



Financing for Sustainable Development Report 2020

Inter-agency Task Force on Financing for Development



United Nations

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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 Sustainable Development Goals. 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.

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SCIENCE, TECHNOLOGY, INNOVATION AND
CAPACITY-BUILDING





Chapter III.G



Science, technology, innovation and capacity-building

1. Key messages and recommendations

To achieve the Sustainable Development Goals (SDGs), countries at all stages of development must increase their capacities in science, technology and innovation (STI). New practices and technologies need to be developed and transferred where they are most needed in order to strengthen productivity growth, lower the environmental impact, and reduce inequalities between and within countries. Governments, companies and civil society organizations need to ensure that technological discoveries are transformed into innovations that respond to society's needs and contribute to sustainable development.

This chapter complements the analysis of the thematic chapter (chapter II)—which addresses the role of digital technologies—by reviewing the progress in implementing the commitments and calls for action on and capacity-building in the Addis Ababa Action Agenda.

While there has been important progress in most STI indicators, large gaps remain between developed and developing countries, particularly in least developed countries (LDCs); for instance, the gap in research and development (R&D) spending between developed and developing countries has increased in most regions. While the gender gap has shrunk in most countries with respect to tertiary education, it remains large in terms of Internet access and has increased in LDCs overall. *Knowledge-sharing and collaboration should be strengthened to ensure that no one is left behind, including by supporting education systems, improving affordable access to the Internet and further increasing international cooperation in science, technology and innovation.*

New and emerging technologies have spread rapidly, supporting SDG progress and spurring financial innovation and inclusion in particular. Over time, the impact of these technologies will affect all sectors and countries. *All countries need to develop and strengthen their capacities for technological adaptation and innovation, in line with the development of national innovation systems and regulatory frameworks, supported by an enabling international environment.*

Both the Technology Facilitation Mechanism (TFM) and the Technology Bank—two key outcomes of the Addis Agenda in support of STI—have been set up and operationalized over the past few years. *Continued joint efforts of Member States of the United Nations, supported by the United Nations system, can help these mechanisms deliver on their mandates, to support developing countries' adaptation of new technologies for sustainable development.*

The next section reviews a comprehensive set of STI indicators, highlighting progress and areas for further action. Section 3 analyses main trends in new and emerging technologies and their impact on sustainable development, while section 4 reviews their effect on the financial sector and financial inclusion. Section 5 takes stock of United Nations actions on STI, including support for the TFM and the Technology Bank.

2. Measuring progress towards the Addis Agenda in science, technology and innovation

While the Addis Agenda does not provide quantitative targets, this section reviews indicators that can help assess progress in the area of STI. It highlights areas of progress and those where additional policy action is needed. It also reveals a lack of comparable information across countries for many relevant commitments.

The commitments are clustered around three areas: (i) providing an enabling environment, by improving connectivity and promoting entrepreneurship; (ii) increasing learning and innovation by public and private actors, including by raising enrolment in tertiary education, employing more researchers and investing more in R&D; and (iii) transferring knowledge across borders, by increasing foreign direct investment (FDI)

in R&D activities, encouraging the movement of students, strengthening online learning and increasing international cooperation.

2.1 Providing an enabling environment

People are more connected

To raise capabilities in STI, people need to be connected. Globally, the number of broadband subscriptions is on the rise, although with a different pattern between developed and developing countries. While in developed countries, there are now 36 fixed broadband connections for every 100 persons, developing countries only reach 11 connections per 100 inhabitants, and LDCs only 2. On the other hand, mobile broadband connections are rising faster in developing countries, reaching 75 connections per 100 inhabitants.¹

As a result, the number of people using the Internet continues to grow, reaching 54 per cent of the global population in 2019. The gap between developed and developing countries has narrowed considerably, especially for Latin America and the Caribbean, Western Asia, and East and Southeast Asia (figure III.G.1). Still, almost half the world is not connected. Internet use in Africa and South Asia is still much lower but has been growing at a faster pace. Growth was slowest in LDCs, causing them to fall further behind in terms of connectivity.

Affordability of services is a major barrier for expanding usage; almost a third of the world's people live in countries where broadband plans are unaffordable for average incomes. While in almost all developed countries, a mobile broadband subscription with a 1.5 Gb data package costs less than 2 per cent of gross national income (GNI) per capita, in most LDCs it costs more than 5

per cent; as an extreme example, in the Democratic Republic of the Congo, at 20 dollars per month, the cost reaches 53 per cent of GNI per capita. Poor and marginalized groups continue to face barriers to Internet access, and all the opportunities that come with it. Women are still 16 per cent less likely than men to access the Internet in developing countries (33 per cent less in LDCs), and the gender gap is widening in the Asia-Pacific region, Africa and Western Asia as men are gaining access at a faster rate than women.²

Entrepreneurship is rising

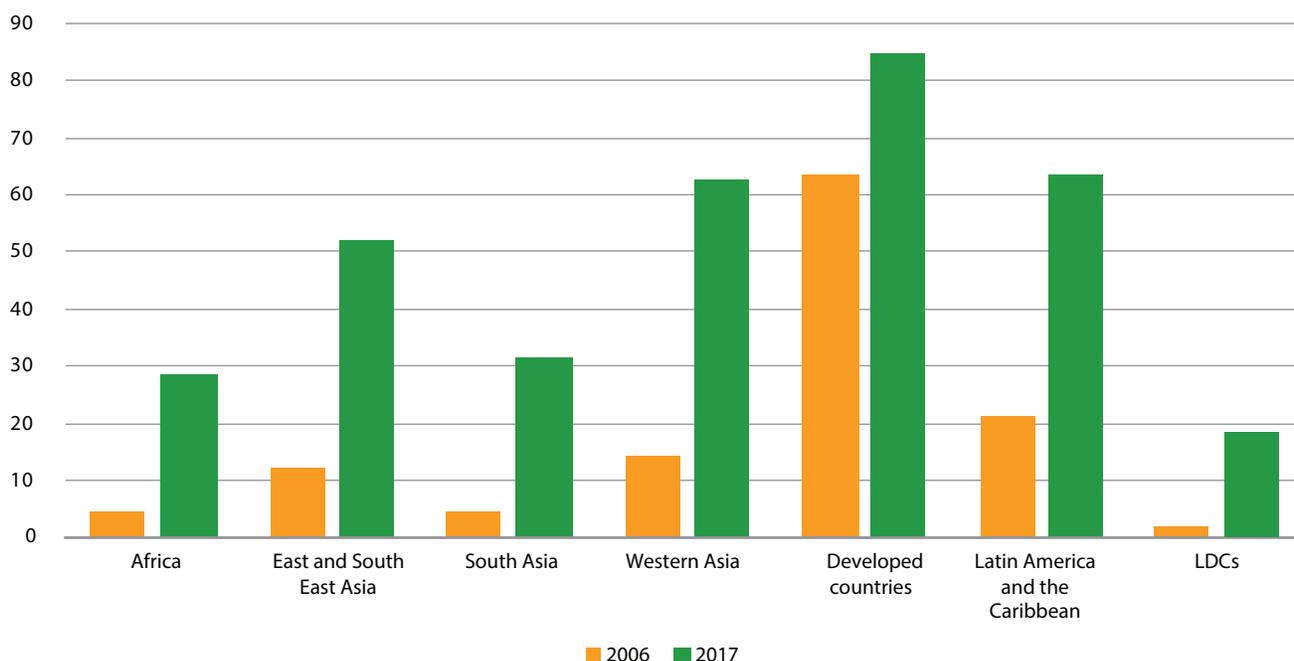
New ideas need to be put into action, and while large companies have more capacity for R&D, it is often newer, more agile firms that can implement the most innovative ideas. Markets with many new companies also tend to be more competitive, which can spur innovations from all companies, both new and old. Available data shows that new business registrations of private, formal sector companies grew over the past decade across the world (figure III.G.2). On average there are more new business registrations in developed economies, but with large variations among countries, reflecting institutional differences. All 29 African and Asian countries with available data registered an increase over the previous decade.

2.2 Increasing learning and innovation by public and private actors

More people are getting tertiary education

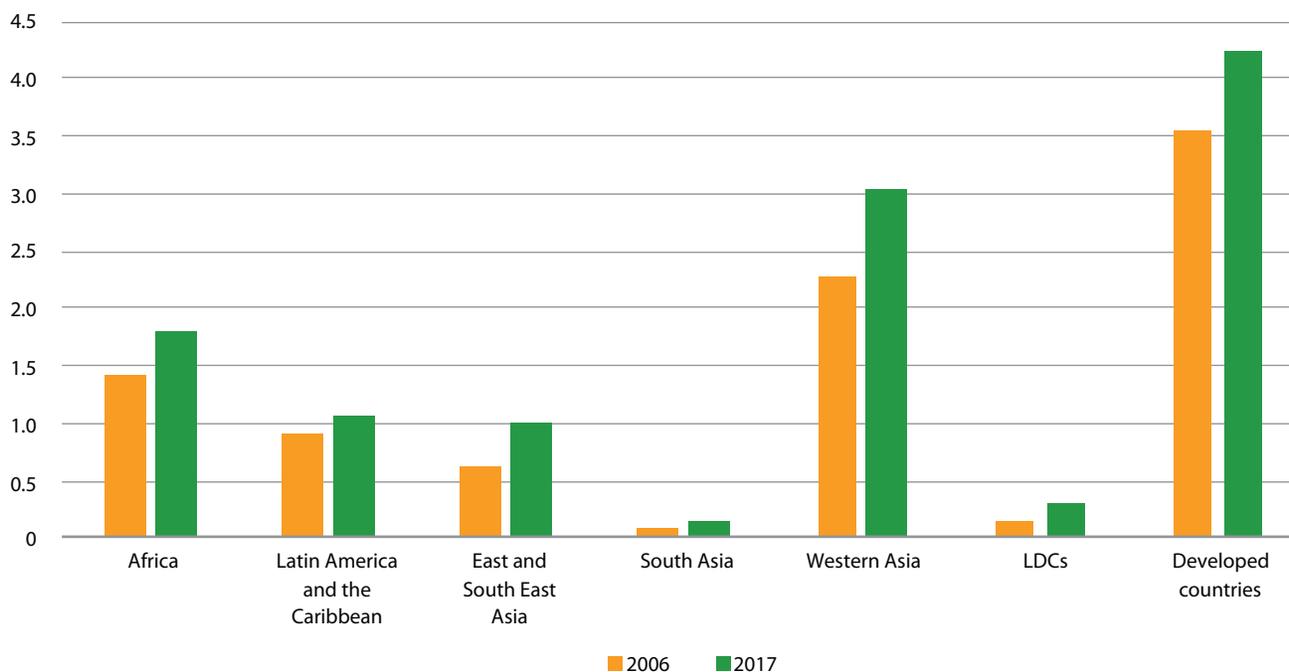
In the Addis Agenda, Member States pledged to enhance vocational and tertiary education and to scale up investments in science, technology,

Figure III.G.1
Percentage of individuals using the Internet, 2006 and 2017
(Percentage)



Source: UNCTAD, based on ITU.

Figure III.G.2
New business registrations per 1,000 people, 2006 and 2017



Source: UNCTAD, based on World Bank.

engineering and mathematics education.³ While enrolment rates in tertiary education are growing across the world, disparities between countries persist, and enrolment rates in LDCs (while doubling since 2006) are only a fraction of those in developing countries overall. Regionally, enrolment rates have doubled in Asia and grown by a third in Latin America and the Caribbean since 2006 (figure III.G.3.A).⁴

Women have higher enrolment rates in tertiary education than men overall, but with large disparities between regions. Women have higher enrolment rates in developed countries and in Latin America and the Caribbean, but in Africa and South Asia they only recently reached parity (figure III.G.3.B). Enrolment rates in LDCs are one third lower for women than men, but the gap has narrowed over the past decade.

More resources are devoted to R&D

The Addis Agenda calls for more resources devoted to STI. Indeed, investment in research and development increased from 1.55 to 1.68 per cent of world gross domestic product (GDP) from 2006 to 2016. Outside East and Southeast Asia, however, the gap between developed and developing economies was not reduced (figure III.G.4). In South Asia, R&D spending as a share of GDP declined. The share of total R&D investment that comes from Governments (as a percentage of GDP), which historically has been an important driver of innovation, dropped slightly over the past ten years.⁵

The number of researchers worldwide is growing, and developing countries as a group have been catching up, albeit from a low base. In all regions, except in Central Asia, the R&D gap between developing and developed countries has narrowed, although progress in Africa and the LDCs has been modest and differences are still large. While in developed countries there

are 3,915 researchers per million inhabitants in 2017, there are only 280 in South Asia and 103 in Africa.

2.3 Transferring knowledge across borders

Despite some positive developments discussed above, large disparities between countries persist. Strengthening tertiary education systems, increasing access to online education in areas related to sustainable development, and stepping up international cooperation in STI can help developing countries harness STI for the sustainable development agenda.

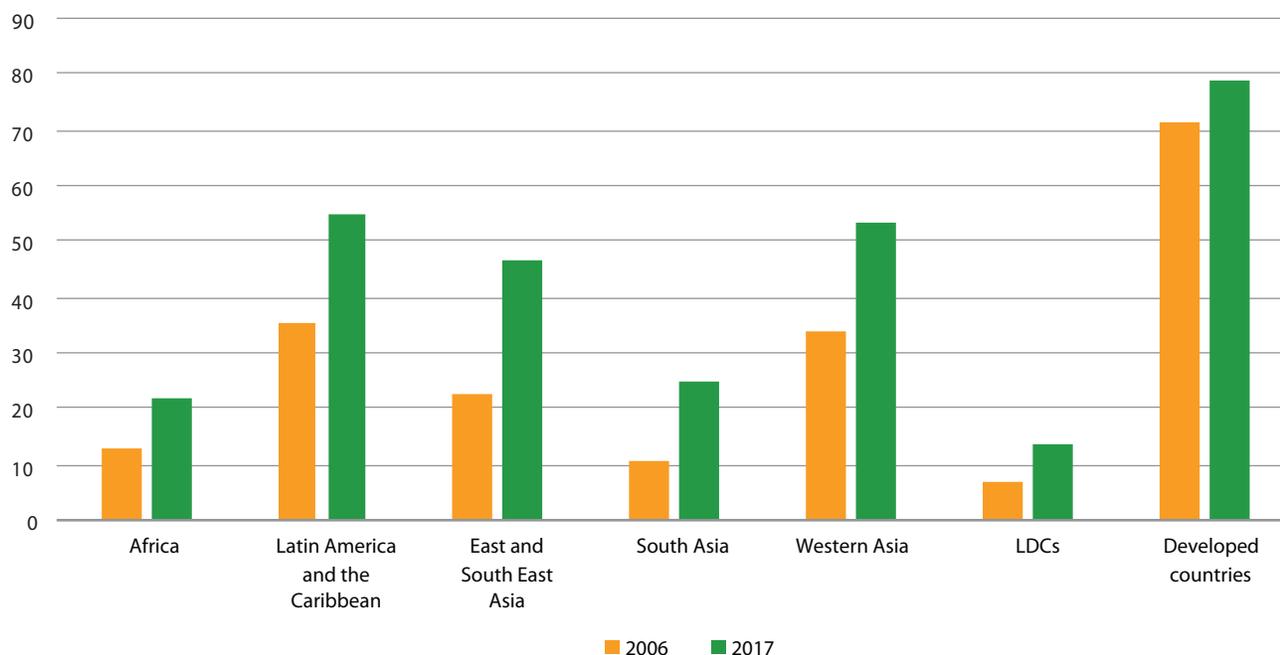
More people are moving abroad to study

Giving students the opportunity to pursue their tertiary education abroad widens the possibilities for individuals and helps upgrade scientific capabilities for home countries, especially for small and developing countries. In the short to medium term, study abroad can be an opportunity to complement the capacities of national education systems, although it needs to be well-managed to avoid increasing brain drain.

The share of tertiary students studying abroad grew significantly over the last decade. The share is highest in developed countries, but it also increased in most developing regions—except in Africa, where an exceptionally high rate of students studied abroad in 2006 and domestic university enrolment significantly expanded in the following decade (figure III.G.5).

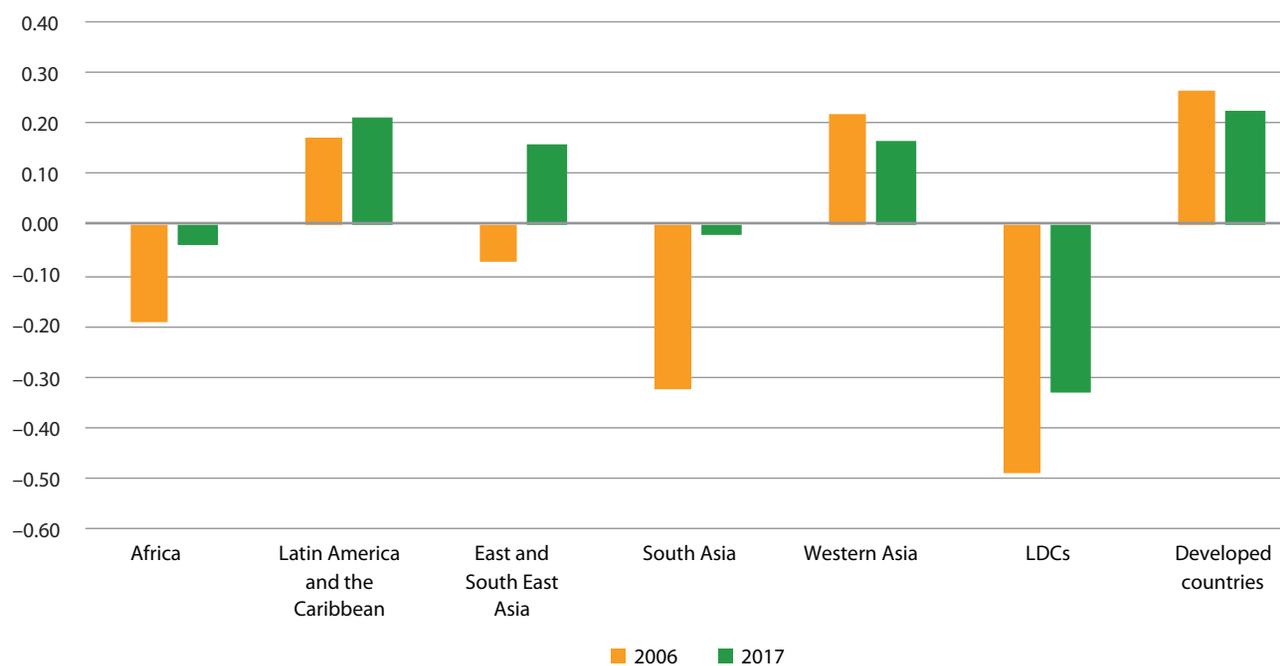
Official development assistance (ODA) for education grew by 10 per cent in real terms between 2006 to 2017 and, within that, ODA to tertiary education grew by 7 per cent. Nonetheless, this lagged the overall growth of ODA of 21 per cent.⁶

Figure III.G.3.A
A. Gross enrollment rates in tertiary education, 2006 and 2017
 (Percentage)



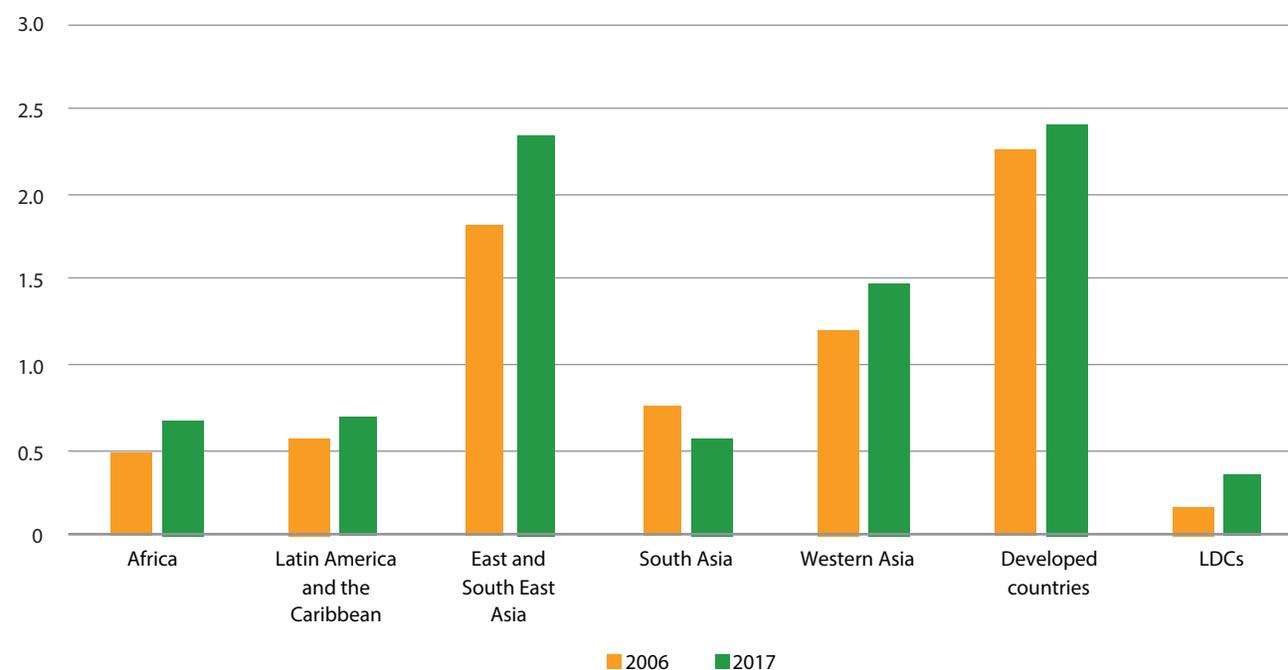
Source: UNCTAD, based on UNESCO.

Figure III.G.3.B
B. Gender gap in gross enrollment rate, by region, 2006 and 2017
 (Percentage)



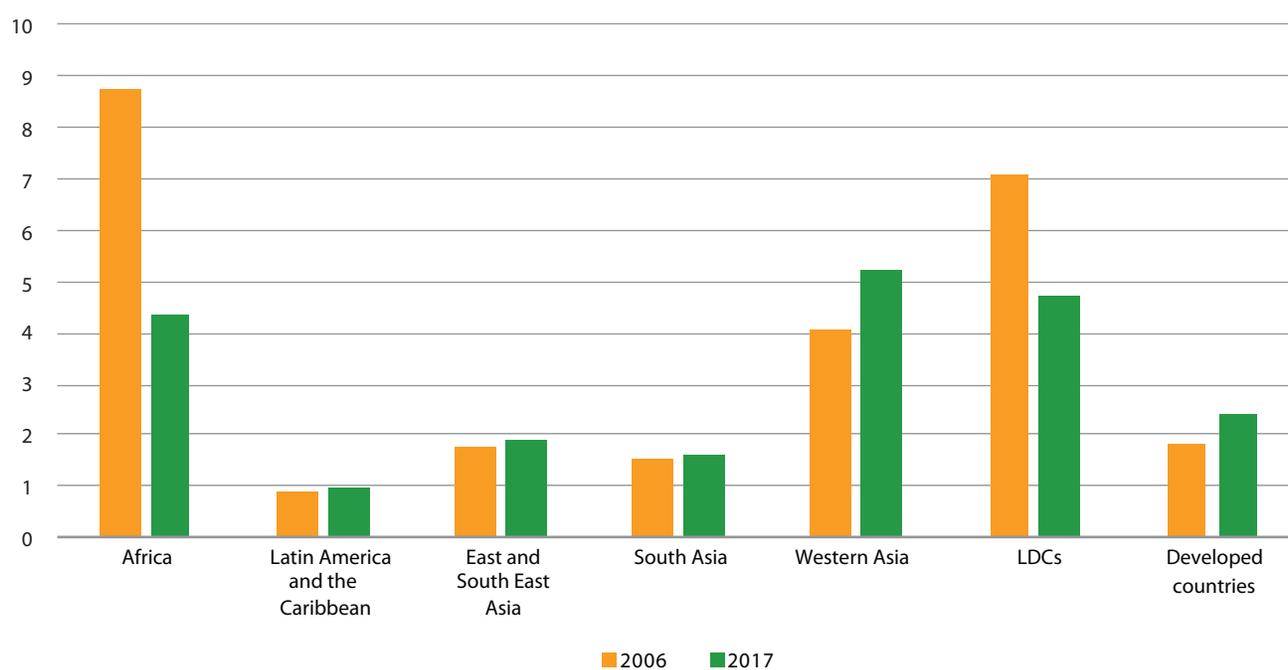
Source: UNCTAD, based on UNESCO.

Figure III.G.4
Research and development spending as a percentage of GDP, 2006 and 2017
 (Percentage)



Source: UNCTAD, based on UNESCO.

Figure III.G.5
Percentage of tertiary students abroad, by region of origin, 2006 and 2017
 (Percentage)



Source: UNCTAD, based on UNESCO.

More people enrol in online education

Online education is another opportunity to upgrade skills beyond the possibilities offered by national education systems. The number of massive online open courses (MOOCs), one of the most popular methods of online education, has increased dramatically in the past few years. Nonetheless, there are important barriers for enrolment in developing countries related to connectivity, skills (most MOOC participants already have some university education) and language (most courses are offered in English and a few other international languages). There is no official data on the use of online education, but enrolment figures from Coursera, the world's leading online learning platform for higher education, show that, while enrolments are more common in developed countries, developing countries are catching up fast (figure III.G.6). The high level of adoption of Coursera in Latin America reflects in part the availability of courses in Spanish (registrations from Brazil are well below the regional average) and partnerships with local universities that tailor the content to local needs.

Foreign direct investment flows to developing countries are not growing

The Addis Agenda also calls for the international community to “foster linkages between multinational companies and the domestic private sector to facilitate technology development and transfer”.⁷ While overall flows of FDI to developing countries have been relatively constant in nominal terms, the stock of FDI in these countries has grown. This increase in multinational corporations' productive capacities in developing countries implies greater opportunities for technology transfer to domestic companies.

FDI can also contribute to STI capacities in a more direct way, when multinational corporations locate R&D facilities in developing countries—which they do partly to access the growing set of skilled workers and partly to access policy advantages targeting this type of investment. However, companies locate R&D facilities only in places with strong innovation capacities, which only a handful of developing countries have. Data from FDI Markets⁸ shows that multinational corporations concentrate most of their R&D projects in developed countries,⁹ and that this proportion has been stable over the past decade. Moreover, projects that do go into developing countries are highly concentrated in China (17 per cent of the total between 2006 and 2018) and a few other countries in East Asia (11 per cent) and Latin America and the Caribbean (4 per cent). Africa receives only 1 per cent of the total, and there has been no single project registered in an LDC.

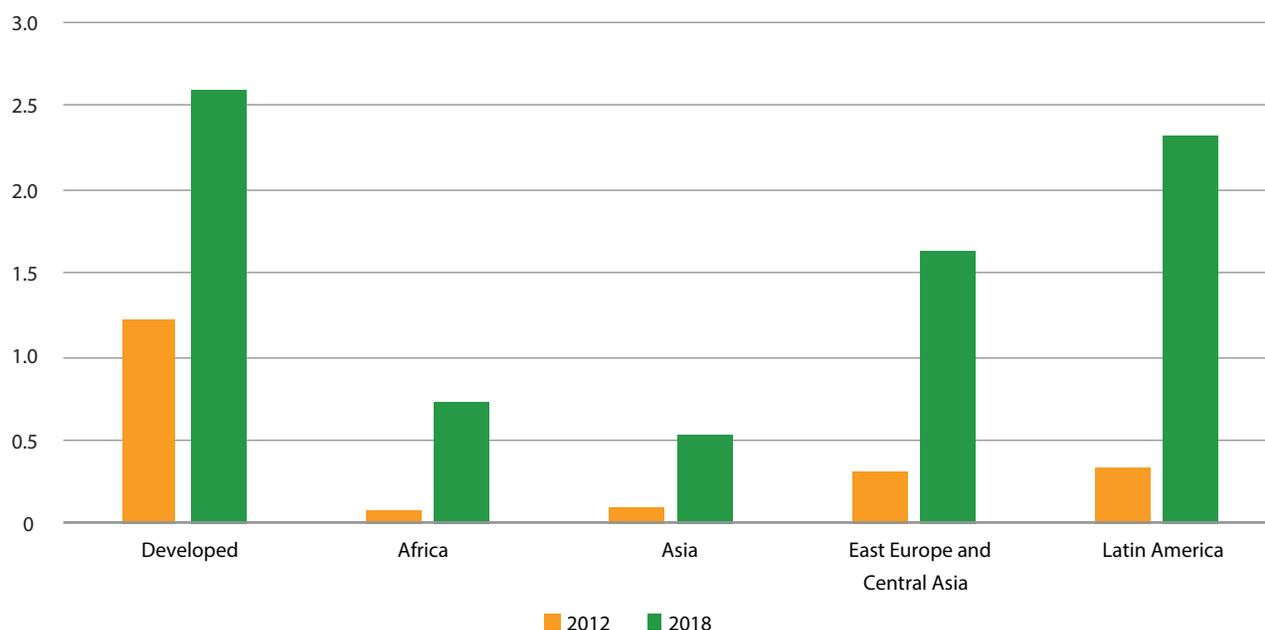
2.4 International collaboration

Beyond education (reviewed above), ODA also directly targets STI activities. While there is no internationally agreed measure of ODA for STI,¹⁰ estimates show a sharp increase in such funds since 2014 (figure III.G.7). ODA for STI has outpaced total ODA growth since 2014, indicating increased donor commitment to this area. ODA for STI to LDCs also increased in recent years, doubling between 2016 and 2018, albeit from low levels.

Medical research is one of the areas receiving increased ODA in the past few years. There are several important initiatives that are also supported by private companies and donors, such as the Vaccine Alliance, The Pool for Open Innovation Against Neglected Tropical Diseases or the Drugs for Neglected Disease Initiative.¹¹

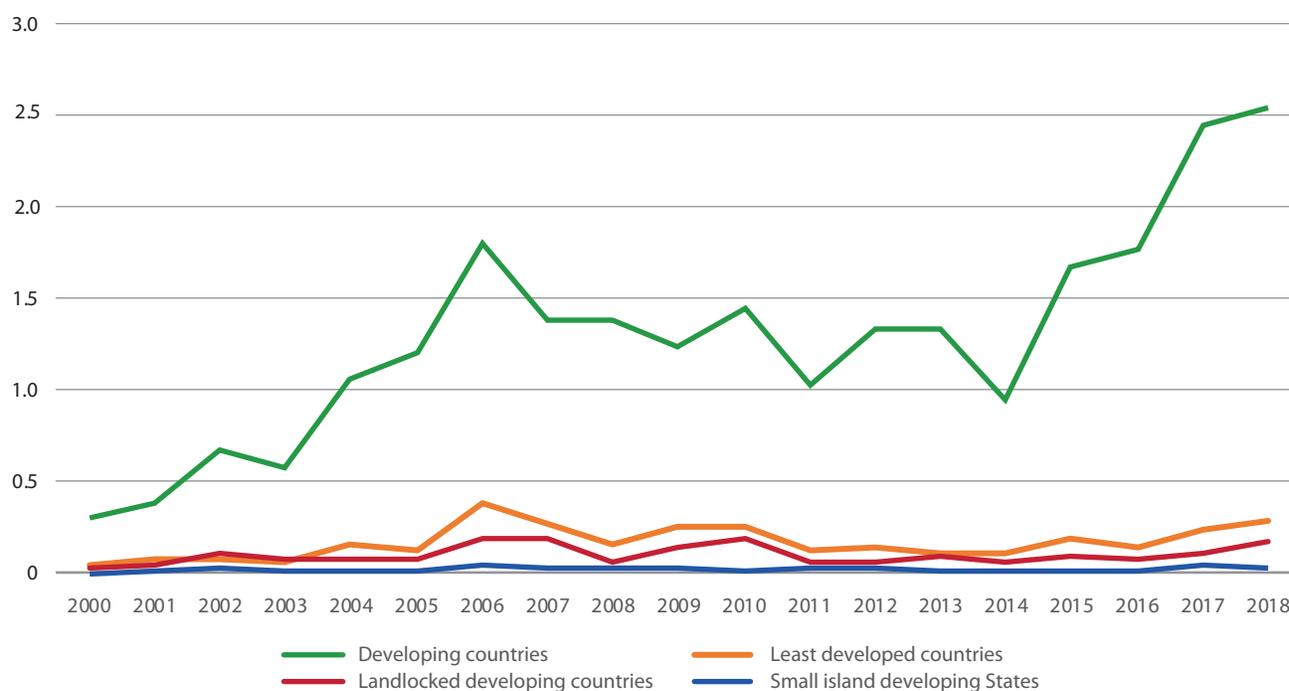
Figure III.G.6

Number of registered students in Coursera per 100,000 inhabitants, by region, 2012 and 2018



Source: UNCTAD, based on data provided by Coursera.

Figure III.G.7

ODA flows to developing countries targeting science, technology and innovation activities, 2000–2018*(Billions of United States dollars)*

Source: UN DESA, based on OECD/DAC.

The Addis Agenda also encourages the dissemination of environmentally sound technologies to developing countries. Several institutions have been created for this purpose, such as the Green Climate Fund, Eco-Patent Commons or WIPO-Green Marketplace for Sustainable Technology. A survey of participants in this market revealed that intellectual property rights are not a major barrier for the adoption of environmentally sound technologies, and that scientific infrastructure, human capital or the investment climate are far more relevant.¹²

Within the United Nations Framework Convention on Climate Change (UNFCCC), the Clean Development Mechanism was designed to allow technology transfer to developing countries, but relatively few projects have achieved this aim so far. Currently, the UNFCCC Technology Mechanism—hosted by the United Nations Environment Programme and the United Nations Industrial Development Organization—promotes this type of technology transfer. Since 2014, it has received 284 requests for technical assistance and started 180 technology transfer projects, from supporting e-mobility transition in Jakarta to assessing geothermal resources in Kenya.

3. New and emerging technologies and the Sustainable Development Goals

Chapter II analysed the impact of digital technologies on financing policies and institutions. This section reviews trends in nine relevant new and emerging technologies—some in the digital domain and discussed in

chapter II, others going beyond the digital field (table III.G.1). It then explores the potential impact of these technologies on the SDGs.

Table III.G.1

Emerging technologies

Artificial intelligence	The capability of a machine in cognitive activities typically performed by human brains, such as perceiving, reasoning, learning, interacting with the environment, problem solving, and even exercising creativity ^a
Internet of things	Large number of physical devices that are collecting and sharing data through the Internet ^b
Big data	Datasets whose size or type is beyond the ability of traditional databases to capture, manage and process
Distributed ledger technology / blockchain	A time-stamped series of immutable records of data, supported by a resilient distributed architecture, which can be public (e.g., Bitcoin, Ethereum) or private (e.g., private stablecoins or supply chain ledgers)
5G	The next generation of mobile Internet connectivity, with download speeds of around 1-10 Gbps (4G is around 100 Mbps) ^c and more reliable connections ^d
3D printing	Production of three-dimensional objects using a digital file
Robotics	Programmable machines able to carry out actions and interact with the environment via sensors and actuators either autonomously, or semi-autonomously ^e
Drones	Flying robots that can be remotely controlled or fly autonomously with the help of on-board sensors and GPS
Gene editing	A tool to insert, delete or modify genomes in organisms (also known as genome editing) ^f

Source: UNCTAD (forthcoming), Technology and Innovation Report 2020.
a McKinsey&Company, “An executive’s guide to AI.” Available at <https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/an-executives-guide-to-ai>.
b Steve Ranger, “What is the IoT? Everything you need to know about the Internet of Things right now.” Available at <https://www.zdnet.com/article/what-is-the-Internet-of-things-everything-you-need-to-know-about-the-iot-right-now/>.
c Sacha Kavanagh, “How fast is 5G?” Available at <https://5g.co.uk/guides/how-fast-is-5g/>.
d John McCann, Mike Moore and David Lumb, “5G: everything you need to know.” Available at <https://www.techradar.com/news/what-is-5g-everything-you-need-to-know>.
e Alex Owen-Hill, “What’s the Difference Between Robotics and Artificial Intelligence?” Available at <https://blog.robotiq.com/whats-the-difference-between-robotics-and-artificial-intelligence>.
f Reports and Data, “Genome Editing Market To Reach \$10.1 Billion By 2026 | CAGR: 14.8%” Available at <https://www.reportsanddata.com/press-release/global-genome-editing-market>.

3.1 Technology trends and key players

Artificial intelligence (AI) is the technology that has received the most attention from researchers, as measured by the number of publications, which totalled over 400,000 between 1996 and 2018. Robotics followed, with over 250,000 publications in the same period. AI also accounts for the largest number of patents filed during those years, followed by the Internet of things (IoT).¹³

China and the United States of America are the most active countries in research across the 9 technologies, respectively accounting for 16 and 24 per cent of publications and 46 and 16 per cent of patents.¹⁴ Their companies are also industry leaders in most of these areas, implying a transition from the traditional developed-developing country divide. Companies from the United States dominate the fields of AI, Internet of things, big data and distributed ledger technology (DLT). These areas benefit extensively from the services of cloud computing platforms, the most important of which are based in the United States. Chinese companies play a relatively more active role in manufacturing-related technologies such as 5G, robotics and drones (table III.G.2).

Only 5G and robotics are not dominated by American or Chinese companies. In these two technologies, traditional manufacturing companies take the lead, such as Samsung from the Republic of Korea, Mitsubishi from Japan, or ABB, Ericsson and Nokia from Europe.

Regarding implementation, the IoT is currently the most widespread technology provider, with an estimated annual market size of \$130 billion worldwide. It involves a wide range of components already in use, such as smartphones, wearables and computers, and has important industrial applications, such as smart meters and thermostats. Drones are the second

Table III.G.2
Top technology providers (AI, IoT, big data, blockchain, 5G, 3D printing, robotics, drone and gene editing)

AI	IoT	Big data	Blockchain	5G
Alphabet	Alphabet	Alphabet	Alibaba	Ericsson
Amazon	Amazon	Amazon Web Services	Amazon Web Services	Huawei (network)
Apple	Cisco	Dell Technologies	IBM	Nokia
IBM	IBM	HP Enterprise	Microsoft	ZTE
Microsoft	Microsoft	IBM	Oracle	Huawei (chip)
	Oracle	Microsoft	SAP	Intel
	PTC	Oracle		MediaTek
	Salesforce	SAP		Qualcomm
	SAP	Splunk		Samsung Electronics
		Teradata		

3D printing	Robotics	Drone	Gene edition
3D Systems	ABB	3D robotics	CRISPR Therapeutics
ExOne Company	FANUC	DJI Innovations	Editas Medicine
HP	KUKA	Parrot	Horizon Discovery Group
Stratasys	Mitsubishi Electric	Yuneec	Intellia Therapeutics
	Yaskawa	Boeing	Precision BioSciences
	Hanson Robotics	Lockheed Martin	Sangamo Therapeutics
	PalRobotics	Northrop Grumman	
	Robotis		
	Softbank Robotics		
	Alphabet/Waymo		
	Aptiv		
	GM		
	Tesla		

Source: UNCTAD (forthcoming), Technology and Innovation Report 2020.
Note: Top technology providers are determined on the basis of reports from market research companies. American companies are marked in green, Chinese companies in orange and others in grey.

most widespread, with an estimated annual market size of \$69 billion. Other technologies with the potential for wide applications, such as gene editing or DLT, have a relatively small market size, as mass applications have not yet been developed. The expansion of 5G seems assured, but it still has a relatively small footprint as of 2018 (table III.G.3).

While some of these technologies have already reached appreciable market size, their real importance lies in their potential to grow and disrupt larger industries. It is not the current size of the robotics industry

Table III.G.3
Market size estimates of new technologies
(Billions of United States dollars)

Technology	AI	IoT	Big data	Blockchain	5G	3D printing	Robotics	Drones	Gene editing
Year of estimate	2017	2018	2017	2017	2018	2018	2018	2017	2018
Market size	16	130	32	1	1	10	32	69	4

Source: UNCTAD (forthcoming), Technology and Innovation Report 2020.

that is relevant, but the capacity of robots to radically transform a large industry—such as the automotive industry, with a market size of over \$1 trillion. Crucially, they are all, to different degrees, multipurpose technologies that can be applied to practically all sectors in the short to medium term. This highlights the importance, for all countries, of continuing to invest in these areas.

Still, not all industries will be equally affected, nor will all industries adopt new technologies at the same pace. For example, the manufacturing sector is a top user of almost all new technologies, including for predictive maintenance, quality control, human-robot collaboration, design, and adoption to market demands. The financial sector is a big user of AI, the IoT, big data and DLT for credit decisions, risk management, fraud prevention, trading, personalized banking and process automation (see chapter II).

3.2 Impact on the sustainable development agenda

Deploying new technologies could be transformative for the sustainable development agenda, as they offer solutions that are better, cheaper, more scalable and faster to replicate. They can raise productivity, increase environmental sustainability (see box II.3 in chapter II) and improve the delivery of basic services. For example, during the COVID-19 crisis, open government data has helped some countries rapidly map the outbreak, thus helping contain transmission. Nonetheless, without strong regulatory and policy frameworks, they can also lead to rising inequality within and between countries (see chapter II), although new technologies (driven by the technological and market leadership of China and the United States) no longer display a traditional developed-developing country divide.

Policymakers can help guide new technological solutions towards the most pressing problems, as defined by the sustainable development agenda, and also use regulatory and policy frameworks to prevent the rise in inequality within countries that may come with technological change.

Even if national innovation systems are weaker in developing countries, new technologies can create opportunities for leapfrogging, allowing

countries to bypass intermediate stages of technology without neglecting traditional and more labour-intensive development pathways (see chapter II for a discussion of such a two-pronged approach). To reap the full benefits, developing countries need to increase the capacity of their institutions to adapt and absorb foreign technologies and to generate local innovations (box III.G.1). In addition to local capacities in developing countries, there is also a need for a global enabling environment for creating, diffusing and adapting knowledge that is relevant for the SDGs.

4. Fintech trends and financial inclusion

New and emerging technologies have already begun to transform the financial sector (see chapter II), and fintech has been an important driver of financial inclusion. Developments in financial technology have been shaped by country-specific conditions, including differences in the availability and quality of necessary infrastructure and complementary technology, as well as financial sector characteristics and regulatory standards. As a result, fintech growth has been uneven among countries and regions.

The benefits of fintech do not materialize automatically, and country authorities need to provide the appropriate enabling environment while mitigating associated risks, including excessive borrowing, fraud, loss of financial integrity (i.e., use of fintech tools for money laundering and terrorism financing purposes), new forms of exclusion and data privacy concerns.

While global fintech activities have grown rapidly in recent years, their exact scope is difficult to assess, given the fast-paced innovation cycle and lack of internationally agreed definitions. Only limited data is available, mainly from research organizations and consultancies, focusing on select indicators and data sources. Nevertheless, it is possible to identify some key trends, at both the global and regional levels.

Box III.G.1

A new concept for scientific and innovative development in Kyrgyzstan

Based on its National Strategy for Sustainable Development 2013–2017, the Government of Kyrgyzstan in 2017 introduced the “Concept for scientific and innovative development until 2022” (Concept 2022). Its goal is to strengthen the country’s national innovation system (NIS) to address several challenges, such as the fragmented governance structure of existing innovation networks and insufficient linkages between research institutes and the private sector.

While education levels are relatively high compared to countries with similar income levels, research institutes have been poorly funded and staffed. A relatively small and inward-looking private sector has meant limited demand for research and development services. Innovation governance across a nascent network of innovation intermediaries—incubators, technoparks and technology transfer centres—has been fragmented across multiple institutions and insufficiently resourced.

To overcome these obstacles, Concept 2022 takes a holistic approach to developing applied research capacity in priority areas such as food security, information and communications technology, health, energy, and tourism. Following an integrated NIS concept, it addresses most aspects of the system, rather than focusing only on research, as previous approaches did. It prioritizes the absorption and adaptation of existing technologies as a more realistic goal rather than aiming to develop competitive expertise at the global technology frontier. It puts the Kyrgyz manufacturing industry at the centre of efforts, aiming to get other parts of the innovation system—including over 70 applied research institutes—to support its modernization. It also emphasises international cooperation, foreign direct investment linkages, and technology transfer centres.

Source: ECE (2019), Innovation for Sustainable Development Review of Kyrgyzstan.

4.1 The evolving fintech landscape

Investment in fintech companies

Annual investment trends in fintech companies show a slowdown after several years of strong growth, amid some signs that the sector is beginning to mature. Total investment in fintech through venture capital (VC), private equity (PE) and mergers and acquisitions (M&A) rose from \$18.9 billion in 2013 to \$135.7 billion in 2019. The average deal size more than tripled, from \$16.7 million to \$50.4 million over this time, suggesting that firms getting funded or acquired have become more mature over the years.¹⁵ Fintech investments continue to be highest in the Americas, although growth rates there have moderated, while investment in European fintech has increased steadily since 2016 (figure III.G.8). The slight decline in total investments in 2019 followed a spike in 2018 that was driven by a few megadeals, including a record late-stage VC financing round for Ant Financial and a very large private equity investment in Refinitiv in the second and fourth quarters, respectively.¹⁶

In 2018 and 2019, M&A was a main driver of fintech investment in the Americas and in Europe, in an early sign of consolidation in more mature fintech categories, such as payments, as well as an increase in the purchase of fintech start-ups by incumbents. In the Asia-Pacific region, VC was the dominant source of investment in 2018, but M&A has become more important in 2019.¹⁷

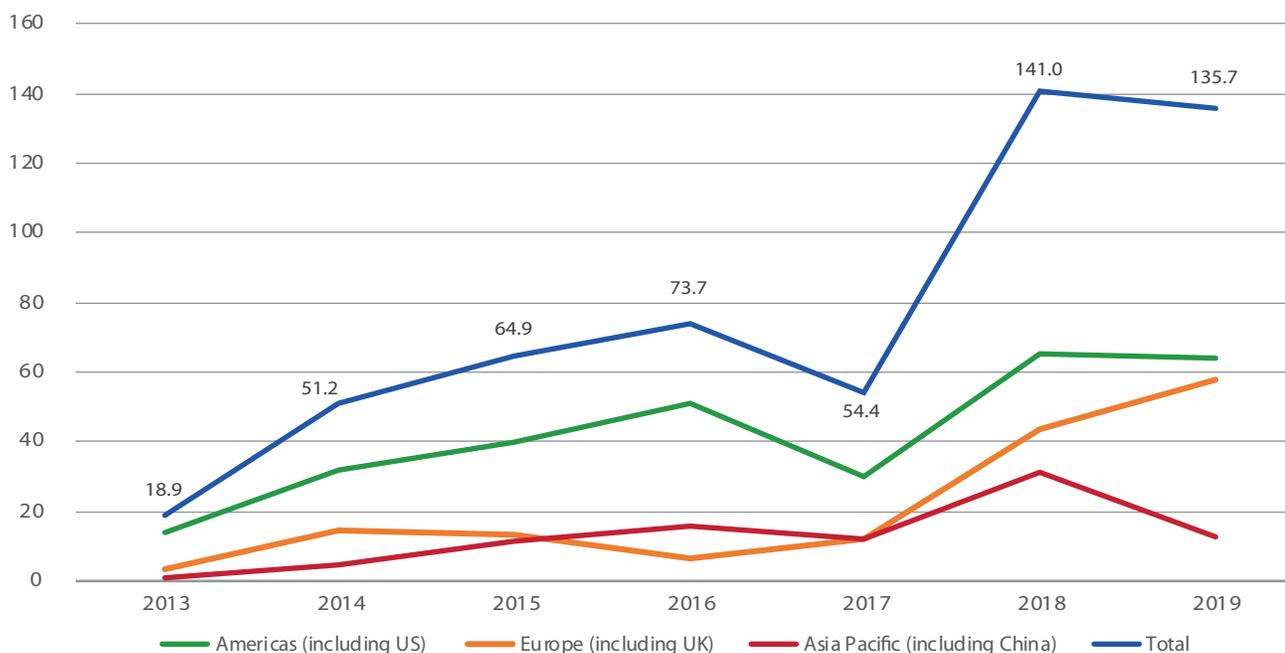
Big tech in finance

Big tech companies are increasingly entering the market for financial services, using the comparative advantages provided by their large number of established users, wealth of data, and analytical capacity. Financial services can also create synergies with existing big tech activities and strengthen the dynamic feedback loop between data analysis, network externalities and other activities.¹⁸ For example, payment services are a natural extension for e-commerce platforms that facilitate a smooth customer experience and guarantee the settlement of transactions in a fully integrated system, while providing the platforms with additional information about users' payment behaviour.

All major big tech companies are now offering integrated payment systems, accounting for about 11 per cent of their revenues in 2018.¹⁹ Some use third-party infrastructures to process and settle payments while others have developed their own proprietary systems. Like other fintech services, big tech's proprietary payment systems have expanded more in places and areas less served by the traditional financial sector (such as Alibaba's Ant Financial and Tencent's WeChat Pay). This, in addition to the large size of their user base, could explain the important role big tech companies play in the Chinese mobile payment sector (figure III.G.9). Increasingly, some big tech companies are also offering other types of services, such as cross-border payments (including remittances), money market funds, credit provision and insurance products.²⁰

Owing to their large-scale and growth potential, big tech participation in fintech presents challenges that go beyond the risks associated with

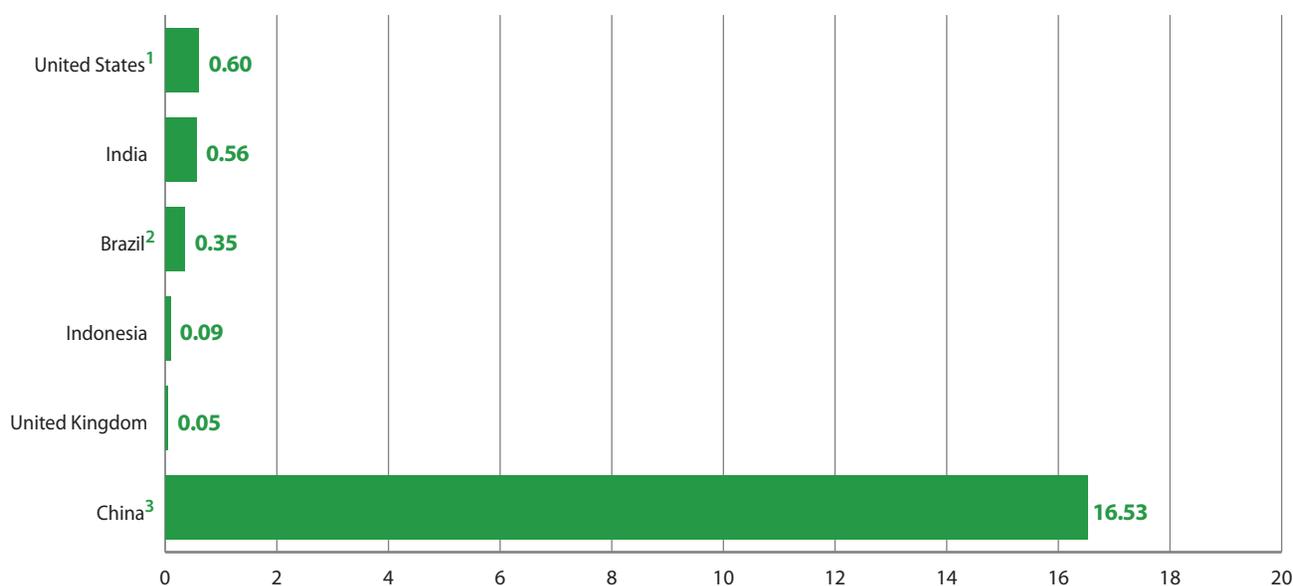
Figure III.G.8
Total fintech investment activity, by region, 2013–2019
 (Billions of United States dollars)



Source: KPMG, The pulse of fintech 2019.

Note: Regional reporting by KPMG is limited to three regions: Americas, Europe and Asia Pacific.

Figure III.G.9
Big tech mobile payment services, 2017
 (Payment volumes as percentage of GDP)



Source: BIS, Annual Economic Report 2019, p.58.

Note: ¹ 2016 data. ² Estimate based on the public data for Mercado Libre. ³ Only mobile payments for consumption data (i.e. excluding mobile payments for money transfer, credit card payments and mobile finance).

smaller-scale fintech providers, including the risk of market dominance and questions about the extent of personal data collection and use (see chapter II).

4.2 Fintech and financial inclusion

Fintech has supported strong growth in financial inclusion in recent years, across all three functional areas of financial markets (see chapter III.B). In the payments arena, mobile money providers have played a key role in enabling a growing number of users to make and receive digital payments. Regarding intermediation, alternative finance platforms have permitted many previously underserved individuals and enterprises to make greater use of formal financial intermediation services, such as loans and savings. More recently, mobile money providers have also begun to offer such services. As to information management, microinsurance schemes have also benefited from fintech innovations, both in terms of increased accessibility and improved risk assessments.

Both individuals and micro, small and medium-sized enterprises (MSMEs) have benefitted from this increased access to and better quality of formal financial services, although the types of fintech services used by both groups are often different. For instance, in the payments category, MSMEs tend to use online payment processors and mobile points of sale payment machines, while consumers use other services, such as mobile money, to make purchases. However, usage also differs by country and by type of enterprise, and important overlaps exist, with microenterprises in particular often using the same services as households.

Digital payments

Being able to access and use digital payment services through mobile devices (mobile money) has benefited unbanked and underbanked populations—including through lower fees, time savings and reductions in travel costs—as traditional banking services are expensive, and often unavailable in remote locations. It is also a useful tool for MSMEs, as it permits fast and frictionless settlement of accounts, and the easy access to agent networks facilitates transfers between cash and digital money.

Over the past ten years, mobile money has become an integral part of the payments system in a growing number of countries. As of December 2018, 866 million mobile money accounts were registered globally, and transaction values reached \$40.8 billion.²¹ This translates to average monthly transactions worth \$206 per active mobile money consumer.²² A total of 46 per cent of registered mobile money customers worldwide were located in sub-Saharan Africa, 33 per cent in South Asia and 11 per cent in East Asia and the Pacific.²³

While most mobile money transactions in 2018 were still cash-in and cash-out operations, the values of digital transactions have been growing quickly, at 24 per cent year on year. The main drivers of this digital growth were bill payments and bulk disbursements, 68 per cent of which were originated by businesses.²⁴ Anecdotal evidence in two sub-Saharan African countries shows that 80 per cent of MSMEs have a mobile money account, 83 per cent of which use it for business purposes.²⁵

Digital payment of government transfers can also play an important role in increasing access to the formal financial sector. While enhancing the efficiency of government service provision and reducing leakages, such

transfers come with the added benefit of providing a personal account to some of the poorest and most vulnerable populations (see chapter II).

Increased account ownership is not enough for meaningful financial inclusion, if these accounts are not actively used. While in some developing countries—particularly those with widespread adoption of mobile money accounts, such as Kenya—account owners make significant use of digital payments, other countries still lag behind. In India, despite increased account ownership, less than half of all account owners used them to make or receive at least one payment in a 12-month period in 2017.²⁶ This points to the need for a supportive infrastructure and payments ecosystem, in addition to financial and digital literacy and appropriate customer protection, that allow people to use their accounts in safe, convenient and affordable ways (see chapter II).

Digital financial intermediation

Digital lending—by digital payment firms, digital banks, through peer-to-peer (P2P) platforms, mobile network operators in partnership with banks, or other models—has grown substantially over the past five years. Both individuals and MSMEs benefit from the improved access to and lower cost of credit. However, use of these technologies also creates new risks (see chapter II).

Global volumes of alternative finance that consist mainly of P2P lending and online crowdfunding are estimated to have increased from around \$12 billion in 2013 to over \$415 billion in 2017.²⁷ This expansion was driven largely by the Asia-Pacific region, which experienced the highest average growth and accounted for \$362 billion in 2017. Volumes in the Americas and in Europe reached \$44 billion and \$12 billion, respectively, in 2017. China accounted for more than 99 per cent of the alternative finance volume in the Asia-Pacific region, while the United States accounted for around 96 per cent in the Americas and the United Kingdom of Great Britain and Northern Ireland for approximately 70 per cent in Europe.²⁸ Alternative finance volumes in Africa and the Middle East remain low in terms of international comparison, at a combined \$358.9 million in 2016 (by definition, this amount does not reflect the increasingly important role of mobile money in several African countries).²⁹

Despite continued high growth, recent trends reveal a deceleration that most likely reflects maturity of the sector, as growth rates are measured from an ever-increasing base. In the Asia-Pacific region, annual growth slowed from 325 per cent in 2015 to 138 per cent in 2016 and 48 per cent in 2017, while in the Americas it slowed from 145 per cent in 2015 to 23 and 26 per cent in 2016 and 2017, respectively. Growth in Europe was relatively lower and less volatile over time, slowing from 60 per cent in 2015 to 41 per cent in 2016 and 39 per cent in 2017.

A large share of alternative finance is being used for MSME funding, albeit with regional differences. In 2017, business funding accounted for 31 per cent of alternative finance in China, 61 per cent in other Asia-Pacific countries, 62 per cent in Europe, and over 85 per cent in Latin America and the Caribbean. In the United States, alternative finance is mainly geared towards consumption, with only 24 per cent dedicated to MSME financing in 2017.³⁰

Mobile money providers have also been extending their range of services to include credit, savings and insurance. In 2018, 23 per cent of providers were offering credit services through partnerships with banks or other

credit providers, and an additional 41 per cent were planning to launch such a service in 2019.³¹ Such blurring of lines between payment function and intermediation can create new risks, including overindebtedness and fraud. This underscores the need to include those operators in the regulatory framework, based on underlying risks (see chapter II).

Overindebtedness of poor and vulnerable households has become a problem in several countries, including in East Africa, where mobile money providers have been rapidly expanding into digital lending. In addition to the negative welfare impact at the household level, this may also imply systemic risks—depending on whether and where credit bubbles materialize—that requires a response from regulators and supervisors. For instance, new legislation was proposed in Kenya in 2018 for the licensing and regulation of digital lenders; since May 2019, the Kenya Banking Charter requires all lenders to disclose terms and conditions.³²

Poorly run or outright fraudulent P2P lending platforms have also caused concern, both for potential borrowers as well as for small retail funders. In China, a dearth of consumer and MSME lending from the traditional banking sector and a lack of investment alternatives for savers fuelled fast P2P lending growth between 2011 and 2015, with the number of platforms rising from 50 to almost 3,500. In 2016, the Chinese Banking Regulatory Commission found that about 40 per cent of existing platforms were fraudulent, and authorities began to tighten regulations. In March 2019, only 1,021 platforms remained in business, and stricter licence requirements introduced in 2019 have reduced this number further.³³

Digital savings, enabled through mobile money accounts or savings accounts linked to mobile money, can be enhanced through tools that nudge users into saving on a regular basis. Key constraints in this context are a lack of understanding and trust on the side of potential clients, as well as actual risks, since such savings are not covered by traditional deposit insurance. Where savings are channelled into P2P lending, higher expected returns also go hand-in-hand with higher risks (see chapter II).

Digital microinsurance

Mobile services can also contribute to the growth of microinsurance schemes, which can help vulnerable populations protect themselves from unexpected emergencies and shocks for very low premiums. As of June 2017, at least 61 million policies had been issued by mobile-enabled microinsurance providers across 27 countries, up from 31 million in 2015. Of these policies, 39 per cent were for life insurance, 26 per cent were for health insurance, and 18 per cent for bundles comprising different combinations of life, health and accident insurance.³⁴ By drawing on alternative sources of data and new data processing technologies, risks can be more precisely estimated. While this allows for lower insurance premiums and wider coverage, there is also a risk of excluding certain individuals or groups (see chapter II).³⁵

Fintech services for micro, small- and medium-sized enterprises

A recent survey on fintech adoption by MSMEs found that, on average, 25 per cent of digitally active MSMEs in five large economies had adopted fintech solutions.³⁶ MSMEs in China had the largest adoption rate, with 61 per cent, followed by the United States (23 per cent), the United Kingdom (18 per cent), South Africa (16 per cent) and Mexico (11 per cent). As reasons for using fintech services, most MSMEs cited the range of functionality

and features, the availability of services around the clock, and the ease in setting up, configuring and using the service.³⁷

While some fintech applications, including those discussed above, are well established and widely used, other technologies, such as DLT (or blockchain), may hold important potential for the financial inclusion of MSMEs, but are still largely in a pilot stage. Several studies have identified the potential benefits of DLT for supply chain financing and trade financing in particular (see also chapter III.D).³⁸

Enabling factors

Despite the progress noted above, technological innovations per se do not necessarily translate into greater financial inclusion. To better harness these innovations, authorities—in cooperation with all relevant stakeholders, including the private sector and civil society—need to ensure the provision of a broad range of enabling factors, including infrastructure, complementary technology, digital and financial education, as well as an appropriate regulatory framework (see chapter II, and box III.G.2 on enabling fintech for remittances).

Box III.G.2

Enabling fintech for remittances in the Pacific small island developing States^a

Remittance flows to small island developing States (SIDS) in the Pacific amount to an average of 9.7 per cent of gross domestic product (GDP) and are an important source of household income. Yet, the cost of sending \$200 of remittances to Pacific SIDS is among the highest in the world, at an average of 11.6 per cent during 2011–2017. These countries' geographical constraints (isolation, remoteness and population dispersion) provoke severe infrastructure gaps that, in turn, contribute to the high operational costs of traditional financial services, including remittances.

In recent years, fintech services have entered the remittance markets in most Pacific SIDS, offering competitive services at consistently lower prices. Nonetheless, the uptake of fintech services for remittance transfers remains low in the region, with 72 per cent of Fijians, 92 per cent of Samoans and at least 83 per cent of Tongans who receive money from abroad relying on traditional money transfer operators. This is likely due to a lack of necessary enabling factors: in addition to the availability and accessibility of such services, there is also a need for awareness on the side of consumers, as well as enhanced literacy and trust.

As countries find themselves in different categories, policy recommendations vary. Some countries like Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, Palau and Tuvalu could start by encouraging the availability of fintech services, while the more pressing issue for countries like Papua New Guinea, Solomon Islands and Vanuatu is an increase in accessibility to such services, by improving infrastructure coverage and quality. For countries that are more advanced in terms of fintech adoption, such as Samoa and Tonga, policy emphasis should be geared towards awareness, financial education and consumer confidence. Where fintech is already well

established as a tool for financial inclusion in the urban areas, as in Fiji, a focus should be placed in promoting inclusivity for those who live in rural and more isolated regions.

^a Adapted from Hongjoo Hahm, Tientip Subhanij and Rui Almeida, "Finteching remittances in paradise: a path to sustainable development", Working Paper Series, Macroeconomic Policy and Financing for Development Division (Bangkok: United Nations Economic and Social Commission for Asia and the Pacific, October 2019).

5. United Nations actions on science, technology and innovation

Various United Nations entities contribute to ongoing efforts to enhance Member States' capacity in STI to achieve the SDGs. This section discusses two key outcomes of the Addis Agenda: the United Nations Technology Facilitation Mechanism (TFM), and the United Nations Technology Bank for LDCs.

5.1 The Technology Facilitation Mechanism: an overview

Despite limited resources, significant progress has been made towards operationalization of the TFM. The Mechanism comprises four components: (i) the United Nations Interagency Task Team on Science, Technology and Innovation for the SDGs (IATT), which has 42 United Nations entities as members; (ii) the 10-Member Group of representatives from civil society, the private sector and the scientific community, who work together with the IATT to develop and operationalize TFM workstreams; (iii) the annual Multi-stakeholder Forum on Science, Technology and Innovation for the SDGs (STI Forum); and (iv) the TFM online platform as a gateway for information on existing science, technology and innovation initiatives, and as a platform for building partnerships and matchmaking.³⁹

Interim results of the start-up phase (2016–19):

Key areas of work of the IATT include:

- **STI road maps** and action plans to help realize the SDGs have been among the central topics addressed in the first four STI Forums. The Group of Twenty (G20) outcome package (Osaka Leader's Declaration, 2019) also contains guiding principles on STI for SDGs road maps. The United Nations IATT subgroup for STI road maps has developed a joint guidebook⁴⁰ which is piloted in five countries: Ethiopia, Ghana, India, Kenya and Serbia;
- **The new and emerging technologies subgroup** has collected and synthesized inputs—from both within the United Nations system and external expert communities—on the impacts of rapid technology change on the SDGs in the form of an informal document that continues to grow,⁴¹ and has coordinated United Nations work on this topic;⁴²
- The subgroup **on gender and STI** has mapped relevant United Nations initiatives aimed at empowering women and girls in the field of STI through capacity-building, information sharing, policy setting and awareness-raising (see also box III.G.5);

- The IATT and the 10-Member Group has been working to operationalize the **online platform**, 2030 Connect, which will provide access to a wide range of resources, including publications, training opportunities, and technology offers and requests;
- The IATT also conducts joint **training workshops** (see boxes III.G.3 and III.G.4 for other examples of United Nations entities' capacity-building work).⁴³

Box III.G.3

Knowledge-sharing and capacity-building for technology development and innovation

Through its global patent database, PATENTSCOPE, the World Intellectual Property Organization (WIPO) provides access to international Patent Cooperation Treaty applications as well as patent documents of participating national and regional patent offices. These contain key information for researchers to support technological development and innovation, and facilitate technology transfer. Other services include a dedicated programme of work for least developed countries (LDCs) to support efforts in building or strengthening their innovation capacity. As part of this work programme, the Transfer of Appropriate Technology Program is designed to help beneficiary countries build an appropriate technology base in support of nationally identified development needs.

Access to Research for Development and Innovation (ARDI), a programme coordinated by WIPO together with its partners in the publishing industry, aims to increase the availability of scientific and technical information in developing countries and LDCs. Through the Access to Specialized Patent Information, an initiative with leading patent information providers, eligible patent offices and academic and research institutions in developing countries receive free or low-cost access to sophisticated tools and services for retrieving and analysing patent data.

Source: WIPO.

STI Forum support and partnerships

Launched in 2016, the annual STI Forum convenes participants from the public and private sectors, civil society and academia, to discuss STI solutions for achieving the SDGs. Forums have facilitated interaction, matchmaking and the establishment of networks between relevant stakeholders.⁴⁴ The STI Forum also strengthens the science-policy interface by reporting to the High-level Political Forum on Sustainable Development in support of its review of SDG progress. The co-chairs of the STI Forum present outcomes to the Commission on Science and Technology for Development (CSTD), while the Chair of the CSTD presents its negotiated outcome to the STI Forum.

5.2 United Nations Technology Bank for Least Developed Countries

The United Nations Technology Bank for Least Developed Countries was operationalized in December 2018. In 2019, technology needs diagnostic work was initiated in Bhutan, the Gambia, Guinea, Timor-Leste and Uganda, in

collaboration with the United Nations Conference on Trade and Development (UNCTAD) and the United Nations Educational, Scientific and Cultural Organization (UNESCO). In 2020, an additional 10 countries will be added to this assessment programme.

Under the Digital Access to Research Programme, awareness-raising and capacity-development workshops continued across 15 countries in 2019, training over 1,000 researchers, academics and librarians from universities, research institutes, professional associations and government agencies. In 2020, the Technology Bank will partner with the Food and Agriculture Organization to deliver dedicated training to LDCs through an open online course. In 2019, the Technology Bank also initiated a programme to strengthen existing national academies of science and to support the creation of academies within LDCs to improve scientific input to national discourse and policymaking.

Box III.G.4

Development and transfer of the sterile insect technique

Sterile insect technique (SIT) is an environmentally friendly insect pest-control method involving the mass rearing and sterilization of a target pest, ultimately leading to a diminished wild population or to its eradication without the use of chemical insecticidal. Over the past decades, the use of SIT has contributed to the cost-effectiveness of area-wide integrated pest management programmes.

Following the significant progress made on the development of SIT to control disease-transmitting mosquitoes—which are vectors for dengue, chikungunya, Zika and yellow fever—the International Atomic Energy Agency (IAEA) has expanded the use of this technology to a variety of pests that have major economic impact. The transfer of the technology package to countries for field trials has allowed for improved plant, animal and human health, cleaner environments, increased crop and animal production, and accelerated economic development. Integrated with other control methods, SIT has been successful in controlling fruit flies, screwworms and moths. Pilot projects are being implemented to suppress vector populations in countries like Greece, Malaysia and Mexico.

Source: IAEA.

Box III.G.5

The EQUALS Global Partnership for Gender Equality in the Digital Age

EQUALS is a multi-stakeholder partnership bringing together international organizations, private sector companies, Governments, NGOs, regulatory agencies and academic institutions to bridge the gender digital divide. It aims to ensure that women and girls are given access, equipped with skills, and supported in developing the leadership potential to work and succeed in the information and communications technology sector. Founded by GSMA, the International Trade Commission, the International Telecommunications

Union, United Nations University, and UN-Women, the partnership counts on more than 90 partners to address the multiple facets of the gender divide in technology across four areas (Access, Skills, Leadership and Research).

Through its Leadership Coalition and Skills Coalition, partners work together to identify and deliver tailored workshops and e-learning

courses on both hard tech skills and leadership skills. For example, the Business and Leadership for Women in the Technology Sector course series focused on topics such as strategic management and how to digitalize your business. The Digital Skills Fund supports local initiatives providing gender-sensitive skills training across countries in the Global South. Other projects, such as the EQUALS Badges coordinated by EY, will help women develop future-focused skills.

Endnotes

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- 3 *Addis Ababa Action Agenda of the Third International Conference on Financing for Development (Addis Ababa Action Agenda)* (United Nations publication, Sales No. E.16.I.7), para. 119.
- 4 97 countries have data on STEM enrolment, but only 36 have sufficient data for a comparison with ten years ago. In 2018, about a quarter of tertiary education students were enrolled in STEM subjects, albeit with large variations by country, which are unrelated to levels of development. Shares were as low as 15 per cent of total students in Ghana or the Netherlands and as high as 40 per cent in Myanmar or Tunisia.
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- 22 An active consumer conducts at least one mobile money transaction during a 90-day period.

- 23 The Middle East and North Africa accounted for 6 per cent, while Latin America and the Caribbean and Europe and Central Asia accounted for 3 per cent and 1 per cent, respectively.
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- 26 Asli Demirgüç-Kunt and others, *The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution* (Washington, D.C., World Bank, 2017), p.56. Available at <https://globalfindex.worldbank.org/>.
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