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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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FINANCING SUSTAINABLE DEVELOPMENT IN AN ERA OF TRANSFORMATIVE DIGITAL TECHNOLOGIES



Chapter II

Financing sustainable development in an era of transformative digital technologies

1. Introduction

Digital technologies have come into much sharper focus since 2015, impacting the main areas of finance and development highlighted in the Addis Ababa Action Agenda: (i) financial markets; (ii) public finance; and (iii) development pathways (trade and investment).

Digital technologies create tremendous opportunity for achieving a more sustainable financial system that supports the Sustainable Development Goals (SDGs). The promise of digital technologies is clear: they can enable inclusion and wider access to products and services and increase efficiencies, particularly in the financial sector and in public financial management. They can also strengthen societal resilience to crises. During the COVID-19 outbreak, digital communication tools help sustain human interaction and continuity in some vital economic activities, although many developing countries do not have such capacities, putting them at a disadvantage.

But like similar transitions in previous eras, rapid technological change also causes "growing pains" and the emergence of new risks. How quickly and effectively policies and regulatory frameworks adjust will determine their contribution to sustainable development.

Currently, our institutions and policy frameworks are often ill equipped to address new risks, such as the growing dominance and market power of big tech firms across sectors and national borders. In some sectors and countries (e.g., payments in China, financial inclusion in East Africa), digital technologies are causing rapid and dramatic change; in others, impacts are much more gradual or uncertain. How frontier digital technologies will evolve over the next ten years, and how they will affect inequality, jobs, and development pathways, remains unclear.

However no country, and no financing and economic policy domain, will remain entirely unaffected. While policy solutions will always be context specific and depend on a country's unique circumstances, all countries must get ready today to be prepared for an increasingly digital economy of tomorrow. This thematic chapter of the Financing for Sustainable Development Report 2020 presents policy options across all action areas of the Addis Agenda to harness the potential of digital technologies for the benefit of people, ensuring that gains are shared widely and risks are managed carefully, and that national actions are supported by collective global measures.

Several key recommendations emerge from the analysis in this report:

- *Take a strategic approach* to digital finance to provide a common frame of reference for all actors. This can take different forms—as part of a science, technology and innovation (STI) strategy or road map, a dedicated digital economy strategy, or explicit integration of digital technologies in the broader planning process (e.g., embedded in a country's integrated national financing framework);
- *Put basic building blocks in place* today to participate in the digital economy, including (i) prerequisite infrastructure; (ii) digital skills; and (iii) updated enabling regulatory and policy environments;
- *Revisit policy frameworks and the regulatory architecture* to respond to the cross-cutting and wide-ranging effects of digital technologies on financing. Silo-style regulation will not be viable when digital technologies, information and communications technology (ICT), data, finance, and other sectors interact in myriad ways;
- *Maintain a level playing field* to ensure that the entry of players that harness the power of big data leads to innovation and diversification rather than market domination (e.g., big tech in the financial sector). Digital technologies should benefit people not just as consumers, but also in their role as producers and workers;
- *Identify labour-enhancing development pathways* to pursue structural transformation while avoiding to incentivize the adoption of labour-replacing digital

technologies when creating decent jobs is a major policy challenge. Preparing for the digital age can be pursued in parallel to supporting labour-enhancing development pathways, in a two-pronged approach;

- ***Step up global collaboration*** on digital technologies and finance to create spaces for peer learning among policymakers and regulators, to strengthen capacity support, and to facilitate coordinated responses, such as global guidelines and standards.

The next section of this chapter lays out the challenges and opportunities that digital technologies create for sustainable development. It traces these to the unique properties of digital technologies (an almost costless flow of unprecedented amounts of data, which lowers transaction costs and can help overcome inefficiencies linked to information failure) and describes their impacts on financial and product markets. The third section puts forward financing policy and institutional responses across the action areas of the Addis Agenda to achieve the SDGs. This section examines the basic building blocks of a digital economy, and the three highlighted areas of finance and development: financial markets, public finance and development pathways.

2. The impact of new digital technologies on economies and societies

2.1 Which opportunities and challenges do digital technologies create for sustainable development?

Digital technologies can be a key lever for achieving the 2030 Agenda for Sustainable Development and leaving no one behind. Ranging from technologies that have become ubiquitous, such as mobile phones, to frontier technologies like artificial intelligence (AI), they offer the promise of greater access for more people to an ever-widening array of products and services (see box II.1 for an overview of key digital technologies). Some have called digital technologies inherently inclusive due to the unique properties they possess.[1] Furthermore, by enhancing efficiency, digital technologies can also be an enabler for sustained,more sustainable and resilient growth, decarbonization, and resource and energy efficiency.[2] For example, during the COVID-19 outbreak, remote communication technologies enabled the preservation of essential human interactions and thus prevented the complete cessation of economic activity.

Some changes resulting from digital technologies are gradual and almost imperceptible, while others are sudden and obvious. There are countless examples across all 17 SDGs where digital technologies are already making a difference.[3] In the financial sector, digital technology is being leveraged to facilitate payments, intermediation and risk management, with important implications for the poor and underserved. In public financial management, they help deliver programmes more effectively and reduce leakages. In manufacturing and services, digital technologies are changing the nature of production and work.

Their ability to address sustainable development challenges is of course not limitless; digital technologies are not a panacea. Many people remain excluded from the digitalized economy (box II.2 spells out how the terms "digital" and "digitalized" economy will be used in this report). Impacts on the distribution of income and opportunities are highly ambiguous. Furthermore, digital technologies have not led to less resource-intensive growth patterns. Indeed, uncertainty over viable sustainable development pathways abounds.

Questions arise across all three dimensions of sustainable development:

- What will be the jobs of the future? What are viable development pathways in the digital era?
- Are we heading for an era of inclusion and opportunity, or will the digital and data divide further increase inequalities and discrimination?
- Will digitalization dematerialize production and reduce our environmental footprint, or will increased energy use caused by digitalization outpace potential energy savings?

Box II.1
What are the key digital technologies?

Technological innovation has been the main driver of long-term growth and prosperity over the last 200 years. Transformative general-purpose technologies, such as electricity or the internal combustion engine, have fueled global growth of gross domestic product. Each of these technologies spawned a wealth of innovations that, once economies and societies had fully adjusted, lifted living standards for the vast majority.[a]

Digital technologies, which build on the storage and processing of information represented in bits, were first developed after the Second World War. Software and hardware industries have grown rapidly ever since, but for much of the twentieth century, their impact remained limited. It was only with the rise of the Internet in the 1990s, which enabled computer-to-computer communication at low cost, that multiple markets and sectors were impacted, and digital technology became a new, general-purpose technology.[b]

Increased connectivity has been a defining feature of digital technological progress over the last three decades. Today, devices and people routinely share enormous amounts of data, leaving rapid, real-time trails of information behind. Building on this ubiquity of digital data and increasing computational power, recent years have seen the emergence of several closely linked digital frontier technologies:[c]

- ***Cloud computing*** refers to shared pools of hardware comprised of computer networks, servers, data storage and applications software that can be rapidly mobilized through the Internet. Cloud computing minimizes fixed costs for hardware and other complementary investments. Companies using cloud services by third-party providers such as Amazon, Google, Microsoft, IBM, Alibaba and others are billed according to storage space and computer run time. They do not have to shoulder the full costs of acquiring, setting up, and operating hardware and software;
- The diffusion of smartphones and other Internet connected devices has facilitated aggregation of ***big data*** sets that underlies the implementation of digital technologies. With the advent of cloud storage, very large data sets can be conveniently stored, accessed and analysed on a massive

scale. Superfast computers can use big data to discern patterns and predict trends, which can aid decision-making in areas ranging from finance to aero-engine maintenance;

- ***Artificial Intelligence*** (AI), which includes machine learning and deep learning, is at the leading edge of digital technology. A new crop of algorithms and the availability of much greater computing power is enabling machines to learn from the examples and experience captured in big data. For example, a deep learning algorithm for a self-driving car must recognize vehicles, pedestrians and cyclists, in all hours of the day and in all weather conditions. With the help of thousands of images, the nested set of algorithms for neural networks conceptualizes the image of a vehicle. Once trained, the network can identify any vehicle with a high degree of probability. The utility of neural networks extends to robo-investment, credit analysis and other areas;
- With 5G networks, greater interconnection and improved edge computing devices, the ***Internet of Things*** (IoT) and the Internet of Manufacturing Things (IoMT) is likely to flourish. AI-enabled computers the size of a credit card are already installed in vehicles, in machinery and infrastructures to monitor conditions, signal problems and trigger a response;
- ***Distributed ledger technology*** (DLT) is a database technology that allows the creation, storage and secure transfer of information. Often referred to as blockchain, this technology stores records of information across distributed computers. DLT can be public (permissionless), in which case all participants have the exact same role, or private (permissioned), where some participants have specific rights, such as the ability to accept new participants or audit the ledger.

a Shahid Yusuf, "Development Pathways in the Context of New and Emerging Digital Technologies" (2019). Background paper prepared for this report.
b Avi Goldfarb and Catherine Tucker, "Digital Economics", Journal of Economic Literature, vol. 57, Issue 1 (March 2019), pp. 3-43. Available at https://doi.org/10.1257/jel.20171452.
c Adapted from Yusuf. 2019.

Digital technologies, jobs and growth

Concerns about the digital economy are greatest around jobs. Estimates of future job losses due to automation and AI vary widely, ranging from a low of 5 to 10 per cent to almost half of all existing jobs.[4] So far, the widespread introduction of digital technologies has not led to a rise in unemployment. There is, however, evidence that digital technologies have contributed to greater wage inequality in developed countries, as routine and manual jobs have disappeared, with those affected by job losses forced to accept lower-skilled and lower-paying jobs (e.g., in services industries)[5] (see chapter I on the global context).

While most analysis of automation focuses on developed countries, developing countries are also affected. Developing countries' comparative advantage of low-cost labour may erode.[6] Automation could reduce the potential of the manufacturing sector (and some services) to absorb the large number of workers, including youth, that enter the labour force each year.[7] So far, evidence of adverse effects of automation in developing countries is limited, but this may change over time. This raises the question whether traditional development pathways that focus on labour-intensive manufacturing exports are still viable.

These questions are mirrored in what is sometimes called the "productivity paradox". On the one hand, the accumulation of ICT capital and digital technologies contributes to global growth of gross domestic product. Mobile broadband penetration and digitalization is essential for regional economic growth in developing countries in particular.[8] On the other hand, expectations of rapid income and productivity growth are not yet matched by hard evidence. This may reflect excessive optimism regarding digital technologies' transformative potential,[9] or mismeasurement, or merely a time lag until such potential is fully realized. Indeed, historically, major new technologies have taken decades to have measurable effects[10] (see also box I.3 in chapter I). At this point, there is uncertainty over the medium- and long-term growth impacts of digitalization.

Digital technologies and inclusion

Because digital technologies provide goods and services at dramatically reduced cost, they have facilitated the inclusion of marginalized and excluded people. Financial inclusion is the most prominent example and signature success story, with fintech playing a key role in the rapid growth of access to financial services globally (see chapter III.G). Yet, the impact of digital technologies on equity is ambiguous. Access to digital technologies remains very uneven. While over three quarters of the world's population is likely to have access to or own a mobile phone, only half is using the Internet. The gender gap in Internet use is growing in Africa and in least developed countries (see also chapter III.G).[11]

Digital technologies may also exacerbate inequality and discrimination, as algorithms inherit biases from their human authors, or as AI is developed with data that contains a history of bias and discrimination. Algorithms and AI—ranging from ranking job applications, deciding who qualifies for insurance and more—have serious implications, including on gender equality and women's empowerment. For example, fintech lenders, informed by algorithmic decision-making, have been found to charge interest rate premiums to minority communities,[12] while advertisements for high-paying jobs are disproportionally targeted at men. Popular voice assistants are commonly coded as female by default.[13]

Furthermore, access to more advanced production technologies remains highly unequal. Far from making geographical location irrelevant, economic activity related to digital technologies is increasingly concentrated in a few urban areas with good infrastructure and, especially, access to a large pool of highly skilled workers. This contributes to a self-reinforcing mechanism that increases the concentration of opportunity, income and wealth. Geographic concentration of value capture in the digital economy also extends beyond borders: the two largest economies alone, the United States of America and China, account for 97 per cent of market capitalization of platforms valued at more than $1 billion globally (72 and 25 per cent, respectively).[14]

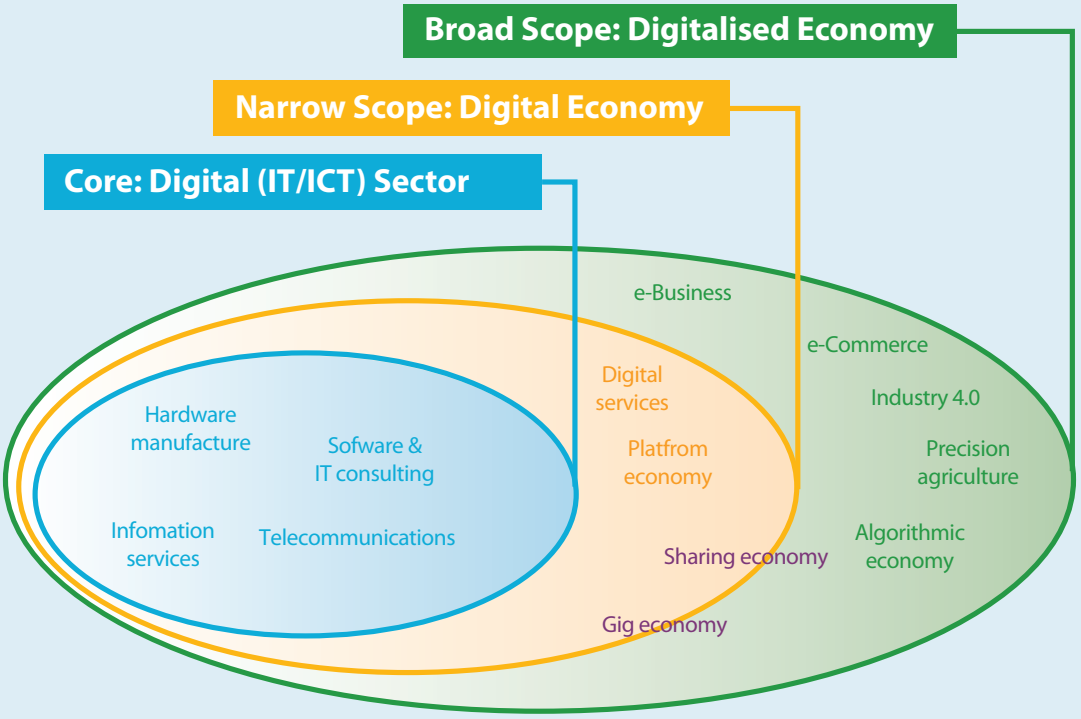
Box II.2
The digital and digitalized economy: on terminology

Digital technologies impact all sectors of the economy. In line with other recent major United Nations reports, this chapter differentiates between the following:

- The *core digital sector*, responsible for developing and providing key digital technologies (for example, cloud computing and artificial intelligence);
- The *digital economy*, or "that part of economic output derived solely or primarily from digital technologies with a business model based on digital goods or services,"[a] which includes a broader range of activities that create economic value through the application of these technologies (for example, digital platforms and digital services); and
- The *digitalized economy*, which describes wider structural implications of digitalization for the economy as a whole.[b]

a Rumana Bukht and Richard Heeks, "Defining, Conceptualising and Measuring the Digital Economy", ESRC Development Informatics Working Papers Series No. 68 (2017).
b J. Scott Brennen and Daniel Kreiss, "Digitalization", The International Encyclopedia of Communication Theory and Philosophy (23 October 2016).

Figure II.1
Conceptual overview of the digital economy



Source: Bukht & Heeks (2017), UNCTAD (2019).

Digital technologies and the environment

Digitalization holds the prospect of dematerialization of production, and thus of more sustainable growth patterns. This is because more services can be provided digitally, and because "smarter" production and distribution systems can enhance efficiencies—for example, with respect to energy use (box II.3). At the same time, digitalization dramatically increases energy use. So far, this demand-effect far outstrips any other effects on sustainability. Digital technologies were responsible for 2.5 per cent of global greenhouse gas emissions in 2013, and this share is predicted to increase to 4 per cent in 2020 and 8 per cent in 2025, mostly due to increases in energy consumption.[15]

Before analysing financing policy and institutional responses that can help ensure that digital technologies contribute to sustainable finance and achieving the SDGs (section 3), it is first necessary to understand the unique properties that characterize digital technologies.

2.2 What are the economic properties of digital technologies?

Digital technology has dramatically reduced the costs of storing, processing and transmitting data. As a result, it has made unprecedented amounts of economically relevant information available to economic agents, such as digital data collected from the footprints of personal, social and business

Box II.3
Digital technologies and energy use

Digital technologies, and especially new networked and artificial intelligence (AI) applications, are rapidly emerging as important drivers of change in energy systems and for energy demand.[a] Internet-connected digital technologies and "smarter" energy systems (e.g., smart heating controls) will play an important role in transitioning to a more sustainable and energy efficient economic system. Yet, energy savings may be concentrated, or even outweighed by the high energy use of many digital innovations. For example:

- The energy footprint of all smart phones per average year of use was 30 per cent larger than that of passenger cars in 2015, and this gap is expected to continue to grow in line with more rapidly increasing numbers of smart phones;[b]
- Online video streaming is on the same order of magnitude as air transport in terms of energy use and CO2 emissions (1.0 and 2.5 per cent of global CO2 emissions, respectively). Video streaming on mobile phones is vastly more energy consuming, with 5G expected to further increase overall power consumption;[c]
- Algorithms rely on vast amounts of data that are stored in data centers. Bottom-up estimates for data centers' energy use in 2030 range from between a five-fold increase (from 200 to 1,000 TWh) to a fourteen-fold increase to roughly 4,900 TWh.

Traditional government energy policies, such as electricity market reform and price incentive schemes, are needed to support the development of new services and devices that are energy-efficient or energy-saving. Government-backed, long-term research and development on novel materials, devices and new computing architectures including quantum computing can further help to reduce power consumption of digital technologies and AI systems.[d]

a Roehrl Richard, "Exploring the impacts of artificial intelligence on the global energy system", SLP/TFM Research Paper (December 2019). Available at https://sustainabledevelopment.un.org/index.php?page=view&type=12&nr=3335.
b Vaclav Smil, Energy and Civilization: A History, (Cambridge, Massachusetts, The MIT Press, November 2018).
c Chris Preist, Daniel Schien and Paul Shabajee, "Evaluating Sustainable Interaction Design of Digital Services: The Case of YouTube", in Proceedings of CHI Conference on Human Factors in Computing Systems Proceedings (Glasgow, Scotland UK, May 2019).
d Klaus Fichter, "E-commerce: sorting out the environmental consequences", Journal of Industrial Ecology, vol.6, Issue 2 (08 February 2008), pp. 25-41.

activities on mobile phones, social media and the Internet (see also box II.4 on the data economy).

Analogous to previous periods of technological change, digital technologies impact economic activity in two broad areas:

- They facilitate a more effective exchange or flow of information, goods and services. Companies have access to relevant economic and financial information, can more easily reach customers, coordinate suppliers, and organize their operations. This is similar in impact to the contributions made by railways, shipping containers, telegrams and similar innovations in the past;[16]
- They increase efficiency and lower the cost in the production of goods and services. Digitalization allows companies to save on raw materials, energy, storage space, time and labour. Information and communications technology, robots and other digital technologies play the same role that the spinning jenny or the steam engine played in previous industrial revolutions.

Why digital is different

Digital technologies also possess several unique properties that qualitatively change how goods and services are produced and, in some cases, change market structures.[17] They include

- Information, search and transportation costs that are close to zero. Unprecedented amounts of data can be collected because digital activity is easily recorded and activities can be tracked. This can help to overcome information-related market failures—in finance, for example. Searching for information is also cheaper, helping consumers to discover a wider variety of goods and supplies, and firms to access new markets;
- Digital goods represented in bits can be reproduced at essentially zero cost (economies of scale in economic terms) and can be consumed over and over again (i.e., they are non-rival in consumption). Additional users often increase the value of digital goods for existing users (network effects), which can lead to large firms and greater market concentration. Digital firms can thus grow quickly and obtain large market shares and achieve vast scale without mass.

2.3 How do digital technologies affect market structures and business models?

The properties described above find their reflection in market outcomes. Digital technologies lower production costs and prices. In a digitalized economy, firms might find it easier to access new markets. But this has not always led to more competition. Instead, market concentration is growing in many sectors, particularly in the digital economy itself where global platforms play a dominant role. So how are market structures and business models affected?

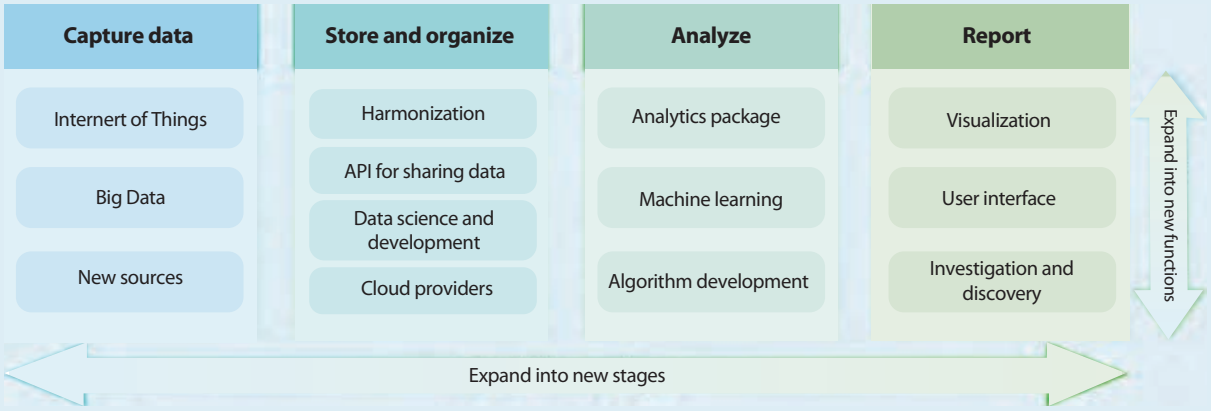
First, ***lower prices*** are a key benefit of digital technology. For example, in the media industry, most products are now sold in digital format, so that the cost of production and distribution of additional items (the marginal cost) is almost zero. In the financial sector, digital technology can lower the cost of financial services, including credit, and expanding its reach to the previously unbanked. In sectors where goods and services are still delivered physically, key components in the value chain—such as design, marketing, back-office work, or logistics management—can be digitized and provided at reduced cost. Technologies such as AI facilitate analysis of vast amounts of data and solve increasingly complex problems. As a result, a growing number of tasks previously performed by humans can be

Box II.4
The data economy[a]

Digital data has become an increasingly important input for the production of goods and financial and other services. Companies have learned to harvest and extract valuable information from vast amounts of data and turn it into an asset of significant value.

The data value chain begins with data collected from individuals and connected devices in the Internet of Things. Aggregators and custodians store and organize the data, making it accessible and marketable. Algorithms analyse and extract useful information. Data presenters then translate the results into insights for their clients. Data giants like Amazon leverage the entire data value chain. They capture data from both consumers and their production chain, organize and analyse the data, and extract insights.

Figure II.4.1
The data value chain



Source: UN DESA elaboration based on Opher and others., 2016.

The data economy is growing in size; it represents 1.0, 0.8, and 0.5 per cent of gross domestic product (GDP) of the United States of America, Japan and the European Union, respectively. It also generates much larger indirect and secondary economic effects. In the European Union, for example, the total impact of the data market on the region's economy in 2017 was €336 billion, or 2.4 per cent of total GDP. This is because the data increases the value of upstream industries that can monetize it.

How value is generated in the data economy has important distributional, privacy, ethical and public policy implications. Data-driven industries are highly concentrated. Access to detailed personal data increasingly allows companies to charge each customer different prices. The collection and use of personal data, designed to influence behavior, also carries with it a potential for abuse. With a few large firms dictating the terms and conditions of data availability and use (as well as capturing the profits), the data economy can further exacerbate income and wealth inequality, and even impact the security and stability of political systems.

a Based on Hoi Wai Jackie Cheng, Marcelo LaFleur and Hamid Rashid, "Data Economy: Radical transformation or dystopia?", UNDESA Frontier Technologies Quarterly (New York: United Nations Department of Economic and Social Affairs, January 2019). Available at https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/FTQ_1_Jan_2019.pdf.

automated. This includes increasingly non-routine and cognitive tasks that were once long beyond the remit of machines.[18]

Second, digitalization technologies can ***lower entry barriers*** and present opportunities for firms, including those in developing countries, to access larger markets. The Internet, cloud-based computing, and open software drastically reduce the need for major investments in software and services. Even cutting-edge technologies such as AI can now be rented by firms in both developed and developing countries by the hour through cloud-based computing platforms. In many sectors, the main non-labour costs of a start-up are a laptop computer and an Internet connection, together with cloud-based computing services and/or a 3D printer.[19] Digital technologies' impact reaches beyond the core digital economy: by reducing export costs for micro, small and medium-sized enterprises (MSMEs) in developing countries, the Internet has expanded their access to global markets.[20] Cheap reproduction and easier search and matching of actors mean that geographic boundaries become much less relevant.

Third, ***online platforms*** have emerged as important new forms of intermediation. Platform-centred businesses have a major advantage in the data-driven economy. They can record and extract all data related to online actions and interactions among their users. This data can then be monetized, for example, by selling targeted online advertising, operating e-commerce platforms, renting out cloud services, or allowing consumers and/or firms to share their underutilized assets (the sharing economy).[21] Thanks to network effects (a product or service gains additional value as

more people use it), online platforms can grow and gain market share very quickly.

Seven of the world's top eight companies by market capitalization use platform-based business models. Google has about 90 per cent of the global market for Internet searches. Facebook accounts for two thirds of the global social media market. Amazon boasts an almost 40 per cent share of the world's online retail activity. In China, Alibaba has been estimated to have close to 60 per cent of the Chinese e-commerce market. WeChat (owned by Tencent) has more than one billion active users and, together with Alipay (Alibaba), its payment solution has captured virtually the entire Chinese market for digital payments. Such platforms can eliminate intermediaries and rent-seekers, enhancing market efficiencies. At the same time, global digital platforms have taken steps to consolidate their competitive positions, which may end up slowing down economic dynamism and precluding developing-country platforms from reaching competitive scale.[22]

Fourth, ***market concentration*** is growing across industries and countries, despite lower entry barriers. "Winner take most" mechanisms have become more common even beyond the core digital economy, and digital technologies are partly responsible. A small number of so-called superstar firms have increased their productivity (and profits), as increasingly complex technologies require evermore sophisticated complementary investments and highly specialized skills in the workforce, while the majority of firms, even in the same industry, have lagged behind.[23]

3. Sustainable financing and development policies for a digital era

Changing business models and market structures demand a comprehensive rethink of financing and development policy and regulatory approaches. Digital technologies

- ***Affect all parts of society and economy***, hence any policy responses need to be mindful of their impacts across traditional industry boundaries, policy domains and on various stakeholders;
- Are ***complex and highly technical***, so that no one actor is likely to have sufficient knowledge and information to make informed decisions;
- Are ***evolving rapidly***, so that experiences with new technologies are often limited and ***uncertainty*** over future developments ***is high***.

For this reason, countries should take a strategic, whole-of-society approach, which engages all relevant stakeholders, and can solicit relevant information, raise awareness and provide a common frame of reference for all actors.[24] This is reflected in the Addis Agenda, where Member States committed to "adopt science, technology and innovation strategies as integral elements of our national sustainable development strategies". In practice, these strategic responses can take different forms—as part of an STI strategy or STI road maps, a dedicated digital economy strategy, or through the explicit integration of digital technologies in broader planning processes (e.g., embedded in a country's integrated national financing framework).

The concrete elements of these strategies will vary depending on each individual country's stage of development and its respective involvement in the creation and use of digital technologies. Since technological change is a key source of growth and sustainable development, all countries need to exploit its potential while being mindful of any possible negative externalities. This requires, before all else, investment in the basic building blocks that enable participation in the digital economy.

Putting basic building blocks in place: investing in infrastructure and skills to be digital-ready ***(Addis Agenda action area G, on science, technology, innovation and capacity-building, and data)***

The basic building blocks of a digital economy—infrastructure, Internet access, digital skills and regulatory and data policies—ensure that individuals and firms are connected to and can function in the digital world. But providing access alone is not enough to address new opportunities and risks in financial markets, respond to new challenges and opportunities in public finance, and chart viable development pathways. The remainder of the chapter will look at policy and institutional responses across the action areas of the Addis Agenda, clustered in three broad financing areas:

(i) ***The financial sector:*** How is fintech changing financial markets across payments, savings and credit, and risk management? Will fintech make access to financial services more or less equitable? What are the challenges, such as to financial stability, and what are the policy options? ***(Addis Agenda action areas B, on private business and finance; E on debt and debt sustainability; and F on systemic issues)***;

(ii) ***Public finance:*** How can policymakers use digital technologies to enhance public financial management efficiency and combat illicit financial flows, while adapting tax and expenditure policies to a digitalizing economy? ***(Addis Agenda action area A);*** and

(ii) ***Development pathways:*** How is the developmental model changing? What investment, trade and technology policy options exist to find development pathways in the context of digitalization? ***(Addis Agenda action areas B, on private finance and investment, C on international development cooperation, D on trade, and G on science, technology, innovation and capacity building)***.

3.1 Becoming digital-ready

Closing digital gaps requires investments in physical infrastructure, affordable access, digital skills and data.

Digital infrastructure

Affordable connectivity remains a challenge, particularly in least developed countries and remote regions. Digital infrastructure is one of the basic preconditions for affordable access to the Internet. It ranges from the point where the Internet enters a country, such as submarine cable landing stations or satellite dishes (the first mile), the national backbone infrastructure, such as a national and intercity backbone network (the middle mile), to local access networks that connect users (the last mile), as well as non-visible components such as data and data centres, spectrum, and others (the "invisible mile").[25]

Developing such broadband networks requires significant investment. Both public and private investments are usually needed to create and maintain high-quality ICT infrastructure. Markets are most likely to deliver this infrastructure closest to the end user, particularly in cities, where ICT infrastructure investments often have a positive financial return. Public sector involvement is often necessary in the first and middle miles. Public involvement will also likely be necessary to close most of the remaining gaps in broadband network infrastructure, which tend to be in

Figure II.2
Financing policy responses to the digital revolution – a strategic approach

Source: UN DESA.

geographically or economically challenging areas, such as rural areas in developing countries (box II.5).[26]

Internet exchanges, data centres and cloud computing and hosting services are a hidden—or non-visible—component of digital infrastructure. This core Internet infrastructure is vital to developing a local Internet ecosystem. For example, if national data centres have limited capacity, and data and cloud computing applications are hosted abroad, there could be significant cost implications as well as vulnerabilities.

Box II.5
Financing mechanisms to enable broadband infrastructure projects[a]

Broadband infrastructure projects, particularly the development of national backbone infrastructure, are capital-intensive projects. A combination of financing mechanisms is often used to support the roll-out of infrastructure installation; they include equity financing, but usually investment credit offered by the public and private banking market represents the most important financing mechanism.

Access to the private investment credit market depends on economic viability of the infrastructure project. As ICT prices have fallen, operators in many countries have experienced falling average revenues per user. But the telecommunications industry remains generally profitable, even if margins are lower than a decade ago. However, when national backbones are extended to underserved areas (e.g., areas that are geographically remote, have low population density, or are poor), public support will often be needed. Direct subsidies can be made available, for example, through universal service obligation funds created specifically to foster telecommunication development, or through specific tax exemptions applied to operators who engage in the project. Indirect subsidies include (i) the lowering of spectrum licensing fees in exchange for a commitment to deploy and provide service in less profitable areas or (ii) converting an operator fines backlog into obligations to deploy and provide broadband services in these regions.

a Based on ITU, Infrastructure business planning toolkit 2019.

Complementary Infrastructure

The most important complementary infrastructure is reliable access to affordable energy, since significant electricity is required to power the ICT sector (box II.3). The projected energy demand to support a future digital economy needs to be taken into account in countries' energy infrastructure investment plans. Traditional connectivity also matters for digital trade, as high trade logistics costs (e.g., transport costs caused by poor infrastructure) hamper participation in the broader digitalized economy—a particular challenge for landlocked developing countries. In e-commerce, logistics account for 26 per cent of final prices for MSMEs in developing countries, on average—almost double the share in developed countries.[27]

Enabling policy frameworks and regulation

Connectivity can also be hampered by excessive market concentration, mismanaged privatizations, and other factors. Digital policy and regulatory frameworks need to be reviewed to address such challenges. Key interventions for policymakers and regulators include the establishment of national broadband plans, open access and infrastructure sharing, or requirements of major infrastructure providers to include the provision of optical fibre.[28]

As digital technologies become pervasive and have impacts across all sectors, regulators are grappling with and have to address an increasingly complex set of challenges. Traditional silo-style ICT sector regulation is unlikely to prove viable for much longer. Because digital infrastructure, services and content are relevant across industries and national borders, the existing regulatory architecture needs to be revisited. For example, the International Telecommunication Union has noted the development of a more holistic approach to ICT regulation—referred to as the 5th generation of regulation—which could enable regulators to collaborate with other sectors, such as finance, in harmonizing regulation for the entire ICT ecosystem. This regulatory approach is collaborative and involves consulting Governments, regulators from different sectors, market actors and consumer associations, and enhancing adaptive capacity to support effective response to rapidly changing contexts and market behaviour.

Digital skills: education and training policies

Lack of digital skills is a major obstacle to greater access to and use of digital technologies. This skills gap, along with affordability, is often the primary reason individuals and households as well as firms do not use the Internet. In a survey of more than 2000 MSMEs in 111 countries, firms noted lack of technical skills as the second-most important challenge for e-commerce participation.[29]

Curricula in schools and universities can be adapted to include digital literacy, including basic digital skills as compulsory elements, along with more advanced ICT-related skills (e.g., coding). Digital skills education for women and girls needs to be accelerated rapidly to establish more women as digital creators.

Digital technologies in turn can contribute to more effective learning outcomes. Ed-tech, which applies ICT to improve education (e.g., through computer-assisted learning or online learning), can also strengthen students' digital skills. Blended programmes and computer-assisted learning, such as games, can be particularly effective in this context.[30] While digital technologies are allowing more children access to learning, especially in remote regions and during humanitarian crises, many miss out. About 29 per cent of youth worldwide – around 346 million individuals – and 60 per cent of African youth are not online, compared with just 4 per cent in Europe.[31]

Digital skills training should also be part of professional development programmes and technical and vocational training. Effective technical and vocational programmes can play an essential role in strengthening job-specific digital skills. Experience suggests that targeted programmes—those focusing on women or long-term unemployed, for example—are likely to yield greater results, and that the involvement of businesses allows for programmes that are better aligned with firms' needs.[32] Digital skills might be most effectively acquired through on-the-job training. Governments could also incentivize this in different ways, such as through tax rebates or co-financing schemes.[33]

Countries are experimenting with new models to support ICT skills development. For instance, Rwanda is employing young Rwandans as "digital ambassadors" who are trained in ICT and soft skills and then provide training on using the Internet and other ICT technologies throughout the country, including in rural communities. Bangladesh has set up thousands of Union Information Service Centers, which offer access to the Internet along with training.

Data policies

National data policies are necessary to protecting the essential rights of individuals and companies and unlocking the economic opportunities that lie in collecting, sharing and analysing individual data.

Effective legislation that addresses ***data privacy and security*** for consumers and firms is not yet in place in many countries. A recent development in this area is the General Data Protection Regulation(GDPR) in the European Union (EU), which defines standardized data protection laws for all member countries and lays down the rules relating to the processing of personal data by an individual, company or organization, including the transfer of personal data outside the EU. The GDPR makes it easier for EU citizens to understand how their data is being used and clarifies what companies that process personal data must do to safeguard these rights. Several countries outside the EU have since introduced measures aligned with the EU approach, and several major ICT corporations are applying a standardized approach globally.[34] Similarly, the California Consumer Privacy Act specifies new consumer rights relating to the access to, deletion and sharing of personal information collected by businesses.

Privacy and security demands have to be balanced with the objective of ***creating value from data and supporting innovation***. Economic value stems from pooling and analysing large amounts of individual data. Controlling access to large data sets grants individual firms a competitive advantage that could entail a barrier to market entry for competitors and lead to market concentration. Data ownership regulations can help address these issues by defining who can access, use and delete data.[35] To share economic value more widely, several alternative ownership mechanisms are being considered. These range from personal data markets, where users are given ownership rights over their own data, to collective data ownership, where data is treated as a public resource.[36] There could be several different models of collective ownership. In an extreme case, data could be owned by public authorities. Alternatively, public authorities could regulate how data is accessed, used and deleted without assuming ownership. "Data subject rights" grant individuals a range of specific rights, including the right to access, the restriction of processing, and data portability. For example, the EU Payment Services Directive allows customers to transfer data to third-party providers to facilitate a level playing field for market contestants.

Digital identity

Digital identity systems, which allow people to be authenticated through a digital channel, have been introduced in a number of countries. They can significantly increase access to financial services, public services and benefits. This can also benefit education and other key SDG areas, and thus help unlock key benefits of digital technologies.[37] Such systems rely on the basic infrastructure discussed above to be in place. Risks related to data privacy and protection, or exclusion of those that do not have digital identity, need to be addressed.

3.2 Financial markets, macro and systemic issues

Financial markets play a central role in allocating resources in the economy and fueling economic growth. Yet, at the same time, the history of financial markets has been marked by volatility, boom and bust cycles, and financial crises, often impacting other sectors, jobs and livelihoods. People and firms can lack access to financial services, including both deposits and credit, and thus be excluded from full participation in the economy.

Many of these problems are driven by information failures—either missing information or unequal access to information (asymmetric information). For example, there is a clear relationship between market herding and uncertainty.[38] Because digital technologies translate data into unprecedented amounts of financially relevant information, they have the potential to improve the efficiency of markets and facilitate access for previously excluded or underserved populations. Yet, digital technologies also create new challenges. The effect of digital technologies on financial stability, integrity and equity are highly uncertain.

The different functions of financial markets, and the impact of fintech

The financial sector fulfills ***a range of functions*** that help households, businesses and Governments carry out economic activities. These functions can broadly be divided into three categories: ***(i) payments; (ii) intermediation (i.e., savings and borrowing) and (iii) risk management and advisory services.***

Digital technologies are transforming all three areas (table II.1). Their rapid spread has accelerated financial innovation and driven the emergence of new actors and solutions.

(i) Payments

Functioning national payment systems and the ability to send and receive payments across borders are the backbone of the financial system. Over the past ten years, mobile money has become an integral part of the payments system in a growing number of countries, extending financial services to underserved populations. Ten years after M-Pesa (mobile payment) was first launched in Kenya in 2007, over two thirds of the combined adult population of Kenya, Rwanda, Uganda and the United Republic of Tanzania are active mobile money users.[39] 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 needs.[40] Governments have also made productive use of payments innovations, including to pay government salaries and other associated payments (see discussion on public finance below).

New digital innovations, in combination with existing technologies, are increasingly widening the functionality of mobile devices for financial transactions. Micro merchants rely on small card readers to accept digital payments; near-field communication technology transforms mobile devices into payment services that enable contactless payments; and peer-to-peer (P2P) services facilitate financial transactions between two people through the use of digital money. Cross-border mobile money has led to a notable decline in average remittance costs across countries[41] (see chapter III.B).

Distributed ledger technology (DLT) could facilitate messaging, clearing and settlement functions (the back end of financial transactions that support cross-border funds transfers). The SWIFT payment system (see chapter III.F) is currently exploring the use of DLT to improve the speed, transparency, and end-to-end tracking of payments in its "global payments innovation" initiative. DLT have the potential to greatly reduce the cost of trade finance (see chapter III.D) and strengthen correspondent banking relationships. They can be used for regulatory compliance (e.g., compliance with anti-money laundering and combating the financing of terrorism (AML/CFT) standards) through "reg tech". However, DLT can also be used as a way to avoid compliance (see chapter III.F).

DLT are also impacting money as a medium of exchange. Crypto-assets could bring some benefits to financial systems, but they also carry significant consumer and macroeconomic risks that need to be understood and managed by regulators. Furthermore, there is evidence that crypto-assets have proven fertile ground for illicit financial activities, including violations of AML/CFT regulations (see chapter III.F for systemic impacts).

(ii) Intermediation (saving and borrowing)

Mobile money services have lowered banking fees and increased access to services. This has contributed to a rapid increase in account ownership (see chapter III.B and III.G for fintech trends), even if, to date, there is not yet strong evidence of an increase in savings rates.

New technologies also help overcome information failures and information asymmetries that inhibit lending. For example, lenders that do not know

Table II.1
Traditional financial solutions, fintech solutions, and their underlying technological innovations

(i) Payments	▪ Cash/ATM ▪ Checks -Wire transfers ▪ Debit and credit cards ▪ Centralized settlement		▪ Virtual currencies ▪ Mobile payments ▪ DLT-based settlement / P2P payments
(ii) Intermediation: saving and borrowing	▪ Bank deposits and loans ▪ Traditional brokerage ▪ Bonds and equities ▪ Mortgages	Improve efficiency, scope and security in the delivery of financial services	▪ Blockchain bonds, digital assets, mobile market funds ▪ Brokerage platforms ▪ Platform lending ▪ Crowdfunding
(iii) Information management & advisory services	▪ Structured products ▪ Brokerage underwriting ▪ Regulatory compliance ▪ Insurance ▪ -Financial planning and advice		▪ Automated wealth management, robo-advising ▪ Smart contracts, Regtech ▪ e, KYC
Technological innovations	Artificial intelligence, machine learning platforms, cloud computing, big data analysis Distributed Ledger Technologies, cryptography, blockchain mobile technology, Internet of Things application programme interfaces		
Financial institutions	depository institutions: banks, credit unions, mortgage loan companies investment institutions: investment banks, underwriters, brokerage firms contractual institutions: insurance companies and pension funds		

Source: UN DESA, adaptation of IMF.[a]
a IMF, "Fintech: The Experience So Far", IMF Policy Papers (Washington, D.C., IMF, June 2019).

the credit quality of borrowers ask for collateral, charge extremely high interest rates, or do not lend at all. This is one of the reasons for the large MSME financing gap. New sources of non-traditional data can provide more precise information on creditors, enable financial institutions to improve credit screening processes and ultimately increase the supply of credit. By evaluating data sets from payments and platforms (such as utility bills, e-commerce transactions or social media profiles), algorithms can improve credit risk evaluations and provide more precise default predictions. For example, a recent study found that using simple online accessible information or "digital footprints" of individuals can exceed the information content of credit bureau scores, helping lenders make better lending decisions and even decreasing the need for costly security mechanisms like collateral.[42] In China, Alibaba uses its data, including payment data from Alipay, to support the activities of its finance affiliate, Ant Financial.

However, employing digital technologies in lending decisions can also create new micro and macro risks. First, there is increasing evidence that algorithmic lending decisions based on historical data often codify inequalities and biases, thereby perpetuating existing inequalities.[43],[44] In addition, in some fintech markets, annualized interest rates (including hidden fees) can be very high, sometimes over 100 per cent. There has also been a proliferation of digital lending platforms. In Kenya, there were least 49 active digital lending platforms in 2018, and more than a third of mobile phone owners had taken out a digital loan, many of whom (35 per cent) borrowed from more than one digital lender, underscoring the importance of information-sharing across platforms.

Instead of supporting productive investment, digital finance may in some cases be fueling credit bubbles, with consumer lending dominating credit growth in some frontier markets.[45] In other words, traditional financial market problems often remain, even in non-traditional financial markets (see chapter III.F. for a discussion on the role of macroprudential policy to address such risks). Digital technologies can help lenders better understand the idiosyncratic risks of companies, but more information does not necessarily solve the fundamental uncertainty inherent in economic decision-making or eliminate systemic risks, such as economic slowdowns or shocks (see also box II.6 on P2P platform lending and crowdfunding). Institutional weaknesses that impede markets (e.g., weak legal frameworks) still need to be addressed. This underscores the important role of regulators and policymakers in digital transformation.

Box II.6
Peer-to-peer platform lending and crowdfunding

New technologies have the potential to bypass traditional, weak credit market infrastructure. Fintech solutions include peer-to-peer (P2P) platform lending and crowdfunding. These mechanisms allow individuals to lend directly to borrowers, rather than going through intermediaries in the traditional financial sector. An interesting feature of this type of lending is that it allows savers more ownership of their investment decisions (see the upcoming report of the Secretary-General's Digital Finance Task Force); it could also facilitate more sustainable investing, since surveys show individual savers have greater interest in sustainability than their investment advisors (see also chapter III.B in Financing for Sustainable Development Report 2020).

Removing intermediaries can lower costs and increase market efficiencies. As financial markets have grown more complicated, the role of intermediaries has grown more complex. Some financial transactions involve very long chains of intermediaries[89] (sometimes up to 10 intermediaries), each of whom gets a fee for a small piece of market information that is necessary for the transaction.

Yet, completely bypassing intermediaries can also pose risks. One of the primary roles of financial markets is to "intermediate credit" and pool risk. For example, a commercial bank collects customer (demand) deposits and transforms these into long-term loans. The bank is fulfilling a crucial role in pricing and managing credit and maturity risk by collecting financially relevant information, diversifying risk, and holding adequate reserves. In comparison, some crowdfunding platforms act as an agent on behalf of investors by providing monitoring and servicing functions, but they do not assume systemically important responsibilities like pooling and transforming financial risk. Instead, this risk may remain with small investors, who are least able to bear it cost-effectively.

Source: UN DESA

(iii) Information management, financial planning and insurance

Trade-offs between increased efficiencies and heightened risks and equity concerns also occur in risk management. Algorithmic trading—that is, automated trading instructions that facilitate large and frequent trading transactions—has been around since the 1970s. Thanks to big data, AI and machine learning, algorithmic trading tools have now expanded into investment and portfolio management services, and have become accessible to customers. For example, e-trading platforms and robo-funds employ portfolio management algorithms that undertake investments guided by the analysis of big data.

Rather than reduce market herding, increased reliance on algorithms could conceivably increase market volatility, which requires further study. Digitalization of financial markets has dramatically increased the speed of transactions, as already reflected in "flash crashes". Widescale implementation of algorithmic trading strategies based on the same big data sources and AI programs could lead to large-scale immediate portfolio reallocations, "correlated mistakes" and greater volatility.[46] The growth of crypto-assets and stable coins could pose an additional risk factor (see chapter III.F).

The ability to more precisely assess financial risk enables insurance companies to offer mobile, on-demand, pay-per-usage and parametric insurance solutions. Insights from big data can help customers to reduce risk premiums or avoid insuring against risk altogether by facilitating risk prevention. However, the increasing reliance on non-traditional data sources for screening or monitoring potential risks can also lead to highly targeted and individualistic pricing models. If taken to their extreme, they could eventually exclude high-risk groups from insurance markets and undermine the foundational principles of risk pooling (see chapter III.B).

Financial market structure: from competition to concentration

Digital technologies reduce barriers to market entry and facilitate the decentralization of key functions of financial markets. For example,

pay-as-you-go access to storage, networking, servers, and other computing resources in the cloud minimize the cost of operational routines. Application programme interfaces simplify sharing personal and product data securely among financial institutions. DLT allows simultaneous access, validation, and record updating across a network of multiple entities or locations. These innovations have facilitated outsourcing of operational and client-facing activities. They have also enabled the emergence of new types of financial players, such as online P2P or crowdfunding platforms, that can potentially disintermediate markets and threaten established financial institutions. As a result, incumbents increasingly face revenue loss to fintech innovators. In a recent survey, 88 per cent of incumbent financial institutions worry about losing part of their business to fintech companies, and 82 per cent expect to significantly increase fintech partnerships to improve services.[47]

Perhaps the most significant source of disruption in the financial sector is the entry of big tech companies. Because of their size and the vast amount of information they possess, they may in the future come to dominate, rather than diversify, the provision of certain financial services (see chapter III.G). In the longer term, this level of market concentration could lead to reduced innovation and increased financial fragility. The failure of these firms could lead to widespread disruption. In China, two firms account for 94 per cent of the market. Because of their global dominance, big tech companies could also crowd out domestic actors in smaller markets.

What policies are needed to respond to new and emerging technologies in financial markets?

Because technology can change the very structure of financial markets, it calls into question whether existing regulatory and policy frameworks are adequate to deal with the challenges. In order to maximize benefits and respond to challenges posed by fintech, regulators and policymakers need to revisit and update regulatory frameworks. Most importantly, enhanced and new forms of cooperation between different bodies of public oversight will be needed to address the cross-sectoral and cross-border implications of digital technologies.

For example, financial regulators and ICT need to cooperate to exploit opportunities and risks related to fintech. Given big tech's business models, which are built around network effects, and a natural tendency to dominate markets via economies of scale and scope, regulators will also need to explore new ways of cooperation with competition authorities to ensure a level playing field. Disruptions that cross jurisdictional borders require international cooperation to prevent regulatory arbitrage.

This section explores national policy actions and international cooperation in three areas: (i) consumer protection, (ii) competition (including data) and (iii) financial stability.[48]

Consumer protection: Digital technologies give financial institutions access to unprecedented amounts of information on consumers. This requires safeguarding mechanisms to protect consumer data privacy and security (see section on basic building blocks above).[49] Where financial institutions outsource operational activities to cloud service providers, regulatory frameworks need to ensure the adequacy of information security and data confidentiality.[50] To avoid new forms of financial exclusion, regulators should work to ensure an ethical and responsible use of AI and mitigate for potential biases and discrimination by, for example, updating nondiscrimination policies, rules and laws to apply to digital practices, or requesting operators of algorithms to assess and disclose bias impacts.[51] They could also consider strengthening programmes that offer concessional lending to groups experiencing discrimination (e.g., women- or minority-owned businesses in the United States). In order to prevent the establishment of disparate regulations across regions and prevent regulatory arbitrage, cross-border cooperation is essential.

Competition: As discussed, big tech companies' ability to collect, analyse and use vast amounts of data could allow them to become dominant players in financial markets. While their market entry can promote innovation, it also challenges the traditional understanding and scope of financial regulation. Areas such as competition and data privacy become core concerns for financial regulators (see basic building blocks section above). Regulators can also aim to level the playing field between big tech and traditional financial institutions. To this end, regulatory gaps that may remain between big tech companies and regulated financial institutions—around know-your-customer and CFT measures, for example—need to be closed.

Financial stability and integrity: Regulatory frameworks may also need to be adjusted to address potential financial stability risks from fintech. To effectively manage such risks, financial regulators will need to increasingly shift focus to the underlying risks associated with the financial activity rather than the type of financial institution providing financial services. International regulatory standards will also need to adapt to the new landscape.

At the same time, policymakers should not discourage innovation or nudge financial activities to an unregulated space. Finding this balance is challenging, particularly in a fast-evolving space. Institutional experimentation—such as using regulatory sandboxes and modified licensing agreements—can create controlled environments where new technologies and innovations can be tested. Sandboxes can encourage greater collaboration across policy areas and institutions (e.g., between financial regulators, competition authorities and data protection authorities). Dialogue with all stakeholders, including new service providers, can facilitate a better understanding of different perspectives and needs. Spaces for peer learning between countries can be helpful, along with enhanced capacity-building efforts.[52]

In addition, authorities need to keep a close eye on global systemic risks arising from the operation of global crypto-assets and stable coins. Digital technologies can also facilitate activities that undermine market integrity—for example, market manipulation—or for criminal abuse—including money laundering, tax evasion, and purchase of illegal goods or services. Relevant authorities will need to establish comprehensive and advanced RegTech and SupTech capabilities to make AMF/CFT implementation increasingly effective (see chapters III.A and III.F).

3.3 Public finance

Digital technology is reshaping how Governments design and implement their tax, spending and fiscal policies. It has direct impacts on public financial management, opening the door for major efficiency and effectiveness gains. But there are indirect impacts as well. A more digitalized economy creates challenges for public finance and raises new questions about how to mobilize revenue and adapt and prioritize expenditure.

Digital technology and public financial management

Digital technologies can support authorities in managing public resources. As discussed below, they can

- Facilitate access to timely and precise information on the state of the economy;
- Facilitate public financial management and service delivery; and
- Improve transparency and accountability.

To do so, the basic building blocks discussed above need to be in place across the public sector: appropriate ICT infrastructure, adequate organizational capacity and skilled staff. Not all technologies are equally suitable for use in all countries, and existing IT infrastructure and institutional capabilities may limit the speed at which Governments can transform their public financial management systems through digitization. Indeed, country experiences with previous IT-based reform efforts, such as Financial Management Information Systems, offer cautionary lessons, and suggest that customized solutions, institutional capacity-building, and clearly identified government needs are prerequisites for successful implementation.[53] Where capacities are limited, the focus may need to be on small pilot programmes, while putting in place conditions that enable the implementation of some of the basic components of an integrated and unified public financial management system.[54]

Access to timely information: New and emerging digital technologies provide Governments with greater data storage capacities and advanced analytical capabilities to analyse the economy. They can increase responsiveness of government decision-making and service delivery. For example, nowcasting can give authorities a timely impression of macroeconomic conditions and can support alignment between policy objectives and funding. By providing information about current consumption and economic activity through real-time data from value-added and payroll taxes, nowcasting can help predict output. This is especially useful in countries where daily fiscal data are available but reliable national accounts statistics are difficult to obtain.[55]

Effective and efficient public financial management and service delivery Digital technologies can help Governments target public spending and deliver programmes and services in effective and cost-efficient ways. This can strengthen the effectiveness of public administration, build public trust and support the provision of faster, more reliable services to citizens and the private sector, thus removing barriers to the development of the economy. Digital payroll and human resources systems can greatly improve the accuracy of payments and increase the convenience of accessing funds. The digitalization of payments to citizens can help reduce leakage and corruption, as well as allocation inefficiencies. Digital government payments have also been a major driver in enhancing financial inclusion. Account ownership has risen sharply in countries that have introduced digital government transfers. Globally, about 80 million people opened an account to receive public sector wages, 120 million to receive a public sector pension, and 140 million for other public transfers.[56] India's Jan Dhan Yojana scheme more than doubled account ownership at financial institutions between 2011 and 2017, reaching 80 per cent of the Indian population and allowing direct transfers of government assistance.[57] E-procurement systems can increase transparency, increase competition between bidders, and lead to higher quality public purchases and lower costs.[58]

Digital technologies and innovative software also provide an opportunity for tax administrations to improve their efficiency, functioning and enforcement capacities. Technology is creating new tools to improve tax compliance and reduce the administrative burden on taxpayers. Technology can help improve the accuracy of information in tax administration databases, not least with the adoption of e-filing procedures. Big data analysis can help spot fraudulent tax returns by matching data from different governmental and non-governmental sources. Artificial intelligence programmes can be created to spot suspicious transactions or tax situations, flagging these for review by tax, customs or money laundering authorities. More targeted enforcement both helps increase domestic revenue mobilization, and also improves the perception of fairness of the fiscal system, and thus strengthens the social contract (see also chapter III.B.)

Transparency and accountability: New digital technologies can also promote accountability by helping Governments to publish more timely and accurate information on public financial management. They can support better engagement with citizens and businesses through fiscal transparency portals, integrated tax portals, e-government services portals, social media, mobile applications, Short Message Service (SMS), and digital publishing of budget proposals. Mobile applications can give individuals a convenient and low-barrier way to voice concerns, provide feedback and effectively monitor and evaluate different aspects of public financial management. Moreover, there is a clear link between the levels of integrity and trust in society. Integrity is recognized as a precondition for effectiveness and for building and maintaining public trust in government, international organizations and civil society. This has been recognized repeatedly and consistently, most prominently in article 8 of the United Nations Convention against Corruption (UNCAC).

Public finance in a digitalizing economy

As digital technologies increasingly reshape economies, their impacts on public finance broaden. Digital technologies increasingly affect how countries can raise resources, particularly taxation: as business models change, companies achieve large scale without mass and service markets where they have no physical presence, raising novel and difficult questions around taxing rights between jurisdictions. They also affect how countries can prioritize expenditures. Digital technologies can provide options, for example, in the design of social protection systems when employment is becoming more precarious.

Taxation in the digital economy: The digitalization of the economy is exacerbating concerns about a century old system of international taxation that was already straining to accommodate the globalization of business and finance of the previous 30 years. There is a mismatch between where profits are currently taxed, and where and how value is created. Many jurisdictions are unable to tax some companies that are actively and profitably participating in their domestic markets through digital business models. This is of particular concern for developing countries, because they have lower tax administration capacity, less bargaining power against digital platforms, and a lower likelihood of physically hosting digital platforms.

Member States are exploring different options for reforming tax norms, with processes ongoing at the OECD (Organization for Economic Cooperation and Development)/G20 (Group of Twenty) Inclusive Framework for

BEPS (Base Erosion and Profit Shifting) and at the United Nations Committee of Experts on International Cooperation in Tax Matters. Member States and the Committee of Experts hope to reach consensus on solutions by the end of 2020 and mid-2021, respectively. As the tax landscape evolves in the coming years, it is essential to ensure wide and more inclusive participation of developing countries in international discussions on tax norms[59] (see chapter III.B).

Social protection for workers on digital platforms: Despite significant progress made in the past, large gaps in coverage and financing in social protection still exist today. Only 45 per cent of the global population are effectively covered by at least one social protection cash benefit.[60] Digitalization is facilitating good governance in the administration of social protection systems. But it also creates new challenges for coverage and adequacy gaps. This is particularly the case for workers in precarious forms of employment mediated by digital platforms in developing countries.

While such diverse forms of employment may provide greater flexibility to enterprises and workers and lower the cost of services for clients, for workers, they also often translate into lower and volatile earnings and higher levels of income insecurity, inadequate or unregulated working conditions, and no or limited social security entitlements. It is difficult to identify the party responsible for contributing to social insurance since neither buyers (requesting the service) nor the organizers (digital platforms) may recognize an employment relationship entailing responsibilities with regard to social protection. Such gaps in social insurance coverage can also create a higher burden on the current and future expenditure of social assistance and poverty alleviation programmes.

Several policy options can address these gaps:[61]

- Legislative frameworks should be adapted to cover workers on digital platforms. Workers are almost invariably classified as independent contractors in the gig economy, and thus fall outside of the legal requirements attached to the standard employment relationship. If misclassified crowdworkers were reclassified as employees, platforms would be obliged to pay minimum wage and ensure social protection coverage;
- To cover all workers and create a level playing field for employers, minimum thresholds on enterprise size, working time or earnings for contributions should be lowered or removed;
- Administrative and financing requirements and procedures can be simplified. Uber drivers in Uruguay, for example, can download a phone application that automatically deducts social security contributions.

3.4 Development pathways

In response to the increasing digitalization of the global economy, policymakers in developing countries have to adjust their investment, trade, technology, data and competition policies to enable further sustainable development.

Since the 1970s, global production processes in the manufacturing sector are increasingly shaped by global value chains, which open opportunities for developing countries to participate in the global economy, attract direct investment, and access global markets and more advanced technologies.[62] A number of developing countries were able to lever these opportunities to achieve rapid and sustained growth and structural transformation, by building domestic linkages and gradually upgrading to more technology-intensive tasks.[63] Entry in these manufacturing value chains thus provided an "escalator" to economic progress. This is because manufacturing combines three properties:

(i) Its products are ***tradeable***, allowing developing countries to sell beyond small domestic markets;

(ii) It combines low-skilled labour with advanced machinery and capital, facilitating rapid ***productivity growth***;[64]

(iii) It ***employs labour*** with limited skills for the modern economy, which developing countries have in abundance.

Digitalization is changing the calculus in each of these dimensions.

Digital technologies can help make ***more products and services tradeable***, and thus open new opportunities for developing countries to access global markets. As discussed previously, ICT increasingly allow financial, communication and business services to be traded. New online matchmaking platforms are expanding possibilities for individuals and small and large companies to hire remote workers to provide services such as communication, design and architecture.[65] For many MSMEs, digital technologies and the Internet have reduced exporting costs and made it easier to reach foreign customers through online sales and e-commerce (see also chapter III.D).

Nonetheless, while they can facilitate entry into global value chains, ***new digital technologies may make it harder to upgrade within value chains*** and achieve sustained productivity growth. One trend in global value chains is increasing modularization, which simplifies complex production processes by concentrating knowledge-intensive segments into a few stages, standardizing others, and codifying transactions (see also chapter III.D). This has decreased opportunities to upgrade.[66] Advanced digital production technologies remain extremely concentrated in a few countries (box II.7).

Evidence for the ***labour-displacing effect of digital technologies is limited so far***. Robot-intensity remains very low in the sectors that have typically served as entry points for developing countries, such as textiles, apparel and footwear.[67] Reshoring—the relocation of labour-intensive manufacturing activities close to major consumer markets—remains a limited phenomenon. But there are warning signs. Many heavily traded manufacturing sectors are increasingly automated, including electronics, computers, machinery and equipment. The bar for entry and for retaining competitiveness will be rising more generally: as more tasks can be automated, labour will account for a smaller share of production costs; demands on the quality of infrastructure, logistics and connectivity, as well as educational and skills requirements, will rise.[68] Services sectors that create low-skill jobs so far remain mostly not tradeable, while those that are tradeable—such as business services or finance—are unlikely to absorb large numbers of unskilled labour.[69]

How should policymakers respond?

What are promising development pathways in this rapidly evolving context? What policy measures can countries take to pursue them successfully? The answers will depend on a country's factor endowments and capabilities, and its development priorities and needs. But while specific measures will differ, all countries need to be ready to address changes brought about

Box II.7
Adoption of advanced digital production technologies: a concentrated global landscape[a]

Digital production technologies (artificial intelligence, big data analytics, cloud computing, Internet of Things (IoT), advanced robotics and other digital technologies applied in manufacturing activities) remain extremely concentrated across countries, sectors and firms. While some emerging economies are entering into the ongoing race, large parts of the world remain marginalized from the productive dynamics of the new digital era. Moreover, even within economies actively engaging with new technologies, the share of firms using them remains very limited.

This finding is consistent with the experience of previous technological revolutions, which have divided the world into leading and following economies, depending on countries' involvement in creating and using emerging technologies. Based on patent and trade data on four core digital production technologies—industrial robots, CAD-CAM, additive manufacturing and machine learning—four broad categories of economies emerge:

(i) ***Frontrunners***: This group includes the top 10 economies in terms of innovation and use. They account for 91 per cent of all global patent applications and almost 70 per cent of exports of all capital goods associated with those technologies, and include China, Japan, Germany, the United States of America and several others;

(ii) ***Followers***: A second group of 40 economies is actively engaging with new technologies, but to a much lower extent than frontrunners. They include countries active in the production and export of digital production technologies—including advanced emerging economies such as Brazil or India—and those specialized in its use (mainly importers), composed largely of emerging economies such as Mexico, Thailand and Turkey;

(iii) ***Latecomers***: Included here are 29 economies with low patent or trade activity involving Advanced Digital Production Technologies (ADP). While they have marginally engaged with new technologies, it is not clear whether they will succeed in becoming followers;

(iv) ***Laggards***: These are economies with no or very low engagement with ADP technologies.

a This box is based on UNIDO, "Industrial Development Report 2020: Industrializing in the digital age" (Vienna, UNIDO, 2019). Available at https://www.unido.org/resources-publications-flagship-publications-industrial-development-report-series/idr2020.

by digital technologies[70]—whether these are already impacting their economies' competitiveness, whether these impacts are imminent, or whether they are still some years off.

Areas for policy action include

- Revisiting development strategies and identifying pathways that create decent jobs in a digital economy;
- Creating an enabling environment for the digital economy, through skills, regulatory measures, data and competition policies;
- Promoting innovation and learning in the digital economy; and
- Aligning international engagement with national policy objectives.

Making national development strategies fit for the digital age

Countries' industrial and sustainable development strategies must account for the myriad ways in which digital technologies can affect their development prospects. Leading economies (box II.7) will likely focus on maintaining industrial leadership and on supporting innovation in digital technologies. The main challenge for technology followers is ensuring access to technologies and enhancing absorptive capacities.

Most developing countries will need a two-pronged approach. Pursuing structural transformation in an age of digitalization must be mindful of the changing infrastructure, skills and policy requirements. Yet, the adoption of labour-displacing technologies would not be adviseable in countries where the creation of decent jobs is a major challenge. Opportunities can still be exploited in sectors that have not yet been subject to significant technological change. How long this remains possible depends on relative wage costs, but existing estimates suggest that for a sector such as furniture, investing in robots would not be economical for another decade (in an African middle-income country) or two (in an African least developed country).[71] Low-tech labour-intensive production can and likely will coexist with more automated and AI-enabled production.

At the same time, investments in the digital economy pay off. Recent research covering 12 African countries indicates that Internet access facilitated by submarine cables has stimulated job growth in skill-intensive occupations.[72] This suggests that low-tech production in some sectors can be combined with a parallel focus on enhancing readiness for a more digital future.[73]

Creating an enabling environment for digitalization

Section 3.1 discusses the basic building blocks for participating in the digital economy: investing in infrastructure, providing improved access to the Internet, enhancing digital skills, regulatory and data policies. Within this context, additional supportive measures can strengthen investment and trade capabilities. Skills training for employees need to be complemented by efforts to ***strengthen managerial and organizational practices and capabilities*** of firms. "Maker spaces," technology parks and business incubators can provide continued advice and mentoring for digital start-ups and can complement broader efforts of entrepreneurial knowledge creation through vocational training, internships and apprenticeships.[74]

Digital business models, characterized by intangible assets that are difficult to resell and value, pose challenges for traditional ***financing models***. Intangibles-intensive industries tend to rely more on equity finance,[75] and limited access to finance is one of the main bottlenecks for the development of the digital entrepreneurship ecosystems in developing countries. Other types of financing mechanisms, such as angel investors and venture capital, often play a role (see chapter III.B.). Governments can offer programmes and instruments for financing innovative activities in the early stages. Development banks could also play a useful role in this funding ecosystem.

Competition policies need to adjust for a digital age. Traditional enforcement tools are not well adapted to the business realities of online platforms. Non-monetary prices for consumers, personalized pricing facilitated by algorithms and other features make it difficult to define the relevant market, establish a theory of harm, or determine the type of abuse of market power under current legal frameworks. *Competition authorities need to look at markets through a wider lens*. Emerging issues include addressing competitive relationships and strategies across markets; entry barriers; conflicts of interest; the emergence of gatekeepers and bottlenecks; and the use and control of data and the dynamics of bargaining power. For example, merger control regimes should be reformed to be able to scrutinize the acquisition of small start-ups by big technology companies. Competition authorities need to analyse impacts on innovation, potential or future competition, control over data and entrenching of market power by incumbents[76] (see box II.8 for country examples).

Box II.8
Competition policies for a digital age

Countries have taken different steps to create competition policy tools adapted to the new business realities:

- The revised competition law in Germany includes new criteria to assess the market position of platforms, such as direct and indirect network effects; the parallel use of services from different providers and the switching costs for users; economies of scale arising in connection with network effects; access to data relevant for competition; and innovation-driven competitive pressure;
- The Government of India's new e-commerce rules prohibit e-commerce platforms from selling products from companies in which they have an equity interest. Platforms are required to provide services, including fulfilment, logistics, warehousing, advertisement and marketing, and payments and financing to sellers on the platform at arm's length and in a fair and non-discriminatory manner. Platforms are not permitted to mandate any seller to sell any product exclusively in their marketplaces;
- Regulation can also be used to ensure market access and level playing fields in digital markets, which may reduce the need for ex-post intervention by competition authorities. The European Union (EU) Payment Services Directive (PSD2) allows users to transfer data to other service providers. The EU also adopted a regulation to improve fairness of online platforms' trading practices in June 2019;[a]
- Competition law enforcement and regulation for big global technology companies are particularly challenging for developing countries, which often have relatively young competition authorities with limited resources. In addition, platforms do not necessarily have physical presence in countries where they operate, but their practices affect local businesses and consumers. Regional competition rules and authorities may be an option, such as COMESA Competition Commission in Africa, which reviews mergers affecting the COMESA region. The Intergovernmental Group of Experts on Competition Law and Policy of the United Nations Conference on Trade and Development provides an international forum to exchange knowledge and experiences in the area of competition law and policy.[b]

a "Regulation (EU) 2019/1150 of the European Parliament and of the Council of 20 June 2019 on promoting fairness and transparency for business users of online intermediation services", Official Journal of the European Union (2019). Available at https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1150&from=EN.

b See the latest discussions on the competition policy in the digital economy at UNCTAD, "Competition issues in the digital economy" (United Nations publication, TD/B/C.I/CLP/54, 1 May 2019); UNCTAD, "Report of the Intergovernmental Group of Experts on Competition Law and Policy on its eighteenth session" (United Nations publication, TD/B/C.I/CLP/55, 19 August 2019). Available at https://unctad.org/en/Pages/MeetingDetails.aspx?meetingid=1895.

Promoting innovation and learning in the digital economy

The public sector can also play a more proactive role by taking a variety of *demand-side measures* to support innovation. Because technology has a large tacit component (i.e., knowledge that is not codifiable), it is acquired in large part through learning by doing. Without public support, the risks and costs associated with learning and adopting new technologies can outweigh the benefits of competing with established firms from leading economies. Demand-side measures include the following:

- Strategic *public procurement* can be used to support the growth of national digital production capabilities. For example, the e-Sri Lanka initiative included provisions to support the participation of domestic firms in public IT tenders. Local content promotion was combined with capacity support and awareness raising and has increased local MSME participation in winning bids;[77]
- *Publicly funded research* often plays a catalytic role in supporting innovation. Building minimum levels of technological and production capabilities typically requires independent research and development efforts to build a solid technological base. It also requires access to the global knowledge base. The public research system can contribute to strengthening firms' capabilities to absorb, use, and eventually develop digital technologies. For example, public funding for research encourages project proposals for advanced digital production technologies in Colombia and Turkey.[78] Governments can also encourage partnerships between existing academic organizations and firms, by creating spaces for co-creation and applied research, or set up targeted research institutions that act as incubators for new businesses;[79]
- *"Mission-oriented" interventions* can provide incentives or dedicated funding for desirable technologies and outcomes.[80] Many countries have initiatives to support specific digital production technology development. Gender-responsive approaches can bring gender analysis into algorithmic and AI design. In the context of digital technologies, Governments can also try to steer research and innovation into directions that augment existing workers' skills and capabilities, rather than labour-saving technologies that replace labour and contribute to inequality or wage polarization (box II.9).[81]

Box II.9
A robot tax against dystopia?

Historically, automation did not lead to mass unemployment thanks to the emergence of new sectors and tasks satisfying new demand. But what if this time is different? What if robots and artificial intelligence outperform humans, replacing more workers than are needed for emerging tasks?

Robots and computer-assisted machines are not liable to payroll taxes. Yet, formal employer-employee relationships provide the financial bedrock for social insurance systems that also cover unemployment benefits. Rapid automation could thus provide a double shock to public finances, decreasing revenues and increasing expenditures triggered by mass job displacements.

This would require novel forms of general taxation. Some have proposed a "robot tax" to raise revenues to supplement decreasing labour taxes, and to disincentivize or slow use of job-displacing robots. Lawmakers could, for example, levy a fee on labour-replacing robots equivalent to the payroll taxes paid by employees and employers, or disallow tax deductions for businesses that invest in human-replacing technologies. This would correct current biases in the tax code, which often subsidizes capital investment, incentivizing automation where human beings would otherwise remain competitive.[a] At the same time, increasing the cost of innovative activities, through additional taxes, could dampen productivity and economic growth.

Source: UN DESA

a Daron Acemoglu and Pascual Restrepo, "Automation and New Tasks: How Technology Displaces and Reinstates Labor", Journal of Economic Perspectives, vol. 33, Issue 2 (2019).

Aligning international engagement with national policy objectives

Digital technologies have created new opportunities to access global markets. At the same time, increasing global market concentration in some core sectors of the digital economy threatens to prevent development of local digital capabilities, platforms and firms. Countries should run a coherence check on the "rules of engagement" with the global economy to assess whether they are fit for purpose for this digital age. There is also significant scope to further enhance the contributions of development cooperation, and South-South cooperation in particular, to help close digital divides (box II.10). Areas of interest include:

- ***E-commerce*** is growing quickly, but many of the poorest developing countries struggle to take advantage of opportunities created. The WTO Information Technology Agreement eliminates tariffs on a number of IT products, and WTO members do not currently impose any custom duties on electronic transmissions (see chapter III.D).[82] At the same time, the effect these measures may have on tax revenues is not fully understood, particularly as the digital economy grows in size, and in light of challenges with digital taxation. They may also put local firms at a disadvantage in those areas (such as online platforms) that are characterized by strong cross-border concentration and monopolization. Therefore, multilateral rules to regulate e-commerce may be needed to ensure a level playing field;
- The cross-border and global dominance of ***global Internet platforms*** can pose challenges for local firms. In some countries, policymakers have engaged actively with global platforms to ensure that local companies have access to them. Others have taken steps to enable the growth of local platforms. For example, prohibiting market access to global ride-sharing companies, gave local providers space to develop their own businesses in Ethiopia;[83]
- In the digital sector, ***access to technology*** can, in principle, be more straightforward, given that its products exist as pure applied and codified knowledge[84]. Open-source software makes its source code publicly available, supporting the development of absorptive capacities. On the other hand, many companies treat their source code as trade secrets. Some recent trade and investment agreements prohibit Governments from adopting any policies that require sharing of source code, except for national security reasons.[85] This includes technology transfer clauses, joint ventures and training agreements;
- Because emerging digital technologies rely on access to large amounts of digital data, the regulation of the ***flow and transfer of data across borders*** takes on increasing importance. Digital data flows easily across national borders, enabling tighter economic links, value chains and social connections. However, such data flows also create challenges for data privacy and security, economic policy and national security. In response, some countries restrict data flows, through data localization requirements, tariffs, or bans on trading data. For example, Rwanda has adopted a Data Revolution Policy that ensures that it retains exclusive sovereign rights on its national data, notwithstanding the possibility to host sovereign data outside the country under agreed terms.[86] Several recent and ongoing trade negotiations have sought to ensure free flow of data across borders by imposing constraints on national regulatory interventions. More careful analysis on the costs and benefits of free versus regulated cross border data flows is needed to understand how technology followers can maintain sufficient space for national regulatory interventions in the interest of legitimate public policies, and effectively build domestic capacities to participate in the data-driven digital economy;[87]
- As intangible assets become more important, so does the importance of ***intellectual property rights regimes*** that aim to balance the rights and interests of the creators of knowledge with those of its users and the larger public interest. Striking this balance is becoming more difficult in the digital age, particularly because of the nature of new technologies and data as a resource; ease of cross-border transactions; and because of market concentration and market power of lead firms in core ICT sectors. There is an ongoing debate whether (and if so, how) intellectual property systems need to adapt to answer new questions—for instance, whether data can qualify for intellectual property protection, or to what extent intellectual property protections could constrain national authorities in regulating AI and other algorithms with regard to their social impacts. These questions require further study and discussion.[88]

Box II.10
Development cooperation in a digital world

The adoption and utilization of digital technologies remains highly uneven across the globe. Development cooperation can help close these gaps, and international dialogue can enhance peer learning across countries in a rapidly evolving field.

Most major development cooperation providers have adopted digital strategies to promote the use of digital technologies in development projects, and to support digitalization for sustainable development in partner countries. Yet, while development cooperation actors recognize the importance of digitalization, available estimates suggest that only a small fraction of official development assistance is dedicated to it (see also chapter III.G).[a] For example, only 1 per cent of project funding by multilateral development banks targeted the information and communications technology sector between 2012 and 2016.[b]

South-South digital cooperation and regional integration initiatives can play an important role in sharing good practices and learning from existing regulatory experiences. Areas of significant promise include[c]

- *Broadband ecosystem:* More advanced developing countries can support others in developing broadband infrastructure to create a level playing field and access to opportunities arising from digital services;
- *Digital payment infrastructures and e-commerce:* Regional digital payment infrastructure capacities such as the Integrated Regional Electronic Settlement System of the Southern Africa Development Community facilitate financial transactions at the regional level and support regional e-commerce. Flanked by a regional e-commerce strategy that provides uniform rules for consumer protection, intellectual property, competition, taxation and information security, this can foster the integration of regional markets;
- *Development banks and digital entrepreneurship:* National and regional development banks can play an important role in financially supporting micro, small and medium-sized enterprises to develop digital innovations and technology for use at the regional level. Intraregional investments in digital technologies can foster technology transfers between regions if they allow source-code sharing.

Source: UN DESA

a UNCTAD, "Donor support to the Digital Economy in Developing Countries", UNCTAD Technical Notes on ICT for Development No. 13 (United Nations publication, TN/UNCTAD/ICT4D/13, March 2019).

b World Wide Web Foundation, "Closing the investment gap: How Mulitilateral Development Banks Can Contribute to Digital Inclusion" (Washington, D.C., World Wide Web Foundation, April 2018). Available at http://a4ai.org/wp-content/uploads/2018/04/MDB-Investments-in-the-ICT-Sector.pdf.

c UNCTAD, "South-South Digital Cooperation for Industrialization: A Regional Integration Agenda" (United Nations publication, UNCTAD/GDS/ECIDC/2018/1, 2018).

Endnotes

1 Chen Long and Michael Spence, "Mapping the Digital Economy in 2020" (6 December 2019). Available at https://www.project-syndicate.org/onpoint/digital-economy-analysis-management-by-chen-long-and-michael-spence-2019-11.

2 The World in 2050 initiative, *TWI2050 Report: The Digital Revolution and Sustainable Development: Opportunities and Challenges* (Laxenburg, International Institute for Applied Systems Analysis, 2019).

3 ITU, "Digital Technologies for Achieving the 2030 Agenda" (forthcoming).

4 For an overview of current studies and estimated job losses, see Thereza Balliester and Adam Elsheikhi, "The Future of Work: A Literature Review", ILO Research Department Working Paper No. 29 (Geneva, International Labour Office, 2018); Andrew Keisner and others, "Breakthrough technologies – Robotics, innovation and intellectual property", WIPO Economic Research Working Paper No. 30, (Geneva, WIPO, 2015).

5 David Autor and David Dorn, "The Growth of Low-Skill Service Jobs and the Polarization of the US Labor Market", *American Economic Review*, vol. 103, Issue 5 (August 2013), pp. 1553-1597.

6 Dani Rodrik, "New Technologies, Global Value Chains, and the Developing Economies", Pathways for Prosperity Commission Background Paper Series No.1 (Oxford, Pathways for Prosperity Commission, 2018).

7 Dani Rodrik, "Premature deindustrialization", *Journal of Economic Growth*, vol. 21, Issue 1 (2016).

8 Raul Katz and Fernando Callorda, *The economic contribution of broadband, digitalization and ICT regulation* (Geneva, ITU, 2018). Available at https://www.itu.int/pub/D-PREF-EF.BDR-2018.

9 See for example, for a 'techno-pessimist' view, Robert J. Gordon, *The Rise and Fall of American Growth: The U.S. Standard of Living since the Civil War* (Princeton, Princeton University Press, 2015).

10 Erik Brynjolfsson, Daniel Rock and Chad Syverson, "Artificial Intelligence and the Modern Productivity Paradox: A Clash of Expectations and Statistics", *The Economics of Artificial Intelligence: An Agenda* (Chicago and London, The University of Chicago Press, 2019). Available at https://faculty.chicagobooth.edu/chad.syverson/research/aiparadox.pdf.

11 ITU, *Measuring digital development: Facts and figures 2019* (Geneva, ITU, 2019). Available at https://www.itu.int/en/ITU-D/Statistics/Documents/facts/FactsFigures2019.pdf.

12 Robert Bartlett and others, "Consumer-Lending Discrimination in the FinTech Era", NBER Working Paper No. 25943 (Cambridge, National Bureau of Economic Research, June 2019).

13 Mark West, Rebecca Kraut and Han E, "I'd blush if I could: closing gender divides in digital skills through education" (EQUALS Skills Coalition and UNESCO, 2019).

14 *Digital Economy Report 2019: Value Creation and Capture: Implications for Developing Countries* (United Nations publication, Sales No. E.19.II.D.17).

15 The World in 2050 initiative, *TWI2050 Report: The Digital Revolution and Sustainable Development: Opportunities and Challenges*.

16 Pathways for Prosperity Commission, "Charting Pathways for Inclusive Growth: From Paralysis to Preparation" (Oxford, Pathways for Prosperity Commission, 2018). Available at https://pathwayscommission.bsg.ox.ac.uk/charting-pathways-report.

17 Avi Goldfarb and Catherine Tucker, "Digital Economics", *Journal of Economic Literature*, vol. 57, Issue 1 (March 2019), pp. 3-43. Available at https://doi.org/10.1257/jel.20171452.

18 See for example Carl Benedikt Frey and Michael Osborne, "The Future of Employment: How Susceptible are Jobs to Computerisation?", Oxford Martin School Working Paper (Oxford, University of Oxford, 17 September 2013). Available at https://www.oxfordmartin.ox.ac.uk/downloads/academic/future-of-employment.pdf.

19 See for example *Digital Economy Report 2019*.

20 See for example Ana Paula Cusolito, Raed Safadi and Daria Taglioni, *Inclusive Global Value Chains: Policy Options for Small and Medium Enterprises and Low-Income Countries* (Washington, D.C., World Bank and OECD, 22 August 2016). Available at https://openknowledge.worldbank.org/handle/10986/24910.

21 *Digital Economy Report 2019.*

22 Ibid.

23 See for example David Autor and others, "The Fall of the Labor Share and the Rise of Superstar Firms", Quarterly Journal of Economics (forthcoming).

24 *Digital Economy Report 2019.*

25 *World Development Report 2016: Digital Dividends* (Washington, D.C., World Bank, 2016).

26 *ICT Infrastructure business planning toolkit 2019* (Geneva, ITU, 2019). Available at https://www.itu.int/dms_pub/itu-d/opb/pref/D-PREF-EF.ICT_STRUCT_KIT-2019-PDF-E.pdf.

27 *Global Value Chain Development Report 2019: Technological Innovation, Supply Chain Trade, and Workers in a Globalized World* (Geneva, WTO, 2019).

28 *ICTs, LDCs and the SDGs: Achieving universal and affordable Internet in the least developed countries* (Geneva, ITU, 2019). Available at https://www.itu.int/dms_pub/itu-d/opb/ldc/D-LDC-ICTLDC-2018-PDF-E.pdf.

29 Ibid.

30 Maya Escueta and others, "Education technology: an evidence-based review", NBER Working Paper No. 23744 (Cambridge, National Bureau of Economic Research, August 2017).

31 *The State of the World's Children 2017: Children in a Digital World* (New York, UNICEF, 2017)

32 *SME Competitiveness Outlook 2018: Business Ecosystems for the Digital Age* (Geneva, ITC, 2018).

33 *World Development Report 2016: Digital Dividends*.

34 *Digital Economy Report 2019.*

35 Ibid.

36 See for example *Digital Economy Report 2019;* OECD, "Data in the digital age" (Paris, OECD, March 2019).

37 White and others, *Digital identification: A key to inclusive growth* (McKinsey Global Institute, April 2019).

38 Sushil Bikhchandani and Sunil Sharma, "Herd behavior in financial markets", IMF Working Paper WP/00/48 (Washington, D.C., IMF, 2000).

39 GSMA, "2017 State of the Industry Report on Mobile Money" (London, GSMA, 2018). Available at https://www.gsma.com/mobilefordevelopment/resources/2017-state-industry-report-mobile-money/.

40 Nika Naghavi, "Sub-Saharan Africa: The enduring epicentre of mobile money – Part 2". Available at https://www.gsma.com/mobilefordevelopment/africa/sub-saharan-africa-the-enduring-epicentre-of-mobile-money-part-2/.

41 World Bank, "Remittance Prices Worldwide", (Washington, D.C., World Bank, 2019).

42 Tobias Berg and others, "On the rise of fintechs–credit scoring using digital footprints", NBER Working Paper No. 24551 (Cambridge, Massachusetts, National Bureau of Economic Research, April 2018).

43 For example, comparing the default predictions that a hypothetical lender would make by using a traditional statistical model to predictions derived from an algorithm that bases lending decisions on supervised machine learning techniques, data from US mortgage lending suggests that the gains from fintech based lending tend to favor racial groups that already face an advantage in traditional credit markets.

44 Andreas Fuster and others, "Predictably Unequal? The Effects of Machine Learning on Credit Markets" (6 November 2018).

45 For example, in 2017 one Sub-saharan African country reported a growth of 2000 SME loans vs. 2 million consumer loans, see https://www.boz.zm/credit-market-monitoring-reports.htm.

46 Joseph Stiglitz and others, *Stability with Growth: Macroeconomics, Liberalization and Development* (Oxford, Oxford University Press, 2006).

47 Manoj Kashyap and others, "Global FinTech Report 2017" (London, PwC, 2017). Available at https://www.pwc.com/gx/en/industries/financial-services/assets/pwc-global-fintech-report-2017.pdf.

48 Kathryn Petralia and others, *Banking disrupted? Financial Intermediation in an Era of Transformational Technology*, Geneva Reports on the World Economy 22 (Geneva, ICMB Studies, 2019).

49 Ibid.

50 Johannes Ehrentraud and others, *Policy responses to fintech: a cross-country overview*, FSI Insights on policy implementation, No. 23 (BIS, January 2020).

51 Nicol Turner Lee, Paul Resnick and Genie Barton, "Algorithmic bias detection and mitigation: Best practices and policies to reduce consumer harms", Brookings Report (Washington, D.C., Brookings Institution, 22 May 2019).

52 Chales Taylor, Aquiles Almansi and Aurora Ferrari, "Prudential Regulatory and Supervisory Practices for Fintech: Payments, Credit and Deposits" (Washington, D.C., World Bank, 2020).

53 Marco Cangiano, Alan Gelb and Ruth Goodwin-Groen, "Public Financial Management and the Digitalization of Payments", CGD Policy Paper 144 (Washington, D.C., CGD, June 2019).

54 AlphaBeta, "Digital Innovation in Public Financial Management (PFM): Opportunities and implications for low-income countries" (AlphaBeta, July 2018).

55 Sanjeev Gupta and others (eds.), *Digital Revolutions in Public Finance* (Washington, D.C., IMF, 2017).

56 Asli Demirgüç-Kunt and others, The Global Findex Database 2017: Measuring Financial Inclusion and the Fintech Revolution (Washington, D.C., World Bank, 2018).

57 Reserve Bank of India, "Trend and Progress of Banking in India 2017 - 2018" (Mumbai, Reserve Bank of India, 2018), p.79. Available at https://www.rbi.org.in/scripts/AnnualPublications.aspx?head=Trend%20and%20Progress%20of%20Banking%20in%20India.

58 OECD, "Productivity in Public Procurement: A Case Study of Finland: Measuring the Efficiency and Effectiveness of Public Procurement", (Paris, OECD, 2019). Available at https://www.oecd.org/gov/public-procurement/publications/productivity-public-procurement.pdf.

59 See for example *Digital Economy Report 2019.*

60 *World Social Protection Report: Universal social protection to achieve the Sustainable Development Goals* (Geneva, ILO, 2017).

61 Policy options presented below draw heavily on the Report for the Recurrent Discussion on Social Protection. Christina Behrendt and Quynh Anh Nguyen, *Innovative approaches for ensuring universal social protection for the future of work*, ILO future of work research paper series (Geneva, ILO, 2018).

62 See for example Richard Baldwin, *The Great Convergence: Information Technology and the New Globalization* (Cambridge, Harvard University Press, 2016).

63 *Trade and Development Report 2018: Power, Platforms and The Free Trade Delusion* (United Nations publication, Sales No. E.18.II.D.7).

64 Dani Rodrik, "Premature deindustrialization".

65 Richard Baldwin, *The Globotics Upheaval: Globalization, Robotics, and the Future of Work* (Oxford, Oxford University Press, 2019).

66 *Global value chain development report 2019: Technological Innovation, Supply Chain Trade, and Workers in a Globalized World* (Geneva, WTO, 2019).

67 Ibid.

68 Mary Hallward-Driemeier and Gaurav Nayyar, *Trouble in the Making? The Future of Manufacturing-Led Development* (Washington, D.C., World Bank, 2018).

69 Dani Rodrik, "New Technologies, Global Value Chains, and the Developing Economies".

70 See, for instance, UNCTAD Rapid eTrade Readiness Assessment. Available at: https://unctad.org/en/Pages/Publications/E-Trade-Readiness-Assessment.aspx.

71 Karishma Banga and Dirk Willem te Velde, "Digitalization and the future of manufacturing in Africa" (London, ODI, March 2018).

72 Jonas Hjort and Jonas Poulsen, "The Arrival of Fast Internet and Employment in Africa", *American Economic Review*, vol. 109, Issue 3 (March 2019), pp. 1032-79.

73 Karishma Banga and Dirk Willem te Velde, "Digitalization and the future of manufacturing in Africa". Available at https://www.odi.org/publications/11073-digitalisation-and-future-manufacturing-africa.

74 *Digital Economy Report 2019.*

75 Jonathan Haskel and Stian Westlake, *Capitalism without capital: the rise of the intangible economy* (Princeton, Princeton University Press, 2018).

76 UNCTAD, "Report of the Intergovernmental Group of Experts on Competition Law and Policy on its eighteenth session" (United Nations publication, UNCTAD/TD/B/C.I/CLP/55, 2019). Available at https://unctad.org/meetings/en/SessionalDocuments/ciclpd55_en.pdf.

77 Fernando Santiago and Miriam Weiss, "Demand-driven policy interventions to foster sustainable and inclusive industrial development in developing countries", Inclusive and Sustainable Industrial Development Working Paper Series WP 17 (Vienna, UNIDO, 2018). Available at https://www.unido.org/api/opentext/documents/download/10378548/unido-file-10378548.

78 UNIDO, "Industrial Development Report 2020: Industrializing in the digital age" (Vienna, UNIDO, 2019).

79 OECD, "Innovation policies in the digital age", OECD STI Policy Papers No. 59 (Paris, OECD, November 2018).

80 Mariana Mazzucato, *The Entrepreneurial State* (London, Anthem Press, 2014).

81 Anton Korinek, "Labor in the Age of Automation and Artificial Intelligence", Econfip Research Brief (January 2019). Available at https://econfip.org/wp-content/uploads/2019/02/6.Labor-in-the-Age-of-Automation-and-Artificial-Intelligence.pdf.

82 *Global value chain development report 2019: Technological Innovation, Supply Chain Trade, and Workers in a Globalized World* (Geneva, WTO, 2019).

83 *Digital Economy Report 2019.*

84 see *Financing for Sustainable Development Report 2019* (United Nations publication, Sales No. E.19.I.7)

85 *Trade and Development Report 2018: Power, Platforms and the Free Trade Delusion* (United Nations publication, Sales No. E.18.II.D.7).

86 Ibid.

87 *Digital Economy Report 2019.*

88 Ibid.

89 Vincent Glode, Christian C. Opp, Xingtan Zhang, "On the efficiency of long intermediation chains", *Journal of Financial Intermediation*, vol.38 (2019), pp. 11-18.