also emerged in one of India's fastest growing occupation categories, Craft and Related Trades Workers. This was mainly driven by different types of technicians needed to work with computer numerical control machines. Such trends will continue.

More generally, a comparison of occupations in the region with advanced economies shows considerable scope for job growth in many sectors. For example, the health and education sectors in the United States account for 15 percent of total employment, while finance, insurance, real

estate, and other business services account for 19 percent. In lower- and middle-income economies of Developing Asia, the corresponding shares range from 3.5 percent to 6 percent, and from 1.5 percent to 6 percent, respectively, suggesting there is much scope for job growth in these services.

Figure 3.4 Occupations with the Highest Proportion of New Job Titles, India, Malaysia, and Philippines

New types of jobs are emerging in high-skill occupations.



Source: ADB (2018).

Note: Calculations are based on comparisons made between NCO 2004 (based on ISCO 88) and NCO 2015 (ISCO 08) for India; PSOC 1990 (ISCO 88) and PSOC 2012 (ISCO 08) for the Philippines; and MASCO-1998 (ISCO 88) and MASCO-2008 (ISCO 08) for Malaysia. ISCO = International Standard Classification of Occupations; MASCO = Malaysia Standard Classification of Occupations; NCO = National Classification of Occupations (India); PSOC = Philippine Standard Occupational Classification.

Box 3.1 The Use of E-commerce and Social Commerce by Asia's Informal Retail Sector

Despite the rapid growth in internet use, e-commerce in Southeast Asia remains in its infancy because of still-developing digital finance and weak logistics (Chadha, 2016). In Southeast and South Asia, less than one-third of companies have their own websites and only about half use e-mail to communicate with clients and suppliers (ADB, 2017). However, despite small e-commerce markets, developing countries lead the world in social commerce—unofficial e-commerce using social media.

Social commerce is characterized by online sales and offline payments. The process begins on a social media platform; is followed by direct communication between buyer and seller, usually using instant messaging apps; and closes using offline payment (Malabuppha, 2017). Cash-on-delivery is widely used (International Trade Center, 2017). The popularity of social media makes them cheaper e-commerce platforms than traditional e-commerce. While websites charge commissions, selling on social media is cost free.

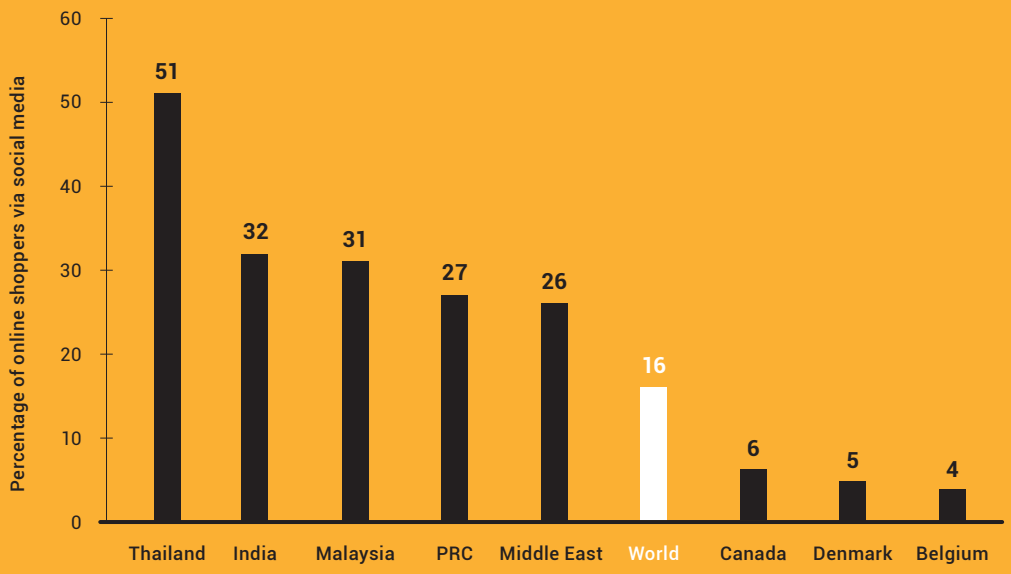
Thailand and India are the world's biggest social media shoppers, with 51 percent and 32 percent of online shoppers using social media, respectively (PricewaterhouseCoopers, 2016) (Figure 3.1.1). Facebook is the preferred platform for online selling in Viet Nam (Asia Pacific Foundation of Canada, 2017) and Indonesia (JakPat, 2015), and is widely used in the Philippines (Llamas, 2017). Thirty percent of e-commerce transactions in Southeast Asia come from social media sales (Chadha, 2016).

India and Southeast Asia are the largest Facebook and Instagram users globally.[a] Social mobile use is also large and growing. Forty-seven percent of Southeast Asia's population actively use social media, with 42 percent accessing from mobile devices (Klemp, 2017).

Social commerce in the region is largely domestic. However, small businesses worldwide are becoming "micro-multinationals" by using digital platforms—including social media—to connect with international customers and suppliers (McKinsey Global Institute, 2016). This has created new opportunities for informal retail sellers. Studies find that small and medium-sized enterprises (SMEs) using e-commerce increase revenues, lower costs, boost

Figure 3.1.1 Online shoppers who said they purchased directly via social media

Thailand and India are the world's biggest social media shoppers, followed closely by Malaysia and the People's Republic of China.



Source: PricewaterhouseCoopers (2016).

Note: The figure shows online purchases via social media sites as a percentage of total online purchases. PRC = People's Republic of China.

profits, add jobs, and are more likely to export and innovate. As digital payment infrastructure and logistics increase efficiency, the informal sector will be better able to tap global markets. In an expanded digital age, the rise of social commerce is making e-commerce a reality for many sellers of limited skills and resources.

Source: ADB (2018).

a. India (250 million) is the largest Facebook user globally; Indonesia (130 million) is fourth; the Philippines is sixth (67 million); Viet Nam is seventh (55 million); and Thailand is eighth (51 million). Indonesia (53 million) and India (52 million) are also the world's third and fourth largest Instagram users, respectively (Statista 2018).


02
NXT
NXT

Automation Will Entail Hardships for Some Workers

While the overall outlook is positive, automation will nonetheless create hardships for some workers. The availability of certain types of jobs will decline. And while new ones appear, they may be in different locations from displaced workers and/or require skills that workers may not possess.

Employment and wages have grown faster in jobs requiring higher levels of cognitive and social functioning and/or intensive ICT use. A deeper analysis of employment trends in five developing Asian economies over roughly the past decade reveals that jobs with a high frequency of interactive tasks (such as internal and external negotiations or planning group activities), cognitive tasks (such as writing memos, analyzing data, and preparing charts and tables), and/or using ICT to perform complex tasks, have enjoyed relatively high growth in employment and wages. For example, employment in these types of jobs expanded 2.6 percentage points faster than total employment annually, while average real wages increased twice as fast as the overall average wage. Conversely, jobs involving mainly manual work—which are lower paying to begin with—have seen relatively limited employment and wage growth, contributing to rising inequality.

People with relatively limited skills could get left behind. Workers with weak foundational skills—which are best learned during childhood and in schools and encompass not only basic reading, writing, numeracy, but also digital literacy and the ability to work in teams and persevere—are typically engaged in routine manual-intensive jobs. Without specific skills development or retraining, they will likely have a difficult time seizing expanded opportunities for more cognitively oriented jobs.

Even some workers in cognitively oriented jobs that have relatively more routine tasks may face hardship. The business process outsourcing (BPO) industry in the Philippines illustrates this point. Industry experts estimate that in 2016, 47 percent of Philippine BPO workers focused on process-driven tasks involving relatively little abstract thinking. With the advent of new technologies, these jobs will likely decline dramatically as a share of total BPO jobs. There will be new opportunities, of course, but they require more specialized training. For example, a worker employed as a medical transcriptionist may find his or her job lost to increasingly sophisticated voice and text/image recognition software. Filling a vacancy involving data analysis (a field where demand is expected to grow) will not be easy for such workers without appropriate training.

Harnessing Technology for Asia's Workers: Policy Responses

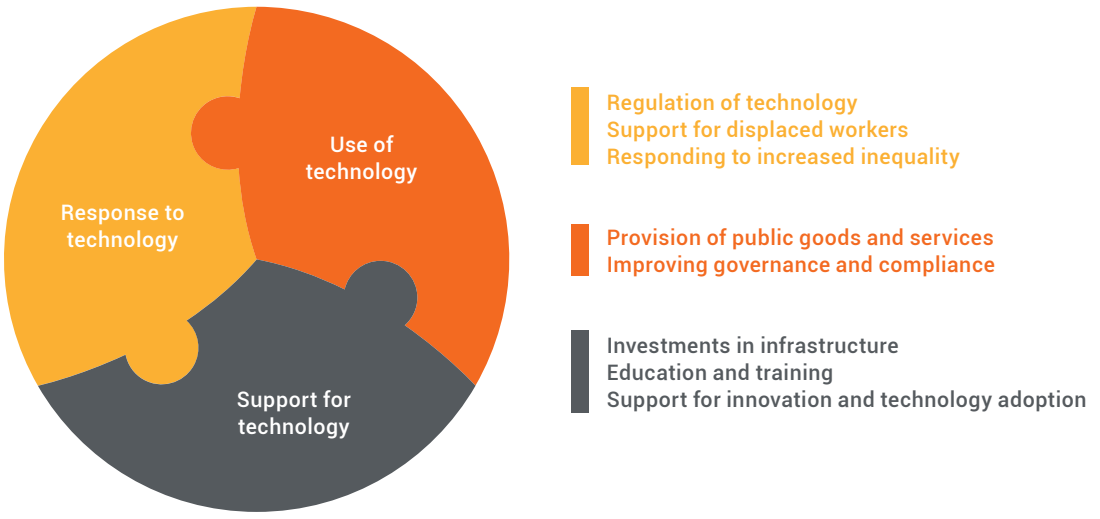
The Fourth Industrial Revolution will change the role of government (Figure 3.5). Governments will need to support educational systems that provide lifelong learning. This will require schools to be equipped and incentivized to develop foundational skills—key to an individual's ability to learn and relearn. Institutions are also needed that provide the specialized skills needed to work effectively with new technologies on the one hand, and develop the expertise required to spearhead innovation on the other. For the former, flexible training programs that can be interwoven with full-time work and completed over a relatively short period are essential. They must cater not only to the young, but to adults

seeking to retrain. Expertise required for innovation depends on a strong research orientation within universities, with help from innovation and incubation hubs acting as links between universities and industry. Finally, pathways linking higher education with technical and vocational education and training (TVET) must be developed to facilitate lifelong learning and, importantly, to enable promising individuals from disadvantaged backgrounds to gain expertise even later in life.

Governments will need to ensure that labor regulations and social protection systems work together to protect workers rather than jobs. Labor markets will need to be flexible, allowing firms to reorganize their workplace and adjust employment in response to new technologies. At the same time, workers must be protected from income loss due to technological obsolescence and supported in finding new jobs. In practical terms, this requires that excessive regulatory barriers to hiring and firing be eliminated while

Figure 3.5 The Role of Government in the Fourth Industrial Revolution

Government policies are needed in the areas of using technology, supporting technology, and responding to technology.



social protection programs are strengthened. Regarding the latter, active labor market programs such as job placement services and training and retraining programs must be made more effective. Simultaneously, well-functioning unemployment benefit and public works programs, expanded health insurance coverage, and well-targeted income transfers are needed.

Governments will need to mobilize resources to support skills development and social protection systems. Programs that help workers train or retrain appear to be dramatically underfunded in Developing Asia. This is also true of spending on social protection. With the share of government revenue to gross domestic product relatively low in many Asian countries, one way to increase revenues is to broaden the tax base and improve tax administration. There is also room for making income taxes more progressive and expanding on the use of capital gains tax, inheritance tax, and property tax in the region. This will not only raise revenue but will promote greater income equality.

Governments must use new technologies to facilitate skills development, job-matching, and social protection. Machine learning and big data analytics can provide increasingly personalized solutions. Adaptive learning technology, for example, changes the content, sequence, and assessment a student encounters in real time depending on performance, with enhanced learning outcomes in schools. New technologies can improve job-matching by assessing and monitoring the evolution of occupations, providing instant feedback to users on the skills employers need and how to acquire them—or what job is best for their career growth. Finally, technological advances in biometric identification can improve the ways social protection programs function by reducing costs, improving the implementation of sophisticated unemployment benefit systems, and tracking services provided by job placement agencies.

Ensuring that new technologies serve the broader development agenda also has implications for public policy in other areas (Box 3.2). Given the central role of the internet in Fourth Industrial Revolution technologies, developing a nationwide broadband backbone is essential. Public-private partnerships (PPPs) will be needed to provide internet access to remote and low-income regions, with appropriate regulations covering mobile and internet providers to ensure internet services are affordable. Regulations must also cover cybersecurity and personal data protection and privacy. Competition policy will have to evolve to ensure that large information technology firms do not abuse their dominant positions. Appropriate public policies are critical to realize the use of new technologies for development.

Box 3.2 Public Policy and Role of Technology

One aspect of new technology that receives considerably less attention is the transformative impact that technology could have on the delivery of public services and effective governance. From the delivery of public goods such as education, health, and social security to market regulation and supervision, technology holds the promise of improving access to public services and making economic growth more inclusive. There are several examples of government use of technology (digital and others) in delivering public services in Asia.

Digital technologies can enable social protection. India's 2008 Aadhaar program is a large-scale digital ID scheme that allows the state to deliver government benefits directly to beneficiaries. Aadhaar has now registered approximately 1.2 billion people, covering 99 percent of the adult population (Singh, 2017; The Hindu, 2017), and has been used to digitize government subsidy flows and passport issuance, among others uses—all benefitting those previously denied service access because they lacked proof of identity (Unique Identification Authority of India). Another example is India's 2014 Pradhan Mantri Jan Dhan Yojana (PMJDY) scheme, aimed at promoting financial inclusion by allowing each household at least one bank account. PMJDY is considered one of the biggest financial inclusion initiatives worldwide, opening 18,096,130 bank accounts in just one week (Pradhan Mantri Jan Dhan Yojana website).

Technologies can enhance access to health services, improve the response to individual and community needs, and improve delivery of a wide range of health services. In 2013, Thailand announced an ambitious plan to produce medical robots, spurred by its desire to become Asia's health care hub (Praiwan, 2013). Robots dispensing pharmaceuticals at Siriraj

Hospital aim to improve patient safety and speed services. Bangkok's Ramathibodi Hospital reportedly conducted the first robotically assisted brain surgery in Asia. New technology can also help alleviate labor shortages in rural areas. For example, in Bangkok there is one doctor for every 850 people, whereas in the country's rural northeast there is one for every 5,308 people. Thailand is trying to meet demand for health services using digital technology. Innovative applications like the AorSorMor Online app connect primary health care units with "Village Health Volunteers" to collect timely information and provide peer support and health monitoring in remote areas (AorSorMor Online webpage). Lastly, the government plans to integrate its public health system with digitized personal health records. This will allow both professionals and patients to access information, monitor progress, seek advice, and make appointments with a doctor online.

Digital technology can help improve the quality of public education. The Philippines is using digital technology to improve the quality of public goods such as education by leveraging the use of social media. For example, Checkmyschool (CMS) is a community monitoring tool that uses technology to motivate government responsiveness. While CMS began as an experimental partnership with the Department of Education in 2011, it now provides third-party monitoring of specific government programs on education delivered directly to schools. It partners with various network organizations to mobilize, train, and deploy citizen monitors in different parts of the country. For instance, CMS is used to crowdsource reports on the poor quality of toilets in public schools. This has resulted in a prompt government response to inspect and then fund repairs to improve the facilities.

References

ADB (Asian Development Bank). 2017. *Aid for Trade in Asia and the Pacific: Promoting Connectivity for Inclusive Development*. Manila: Asian Development Bank.

_____ 2018. *Asian Development Outlook: How Technology Affects Jobs*. Manila: Asian Development Bank.

AorSorMor Online. http://www.ais.co.th/aorsormor/en/.

Asia Pacific Foundation of Canada. 2017. *2017 Survey of Entrepreneurs and MSMEs in Viet Nam: Building the Capacity of MSMEs through Technology and Innovation*. https://apfcanada-msme.ca (accessed March 14, 2018).

Autor, D., and D. Dorn. 2013. "The Growth of Low-Skill Service Jobs and the Polarization of the US Labor Market". *American Economic Review 103* (5): 1553–97.

Chadha, R. 2016. *Social Commerce Counts for 30% of Digital Sales in Southeast Asia*. https://www.emarketer.com/Article/Social-Commerce-Counts-30-of-Digital-Sales-Southeast-Asia/1014830 (accessed March 13, 2018).

Chang, J. H., G. Rynhart, and P. Huynh. 2016. *ASEAN in Transformation: How Technology Is Changing Jobs and Enterprises*. Bureau for Employers' Activities Working Paper 10, International Labour Organization.

Hindu, The. 2017. *Aadhaar Covers 99% of Adults in India: Prasad*. January 27. http://www.thehindu.com/business/Aadhaar-covers-99-of-adults-in-India-Prasad/article17104609.ece.

India, Unique Identification Authority of India. *Aadhaar Authentication*. https://uidai.gov.in/authentication/authentication-overview/authentication-en.html (accessed March 12, 2018).

International Trade Center. 2017. *New Pathways to E-Commerce: A Global MSME Competitiveness Survey*. Geneva.

JakPat. 2015. *Indonesian Online Seller Survey Report*. Jajak Pendapat App (blog), March 9. https://blog.jakpat.net/indonesian-online-seller-survey-report/ (accessed March 15, 2018).

Klemp, S. 2017. *Digital in Southeast Asia in 2017. We Are Social* (blog), February 16. https://wearesocial.com/special-reports/digital-southeast-asia-2017 (accessed March 15, 2018).

Llamas, C. 2017. *Who's Winning the Philippines' E-Commerce Arena: Local or International Players?* http://www.marketing-interactive.com/whos-winning-the-philippines-e-commerce-arena-local-or-international-players/ (accessed March 15, 2018).

Malabuppha, T. 2017. *Thailand E-Commerce Market: What to Expect in 2017*. https://www.pricezagroup.com/2017/thailand-e-commerce-market-expect/ (accessed March 15, 2018).

McKinsey Global Institute. 2016. *Digital Globalization: The New Era of Global Flows*. New York: McKinsey & Company.

_____ 2017. *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation*. McKinsey & Company.

McMillan, M., D. Rodrik, and I. Verduzco-Gallo. 2014. *Globalization, Structural Change, and Productivity Growth, with an Update on Africa*. *World Development 63*: 11–32.

Pradhan Mantri Jan Dhan Yojana. https://pmjdy.gov.in/about.

Praiwan, Y. 2013. *Thailand's Robot Revolution Is Rising*. Bangkok Post, April 23. https://www.bangkokpost.com/tech/local-news/346542/thailand-robot-revolution-is-rising (accessed March 15, 2018).

PricewaterhouseCoopers. 2016. *They Say They Want a Revolution: Total Retail 2016*. https://www.pwc.com/gx/en/retail-consumer/publications/assets/total-retail-global-report.pdf (accessed March 15, 2018).

Singh, M. 2017. "99% of Indians over 18 Now Have Aadhaar Cards". *The Times of India*, January 28. https://timesofindia.indiatimes.com/india/99-of-indians-over-18-now-have-aadhaar/articleshow/56820818.cms.

Statista. 2018. *The Statistics Portal*. https://www.statista.com/statistics/268136/top-15-countries-based-on-number-of-facebook-users/ (accessed March 15, 2018).

World Bank. PovcalNet Database. Washington, DC.

_____ World Development Indicators. Washington, DC.

Chapter 4

The Future of Work in Emerging Europe, Central Asia, and Southern and Eastern Mediterranean

The regions where the European Bank for Reconstruction and Development (EBRD) operates span Central, Eastern and South-Eastern Europe, Southern and Eastern Mediterranean, Central Asia, Mongolia and Turkey. The demographic profiles and challenges faced by Emerging Europe are quite different from the ones facing Southern and Eastern Mediterranean and Central Asia, and will require different policies and solutions. The future of work in these diverse regions will be shaped by the interplay of trends in demography and technology as well as the way education and social protection respond to these trends. Technological advances present formidable policy challenges, but also create opportunities to mitigate the adverse impact of the region's demography.

Populations are aging and birth rates are falling in many emerging markets, but this demographic transition is much further advanced in Emerging Europe. Conversely, the "youth bulge" demographic profile of Southern and Eastern Mediterranean and parts of Central Asia makes job creation particularly challenging.

Emerging Europe benefited strongly from the earlier wave of technological change through capital inflows and integration into global value chains. Today the EBRD regions enjoy relatively high rates of penetration of digital technologies compared with other emerging markets.

The impact of the next wave of technological change may be different. Strong incentives for automation are already evident in Central Europe, the share of medium-skilled occupations has been declining, and the labor share of income has been trending downward. The regions' deficit of governance relative to their per capita income levels may constrain the effectiveness of policy response to change in the workplace.

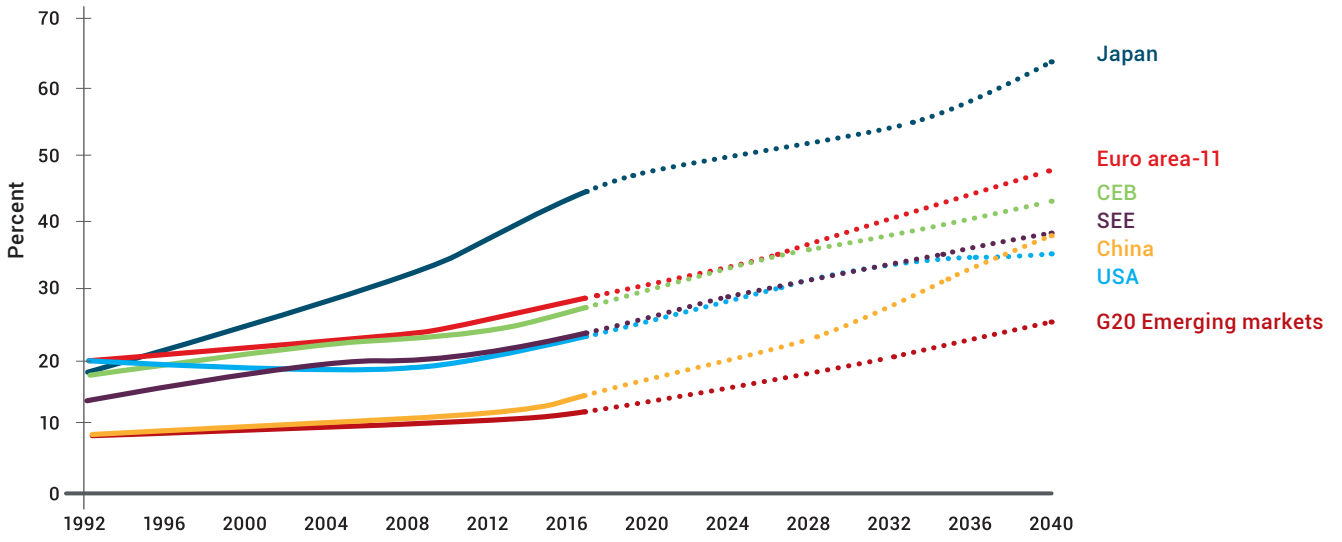
The distributional impact of technology has been further compounded by wage decompression in the transition from centrally planned to market economies, leading to a pronounced rise in inequality and strong and growing support for populism. If these trends are ignored, populism may undermine countries' long-term economic growth and weaken democratic institutions–further feeding populism. Given these pressures, the region faces the challenge of retooling education and social protection systems and leveraging technology to improve transparency, improve the efficiency of government services, and strengthen governance.

The EBRD Regions' Unique and Varied Demography

Populations are aging and birth rates are falling in most emerging markets, but this demographic transition is much further advanced in Emerging Europe. The speed of population aging, reflected in increasing old-age dependency ratio–the ratio of those aged 65 and above to the working-age population–is virtually identical to that of advanced European economies (Figure 4.1). And in terms of levels of old-age dependency, Central Europe and the Baltic States are only about five years behind the advanced economies of the euro area. Both the level of old-age dependency ratio and the speed of increase are higher than in the United States. South-Eastern Europe, in turn, is around ten years behind Central Europe in its demographic transition. On current trends, the working-age population of Central and South-Eastern Europe is expected to shrink by 13.4 percent by 2040; trends are broadly similar in Eastern Europe.

Figure 4.1 Old-age Dependency Ratio

In Emerging Europe, the population is aging and the working-age population is shrinking at high rates.



Source: UN (2017) World Bank (2018a), and authors' calculations.

Note: The old-age dependency ratio is the ratio of population aged 65 and above to those aged 15–64. Projections are based on the median scenario. CEB (Central Europe and the Baltic States) = Croatia, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic, and Slovenia. SEE (South-Eastern Europe) = Albania; Bosnia and Herzegovina; Bulgaria; Cyprus; Greece; Kosovo; FYR Macedonia; Montenegro; Romania; and Serbia. Euro Area-11 = Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain. G20 emerging markets = Argentina, Brazil, China, India, Indonesia, Korea, Mexico, Russian Federation, Saudi Arabia, South Africa, and Turkey.

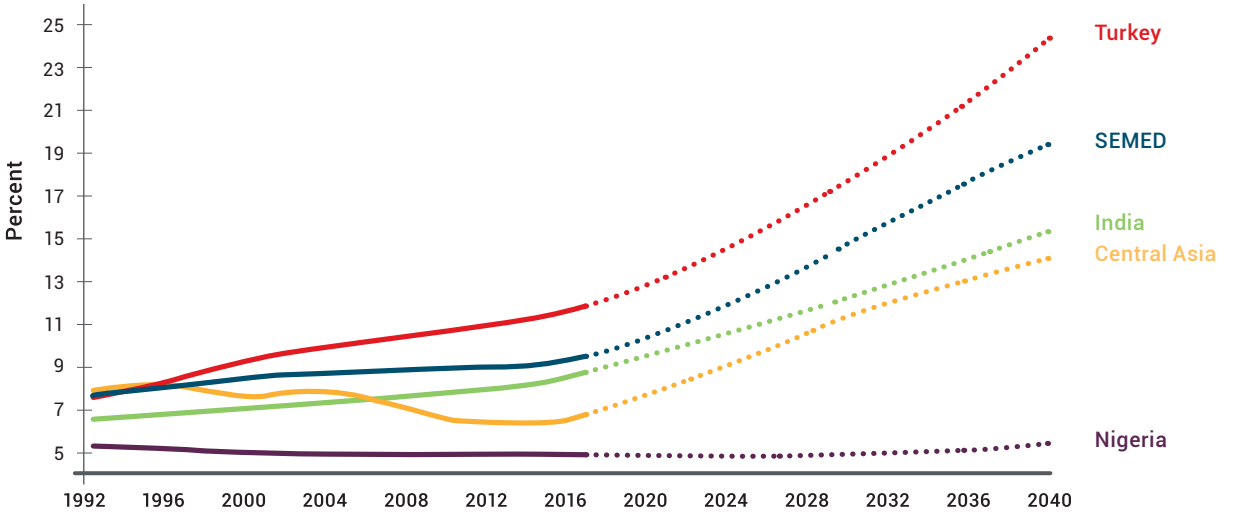
In many economies these trends have been compounded by significant emigration, primarily to the higher-income member states of the European Union (EU). High emigration from the new EU member states following their integration into the EU single market has been unique. It has also been remarkably widespread across all skill levels (Atoyan et al., 2016).

These trends have put significant upward pressures on wages in the region, weighing on the economies' competitiveness as parts of integrated European value chains. In addition, hollowing out of labor markets has made it increasingly difficult for some countries to achieve the critical mass of skills and expertise in specific areas that is required for successful development of new—and old—sectors of the economy.

The picture in Southern and Eastern Mediterranean, Turkey, and parts of Central Asia is very different, with low and slowly increasing old-age dependency ratios (Figure 4.2) and relatively high fertility rates. At the same time, life expectancy in these economies has been improving.

Figure 4.2 Old-age Dependency Ratio, Selected Countries

Meanwhile, in Southern and Eastern Mediterranean and Turkey, low and slowly increasing old-age dependency ratios and higher fertility rates are creating a "youth bulge," with many new entrants into the labor market every year.



Source: UN (2017); World Bank (2018a); authors' calculations.

Note: The old-age dependency ratio is the ratio of population aged 65 and above to those aged 15–64. Projections are based on the median scenario. SEMED (Southern and Eastern Mediterranean) = Egypt, Jordan, Lebanon, Morocco, and Tunisia. Central Asia = Kazakhstan, Kyrgyz Republic, Mongolia, Tajikistan, Turkmenistan, and Uzbekistan.

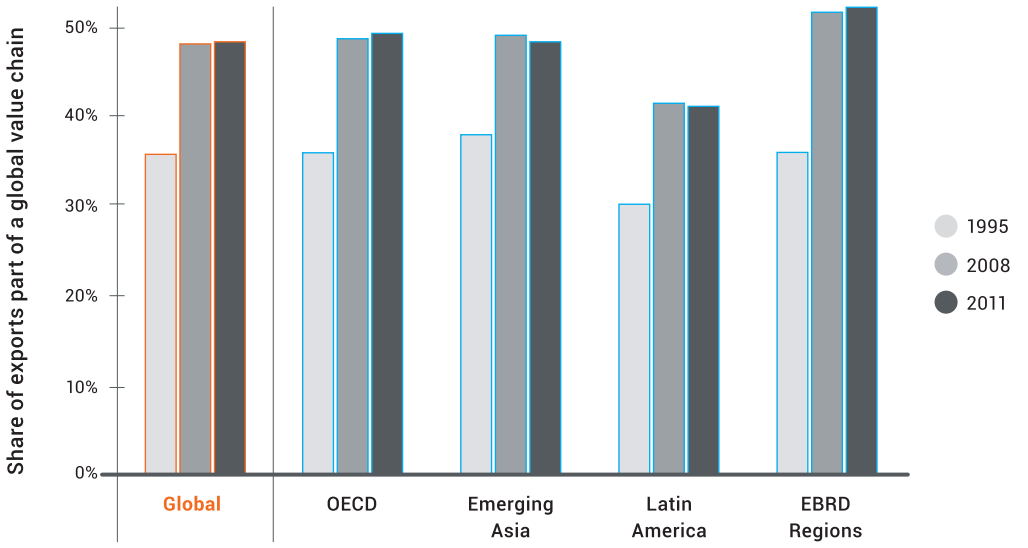
This presents a formidable challenge of dealing with the demographic "youth bulge": that is, creating both the right quantity and quality of jobs for a large number of new entrants into the labor market every year. This challenge is distinct from Emerging Europe's and similar to that faced by South Asia's economies.

Technological Change and Its Impact

Emerging Europe has benefited strongly from advances in transportation and telecommunications (Georgiev, Nagy-Mohacsi, and Plekhanov, 2017). These advances have enabled rapid development of global value chains (Figure 4.3), facilitated foreign direct investment (FDI), and created conditions for offshoring of jobs from advanced economies (see Baldwin, 2016, and Blinder, 2009). High FDI and non-FDI capital flows from the core European economies before 2008 (averaging 9 percent of GDP per year) supported income growth of the middle class and reduced emigration to other EU member states. Many jobs were created in manufacturing assembly, with some higher-paid jobs in research and development (R&D) hubs of multinationals (EBRD, 2014).

Figure 4.3 Shares of Exports that Are Part of a Global Value Chain

Development of global value chains has been very rapid in the EBRD region.



Source: OECD and WTO (2016).

Note: Emerging Asia = Cambodia, China, India, Indonesia, Malaysia, Philippines, Thailand, and Vietnam. Latin America = Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, and Peru. Global sample comprises 63 advanced economies and emerging markets.

As a result, the economies enjoyed rapid growth of total factor productivity (TFP) during the period 1998–2008, well above levels observed in other emerging markets or in advanced economies. TFP growth refers to the residual economic growth that cannot be attributed to changes in factors of production such as capital stock, labor, or human capital. It reflects the efficiency with which these other factors of production are combined to produce a final output. Rapid improvements in TFP during the pre-crisis years were aided by relatively high levels of existing capital stock and human capital, which were used relatively inefficiently under central planning. Once the TFP catch-up potential was exhausted, TFP growth in the region has slowed markedly.

The penetration of digital technologies in EBRD regions has been high compared with other emerging markets and is growing. The rate of broadband penetration increased markedly between 2005 and 2015 to 59 percent on average–above the average rate for large emerging markets, although somewhat below the levels seen in advanced economies (Figure 4.4). E-commerce is estimated to account for about 4.3 percent of retail sales in Poland, a level similar to Spain or Italy.

The next wave of technological advances (the sharing economy and the increased use of artificial intelligence) will reduce the demand for outsourcing jobs in manufacturing and tradeable services because these can instead be automated in higher-income economies (Autor, Levy, and Murnane, 2003). A limited number of jobs may even get reshored (Stentoft et al., 2016).

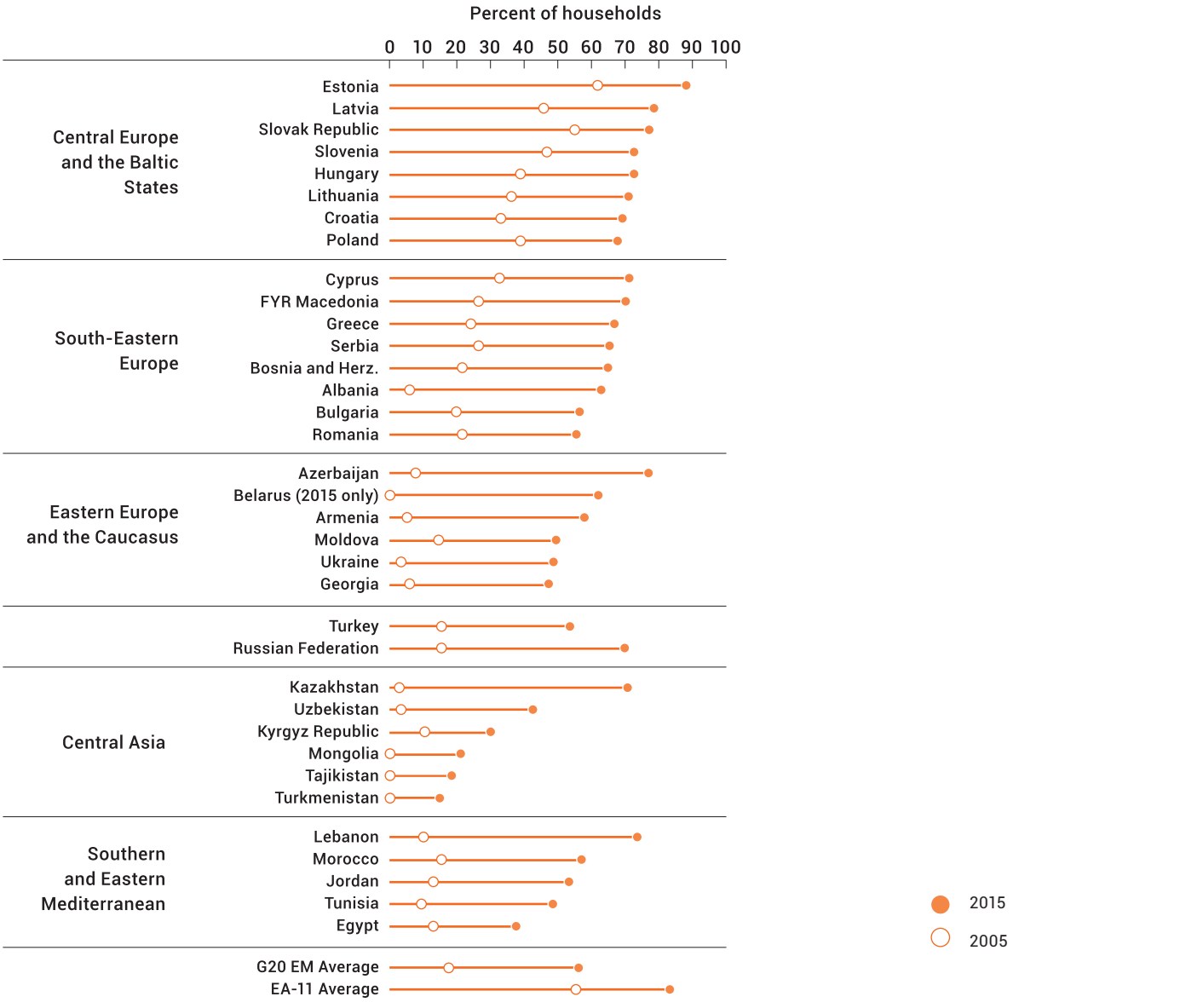
As the labor force in Emerging Europe shrinks and labor costs rise, the incentives to automate jobs may become stronger than in other emerging markets. In fact, automation largely explains why historically the link between adverse demographic trends and countries' per capita growth performance has been weak or nonexistent (Acemoglu and Restrepo, 2017a). Based on the calculations in the World Bank's *World Development Report 2016* on the digital divide, in a number of countries in the EBRD regions including Albania, Croatia, Cyprus, Latvia, Lithuania, and Romania, the share of employment that can be automated within the foreseeable future is close to the OECD average of 56 percent (World Bank, 2016). McKinsey Global Institute (2017) similarly estimates the corresponding share at around 50 percent in Russia.

As of today, the penetration rates of robots in Hungary, Poland, Slovenia, and the Slovak Republic are similar to those in advanced economies and are well above the rates seen in Brazil, China, India, and South Africa (UNCTAD, 2017). At present, robots are primarily deployed in the automotive sector, electronics, appliances, chemicals, and machinery and equipment, but may become widely used in other sectors in the future. The technological advances that drive automation may help reduce upward pressure on wages and maintain economies' competitiveness, albeit potentially at a cost of lower employment rates (Acemoglu and Restrepo, 2017b).

A word of caution is in order when extrapolating into the future the finding that technology has so far offset the impact of adverse demographics on average growth. Countries exposed to rapid aging thus far have been predominantly advanced economies with strong governance, relatively high social cohesion, and an enabling skills mix (notably Japan). The economies in Emerging Europe that are "getting old before they can get rich" will face additional challenges in reaping the growth-enhancing potential of automation. And

Figure 4.4 Share of Households with Broadband Internet Access

The penetration of digital technologies has been high in the EBRD regions compared with other emerging markets.



Source: World Bank (2018a).

Note: EA-11 (Euro area-11) = Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain. G20 EM (emerging markets) = Argentina, Brazil, China, India, Indonesia, Korea, Mexico, Russian Federation, Saudi Arabia, South Africa, and Turkey.

if their governance is weak, then they will have limited capability for effective and inclusive policy responses to these challenges. Many countries in the EBRD regions are experiencing a "deficit of governance" in a sense that their levels of economic and political institutions remain below what could be expected given their levels of income per capita (Figure 4.5). In these cases, multilateral development banks have an important role to play in supporting institution building.

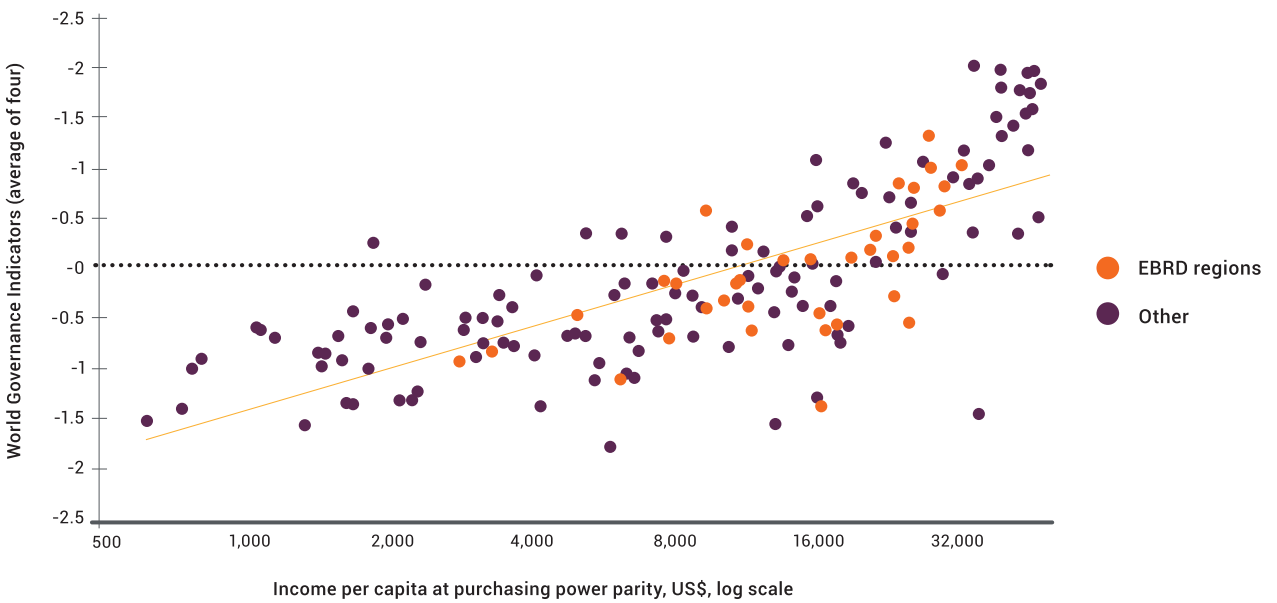
The Risk of Populism and Perspectives for Inclusion

As in the advanced economies, the hollowing of the middle in the EBRD region's labor market has been associated with the rise of populist politicians and reversals in sound economic reforms. If the median voter is increasingly employed in a lower-paid lower-skilled job for which he or she is overqualified, the foundations of democratic decision making may crumble. This risk is exacerbated in those countries where an inflow of migrants leads to perceptions of intensified competition for low-paid service jobs and downward pressures on wages.

In parts of the EBRD regions, the distributional impact of technological change has been compounded by another trend: the transition from the highly compressed wages of the central planning period to the wages determined by the market. As a result, inequality has increased especially greatly in economies in Emerging Europe since the start of the transition from socialism (EBRD, 2016). High average economic growth notwithstanding, only around 44 percent of the population is estimated to have experienced income growth above the average growth in the G7 economies

Figure 4.5 Governance in Relation to per Capita Income

For many economies in the EBRD regions, governance remains relatively weak given their levels of per capita income.

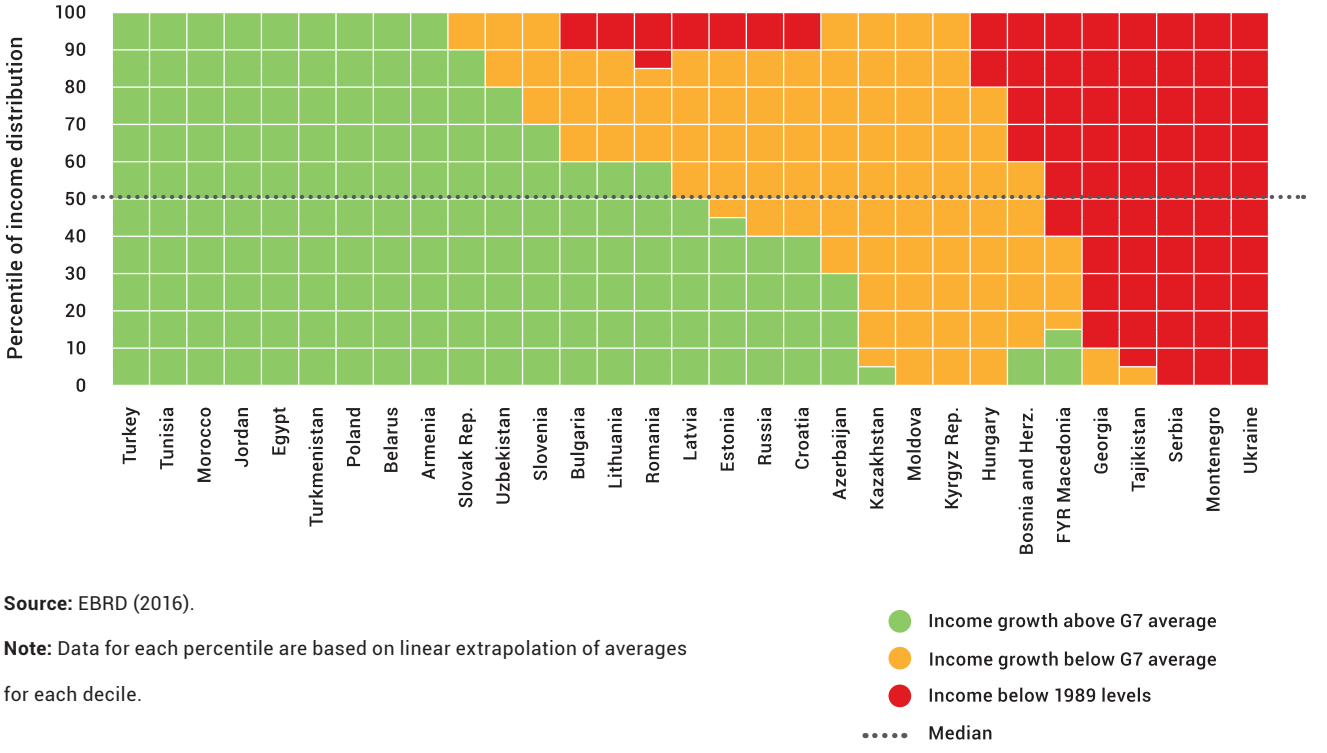


Source: World Bank (2018b); IMF (2017); authors' calculations.

Note: The average of indicators of control of corruption, rule of law, government effectiveness, and regulatory quality. Calculations based on 2016 or the latest data point available. "Other" comprises 138 advanced and developing economies for which data are available.

Figure 4.6 Share of Population with Income Growth above/below the G7 Average, 1989–2016

As inequality has increased in Emerging Europe and Central Asia, less than half the population has experienced income growth above the average growth in the G7 economies.



Source: EBRD (2016).

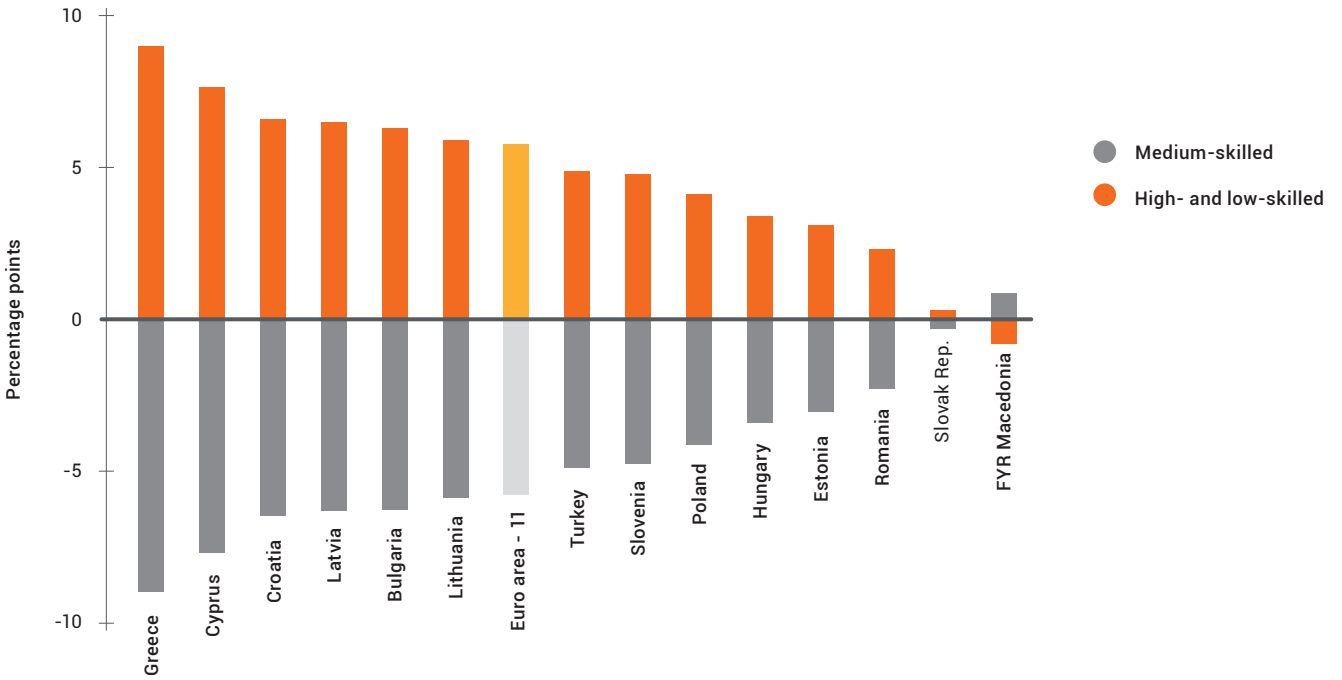
Note: Data for each percentile are based on linear extrapolation of averages for each decile.

(Figure 4.6). Furthermore, parental background has become an increasingly important predictor of an individual's education in the EBRD regions (gender, place of birth, and ethnicity also have considerable explanatory power) (EBRD, 2016), amplifying the effects of inequality of opportunity on lifetime economic outcomes. With automation, existing spheres of inequality risk becoming further entrenched.

In addition, the polarization of jobs has been increasing in Emerging Europe since the mid-1990s, labor force surveys suggest. In particular, the share of medium-skilled occupations has been declining while the shares of low-skilled and high-skilled occupations have been rising. Job polarization is increasing both within and across industries, at a pace similar to that in higher-income European countries (Figure 4.7 and OECD, 2017). Recent evidence also points to job polarization in Egypt (Helmy, 2015). The share of national income accruing to workers in the form of wages and salaries (the so-called labor share of income) in the EBRD

Figure 4.7 Change in the Share of Employment by Skill Level, 2006–16

Medium-skilled jobs have been decreasing at the expense of high- and low-skilled jobs in Emerging Europe.

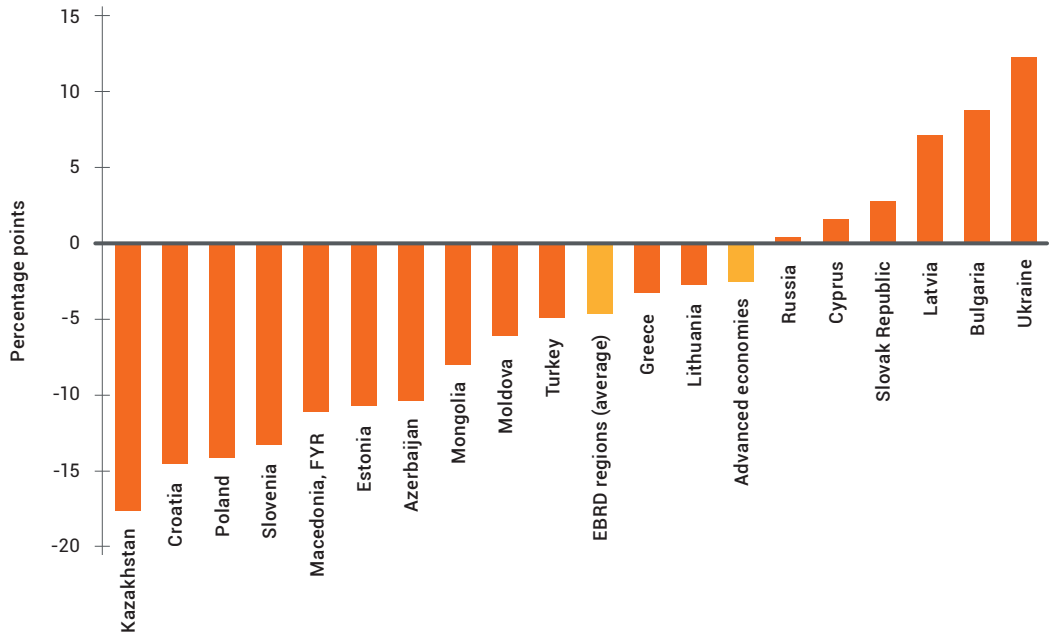


Source: OECD (2017); Eurostat (2018); authors' calculations.

Note: Jobs are classified under the International Standard Classification of Occupations 08 major groups. High-skilled occupations comprise managers, professionals, technicians and associate professionals (groups 1–3). Medium-skilled occupations comprise clerks, craft and related trades workers, and plant and machine operators and assemblers (groups 4, 7 and 8). Low-skilled occupations comprise service and sales workers (group 5) and elementary occupations (group 9). Agriculture and armed forces are excluded (groups 0 and 6). Euro Area-11 is the simple average of the values for Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain.

Figure 4.8 Change in Labor Share of Income, 1994-2017

The labor share of income has been declining in many countries in the regions.



Source: ILO (2018); Karabarbounis and Neiman (2014); and authors' calculations.

Note: The International Labour Organization data is spliced with the data from Karabarbounis and Neiman (2014) using the annual rate of change reported in each source. Advanced economies refers to the simple average of values for Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Italy, Japan, Korea, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, and the United States.

regions has declined by around 4 percentage points since the mid-1990s. This represents a greater average decrease than in advanced economies (Figure 4.8) as in advanced economies, much of the long-term decline in labor share of income happened before the mid-1990s (IMF, 2017).

Fed by the rapidly rising income and wealth inequality, populism in the region was strong in the 1990s and 2000s and has been gaining further momentum. Even the countries with a strong track-record of growth have not been immune to populism.[1] If these trends are ignored, populism and

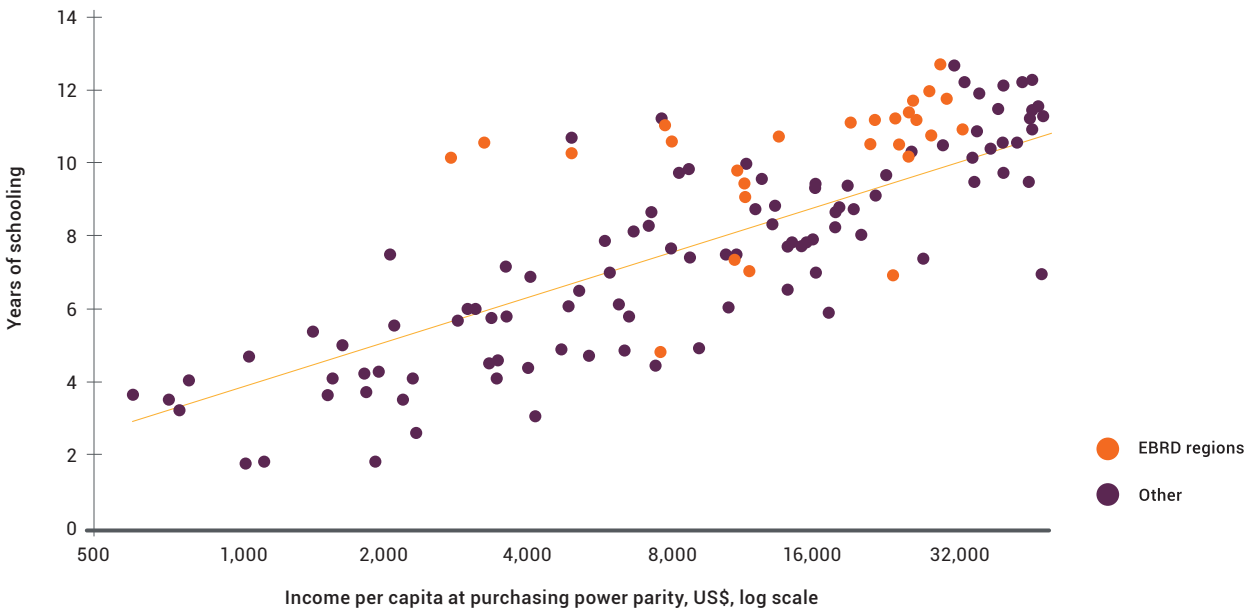
1. Populist movements can be thought of as movements that defend "interests of the people" against the elites or other minority groups. Populists typically view economic and political institutions as unnecessary restraints subverting the will of the people. See Rodrik (forthcoming).

short-termism in economic policy setting may create a vicious cycle, undermine countries' long-term economic growth and weaken their democratic institutions, in some cases risking de-democratization.

Like other emerging markets, the EBRD regions face the challenge of retooling their education and social protection systems. At present, the regions enjoy high levels of formal education relative to their per capita income (Figure 4.9).

Figure 4.9 Education Levels in Relation to per capita Income

Levels of formal education are high relative to the per capita income of countries in the EBRD regions.



Source: Barro and Lee (2013); IMF (2017); and authors' calculations.

Note: Based on the data for 2016 or the latest year available. Education levels are measured as average years of schooling. "Other" category comprises 116 advanced and developing economies outside the EBRD regions for which data are available.

This puts it in a strong position to excel at life-long learning, the key feature of the changing nature of work. Importantly, efforts are needed to leverage private sector participation in designing retraining programs and defining their curricula. Yet high levels of formal education also increase the risk that workers will feel overqualified for their new occupations if job polarization accelerates.

On the positive side, technology can help increase government efficiency and transparency in the areas of education provision and social protection, and beyond. In a region characterized by a shortfall of governance relative to its level of economic development, such technological change may help harness additional growth dividends stemming from improved accountability and reduced corruption. Examples of such initiatives include the comprehensive e-government platform in Estonia and enhanced transparency in public procurement in Ukraine.

Conclusion

For decades, technological change boosted income convergence in emerging markets and the demographic dividend further supported growth and strengthened fiscal positions. Recently, the landscape has been rapidly changing, with labor forces no longer growing and medium-skilled occupations being increasingly at risk of automation.

Emerging Europe finds itself at the forefront of the demographic transition in emerging markets, while countries in Southern and Eastern Mediterranean and Central Asia, Mongolia and Turkey face the challenge of creating a large number of quality jobs every year.

How the future of work will evolve under these circumstances will crucially depend on the policy response in the areas of education, social safety nets, fiscal policy, and the strengthening of economic and political institutions.

References

Acemoglu, D., and P. Restrepo. 2017a. *Secular Stagnation? The Effect of Aging on Economic Growth in the Age of Automation*. *American Economic Review 107* (5): 374-79.

———— 2017b. *Robots and Jobs: Evidence from US Labor Markets*. NBER Working Paper 23285, National Bureau of Economic Research, Cambridge, MA.

Atoyan, R., L. Christiansen, A. Dizioli, C. Ebeke, N. Ilahi, A. Ilyina, G. Mehrez, H. Qu, F. Raei, A. Rhee, and D. Zakharova. 2016. *Emigration and Its Impact on Eastern Europe*. IMF Staff Discussion Note 16/07, International Monetary Fund, Washington, DC.

Autor, D. 2015. *Why Are There Still So Many Jobs? The History and Future of Workplace Automation*. *Journal of Economic Perspectives 29* (3): 3-30.

Autor, D., F. Levy, and R. Murnane. 2003. *The Skill Content of Recent Technological Change: An Empirical Exploration*. *Quarterly Journal of Economics 118* (4): 1279-1333.

Baldwin, R. 2016. *The Great Convergence. Information Technology and the New Globalization*. Harvard University Press.

Barro, R., and J. W. Lee. 2013. *A New Data Set of Educational Attainment in the World, 1950-2010*. *Journal of Development Economics 104* (September): 184-98.

Blinder, A. 2009. *How Many US Jobs Might Be Offshorable? World Economics 10* (2): 41-78.

EBRD (European Bank for Reconstruction and Development). 2014. *Innovation in Transition. Transition Report 2014*. EBRD.

———— 2016. *Transition for All: Equal Opportunities in an Unequal World. Transition Report 2016-17*. EBRD.

———— 2017. *Sustaining Growth. Transition Report 2017-18*. EBRD.

Eurostat. 2018. *Labour Force Survey*. http://ec.europa.eu/eurostat/data/database. Last access March 2018.

Georgiev, Y., P. Nagy-Mohacsi, and A. Plekhanov. 2017. *Structural Reform and Productivity Growth in Emerging Europe and Central Asia*. Working Paper 523, Asian Development Bank.

Helmy, O. 2015. *Skill Demand Polarization in Egypt*. *Middle East Development Journal 7* (1): 26-48.

IIF (Institute of International Finance). 2017. *Capital Flows Tracker*. https://www.iif.com/publications/capital-flows-tracker. Last access March 2018.

ILO (International Labor Organization). 2018. ILOSTAT. http://www.ilo.org/ilostat/. Last access March 2018.

IMF (International Monetary Fund). 2017. *Seeking Sustainable Recovery. World Economic Outlook*, October. Washington, DC: IMF.

Karabarbounis, L., and B. Neiman. 2014. *The Global Decline of the Labor Share. Quarterly Journal of Economics 129* (1): 61-103.

McKinsey Global Institute. 2017. *A Future that Works: Automation, Employment and Productivity*. McKinsey Global Institute Report.

OECD (Organisation for Economic Co-operation and Development). 2017. *OECD Employment Outlook 2017*. Directorate of Employment, Labour, and Social Affairs, OECD.

OECD and WTO (Organization for Economic Co-operation and Development and World Trade Organization). 2016. Trade in Value-Added Database. http://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm. Last access March 2018.

Rodrik, D. Forthcoming. *Is Populism Necessarily Bad Economics? American Economic Review, Papers and Proceedings* (1, May 2018).

Stentoft, J., J. Olhager, J. Heikkila, and L. Thomas. 2016. *Manufacturing Backshoring: A Systematic Literature Review.* Operations Management Research 9: 53-61.

UN (United Nations) 2017. "World Population Prospects. The 2017 Revision, Key Findings and Advance Tables". Working Paper No. ESA/P/WP/248, Department of Economic and Social Affairs, Population Division.

UNCTAD (United Nations Conference on Trade and Development). 2017. *Beyond Austerity. Towards a Global New Deal. Trade and Development Report 2017.* Geneva: UNCTAD.

World Bank. 2016. *Digital Dividends. World Development Report 2016.* Washington, DC: World Bank.

_____ 2018a. World Development Indicators. http://databank.worldbank.org/. Last access March 2018.

_____ 2018b. Worldwide Governance Indicators. http://info.worldbank.org/governance/wgi/#home. Last access March 2018.

Chapter 5

The Future of Work in Latin America and the Caribbean

Information and communication technologies (ICTs) in Latin America and the Caribbean are a relatively untapped opportunity that could improve the region's productivity. However, ICTs are expanding at a slower rate than in developed countries. Informal employment has been traditionally identified as a long-lasting challenge for Latin America and the Caribbean. Digital technologies combined with other trends in labor markets may provide new job opportunities and change the nature of informality.

The demographic trends that fueled the region's economic growth in the past are starting to reverse. Decreased population growth, combined with longer life expectancies, will add pressure to social security systems.

Latin America and the Caribbean must act decisively to take advantage of the upcoming opportunities from technological advancements while minimizing its risks. Public-private partnerships will have to be developed in three fronts: (1) investing in skills for everyone by adapting a system designed to transmit knowledge from an early age to one that allows people to learn throughout their lives; (2) supporting workers as they transition to new jobs and new skills including by creating and refining digital platforms to let workers identify and find job opportunities and undertake training; and (3) rethinking the welfare state because social security systems must adapt to a new digital reality and future demographic changes.

Trends

Information and communication technologies (ICTs) are expanding in Latin America and the Caribbean, although closing the gap with other regions remains a challenge. ICT development and penetration are lower in the region than in the developed world. Latin American and the Caribbean takes advantage of only about 6 percent of its digital potential,[1] compared to an average of 12 percent in Europe and 18 percent in the United States (Bughin et al., 2017). Similarly, broadband development is lower; the region scored 4.28 in the 2016 Broadband Development Index, whereas member countries of the Organisation of Economic Co-operation and Development (OECD), excluding Chile and Mexico, averaged 6.12 (García and Iglesias, 2017). These statistics reflect the region's slow pace of ICT development. In terms of personal, business, and government adoption of ICTs, Latin America and the Caribbean scores considerably lower than the subgroup of advanced economies, and lags Emerging Asia and Europe, and the Middle East, North Africa and Pakistan (Baller, Dutta, and Lanvin, 2016).

1. Digital potential is defined in terms of a country's level of digitalization in its leading sectors (see Khanna et al., 2015).

In addition, ICT access across the region varies considerably by country. For instance, broadband development is higher in the Southern Cone countries than the Caribbean countries.[2] By 2014, 67 percent of Uruguay's households had a personal computer, whereas this figure was 32 percent for Peru and 21 percent for Honduras. Internet access is less extended, with Uruguay again leading with 57 percent, followed closely by Chile, Argentina, and Brazil, at 53 percent, 52 percent, and 48 percent, respectively. Bolivia, Nicaragua, and Haiti trail the list, with values ranging between 17 percent and 4 percent (Baller, Dutta, and Lanvin, 2016).

Latin America and the Caribbean is increasingly connected, with ICTs starting to unleash their potential across the region's economy. Smartphone adoption has increased drastically and is expected to increase from 59 percent in 2016 to 71 percent by 2020, ahead of the global average of 66 percent. Coverage has also increased sharply: mobile operators cover roughly 70 percent of the region's territory. 4G coverage is accelerating as well, doubling in 2016. This expansion is meaningful economically: 1.7 million workers were working in the mobile ecosystem in Latin America and the Caribbean by 2016 (GSMA, 2017).[3]

Increased connectivity and ease of access implies that Latin America and the Caribbean's digital economy is beginning to develop, starting with digital platforms and services. A few examples: 60 million people have LinkedIn profiles, while there are 100 million Facebook accounts in Brazil alone. In Mexico, 35 million electronic receipts are generated daily (Ivanschitz and Korn, 2017). Digital platforms also open doors for entrepreneurship: besides international platforms such as Uber, Cabify, and Airbnb, there has been a surge of locally developed digital services, such as Tappsi (Colombia) for taxis, Arriendas (Chile) for car rentals, Fondeadora (Mexico) and Catarse (Brazil) for crowdsourcing, and Aliada (Mexico) for domestic services (Sundararajan, 2017).

Tecnolatinas (the name given to Latin America and the Caribbean's technology enterprises) make up a varied ecosystem with more than 5000 firms worth $37.7 billion. Argentina and Brazil account for 66 percent of the Tecnolatinas, while 29 percent are in Chile, Colombia, and Mexico. In addition, Latin America and the Caribbean has nine "unicorns": start-up companies worth more than $1 billion (Surfing Tsunamis and Nxtp.Labs, 2017).

Firms taking advantage of new technologies seem to benefit from the comparative advantage they provide. A survey done by the Boston Consulting Group in five countries (including Brazil) found that small and medium enterprises using cloud computing grew almost twice as much as those that did not. Cloud technology's scalability and flexibility allow firms to compete with bigger competitors, regardless of location. Wider adoption of cloud technologies has created 2.7 million jobs in Brazil, and increased GDP by $120 billion, Aggarwal et al. (2013) estimate. "Technology spaces"

2. Similarly, in the Networked Readiness Index of the World Economic Forum, Chile ranks first in the region (38th in the global ranking), whereas Haiti is 137th (out of 140). See Baller, Dutta, and Lanvin (2016).

3. A "mobile ecosystem" consists of a collection of goods and services offered by mobile devices companies (device hardware, operating systems, applications, and user accounts.

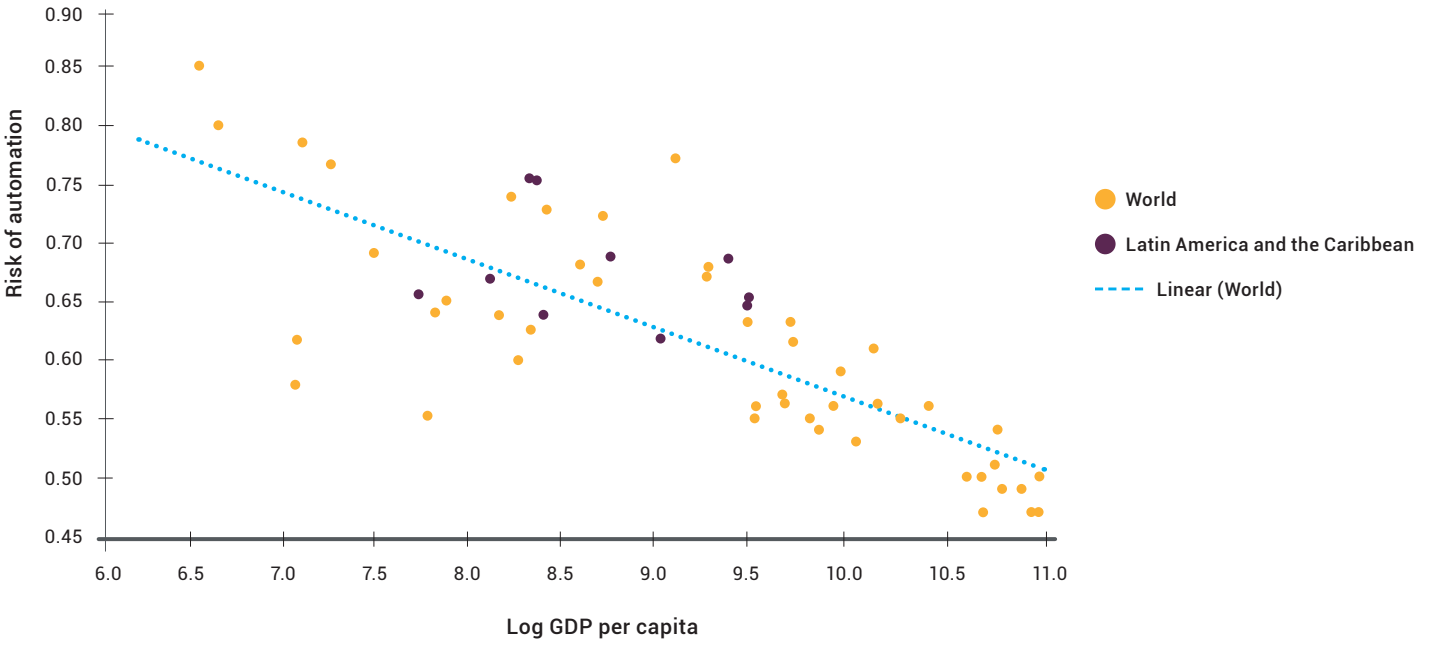
with great untapped potential for Latin America and the Caribbean include fintech, agtech, artificial intelligence and automation, synthetic biology, renewable energies, virtual reality, and the Internet of Things.

Automation puts some workers' jobs at risk. The penetration of robots has negative effects on employment and wages, Acemoglu and Restrepo (2017) find. The more developed the country, the smaller the percentage of occupations at risk of automation, Micco and Soler (forthcoming) note (Figure 5.1). In Argentina and Uruguay, approximately two-thirds of the occupations that currently exist risk being replaced by currently available technologies (Aboal and Zunino, 2017).[4] Overall, Latin American and Caribbean workers spend around half of their time in tasks that could be automated.[5]

Nevertheless, automation is happening more slowly in the region than in developed countries. The density of robots (the number of industrial robots per 100 manufacturing

Figure 5.1 The Percent of Occupations at High Risk of Automation

The region is at an early stage of developing automation.



Source: Micco and Soler (forthcoming).

4. This calculation follows Frey and Osborne (2017).

5. Around 53 percent of time spent working in Colombia and Peru, and around 50 percent of time in Argentina, Brazil, Chile, and Mexico could be automated. See Bughin et al. (2017).

workers) is lower in Latin American and Caribbean countries than in other regions (Nübler, 2017). Density is highest in Mexico, with a value near 0.1, compared to a value near 1 in most developed countries by 2014. To date, vehicle production and the chemical and plastic industries have taken the lead in incorporating robots, comprising 70 percent and 15 percent of the robot stock in the region, respectively. Regional features, such as the abundance of cheap labor or legal frameworks that restrict the adoption of technology, could be playing a role in this phenomenon.

There is a growing body of academic work relating the increasing usage of new technologies with labor market polarization.[6] Regardless, there is little evidence of labor market polarization in Latin America and the Caribbean. By using region-specific skill/task information on occupations (the STEP survey for Bolivia, Colombia, and El Salvador), Messina, Oviedo and Pica (forthcoming) look for evidence of job polarization in Latin American and Caribbean countries. The authors find some evidence of employment polarization for Chile (but no evidence of wage polarization),[7] but no evidence for Mexico. Probably, the slow pace of technology adoption in the region has played a role in slowing the process.

Disruptive technologies that make up the Fourth Industrial Revolution imply an increase in the demand for the so-called twenty-first century skills, regardless of the pace of technology adoption. Cognitive abilities such as creativity, abstraction, and complex problem solving, as well as soft skills associated with emotional intelligence, proactive learning, and communication, will be extremely relevant in a world where technology will take care of the routine aspects of jobs. On the other hand, skills that are associated with technological development, such as the use of new technologies, programming, information design, and data base management, as well as information systems skills like monitoring and evaluation, will be essential as these technologies start to be incorporated into productive processes.

There is growing evidence that, around the world, digital technologies are shifting labor markets toward more flexible and mobile working arrangements, with employment rising in those categories grouped under "alternative work arrangements." Freelancing, self-employment, and temporary work, among other nonstandard work relations, thrive under the structure provided by service apps in smartphones and other digital platforms (Calero, forthcoming). Currently, 4 percent of the workforce in the United States and Europe uses digital platforms to generate their income (Calero, forthcoming). The aggregate relevance of this working agreements for employment is expected to increase accordingly. For the United States alone, between 30 percent and 40 percent of the total labor force may be freelancers (Salazar-Xirinachs 2017). Changing jobs more frequently is another growing trend. According to the U.S. Bureau of Labor Statistics (2015), the average baby boomer

6. Economists refer to the polarization of the labor force when middle-class jobs (requiring a moderate level of skills) seem to disappear relative to those at the bottom (requiring fewer skills) and relative to those at the top (requiring greater skill levels) (Stiglitz, 2012).

7. Wage polarization refers to an increase in wages at the base and at the top of the wage distribution, to the detriment of the middle sector.

(born between 1957 and 1964) held 11.7 jobs in a 30-year period in the United States, while millennials (people born after 1980) will change jobs every two years or less.

Fortunately, most twenty-first century skills are highly transferable. Thus, workers should be better prepared for transitions across jobs and occupations, which will be the norm in a more flexible labor market. The most successful individuals will be those capable of acquiring a combination of soft, cognitive, and technological skills that allows them to transition a more dynamic professional environment.

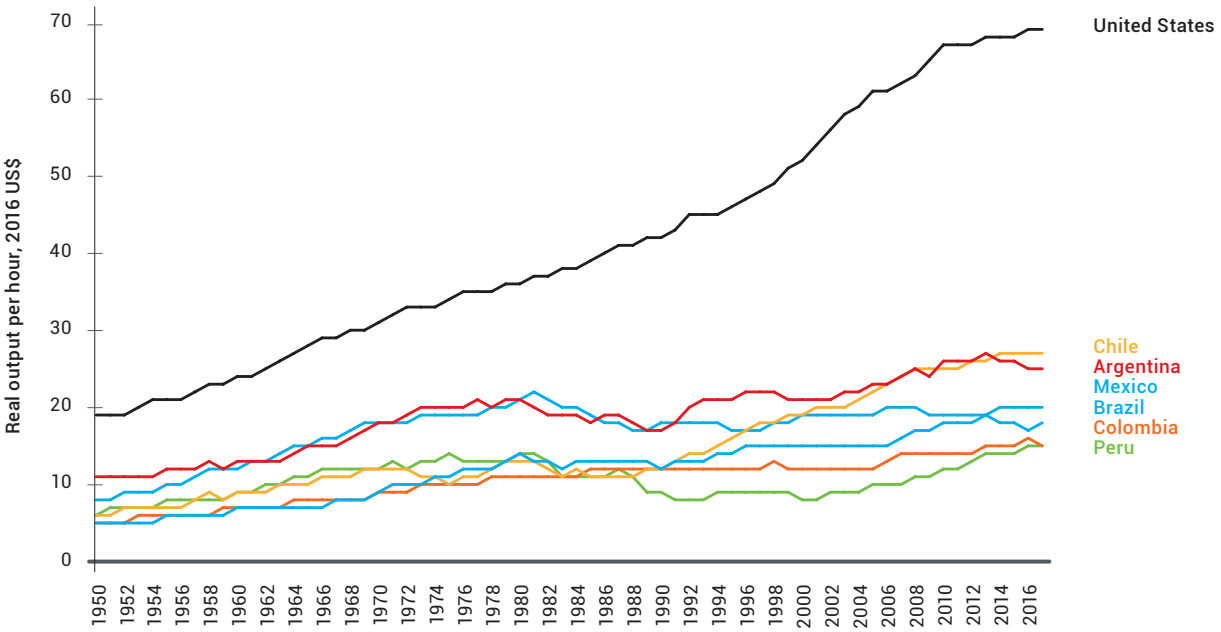
While there is no conclusive evidence regarding the relevance of the "gig" economy or other alternative work arrangements in Latin America and the Caribbean, the increasing pace of ICT penetration combined with the proliferation of digital platforms based on these types of arrangements may favor the rise of the "on demand" economy. For instance, Uber's second largest market is Brazil (Hook and Schipani, 2017), and there were nearly 50,000 registered drivers and 2 million active users in Chile by 2017 (Hidalgo and Morales, 2017). Informal employment rose in Latin America and the Caribbean between 1992 and 2014, particularly for the less educated segments of the labor market (Calero, forthcoming). Among highly educated workers, formal working arrangements prevail. Although "alternative working arrangements" provide innovative ways of promoting labor market participation, specifically for sectors traditionally excluded from job opportunities (Pagés and Ripani, 2017), their growing attractiveness could imply that an increasing number of highly educated professionals decide to work as freelancers, which could shift the nature of informality in Latin America and the Caribbean.

How will these broad trends interact with the challenges that Latin America and the Caribbean faces in relation to informality? Although informal employment has been traditionally identified as a long-lasting challenge for the region, digital technologies combined with other trends in labor markets may change its nature and will probably add an additional layer of complexity to this issue. The increasing incentives created by the new technologies for less educated and highly educated segments of the population alike to be part of the gig economy could lead to a new wave of discussion and analysis of what informality in Latin America and the Caribbean is and how it is composed. The discussion will likely include the need to rethink labor market regulation, understand the challenges that workers face, and consider protections of workers' rights and access to social benefits and pensions. These changes also imply challenges for financing work-related training and education given that resources have traditionally been collected through payroll taxes.

Latin America and the Caribbean has been characterized by moderate economic growth and stagnant productivity. From 2000 to 2017, countries in the region grew on average 2.7 percent per year. Although better than the developed world (with 2 percent for the OECD and 1.6 percent for the EU-28), the region lags the other developing regions (5.4 percent) (The Conference Board, 2017). Further, increasing productivity remains problematic for the region. The productivity gap between Latin American countries and the United States has widened and there are no signs of catching up. Figure 5.2 shows that real output per hour worked was 2.5 times higher in the United States than in Chile, the country in the region with the highest productivity in 2016.

Figure 5.2 Real Output per Hour, Selected Latin American Countries versus the United States, 1950-2017

Real output per hour remains disturbingly low in the region compared to the United States.



Source: The Conference Board (2017).

Worryingly, the average growth rate of labor productivity in the region has been declining in recent years. From an average growth rate of 1.1 percent from 2007 to 2014, this rate dropped to -1.5 percent and -1.6 percent in 2015 and 2016. In 2016, output per worker was merely 29 percent of the equivalent for workers in the United States (The Conference Board, 2017). There is evidence that skills mismatch can help explain a nontrivial share of the productivity gap across countries (McGowan and Andrews, 2015). In line with the previous result, McGowan and Andrews (2017) find that the skills mismatch in Chile is twice as high as in the United States.[8] While more evidence is needed for Latin America and the Caribbean, it is fair to say that to reduce the productivity gap, significant investments in skills development are needed and the skills gap needs to be closed.

8. The difference is 40 percent in Chile versus 20 percent in the United States, using the second round of OECD's PIAAC (Programme for the International Assessment of Adult Competencies) surveys collected between 2014 and 2015.

In addition to reduced productivity growth, reversing demographic trends also thwart economic growth. Economic growth in the region has been driven mainly by increasing labor inputs, reflecting growing populations and the expansion of labor markets. While productivity gains explain 40 percent of economic growth, increasing labor inputs account for the missing 60 percent, for the period 1993–2013, Alaimo et al. (2015) find. The demographic trends that have fueled the region's economic growth are starting to reverse. Decreased population growth caused by declining fertility rates, combined with longer life expectancies, are shifting the region's demographic structure away from its pyramidal shape. By 2030, the rate of employment growth is expected to fall to 1.1 percent per year. Population growth rates are expected to fall from 1.1 percent to 0.65 percent by 2030, but with considerable heterogeneity across regions. Growth rates are highest (and will continue to be highest) in Central America (1.3 percent currently; 0.9 percent in 2030), followed by South America (0.95 percent; 0.57 percent), and with the Caribbean far behind (0.66 percent; 0.38 percent) (UN, 2017). Elderly individuals have increased from 3 percent of the population in 1950 to 6 percent in the 2000 and are expected to become 20 percent of the population by 2030 and 30 percent by 2100 (Salazar-Xirinachs, 2017).

An increasingly older population poses challenges to social security systems. Accordingly, the region's old-age dependency ratio[9] will more than double, from 15.4 to 37.7 by 2050 (UN, 2017). Moreover, the picture for pension savings in Latin America and the Caribbean is grim: less than half of the region's population saves for retirement through a contributory pension system. Households do not compensate through non-pension saving instruments, either (Cavallo and Serebrisky, 2016). For many countries, which also have high rates of informal employment, ensuring provision of social security and pensions is an urgent and complex issue.

Latin America and the Caribbean still faces challenges regarding female labor force participation (LFP). The region's female LFP was 54 percent in 2014, and the gap is wider than in Emerging and Developing Asia, and in advanced economies as a whole (Novta and Wong, 2017). Although female LFP is surprisingly high in the Caribbean, Central America presents the greatest challenges. The potential gains of increased female LFP are remarkable: the region could create $1.1 trillion more in GDP in a best-in-region scenario by 2025, 14 percent higher than what could be created at current conditions of improvement (McKinsey Global Institute, 2015). In turn, by achieving gender parity (in terms of LFP), Latin America and the Caribbean countries would on average increase their GDPs by 14 percent, Novta and Wong (2017) estimate. Thus, improving female LFP could offset the impact of reduced labor force expansion in GDP growth. At the same time, individuals aged 15–29 years constitute around 25 percent of the region's population and will reach their proportionate peak by 2020. This could imply promising growth opportunities if their labor market potential is fully achieved.

9. The old-age dependency ratio is defined as the number of people aged 65+ per 100 individuals aged 25–64.

Investing in skills appears to be the best buffer for workers and jobseekers, given the high degree of uncertainty induced by technological change and automation.

Ideas to Maximize the Benefits and Minimize the Risks of the Fourth Industrial Revolution in Latin America and the Caribbean

The main policy message is that we should invest more in the people of Latin America and the Caribbean. A more educated workforce not only improves the pace of technology adoption but also diminishes the probability of being negatively influenced by it. Investing in skills appears to be the best buffer for workers and jobseekers, given the high degree of uncertainty induced by technological change and automation. Developing these skills is a challenge because many of the new required skills, such as creativity or social adaptability, are difficult to teach. Moreover, the systems to handle this transition are poorly developed (particularly in Latin America and the Caribbean). However, just as technology will provide new opportunities to improve production processes, it will provide new opportunities to train the workforce: for example, by facilitating autonomous and continuous learning, empowering learners, and changing the roles of teachers and instructors from providers of knowledge to mentors, guides, and coaches.

It is imperative to train workers with the best combination of soft, cognitive, and digital skills that will both take advantage of technology and be resilient to its adverse effects. However, knowledge is incremental in the sense that it builds upon previous investments (Cunha et al., 2006; Cunha, Heckman, and Schennach, 2010). As the 2017 IDB's *Development in the Americas* on skills development shows, the region has a low skill base (IDB, 2017). Therefore, there is a need to innovate both in the Latin American and Caribbean region and outside of it. In a parallel fashion, the progressively fluctuating dynamics of the labor market imply that workers will increasingly need to deal with transitions throughout their productive lives. Successful trajectories will require support. Thus, harnessing the potential of new technologies to develop tools to facilitate favorable transitions presents an opportunity for achieving this goal.

Perhaps the best example of learning for the world of work is technical and vocational education and training (TVET). Technological change will speed up the pace at which skills become obsolete. As more tasks become susceptible to automation, people may need to learn faster. As such, the traditional model where people go to school full time and then enter the labor market until they retire is no longer appropriate. The division between learning and earning is already fuzzy and appears to be giving way to a model of lifelong learning. Technology provides the flexibility to learn anywhere and anytime. It makes learning a more tailored, personal experience in terms of content, paths, and evaluations. Examples include the use of virtual reality in practical learning and competence evaluations, as well as blended learning programs that include both virtual and physical learning spaces.

The other great challenge is for education systems to respond to the requirements of the new labor market. To keep up with the challenge, lifelong learning must be flexible and emphasize practical knowledge based on hands-on experience. Teaching methods must be tailored for adults who need to learn to let go of old concepts and learn new ones. On-demand, shorter courses that allow people to perform new tasks in their current occupations or upskill/reskill for new occupations are needed.


FIND A
JOB
JOBS
SEARCH

The right institutional arrangements must also be in place to ease the transitions between learning and earning. Having instruments to order the supply of courses, such as qualifications frameworks, can provide a clear picture of the different paths available to learners. These instruments must make sure that transitions between different learning paths are possible and flexible. They must also support transitions by identifying baseline knowledge required, have the means to recognized previous knowledge regardless of how it was acquired, and provide guidance so that people can make informed decisions to navigate the skills development system.

To make learning relevant for labor markets, it is essential to identify the skills that firms require and ensure that workers have ways of acquiring them. This requires firms to shift the focus of their hiring processes from demanding titles, occupations, and tasks to demanding skills. Having workers with the right skills, rather than having workers who can perform specific tasks, will make firms more flexible and responsive to the changing economic environment. To make sure workers have the right skills, for example, the government of Singapore has launched a program called Skillsfuture, whereby every citizen has access to a credit fund to learn and stay current in the job market. This fund has been available since January 2016 to every Singaporean once they turn 25 years of age, with the aims of helping people take ownership of their lifelong learning process.

Effective public-private collaboration strategies for training people are also needed. How will the private sector face the skills gap? The answer would ideally include a combination of pooling public, private, and individual resources and each actor's comparative advantage so that the allocation of resources is socially optimal. More than resources, this approach requires the private sector to lead the process of identifying and ensuring that the skills identified are the ones they require. Once these skills have been identified, it is essential to work alongside governments to implement initiatives that close the skill gaps, such as apprenticeship programs or training subsidies. Apprenticeships have been shown to help students not only get better, stable jobs, but to increase both occupation-specific skills and socioemotional skills.

Technology is disruptive, but it also offers creative solutions to help workers transition between jobs. A technology that is helpful in this respect is semantic web matching algorithms. They facilitate job search and matching using online data from job portals where both firms and jobseekers provide information from CVs and vacancies. An operational example of these platforms from governments around the world is My Next Move, which provides information for career guidance (occupational descriptions, knowledge and skill requirements, and institutions where training can be obtained) for job seekers and connects them to online job aggregators like Careerbuilder and Indeed. Using another technology, EURES provides information for both jobseekers and employers supporting job search and matching in the European Union. This platform connects jobseekers to vacancies listed in Public Employment Services of various European countries. Another interesting example is the Occupation Outlook app developed by the New Zealand government, which puts information for jobseekers and people looking for careers at their fingertips.

While private initiatives to help workers and firms find one another have existed for some time, the availability of online data has incentivized tech companies like LinkedIn,

Facebook, and Google to step into the search and matching field. Open data made available by public agencies have helped private firms come up with innovative solutions for workers and firms. Google recently launched its new job search tool, Google Careers, and has already expanded its operations to four countries in Latin America: Chile, Colombia, Mexico, and Peru.

The private sector has been quick to expand international occupations and skill classification systems to its needs, creating new proprietary definitions that go far beyond these standard classifications. The main limitation of international classifications is that they were originally conceived to generate comparable statistical information across countries and over time, not to reduce information asymmetries in the labor market. With a growing trend in online job search, technologies that can read and interpret text from CVs and vacancy postings will be more important. These have come a long way from word search to semantic searches that contextualize the search and can provide better matches using machine learning and artificial intelligence in a timely and relevant manner.

Social security systems need to adapt to the new digital reality and future changes in demographics and the labor market. In the next three decades, Latin America and the Caribbean will transit from being one of the youngest regions to one of the oldest. In 2050, one out of five people in the region will be over 65 years old. Such an impressive demographic change will undoubtedly have enormous implications regarding pensions, health, and care for the elderly. In addition, new labor relations and high informality pose challenges to social security. The disintegration of the traditional salaried relationship, the foundation of most social security systems, poses new threats to the financing of health and pension arrangements, as well as increasing the ever-growing inequality between those workers protected by relatively generous pensions benefits and those who have none or rely on noncontributory pensions.

Conversely, technological changes bring enormous opportunities to transit from a social security system anchored in the nineteenth century to new models adapted to the realities of the twenty-first century. Digital tools can allow social security systems to cover people regardless of their working status (freelancer, salaried, independent), due to digitalization of income and transactions. Traditional informal workers detached from formal social security systems could now be connected. For instance, it could be easier to identify and tax the self-employed (formal or informal) working on a platform than those who do not work on a platform. Also, new ways of generating income can increase tax revenue that can help make pensions more sustainable. Furthermore, technologies such as blockchain bring the promise of enhanced efficiency, security, and trust, potentially enabling cooperation among institutions that traditionally lacked incentives to share data and methodologies.

New technologies should also facilitate a process of social innovation regarding savings, social insurance, and risk-sharing arrangements, as well as different ways of packaging retirement solutions. Digital platforms could bring together workers of any category to insure themselves against risks that are either expensive or cannot be diversified in financial markets. Policymakers can facilitate the creation of such solutions by enacting a regulatory framework to ensure transparency and good governance. There are already

products available in the market with such characteristics. Consider the case of tontines, a retirement solution that enables intragenerational risk sharing among participants. Three centuries ago tontines were a popular pension solution, but were rapidly discredited because of operational problems—as well as a perverse incentive for participants to assassinate one another, given that the last person in the savings pool got the largest share. Today, three technological developments make it possible to run a tontine scheme in a safe (anonymous), transparent, and low-cost manner: a digital platform, blockchain, and automated investments.

Although technologies offer the promise of easing the endemic spread of informality and tax evasion in the region, bold public policies should also be put in place. First, regulation and legal definitions should be adapted to cover the new labor market reality of workers immersed in the gig economy. For example, the mandate for the self-employed and other collectives working through platforms to contribute to social security regimes should top the reform agenda. Second, tax and social security authorities should transit to the digital age by upgrading both their hardware and personnel to be able to make use of big data. Big data allow authorities to better fulfill their mandate, communicate better with citizens who will demand more information, and encourage citizens to plan for the future. Third, policymakers can facilitate the creation of innovative solutions by enacting a regulatory framework to ensure transparency and good governance. And last but not least, societies must prepare for an aging world. An aging demographic imposes painful solutions on pensions systems. They will have to adapt to lower fertility and longer life expectancies. Policies must ensure that this cost is shared across several generations.

References

Aboal, D., and G. Zunino. 2017. *Innovation and Skills in Latin America*. *Integration and Trade Journal* 21 (42, August): *Robot-lution: The Future of Work in Latin American Integration 4.0*: 42–57.

Acemoglu, D., and P. Restrepo. 2017. *Robots and Jobs: Evidence from US Labor Markets*. NBER Working Paper 23285, *National Bureau of Economic Research*, Cambridge, MA.

Aggarwal N., J. Bezerra, R. Borno, J. Chen, D. Kennedy, D. Michael, M. Rübmann, and J. Wenstrup. 2013. *Ahead of the Curve: Lessons on Technology and Growth from Small-Business Leaders*. The Boston Consulting Group.

Alaimo V., M. Bosch, D. Kaplan, C. Pagés, and L. Ripani. 2015. *Jobs for Growth*. Washington, DC: Inter-American Development Bank.

Baller S., S. Dutta, and B. Lanvin. 2016. *The Global Information Technology Report 2016: Innovating in the Digital Economy*. Geneva: World Economic Forum.

Bughin J., M. Chui, M. Dewhurst, K. George, J. Manyika, M. Miremadi, and P. Willmott. 2017. *A Future that Works: Automation, Employment and Productivity*. McKinsey & Company.

Calero, C. Forthcoming. *Future of Work: Alternative Work Arrangements*. IDB Discussion Paper, Inter-American Development Bank.

Cavallo, E., and T. Serebrisky, eds. 2016. *Saving for Development: How Latin America and the Caribbean Can Save More and Better. Development in the Americas 2016*. Washington, DC: Inter-American Development Bank.

Conference Board, The. 2017. The Conference Board Total Economy Database™ (Adjusted Version), November 2017.

Cunha, F., J. J. Heckman, L. Lochner, and D. V. Masterov. 2006. *Interpreting the Evidence on Life Cycle Skill Formation*. Chapter 12 in *The Handbook of the Economics of Education* 1, 697–812. Elsevier B. V.

Cunha, F. , J. J. Heckman, and S. M. Schennach. 2010. *Estimating the Technology of Cognitive and Noncognitive Skill Formation*. *Econometrica* 78 (3): 883–931.

Frey C. B., and M. Osborne, 2017. *The Future of Employment: How Susceptible Are Jobs to Computerization?, Technological Forecasting and Social Change* 114: 254–80.

García, A., and E. Iglesias. 2017. *Informe Anual del Índice de Desarrollo de la Banda Ancha en América Latina y el Caribe*. Washington, DC: Inter-American Development Bank.

GSMA (Global System for Mobile Communications Association). 2017. *The Mobile Economy: Latin America and the Caribbean 2017*. London: GSMA.

Hidalgo, F., and D. Morales. 2017. *Choferes Uber crecen 84% en 10 meses y usuarios suman 1,8 millones en Chile*. *La Tercera* February 1. http://www2.latercera.com/noticia/choferes-uber-crecen-84-10-meses-usuarios-suman-18-millones-chile/.

Hook, L., and A. Schipani. 2017. *Battle over Uber and Ride-Hailing Heats Up in Brazil*. *Financial Times*, November 4. https://www.ft.com/content/4e31dbb0-c00e-11e7-b8a3-38a6e068f464.

IDB (Inter-American Development Bank). 2017. *Learning Better: Public Policy for Skills Development. Development in the Americas 2017*. Washington, DC: IDB.

Ivanschitz, R., and D. Korn. 2017. *Computación en nube: la reconversión del espacio en red*. *Integration and Trade Journal* 21 (42, August): *Robot-lution: The Future of Work in Latin American Integration 4.0*: 256–65.

Khanna S., J. Manyika, G. Pinkus, S. Ramaswamy, H. Sarrazin, G. Sethupathy, and A. Yaffe. 2015. *Digital America: A Tale of the Haves and the Have-Mores*. McKinsey & Company.

McGowan, M. A., and D. Andrews. 2015. *The Future of Productivity: Main Background Papers Labour Market Mismatch and Labour Productivity: Evidence from PIAAC Data*. OECD Economics Department Working Paper 1209, OECD.

———— 2017. *Skills Mismatch, Productivity and Policies. Evidence from the Second Wave of PIAAC*. OECD Economic Department Working Paper 1403, OECD.

Messina, J., A. M. Oviedo, and G. Pica. Forthcoming. *Job Polarization in Latin America*. IDB Working Paper, Inter-American Development Bank.

McKinsey Global Institute. 2015. *The Power of Parity: How Advancing Women's Equality Can Add $12 Trillion to Global Growth*. September.

Micco, A., and Soler N. Forthcoming. *The Future of Jobs in Latin America and the Caribbean*. IDB Technical Note, Inter-American Development Bank, Washington, DC.

Novta, N., and J. Wong. 2017. *Women at Work in Latin America and the Caribbean*. IMF Working Paper 17/34, International Monetary Fund, Washington, DC.

Nübler, Irmgard. 2017. *Transformación productiva: Oportunidades para países de ingresos medios*. *Integration and Trade Journal,* 21 (42, August): *Robot-lution: The Future of Work in Latin American Integration 4.0*: 308–23.

Pagés C., and L. Ripani. 2017. *Employment in the Fourth Industrial Revolution*. *Integration and Trade Journal* 21 (42, August): *Robot-lution: The Future of Work in Latin American Integration 4.0*: 262–73.

Salazar-Xirinachs, J. M. 2017. *La metamorfosis del trabajo. Integration and Trade Journal,* 21 (42, August): *Robot-lution: The Future of Work in Latin American Integration 4.0*: 70–83.

Stiglitz, J. E. 2012. *The Price of Inequality: How Today's Divided Society Endangers Our Future*. *Norton.*

Sundararajan, A. 2017. *Capitalismo Colaborativo. Integration and Trade Journal* 21 (42, August): *Robot-lution: The Future of Work in Latin American Integration 4.0*: 58–69.

Surfing Tsunamis and Nxtp.Labs. 2017. *Tecnolatinas: Latin America Riding the Technology Tsunami*. Washington, DC: Inter-American Development Bank.

UN (United Nations), Department of Economic and Social Affairs, Population Division. 2017. *World Population Prospects: The 2017 Revision*, DVD edition.

United States, Bureau of Labor Statistics. 2015. *Number of Jobs Held, Labor Market Activity, and Earnings Growth Among the Youngest Baby Boomers: Results from a Longitudinal Survey.* News Release.

Recent technological innovation in fields such as robotics, automation, and artificial intelligence have reduced the number of workers required in a range of sectors, while lowering costs and increasing reliability. This trend has led policymakers, academics, CEOs, and entrepreneurs to ask what types of jobs will be most affected, what new skillsets will be needed for the jobs of tomorrow, and how governments can ease the transition. ***The Future of Work: Regional Perspectives*** considers how technology is likely to change labor markets in Africa, Developing Asia, Emerging Europe, Central Asia and the Southern and Eastern Mediterranean, and Latin American and the Caribbean in the coming years. The study identifies concrete policy actions countries in these regions could take to face up to the challenges and seize the opportunities presented by emergent technology.