Report of the Inter-agency
Task Force on Financing
for Development

FINANCING FOR DEVELOPMENT: PROGRESS AND PROSPECTS 2018

United Nations

This report is a joint product of the members of the Inter-agency Task Force on Financing for Development (members are shown on page xi). The Financing for Development Office of the United Nations Department of Economic and Social Affairs serves as the coordinator and substantive editor of the Task Force report.

The online annex of the Task Force (http://developmentfinance.un.org) comprehensively monitors progress in implementation of the Financing for Development outcomes, including the Addis Ababa Action Agenda and relevant means of implementation targets of the SDGs. It provides the complete evidence base for the Task Force's annual report on progress in the seven action areas of the Addis Agenda (chapters III.A–III.G). The report is by necessity more concise and selective, and should thus be read in conjunction with the online annex.

The online annex of the Task Force also covers several key cross-cutting initiatives that build on the synergies of the Sustainable Development Goals in-depth:

- Delivering social protection and essential public services
- Ending hunger and malnutrition
- Closing the infrastructure gap
- Promoting inclusive and sustainable industrialization
- Generating full and productive employment for all
- Protecting ecosystems
- Promoting peaceful and inclusive societies
- Gender equality
- Investing in children and youth
- Addressing the diverse needs and challenges faced by countries in special situations
- Global partnership

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Chapter III.G

Science, technology, innovation and capacity-building

1. Key messages and recommendations

Science, technology and innovation (STI) are key means of implementation of the Sustainable Development Goals (SDGs). Expectations about the contribution of STI have increased in recent years as fast-evolving technologies are rapidly changing the development landscape. They open new possibilities to address long-standing development challenges across the SDGs—from poverty and hunger, access to health care and education, to low-carbon energy, combatting climate change, and financial inclusion. They are also changing the development finance landscape, creating opportunities across the action areas of the Addis Ababa Action Agenda (hereafter, Addis Agenda).

Advances in information and communication technologies (ICTs) are at the heart of this technological change. They have vastly increased digital interconnectedness, digital data storage and analytics capabilities at declining cost. Artificial intelligence (AI) in particular, which allows machines and computers to learn to solve problems on their own, could have transformative effects across many sectors of the economy, making it essential that innovations are in the public interest and guided by the 2030 Agenda for Sustainable Development and the Addis Agenda.

Indeed, the transformative power of technology raises complex ethical, socioeconomic and human rights challenges and risks. The rapid pace of technological change puts great adaptive pressure on economies and societies, while our understanding of their socioeconomic implications tends to develop more slowly than technology itself. Both access to and the capacity to adapt and take advantage of technological developments are very unevenly distributed within and between countries. Skills requirements are changing rapidly, which may further increase the digital skills divide. Women and girls, people with disabilities, older persons, indigenous peoples and people living in rural areas may face additional barriers in accessing and using technology.

One often identified risk is that technological change could lead to job losses and increased polarization in labour markets. ***To ensure that technology dividends are shared broadly, countries should put in place policies to support lifelong learning and skills acquisition for all***. At the same time, the significant increase in self-employment and new forms of employment call for ***adapted and strengthened employment and social protection policies. To address continued gender disparities and enhance inclusion of marginalized groups, such policies should emphasize the equitable participation of women and all social groups in decent jobs***.

In development finance, new technologies can help overcome weak contract enforcement, improve administrative procedures, increase access to financial services for those currently underserved and address data gaps. But opportunities will only be available to those who are connected. ***Wide access of individuals and businesses to new technologies, platforms and payment systems is critical, and Governments need to adjust their regulatory frameworks in order to close access gaps while managing risks. Policymakers also need to be proactive in addressing emerging risks to privacy, financial stability, and financial integrity***.

Harnessing technological dividends and sharing them equitably are critical challenges for policymakers. National innovation strategies need to be broad and coordinated with industrial, macroeconomic, educational, social and STI policies, which should support the inclusiveness of these strategies. To help developing countries absorb, develop, integrate and scale up the deployment of key technologies and innovations for the SDGs, ***international collaboration and support for science, technology and innovation remains critical and needs to be scaled up, particularly for the poorest and most vulnerable countries***.

2. New and emerging technologies and the SDGs

New and emerging technologies have the potential to significantly reshape our economies and societies. Due to their potential to disrupt industries and markets, these technologies are sometimes described as being part of a fourth industrial revolution (following mechanization, mass production and the digital revolution) and have the potential to accelerate SDG implementation through their rapidly declining costs and improving performance. This is particularly true for ICTs, whose reliance on open standards and platforms facilitates both widespread deployment and the convergence of several key and mutually reinforcing technologies. AI in particular—which allows machines and computers to address "non-routine" tasks and solve problems on their own—has the potential to become a "general purpose technology" impacting many sectors of the economy.[1]

These technologies and their applications offer new opportunities for economic prosperity, social inclusion, and environmental sustainability, with great potential to contribute to achieving the SDGs.[2] This can be seen in the emergence of innovation-driven entrepreneurs in developing countries that base their business model on specific aspects of the SDGs.[3] For example, agricultural biotechnology can improve productivity and natural-resource-use efficiency, with significant benefits to small farmers. Biological nanotechnology applications are already starting to have an impact on the diagnosis, treatment and prevention of disease. Biotechnology and synthetic biology have enormous potential for addressing the environment, climate crisis and loss of biodiversity through more advanced biofuels and "cleaner" agriculture — that is, agricultural processes with less input of chemical fertilizers and pesticides, and/or a reduction of carbon dioxide through artificial leaf technology. Nuclear and isotopic techniques to track and quantify carbon, water and nutrient movement and dynamics are also used to increase agricultural productivity, resilience, and the sector's greenhouse gas emissions. In Sudan, the application of climate-smart agriculture has allowed hundreds of women, many of whom are refugees or internally displaced persons, to start small-scale farms and home gardens in extremely arid areas. Table 1 presents a wide range of promising emerging technologies across the 17 SDGs, as identified by a group of 158 scientists for the 2016 Global Sustainable Development Report.[4]

The pace of technological change has accelerated significantly. In some areas, such as digital technologies, which are characterized by very low marginal costs and wide distribution through platforms and networks, performance, cost and applicability across sectors is improving at exponential rates. Technologies are also diffused much more rapidly across borders than in the past. For example, the adoption of the steam engine by develop-

1 Matthias Bruckner, Marcelo LaFleur and Ingo Pitterle, "The impact of the technological revolution on labour markets and income distribution", Frontier Issues (New York, United Nations Department of Economic and Social Affairs, 31 July 2017). Available from https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/2017_Aug_Frontier-Issues-1.pdf. The United Nations Interagency Task team on science, technology and innovation (STI) for the Sustainable Development Goals (SDGs) has also begun exploring the impacts of exponential technological change, automation technologies and artificial intelligence on the SDGs.

2 United Nations, Report of the Secretary-General on science, technology and innovation for development (A/72/257). Available from http://undocs.org/A/72/257.

3 United Nations, Science, technology and innovation as catalysts of the SDGs (TD/B/C.II/36). Available from http://unctad.org/meetings/en/SessionalDocuments/ciid36_EN.pdf.

4 United Nations, Global sustainable development report, 2016 edition. Available from https://sustainabledevelopment.un.org/content/documents/2328Global%20Sustainable%20development%20report%202016%20(final).pdf.

Table 1:
Emerging technologies crucial for achievement of the Sustainable Development Goals (SDGs) by 2030

Clusters	Emerging technologies crucial for achievement of the SDGs by 2030	Opportunities in all SDG areas	Potential threats
Bio-tech	Biotechnology, genomics, proteomics; gene-editing technologies and custom-designed DNA sequencing; genetically modified organisms; stem cells and human engineering; bio-catalysis; synthetic biology; sustainable agriculture technology.	Food crops, human health, pharmaceuticals, materials, environment, fuels.	Military use; irreversible changes to health and environment.
Digital-tech	Big Data technologies; Internet of Things; 5G mobile phones; 3-D printing and manufacturing; cloud computing platforms; open data technology; free and open-source; massive open online courses; micro-simulation; E-distribution; systems combining radio, mobile phone, satellite, GIS, and remote sensing data; data sharing technologies, including citizen science-enabling technologies; social media technologies; mobile Apps to promote public engagement and behavioural change; pre-paid system of electricity use and automatic meter reading; digital monitoring technologies; digital security technology.	Employment, manufacturing, agriculture, health, cities, finance, absolute "decoupling," governance, participation, education, citizen science, environment, global data sharing, social networking.	Unequal benefits, job losses, skills gaps, social impacts; global value chain disruption; concerns about privacy, freedom; data fraud, theft, cyber-attacks.
Nano-tech	Nano-imprint lithography; nano technology applications for decentralized water and wastewater treatment, desalination, and solar energy (nanomaterial solar cells); promising organic and inorganic nanomaterials, e.g., graphene, carbon nanotubes, carbon nanodots and conducting polymers graphene, and others.	Energy, water, chemical, electronics, medical industries; high efficiencies; resources saving; CO_2 mitigation.	Human health (toxicity), environmental impact (nanowaste).
Neuro-tech	Digital automation, including autonomous vehicles (driverless cars and drones); IBM Watson; e-discovery platforms for legal practice; personalization algorithms; artificial intelligence; speech recognition; robotics; smart technologies; cognitive computing; computational human brain models; meso-science powered virtual reality.	Health, safety, security (e.g., electricity theft), higher efficiency, resource saving, new types of jobs, manufacturing, education.	Unequal benefits, de-skilling, job losses and polarization, widening technology gaps, military use, conflicts.
Green-tech	**Circular economy**: technologies for remanufacturing, product life-cycle extension and recycling; multifunctional infrastructures; technologies for service integration of centralized and decentralized systems. **Energy**: modern cook stoves; off-grid electricity; mini-grids based on intermittent renewables with storage; battery technology; heat pumps; desalination; small and medium-sized nuclear reactors; biofuel supply chains; solar photovoltaic, wind and micro-hydro technologies; salinity gradient power technology; water-saving cooling technology; LED lamps; advanced metering. **Transport**: integrated public transport infrastructure, electric vehicles, hydrogen-fuelled vehicles and supply infrastructures. **Water**: mobile water treatment technology, wastewater technology, advanced metering infrastructure. Buildings: sustainable building technology, passive housing. **Agriculture**: sustainable agriculture technology; bio-based products and processing, low-input processing and storage technologies; horticulture techniques; irrigation technologies; bio-organometallics. **Other**: marine vibroseis, artificial photosynthesis.	Environment, climate, biodiversity, sustainable production and consumption, renewable energy, materials and resources; clean air and water; energy, water and food security; development, employment; health; equality.	New inequalities, job losses; concerns about privacy, freedom and development.
Other	Assistive technologies for people with disabilities; alternative social technologies; fabrication laboratories; radical medical innovation; geo-engineering technologies (e.g., for iron fertilization of oceans); new mining/extraction technologies; deep sea mining technologies.	Inclusion, development, health, environment, climate change mitigation, resource availability.	Pollution, inequalities, conflict.

Source: UN/DESA, Global Sustainable Development Report 2016.

ing regions took 120 years. Current technologies are clearly spreading within much shorter periods of time. Frontier off-grid renewable energy technologies, for instance, are already allowing some developing countries to rapidly accelerate electrification in rural areas.[5]

At the same time, the transformative power of new technologies raises challenges and risks. Their rapid diffusion puts great pressure on societies and individuals to adapt, and also risks leaving behind those that do not have access to the required skills or infrastructure. Many developing countries struggle to employ new technologies with the same degree of intensity and versatility as developed countries.[6] In the area of ICT, the digital divide remains stark: estimates show that almost half of all households globally still do not have access to the Internet. In least developed countries (LDCs), 85 per cent of households lack Internet access.[7] The gender gap in Internet use has not narrowed globally between 2013 and 2017, and has, in fact, widened noticeably in Africa and in LDCs. Broadband connectivity in developing countries, when available, tends to be relatively slow and expensive, limiting the ability of businesses and people to use it productively.

There are also ethical, socioeconomic and human rights questions that have to be carefully considered in the context of new technologies, from autonomous trading agents in finance to biomedical technology. For example, research has recently found that machine learning algorithms acquire biases from text data reflected in day-to-day culture. More diversity in computer science professions and greater priority for girls and marginalized groups in science, technology, engineering and mathematics (STEM) education can help address these concerns.

The disruption caused by technological change has perhaps been most acutely perceived in labour markets, which have seen job polarization and widening inequalities in many countries. Section 3 below explores impacts, challenges and risks of new technologies for employment and the changing nature of jobs in both developed and developing countries. New technologies are also changing the development finance landscape, from greater financial inclusiveness due to fintech to the regulatory challenges posed by crypto-currencies. Section 4 provides a panorama of their impact across the action areas of the Addis Agenda.

The promise that new technologies hold for sustainable development will be realized only if risks are addressed and benefits distributed equally. It is up to policymakers — both national and international — to create an environment that encourages and facilitates the absorption of technologies, their productive use for sustainable development, and the emergence of new and innovative firms.[8] The concluding section 5 addresses national action and international cooperation for STI.

3. Impact of new technologies on labour markets and jobs

New technologies are affecting the functioning of labour markets and the international division of labour, with new types of employment replacing traditional patterns of work and sources of income. The ability of countries and enterprises to exploit new digital resources will become a key determinant of their competitiveness, but the jobs created will likely require different skills.

The overall effects of digitalization remain uncertain. Some experts argue that computers and robots might be able to perform a significant portion of work at some future point, leading to widespread unemployment; others strongly disagree, underlining the job-creating potential of new technologies. There is, however, broad agreement that innovation may result in temporary job losses. Effects will be context specific, differing greatly among countries and sectors. A key determinant for countries to

5 Sustainable Energy for All, *Global Tracking Framework. Progress toward Sustainable Energy 2017.* The World Bank and the International Energy Agency: Washington, D.C. Available from http://www.se4all.org/sites/default/files/eegp17-01_gtf_full_report_final_for_web_posting_0402.pdf.

6 Marcelo LaFleur, Kenneth Iversen and Lars Jensen, "Globalization of Knowledge and Technology. 2", Frontier Issues (New York, United Nations Department of Economic and Social Affairs, forthcoming).

7 International Telecommuncations Union, ICT Facts and Figures 2017. Available from https://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2017.pdf.

8 *Technology and innovation report* (United Nations publication, forthcoming).

ensure a successful transition will be the strength of their institutions and policy frameworks, which will need to ensure an adequate supply of skilled workers with strong cognitive, adaptive and creative skills necessary for "working with the machines".[9]

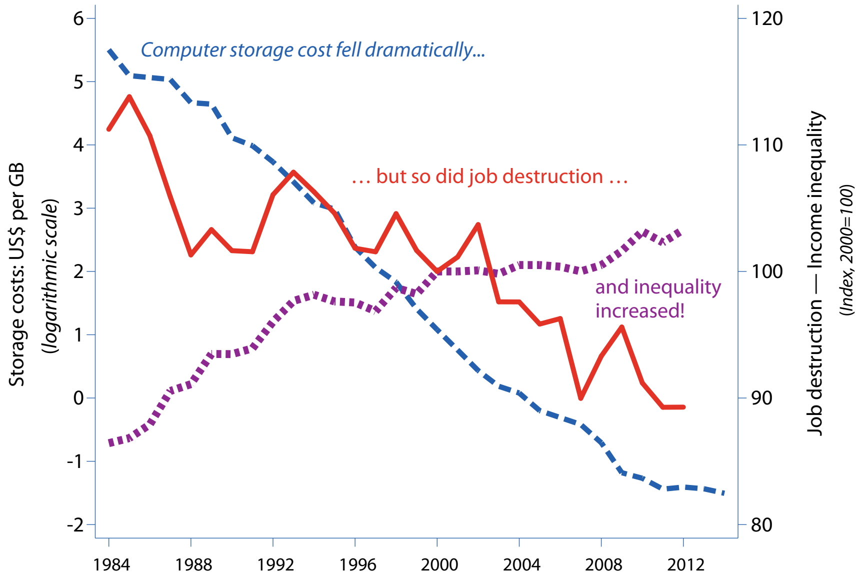
3.1 Labour market trends

So far, there is no evidence that technological change has led to a significant increase in joblessness and aggregate unemployment levels. Global employment continues to expand in line with the labour force, with global unemployment rates falling to 5.7 per cent in 2016.[10] In advanced economies—where technological disruption in the near term is feared the most and costs of digitalization have declined dramatically—job destruction rates have fallen, mostly for reasons related to population ageing (see figure 1).

Nonetheless, there is evidence of a shift in types of employment, which is already observed in increases in inequality, with wage and income growth concentrated at the upper end of the income distribution and job polarization (see figure 2). As jobs are being destroyed in manufacturing and parts of services sectors, employment in both low- and high-skilled occupations has increased. Studies on robotization show that the risk of job loss is high for routine and manual jobs (i.e., those jobs that have a high share of repetitive tasks that can be easily replicated by a machine or software). In the absence of adequate opportunities to acquire new relevant skills, many of those who are at risk of job loss may

Figure 1

Inequality, job destruction and computer storage costs, 1984 – 2013



Source: ILO, database of labour statistics (2013); tenure rates: OECD, Labour Force Statistics; computer storage cost: Luke Muehlhauser, "Exponential and non-exponential trends in information technology", Machine Intelligence Research Institute (2014), available from https://intelligence.org/2014/05/12/exponential-and-non-exponential/.

Note: Job destruction rate is a weighted average of Australia, Belgium, Canada, Denmark, France, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, Sweden, United Kingdom and United States.

9 For a detailed discussion, see *Information Economy Report 2017: Digitalization, Trade and Development* (United Nations publication, Sales No. E.17.II.D.8). The STI Forum and related United Nations expert group meetings have also discussed the impacts of automation technologies on labour markets and employment since early 2016. An expert group meeting in Mexico City in December 2016 suggested a list of specific policy recommendations to address the impact of new technologies on labour markets and other issues.

10 International Labour Organization, *World Employment and Social Outlook: Trends 2017* (Geneva, International Labour Office, 2017). Available from http://www.ilo.org/global/research/global-reports/weso/2017/WCMS_541211/lang--en/index.htm.

be forced to accept lower-skilled and lower-paying jobs, putting further pressure on wages in the low-wage sector.[11] Men and women are differently affected by the changes, which may exacerbate existing gender inequalities in employment (see below). Job polarization also contributes to an increase in precarious forms of employment and long-term unemployment.[12]

While the digital economy has generated profits from larger markets and gains in productivity , the technological dividends have so far not been evenly distributed.[13] Together with the long-standing weakening of labour market institutions, these changes have contributed to the fall in the labour's share of income and a more skewed distribution of incomes (see figure 3).[14]

The key challenge going forward is to ensure that the productivity gains from digitalization are shared more fairly by strengthening labour market institutions (see next section) and by increasing employees' ability to work with new technologies. The skill-biased nature of digitalization is expected to further exacerbate skills and geographical mismatches.[15] Current education and training policies are ill prepared for this transition. With digitalization, cognitive abilities and complex problem-solving skills are becoming more important than physical strength or even technical skills.[16] Moreover, both new labour market entrants and current employees need continuous upgrading of skills and competencies. At the same time, the shift in the nature of employment towards more temporary, less secure jobs risks placing a greater burden on individual workers to acquire the right skills and competences at their own expense.[17] In many parts of the world, women are over-represented in informal occupations or the self-employed, constraining their opportunities for training, lifelong learning and skill acquisition. Providing strong policy support will be essential to ensuring the equal sharing of technological dividends from innovation.

3.2 Technology and institutional change

The technological revolution is impacting the world of work through shifts in the organization of production and a weakening of collective action. Currently, about 15-20 per cent of employees in advanced economies and 40-80 per cent of employees in developing countries are self-employed. Digitalization is expected to lead to a significant increase in self-employment (the "gig economy"), as firms will in-source more services through peer-to-peer networks. This will further weaken the capacity of trade unions and employers' associations to guarantee common labour standards and employment conditions through collective bargaining agreements.

At the same time, new technologies are predicted to improve the functioning of labour markets. AI and big data techniques are increasingly used to improve recruitment processes and could help cor-

11 Daron Acemoglu and Pascual Restrepo, "The race between machine and man: implications of technology for growth, factor shares and employment," NBER Working Paper No. 22252 (Cambridge: National Bureau of Economic Research, May 2016). Available from http://www.nber.org/papers/w22252.pdf; Daron Acemoglu Pascual Restrepo, "Robots and Jobs: Evidence from US Labor Markets," NBER Working Paper No. 23285 (Cambridge: National Bureau of Economic Research, March 2017). Available from http://www.nber.org/papers/w23285.

12 International Labour Organization. *World Employment and Social Outlook: Trends 2017.*

13 Dan Andrews, Chiara Criscuolo and Peter N. Gal, "The best versus the rest," OECD Productivity Working Papers, No. 5 (Paris, OECD, 2 December 2016). Available from http://www.oecd-ilibrary.org/economics/the-best-versus-the-rest_63629cc9-en.

14 International Labour Organization, *Non-standard Employment around the World: Understanding Challenges, Shaping Prospects* (Geneva: International Labour Office, 2016); Organization for Economic Cooperation and Development, *Economic Policy Reforms 2017: Going for Growth* (Paris, 2017); International Monetary Fund, "Understanding the downward trend in labor income shares" in *World Economic Outlook, April 2017: Gaining Momentum?* (Washington, D.C., 2017).

15 Pascual Restrepo, "Skill mismatch and structural unemployment," Massachusetts Institute of Technology Working Paper (Cambridge, 2015). Available from http://pascual.scripts.mit.edu/research/01/PR_jmp.pdf; Soloman Polachek and others (eds.) , *Skill Mismatch in Labor Markets* (Bingley, Emerald Group Publishing, 2017).

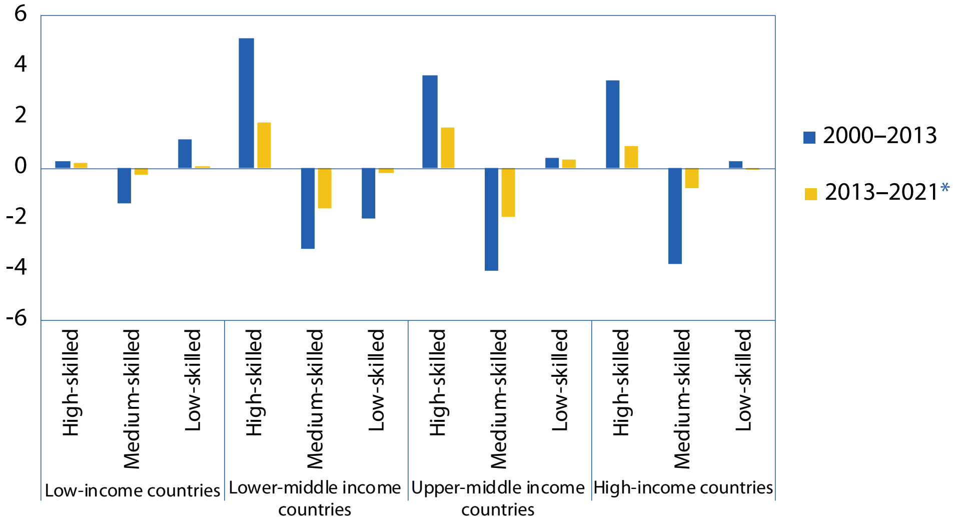
16 See http://reports.weforum.org/future-of-jobs-2016/skills-stability/.

17 International Labour Organization, *Non-standard Employment around the World*.

Figure 2

Changes in employment shares, 2000 – 2013 and 2013 – 2021

(*Percentage*)



Source: ILO, Trends Econometric Models (November 2016).

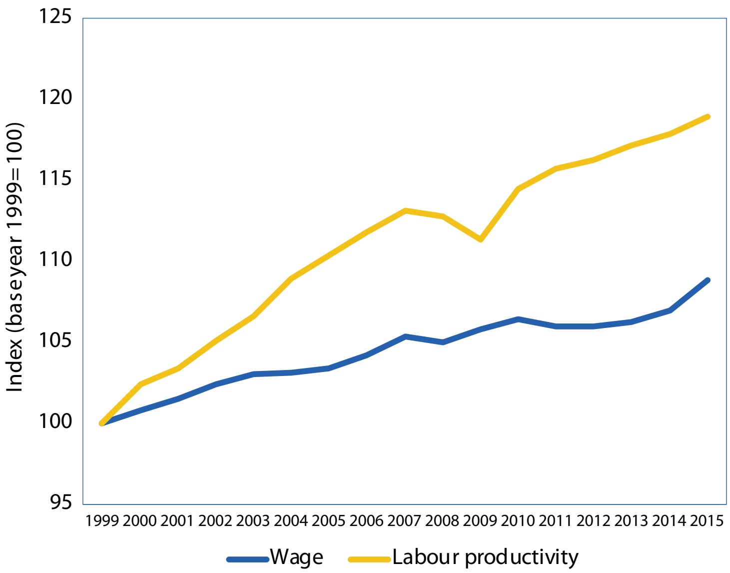
Note: Change in employment shares expressed in percentage points.

* Forecasts after 2016.

Figure 3

Labour productivity and wage growth, 1999 – 2015

(*Index*)



Source: ILO, *Global Wage Report* 2016/17 (2016).

rect skills and geographical mismatches.[18] Digital platforms such as LinkedIn and Monster.com are already connecting individuals with work opportunities in both traditional and digital workplaces. According to McKinsey & Company, for instance, online platforms could match workers and employers to yield 72 million jobs, spurring global gross domestic product (GDP) by 2 per cent within the next decade.[19]

Notwithstanding such efficiency gains, the rise in digital platforms as sources of employment is likely to reduce employment stability, thereby increasing the need for social protection. At the same time, higher volatility and slower growth in wages undermine the sustainability of current social protection systems. This has led to calls for a tax-financed universal basic income as a key pillar of social protection floors (basic social protection), complemented with social security contributory schemes. (see also chapter III.A and its discussion on social protection).

3.3 Effects of globalization

Exports of tradable manufacturing goods and integration into global supply chains have long been an engine of growth and job creation for developing countries. Participation in new digital platforms in sectors such as agriculture or tourism can enable small and medium-sized enterprises (SMEs) from developing countries to compete in well-defined market segments. They offer greater scope for functional upgrading in value chains where producers build trust and potentially move to sell higher value-added exports.[20]

However, digitalization might also speed up "premature deindustrialization" as activities are re-shored to advanced economies.[21] The increasing use of robots in developed countries and some large developing countries, together with new production techniques that demand high skills, will reduce labour-cost advantages of developing countries.[22] Proximity to innovation centres and consumer markets provides further rationales for re-shoring production to developed countries or to emerging economies with growing middle classes.[23] There is some evidence that technology has allowed retention or re-shoring of manufacturing activities in advanced markets. However, re-shoring of production has not gone hand-in-hand with re-shoring of employment.[24]

So far, most developing countries do not seem to be overly threatened by automation, owing to the uneven spread of such technologies across countries and industries. To date, the use of robots remains concentrated in just a few countries and sectors, such as automotive, computers and electronic equipment. In low-skill and labour-intensive sectors such as textiles, automation is not yet economically profitable; nor is it socioeconomically desirable in countries with high numbers of unskilled workers.

18 Ideal, "AI for Recruiting: A definitive guide for HR professionals." Available from https://ideal.com/ai-recruiting/; McKinsey & Company, "A labor market that works: connecting talent with opportunity in the digital age" (Washington, D.C., McKinsey Global Institute, 2015).

19 McKinsey & Company, ibid.

20 *Information Economy Report.*

21 Dani Rodrik, "Premature deindustrialization", *Journal of Economic Growth*, vol. 21, No. 1 (27 November 2015), pp. 1–33; International Labour Organization, *World Employment and Social Outlook: Trends 2015* (Geneva, International Labour Office, 2015). See also http://www.economist.com/news/special-report/21621158-model-development-through-industrialisation-its-way-out-arrested-development.

22 Morris Cohen and others, "Benchmarking global production sourcing decisions: where and why firms offshore and reshore", Stanford University Graduate School of Business Research Paper No. 16-28 (May 2016); UNCTAD, "Robots and Industrialization in Developing Countries", Policy Brief No. 50 (Geneva, October 2015). Available from http://unctad.org/en/PublicationsLibrary/presspb2016d6_en.pdf.

23 Koen De Backer and others, "Reshoring: Myth or Reality?", OECD Science, Technology and Industry Policy Papers No. 27 (Paris, Organization for Economic Co-operation and Development, 2016). Available from http://www.oecd-ilibrary.org/content/workingpaper/5jm56frbm38s-en.

24 Bruckner, LaFleur and Pitterle, "The impact of the technological revolution on labour markets and income distribution".

At the same time, moving up the value chain toward more skill-intensive industries may become harder if robot-based innovation leads to re-shoring and further concentration of such activities in a small number of countries that are technology leaders.[25] It may well be the case that the negative effects of robots are mostly felt in countries that do not use them.[26]

3.4 Structural and gender considerations

Digitalization and automation may also worsen ethnic and gender imbalances, although impacts differ between countries. In the United States of America, for instance, automation in the transportation industry could strongly impact African American, Hispanic and Native American workers, since they are overrepresented and earn better wages than their peers in non-driving occupations.[27] In ASEAN countries, women represent the majority in occupations that are likely to be automated, thus being more vulnerable to unemployment than men.[28] In Argentina on the other hand, female jobholders face an automation probability of 61 per cent, while for men it stands at 66 per cent.[29] Alternative employment opportunities may arise in the care sector, which is expected to expand further, not least because of ageing populations around the world. However, pervasive gender stereotypes perpetuate significant deficits of decent work in this sector and most care work continues to be unpaid, preventing the development of a larger, diversified care services market.

4. New technologies and Financing for Development: opportunities and risks in the action areas of the Addis Ababa Action Agenda

New and emerging digital technologies have the potential to alleviate key constraints and market failures that impede sustainable development finance, such as weak contract enforcement, cumbersome administrative procedures, and paucity of information and data. They can contribute to reducing inefficiencies and to cost savings across the action areas of the Addis Agenda, but they also raise new challenges and risks for policymakers and regulators, discussed below and throughout this report.

4.1 Domestic public finance

Fiscal policy can become more effective thanks to the greater ability of Governments to collect, process and act on information, through both improved public service delivery and tax collection. Digitalization increases efficiencies and saves costs in public financial management (PFM). Gains are accruing from the generation of more and better data, better data management systems and higher computer processing power, which can also lead to better policy design.[30] For developing countries alone, it is estimated that moving government payment transactions from cash to digital could save roughly one per cent of GDP annually with about half accruing directly to Governments, greatly improving fiscal balances.[31] In India, the country's national bio-

25 See the summary of the Inter-agency Task Force technical meeting on "The impact of new technologies on labour markets and the jobs of the future", available from https://developmentfinance.un.org/sites/developmentfinance.un.org/files/IATF%20Technical%20Meeting%20on%20Tech%20and%20Labour%20Markets_Summary_0.pdf.

26 *Trade and Development Report 2017* (United Nations publication, Sales No. E.17.II.D.5.).

27 Center for Global Policy Solutions, "Stick Shift: Autonomous Vehicles, Driving Jobs and the Future of Work", (Washington, D.C., 2017). Available from http://globalpolicysolutions.org/report/stick-shift-autonomous-vehicles-driving-jobs-and-the-future-of-work/.

28 Jae-Hee Chang, Gary Rynhart and Phu Huynh, "ASEAN in Transformation: How Technology Is Changing Jobs and Enterprises", Bureau for Employers' Activities, Working Paper No.10 (Bangkok, International Labour Organization, 2016).

29 Anton Estevadeordal and others (eds.), "Robot-Lución: The Future of Work in Latin American Integration 4.0", *Integration and Trade*, vol. 21, No. 42 (August 2017). Available from http://publications.iadb.org/handle/11319/8487.

30 Sanjeev Gupta and others (eds.), *Digital Revolutions in Public Finance* (Washington, D.C., International Monetary Fund, 2017). Available from https://www.bookstore.imf.org/books/title/digital-revolutions-in-public-finance.

31 Susan Lund, Olivia White and Jason Lamb, "The value of digitalizing government payments in developing countries", in Gupta and others, ibid.

metric identity programme combined with a concerted public effort to increase financial inclusion have allowed an increasing number of government transfer payments to be made directly to individuals, significantly reducing leakage.

Although still in its infancy, distributed ledger technology—popularly called blockchain—is increasingly being applied and piloted in PFM administration as data and transactions infrastructure. Blockchain technology can instil trust and ensure security through its decentralized features. Its ability to work with "smart contracts"[32] can automate transactions such as licensing, revenue collection and social transfers, significantly lowering costs. Estonia, for example, offers citizens a digital identity card based on blockchain, which allows citizens to access public, financial and social services as well as pay taxes.[33] Another area of interest is blockchain's ability to combat illegal activities through improved verification of authenticity and provenance throughout the supply chain (the mining industry provides a good example).[34]

On the resource mobilization side, the increased use of digital payments also provides better means of verifying economic outcomes of taxpayers and can help formalize and tax previously undocumented economic activities. However, digitization also brings new opportunities for tax-avoidance and profit shifting and other financial integrity issues such as money laundering and funding of terrorism.[35] Chapter III.A on domestic resource mobilization includes a detailed discussion of rules for the taxation of the digital economy and cross-border implications in particular. The United Nations Committee of Experts on International Cooperation in Tax Matters and the Organization for Economic Cooperation and Development have both started to look into how the international community can address these issues.

At the national level, Governments need to increase investments not only in their own capacities to take advantage of digitalization, but also in ensuring that all individuals and businesses have access to these systems, and be mindful of adoption costs that may exclude certain sections of society. The collection of ever more detailed data also increases the responsibility of Governments to protect citizens' privacy and to adopt regulatory frameworks that prevent abuse.

4.2 Private finance

Digitally enabled innovation in the financial sector (fintech) offers new business models for providing financial services and is at the heart of financial inclusion in many developing countries. Fintech includes start-ups that provide digitally based financial services, established telecoms firms, and online retailers that use ICT capabilities and customer bases to provide digital financial services, such as mobile-telephone-based money, payments and banking service. Fintech can help overcome traditional impediments to accessing financial services by large segments of the population in developing countries in multiple ways.

First, fintech allows businesses and organizations to reach a wide range of consumers without a large investment in physical infrastructure (other than for ICT, which has broader uses). With the cost and time of financial service provision significantly reduced, resources can be dedicated to expanding reach, which makes smaller transaction markets more attractive from a business perspective. This has implications for lowering the cost of remittance transfers, as discussed in chapter III.B. Second, fintech can reduce collateral requirements and cut monitoring costs, and provide alternative credit-scoring methods where borrowers lack credit history. Online marketplaces are able to extend loans to small and

32 Smart contracts can automatically pay out an entitlement when certain eligibility criteria are met and verified by the blockchain network.

33 Arvind Krishna, Martin Fleming and Soloman Assefa, "Instilling digital trust: blockchain and cognitive computing for government", in Gupta and others, *Digital Revolutions in Public Finance*.

34 See, for example, "Diamonds Are The Latest Industry To Benefit From Blockchain Technology", *Forbes* (10 September 2017) on how blockchains can be applied in the diamond and other industries.

35 Dong He and others, "Virtual currencies and beyond: Initial considerations", IMF Staff Discussion Note (Washington, D.C., International Monetary Fund, January 2016). Available from https://www.imf.org/external/pubs/ft/sdn/2016/sdn1603.pdf.

micro firms active on their platforms owing to the extensive data they are collecting. Fintech can facilitate registration of asset ownership; this can serve as a security measure, allowing more agents to access credit, and facilitate matching between different investors and project/business owners.[36] Improvements to the business environment, such as secure land tenure and property rights, can also raise investment levels. Digitalization can improve registration procedures, and a few initiatives are looking into how blockchain can be used to expand and simplify land and property registration.[37]

At the same time, private finance can be a key source of investment for STI infrastructure. The United Nations Conference on Trade and Development (UNCTAD) estimates the total investment required to build universal basic 3G coverage in developing and transition economies at less than $100 billion, and in LDCs at less than $40 billion.[38] These amounts could be attainable with an enabling framework for private investment and policies aimed at generating sufficient demand, and with government support to achieve universal connectivity, including in thinly populated and low-income areas.

4.3 Development cooperation

The main benefits of digital technologies in development cooperation are cost-savings and efficiency gains through timely and better targeted responses, reduced risk of fraud, and a better understanding of impacts, and thus better program and project design and implementation. As an example, biometric registration data of Syrian refugees in Jordan and Lebanon, collected by UNHCR, is then used by agencies to authenticate identity at ATMs and point of sale.[39] Blockchain technology can help improve humanitarian emergency response coordination, such as digitalizing payments to response workers under the Ebola crisis in Sierra Leone, which helped reduce strikes, fraud and traveling time for workers.[40] Satellite imagery, mobile phone data and AI technology can help identify, predict and target poverty interventions where information is missing, track the movement of displaced people or climate-related changes, and can augment existing monitoring tools.[41]

To the extent that technologies increase transparency and accountability in development cooperation, they could also help raise the general public willingness to provide support. As an example, through the International Aid Transparency Initiative (IATI), data systems and standards are already in place to track financial flows to development and humanitarian projects. Increasing numbers of publishers are adding results to their published projects and increasing traceability.

4.4 Trade

Increasing digitalization and globalization are creating new opportunities for trade. Digitalization helps small businesses and entrepreneurs in developing countries connect with global markets. It also creates new jobs and opens new ways of generating income, jobs and entrepreneurial opportunities. UNCTAD estimates show that some 100 million people are employed by ICT services globally, so far largely in developed countries. Cross-border business-to-consumer (B2C) e-commerce was worth about $189 billion in 2015, which corresponds to 7 per cent of total B2C e-commerce.[42] At the same

36 United Nations Development Programme, "Digitally enabled financial services: how digital technology drives financial inclusion", BPPS Strategic Policy Unit Paper (New York, forthcoming).

37 For example, the ongoing work of Bitland in Ghana, or Bitfury in Georgia. See "Bitcoin, blockchain and the fight against poverty", *Financial Times,* 22 December 2017.

38 *World Investment Report.* Geneva (United Nations publication, Sales No. E.17.II.D.3).

39 See: http://www.unhcr.org/en-us/cash-based-interventions.html and http://www.unhcr.org/en-us/596331dd7

40 Joe Abass Bangura, "Saving money, saving lives; a case study on the benefits of digitizing payments to Ebola response workers in Sierra Leone", Better Than Cash Alliance Case Study Series (New York, Better Than Cash Alliance, May 2016). Available from https://www.betterthancash.org/tools-research/case-studies/saving-money-saving-lives-a-case-study-on-the-benefits-of-digitizing-payments-to-ebola-response-workers-in-sierra-leone

41 See, for example, Joshua E. Blumenstock, "Fighting poverty with data", *Science*, vol. 353, Issue 6301 (19 August 2016), pp. 753-754.

42 *Information Economy Report: Digitalization, Trade and Development* (United Nations publication, Sales No. E.17.II.D.8).

time, changing trade patterns due to digitalization (such as re-shoring, discussed above) could also have negative impacts for developing countries, whose integration into the digital economy will be critical for their ability to compete in global markets.

Blockchain technology also has great potential in trade finance, which is characterized by a large number of stakeholders and mostly paper-based documentation. Potential benefits include simplified processes, reduced settlement times, errors, fraud and disputes, and increased trust between all parties to a transaction. A group of banks have partnered with blockchain service provider IBM on implementing a new blockchain-based global system for trade finance. Similarly, IBM has teamed with another set of banks to build and host a new blockchain-based system for providing SMEs with trade finance.[43] Digitization can also reduce the costs associated with know-your-customer and anti-money laundering rules, thus helping to counter some of the negative trends in correspondent banking.

4.5 Debt and systemic issues

The ability to collect more and better information can improve credit analysis and allow more agents to access credit. More generally, digitalization could enhance economic data collection, support early warning systems and improve risk preparedness. On the other hand, the provision of financial services outside existing supervisory and regulatory frameworks poses new challenges to the regulatory regime, which is currently structured around financial service-providing entities rather than activities. Regulators have already begun to address these issues in the context of cross-border transactions of virtual currencies. The Financial Action Task Force has called on countries to apply anti-money laundering measures to virtual currency exchanges.[44] If virtual currencies were used on a larger scale, they could raise new financial stability risks, and even reduce the effectiveness of monetary policy.[45]

4.6 Data

Digital technologies and the Internet are generating vast amounts of (financial and non-financial) data, raising questions regarding who owns data and how it can and should be used. Governments need to strike the right balance of addressing privacy concerns without stifling beneficial innovations. There is also a need for capacity development in data management and data and process standardization. Efforts to support sharing of best practices in policy and regulation should be strengthened. As an example, authorities and regulators in Kenya (where mobile money was pioneered) are often credited for having put in place appropriate legal and regulatory frameworks guiding the use of digital technologies.[46]

5. National and international actions on science, technology and innovation

Technology is making rapid advances, with impacts felt across countries and sectors. To reap its benefits and to address the significant risks and challenges described above, appropriate policy frameworks need to be in place and complementary investments need to be made, both at the national level and through enhanced international support.

5.1 National innovation strategies

There is no single optimal system or policy blueprint for a national STI policy and innovation strategy, since the innovation context varies greatly between countries. Both public and private actors contribute to the innovation process, with Governments often the main funder of basic research, which is critical to the absorptive capacity of countries. Private actors play a more prominent role in development, demonstration and diffusion of technology. Even in these latter stages, public policy and public funding

43 Martin Arnold, "Banks team up with IBM in trade finance blockchain", *Financial Times*, 4 October 2017.

44 Dong He and others, "Fintech and financial services: Initial considerations", IMF Staff Discussion Note (Washington, D.C., International Monetary Fund, June 2017). Available from https://www.imf.org/en/Publications/Staff-Discussion-Notes/Issues/2017/06/16/Fintech-and-Financial-Services-Initial-Considerations-44985.

45 Dong He and others, "Virtual currencies and beyond".

46 Njuguna Ndung'u (2017). "Digitalization in Kenya; revolutionizing tax design and revenue administration", in Gupta and others, *Digital Revolutions in Public Finance*.

are often critical, and key components of a national innovation strategy.

Recent trends in national innovation strategies show that many Governments, particularly in developed countries, have focused their attention on improving the ability of firms to invest in research, development and innovation, rather than on public research, as a response to budgetary constraints.[47] This includes financing of business innovation and entrepreneurship, rationalizing public research spending, and strengthening ties between public and private research. Global public and private research and development (R&D) expenditure has remained relatively constant, growing only modestly between 2009 and 2015, from 1.64 to 1.70 per cent of GDP. While lower overall, R&D expenditure in developing countries grew at a faster rate, driven to a significant degree by China, which is now second only to the United States in R&D expenditures. In LDCs on other hand, only around 0.24 per cent of GDP is dedicated to R&D. Generally, absolute spending remains highly concentrated, both in terms of countries and firms (see figure 4).[48] The 200 largest global firms, which are concentrated in the United States, Japan and China, account for 70 per cent of all business R&D spending.[49]

Developing countries and their firms and entrepreneurs thus spend significantly less on R&D than developed countries, despite high potential returns associated with technological catch-up. One reason is that returns to innovation cannot be realized in the absence of key complementary factors, such as physical and human capital.[50] National innovation strategies thus need to be broad in order to address broader constraints to innovation, and be embedded in sustainable development and productive diversification strategies. Policies should also take into consideration gender equality throughout the policy process — from design to evaluation — and consider technology foresight and assessment as tools to ensure the inclusive application of STI for sustainable development.

Public leadership is particularly important in so-called mission-oriented innovation that aims to tackle grand structural challenges such as climate change. Indeed, the 2030 Agenda for Sustainable Development calls for transformative change in many areas, which requires public policy to target not only the rate but also the direction of innovation.[51] Many countries are already focusing innovation policies on specific socioeconomic sectors, such as agribusiness, biotechnology, the software industry and climate change. Examples include Inova Agro, a fund targeting the agribusiness sector in Brazil, FONSOFT in Argentina and PROSOFT in Mexico, which provides SMEs in the software industry with competitive funding. Some countries have also implemented taxes and other mechanisms to redirect funds from companies to support sectoral and general research activities. One example is a levy on palm oil producers in Malaysia that funds research in the sector.[52]

Another key constraint is that start-ups and SMEs often have difficulty accessing venture capital. Countries have set up targeted funds and are partnering with multilateral organizations and private venture capital firms to close this financing gap. Examples include the Islamic Republic

47 Organization for Economic Cooperation and Development, *OECD Science, Technology and Innovation Outlook 2016* (Paris, OECD Publishing, 2016). Available from http://www.oecd.org/sti/oecd-science-technology-and-innovation-outlook-25186167.htm.

48 Data from UNESCO Institute for Statistics. Available from http://data.uis.unesco.org.

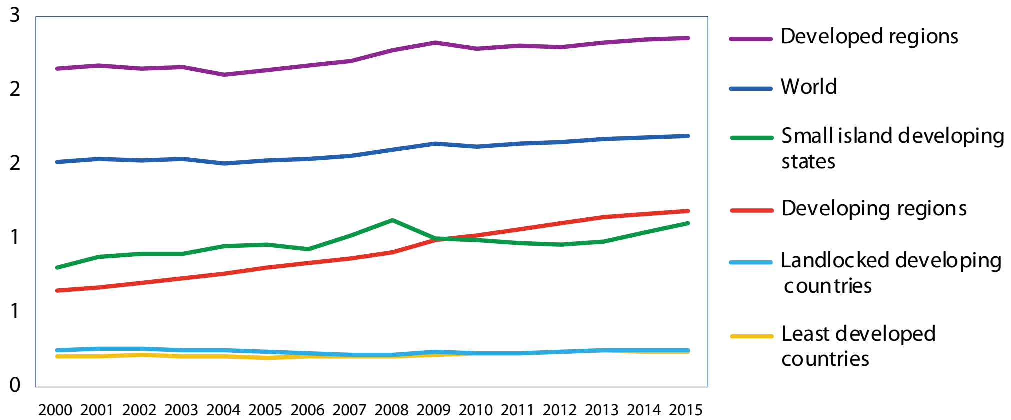
49 Organization for Economic Cooperation and Development, *OECD Science, Technology and Innovation Outlook 2016*.

50 Xavier Cirera and William F. Maloney, *The Innovation Paradox. Developing-Country Capabilities and the Unrealized Promise of Technological Catch-Up* (Washington, D.C., The World Bank, 2017). Available from https://openknowledge.worldbank.org/bitstream/handle/10986/28341/9781464811609.pdf?sequence=4&isAllowed=y.

51 See, for example, Mariana Mazzucato, "Building the entrepreneurial state: a new framework for envisioning and evaluating a mission-oriented public sector, Levy Economics Institute Working Paper Collection, Working Paper No. 824 (Annandale-on-Hudson, New York, Levy Economics Institute, January 2015). Available from http://www.levyinstitute.org/pubs/wp_824.pdf.

52 For a longer and more detailed list of examples drawn from the UNESCO 2015 Science report, see the online annex of this report, and its section on STI and capacity-building, available from https://developmentfinance.un.org/science-technology-innovation-and-capacity-building.

Figure 4
Research and development expenditure, 2000 – 2015
(*Percentage of GDP*)



Source: UNESCO Institute for Statistics. Available from http://data.uis.unesco.org.

of Iran's Innovation and Prosperity Fund, which offers tax incentives and pays partial costs of commercializing knowledge and technology to SMEs, and Azerbaijan's State Fund for the Development of Information Technologies, which provides start-up funding through equity participation or low-interest loans.

5.2 Development cooperation for STI and capacity building, and actions by the UN system and others

National efforts to strengthen science, technology and innovation need to be complemented by international support. Official development assistance for scientific, technological and innovative capacity has increased significantly in recent years, amounting to $1.8 billion in 2016. However, much of the increase in recent years has not benefited the poorest and most vulnerable countries, which have seen STI-specific aid flows stagnate in recent years (see figure 5).

South-South cooperation on STI is an important complement to North-South cooperation. Several developing countries have built up significant STI knowledge, resources and capacity that are sometimes more affordable and appropriate for recipient countries.[53] Through the Development Cooperation Forum, Southern partners have called on South-South and triangular cooperation to take an even more prominent role in unleashing the transformative power of STI.[54] The BRICS countries (Brazil, Russia, India, China and South Africa) have intensified STI cooperation under the BRICS STI Framework Programme.

Several United Nations agencies have also invested considerably in enhancing capacity development for STI. Some agencies developed guidelines and e-learning tools (e.g., the Food and Agriculture Organization), created new training mechanisms, such as academies and virtual institutes (e.g., the International Labour Organization and UNCTAD), implemented pilot projects in volunteering and capacity-building (UNDP-UNV), and carried out

53 South-South and triangular cooperation for achieving the 2030 Agenda: building innovative and inclusive partnerships. United Nations Development Cooperation Forum. Summary document of the DCF Argentina High-level Symposium, 6-8 September 2017. Available from https://www.un.org/ecosoc/sites/www.un.org.ecosoc/files/files/en/dcf/dcf-argentina-summary.pdf.

54 ECOSOC Development Cooperation Forum, "Promoting sustainable development through triangular cooperation", DCF Policy Brief No. 19 (New York, DCF Secretariat, September 2017). Available from https://www.un.org/ecosoc/sites/www.un.org.ecosoc/files/files/en/dcf/brief%203_Triangular_cooperation_final_01_09_17.pdf.

technical assistance initiatives to enhance capacities in the field of technology and innovation (WIPO).[55] The United Nations Department of Economic and Social Affairs (UN/DESA) is implementing a four-year project for mobilizing STI in developing countries for the SDGs. UNCTAD continues to support the development of national capacities in the STI policy field through its science, technology and innovation policy (STIP) reviews, and is currently revising the framework with a view to incorporate SDG considerations into the STIP reviews. To prevent the evolving digital economy from leading to widening digital divides and greater income inequalities, UNCTAD launched the eTrade for all initiative in 2016.[56] The United Nations Educational, Scientific and Cultural Organization (UNESCO) continues to promote international scientific cooperation and capacity-building through several programmes, including GO-SPIN, which supports countries in developing STI policy instruments, as well as its STEM and Gender Advancement tools, which aim at improving measurement and policies for gender equality in STEM fields. The International Telecommunications Union (ITU) has a large capacity-building programme focusing on strengthening skills among its membership in a wide range of ICT-related topics. Through the ITU Academy, which has more than 10,000 users, and its Centres of Excellence network, it delivers face-to-face and e-learning courses to beneficiaries from all regions.[57]

5.3 Technology Facilitation Mechanism

Under the umbrella of the Technology Facilitation Mechanism (TFM),[58] the second STI Forum was held in New York on 15 and 16 May 2017. The Forum attracted more than 800 participants, representing a cross section of scientists, innovators, technology specialists, entrepreneurs, policymakers and civil society representatives. The Forum explored policies and actions for advancing STI to achieve the six SDGs up for review at the 2017 High-level Political Forum and proposed recommendations for action detailed in the Co-Chairs' summary of the STI forum.[59]

The STI forum is organized by the United Nations Interagency Task Team on STI for the SDGs (IATT), which has been co-convened since September 2017 by UNCTAD and UN/DESA, and has 35 active members.[60] The IATT and its members will develop an initial demo version of the online platform of the TFM, which is envisaged as a gateway for information on STI initiatives, mechanisms and programmes around the world, and it is expected to connect suppliers and users of technologies that advance progress towards achieving the SDGs.

5.4 The Technology Bank for the Least Developed Countries

The Addis Agenda reiterated the call from the Istanbul Programme for the creation of a Technology Bank for the LDCs. On 23 December 2016 the United Nations General Assembly established the Technology Bank for Least Developed Countries. In September 2017, the United Nations and the Government of Turkey signed the Host Country Agreement and the Contribution Agreement, and in November, the Council of the Technology Bank adopted the programme of work and budget for 2018. During its first year of work, the Technology Bank, in collaboration with other United Nations entities, including UNCTAD and UNESCO, will focus on preparing STI reviews and technology needs assessments and on promoting digital access to research and technical knowledge in selected LDCs.

55 United Nations, Report of the Secretary-General on the state of South-South cooperation (A/72/297). Available from http://undocs.org/A/72/297. The World Intellectual Property Organization (WIPO) Technology & Innovation Support Center (TISC) initiative aims to assist local users to create, protect, own and manage their own intellectual property rights, strengthen the local technological base and increase technology transfer through Service Level Agreements with national IP Offices, see http://www.wipo.int/tisc/en/.

56 For more information, see https://etradeforall.org/.

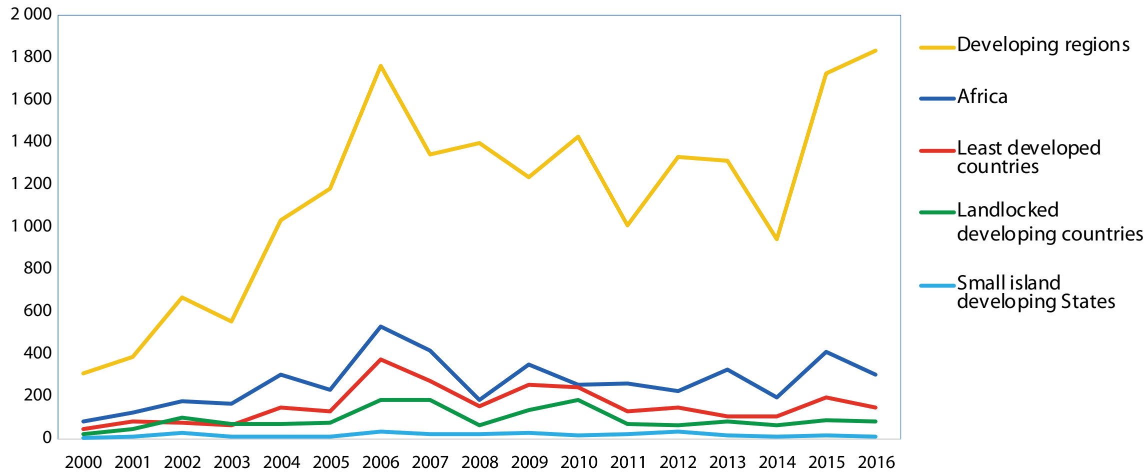
57 See https://academy.itu.int/index.php?lang=en.

58 See https://sustainabledevelopment.un.org/tfm.

59 See E/HLPF/2017/4 of 31 May 2017. Available from http://www.un.org/ga/search/view_doc.asp?symbol=E/HLPF/2017/4&Lang=E.

60 Membership as of October 2017.

Figure 5
Official development assistance for scientific, technological and innovative capacity, 2000 – 2016
(*Billions of United States dollars*)



Source: OECD Creditor Reporting System and UN/DESA calculations.
Notes: Includes ODA commitments reported under education, medical, energy, agricultural, forestry, fishery, technological and environmental research, ICT and research and scientific institutions.