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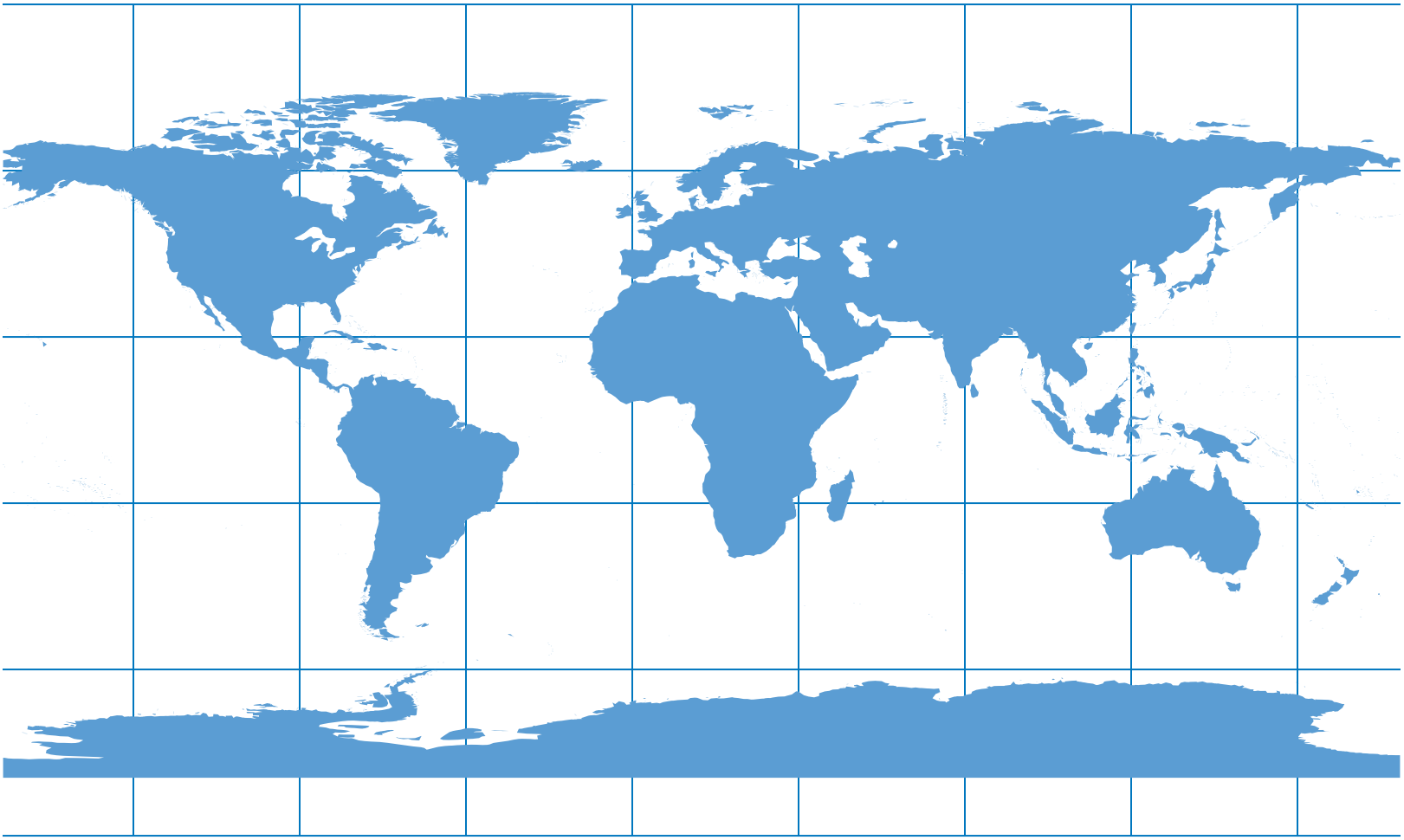
Frontier technologies for sustainable development



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Chapter V

International cooperation for managing frontier technologies

Introduction

International cooperation will play an increasingly important role in shaping the impact of frontier technologies in an age of globalization and interconnectedness

Previous chapters of the *Survey* have demonstrated that frontier technologies possess a strong transformative potential and that institutions and policies play a crucial role in determining how this potential is realized in each country and community. Policies can — and will — determine the impact of those technologies on the Sustainable Development Goals (SDGs). While national policies remain critical, international cooperation will play an increasingly important role in shaping the impact of frontier technologies in an age of globalization and interconnectedness.

For example, without international cooperation, the technology divide discussed in chapter IV will not be bridged. Accordingly, the international community should consider options to facilitate technology transfer and foster national innovation capabilities. Moreover, making the knowledge that underpin certain key technologies more freely accessible at the global level may be crucial to ensuring our common future in the planet.

A concerted international effort will ensure that gains derived from new technological breakthroughs are more equitably distributed within and across countries

Without effective international cooperation, stringent regulations in one country will create opportunities for regulatory arbitrage among countries. In addition, a race to the bottom can occur if countries use less stringent regulations as a strategy to attract foreign investment and participate in global value chains. A case in point is that of differential rates of corporate international taxation. A concerted international effort will be required to ensure that gains reaped through the new technological breakthroughs are more equitably distributed within and across countries to the benefit of all.

The rapid pace of technological change, the uncertainty associated with it, and specific characteristics of emerging technologies may render traditional policymaking cycles and processes inadequate. Those characteristics include their speed of diffusion, the way in which they cross jurisdictional, regulatory and disciplinary borders, and their increasingly political profile in terms of how they embed and exhibit human values and bias (Schwab, 2018). As stated by the Secretary-General of the United Nations, it is crucial to avoid the naïve idea that "traditional forms of regulation like the ones we have today will work to address the challenges of the future" (United Nations, 2017a).

Regulatory mechanisms that bring together all stakeholders — including not only Governments, companies and scientists but also the civil society and academia — are needed. These frameworks must foster freedom of innovation, which is absolutely essential for the future of humankind, while at the same time, protecting and upholding human rights, which is critical for maintaining social cohesion, stability and peace.

Frontier technologies require policy processes that are flexible and adaptable…

Frontier technologies require policy processes that are flexible and adaptable (United Nations, 2018b). In technology development, experimentation generates perspective, revealing not only what technologies can do but also what they cannot do; and provides

some idea of when and at what scale a technology is appropriate. A similar approach to policies, institutions and regulation should be fostered.

…capable of incorporating information and emerging knowledge

A more flexible policy process, capable of incorporating information and emerging knowledge, will be needed to scope, assess, implement and monitor policy interventions. Innovation hubs and public policy labs which embody the spirit of experimentation and inclusion already exist in some countries. Such labs are found, for example, in the European Union[1] and in some cities in the United States of America.[2]

The present chapter addresses the issue of market-power concentration while underscoring that bridging the technology divide makes international cooperation imperative. The "winner-take-most" phenomenon has allowed a small number of technology firms to dominate their respective industries at the global level, challenging traditional checks and balances at the national level. International cooperation must therefore address excessive market power in the frontier technology sectors. This chapter also identifies the challenges faced by international taxation in the context of the digital economy and digitalization. Those operating within the current tax framework, designed with the traditional brick-and-mortar economy in mind, find themselves in uncharted territory when attempting to tax income associated with intangible activities and transactions enabled by the Internet and frontier technologies. The chapter also explores broader ethical questions, complementing the discussion presented in chapter II. It highlights a range of initiatives that are being undertaken by nations and jurisdictions worldwide with the aim of creating or updating relevant laws and regulations so as to ensure that they reflect the evolving challenges associated with emerging technologies.

A global dialogue, involving all stakeholders, is needed to identify the risks and opportunities associated with frontier technologies

The chapter concludes with a discussion on the wider role that is being played by the United Nations through support to Member States as they strive to shape new technologies in ways that promote the common good, human dignity and prosperity and protect the environment. While many frontier technologies present immense opportunities for fostering sustainable development, they also pose considerable risks. A global dialogue, involving all stakeholders, is needed to identify those risks and opportunities. The United Nations can serve as an impartial facilitator among Governments, the private sector and civil society organizations for the presentation of objective assessments of the impact of emerging technologies on sustainable development outcomes.

Bridging the technological divide

The technological divide — both between and within countries — poses significant challenges to the achievement of sustainable development, as highlighted in chapter III. Other chapters, chapter IV in particular, have revealed glaring differences in innovative and absorptive capacities among countries, drawing attention to the persistent, and even growing, technology divide among countries. In its resolution 72/242, the General Assembly noted with concern that "important and growing divides with regard to science and technology remain between and within developed and developing countries".

The technological divide is driven by both inadequate access to and suppressed demand for technologies

The technological divide, however, is not driven exclusively by lack of access to emerging technologies. While it is necessary to improve access to new technologies, granting access does not necessarily translate into their widespread adoption and diffusion. New

1 See https://ec.europa.eu/jrc/en/news/policy-labs-innovative-take-public-administrations-better-policies.

2 See www.governing.com/commentary/col-data-policy-labs-states-urgently-need.html.

technologies that are clearly superior to existing alternatives have not always being widely adopted, despite active and continuous interventions from the development community. In this regard, there is increasing awareness of the importance of feed-back linkages between supply and demand in the innovation process, particularly of how feedbacks from users can help to better direct resources and capabilities for innovation to meet societal or market needs (OECD, 2011). Clearly, the factors that suppress demand for welfare-improving technologies need to be addressed.

Support international technology transfer and national innovation

One key challenge for bridging the technology divide is to improve access to technologies. As discussed in chapter IV, many developing countries tend to rely heavily on foreign technology adoption in advancing their national technological development. Developing countries also need to achieve a certain level of indigenous innovation activity in order to build absorptive capacity and, eventually, move closer to the global technological frontier.

The international community has a role to play in supporting both cross-border technology transfer and nations' indigenous innovation efforts

The international community has a role to play in supporting both cross-border technology transfer and nations' indigenous innovation efforts. The following discussion highlights four areas in which international cooperation can be particularly conducive to improving access to technologies. The discussion aims at promoting an international discussion on their potential and our common future, while acknowledging at the same time that some of the proposals may be difficult to achieve.

Improve flexibilities of the global intellectual property rights (IPR) regime

Rigidities in the global IPR regime make technology transfer difficult

The protection of intellectual property rights (IPR) serves to encourage innovation by ensuring that innovators are sufficiently compensated for their efforts.[3] However, rigidities in the global IPR regime make technology transfers difficult. The IPR protections within the World Trade Organization (WTO) framework are not aligned adequately with the needs of developing countries, as they often tilt towards protecting well-established rights, traditionally emanating from developed countries. This view is echoed in the 2011 *Survey* (United Nations, 2011), where it is argued that the world's heavy reliance on private transfer of technology — supported by the current global IPR regime — is not necessarily optimal, as private investment-dependent technological diffusion would be too slow.

The TRIPS Agreement allows WTO member States to retain some important flexibilities in accessing technologies through international channels

The World Trade Organization Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) has nevertheless allowed WTO member States to retain some important flexibilities in terms of accessing technologies through international channels (Kamperman Sanders, 2018). One example is the latitude provided by the Agreement to countries in interpreting three criteria of patentability, i.e., novelty, involvement of an inventive step, and industrial applicability, taking into account domestic

3 At national levels, protection of IPR involves a range of institutions, including legislative bodies (which design IPR laws), judicial systems (which adjudicate IPR-related disputes), national patent and trademark offices (which administer the patent and trademark systems) and tax and trade authorities (which enforce IPR measures that involve taxation and tariffs). At the international level, the TRIPS Agreement — the most comprehensive multilateral IPR agreement — anchors the global IPR regime, which also consists of a wide range of trade and investment agreements having IPR components. WTO and the World Intellectual Property Organization (WIPO) are two multilateral entities that provide international forums for discussing and making decisions on IPR-related matters.

development objectives.[4] For example, in 2015, the WTO Council for Trade-Related Aspects of Intellectual Property Rights extended — until January 2033 — its previous decision on exempting the pharmaceutical products of least developed countries (LDCs) from complying with key provisions of the TRIPS Agreement. Among other things, the exemption allows LDCs to choose whether or not to protect pharmaceutical patents and clinical trial data.[5] Yet another flexibility under the patent system makes it possible for countries to engage in compulsory licensing, i.e., a Government can allow someone else to produce the patented product or process without the consent of the original patent owner. Bond and Saggi (2016) argue that compulsory licensing is perhaps the most important kind of flexibility provided by the TRIPS Agreement.[6] Specifically, article 31 of the Agreement outlines the conditions under which compulsory licensing is allowed, while leaving space for Governments to interpret those conditions.

Lack of access to original test data poses challenges to reproduction of a technology by other firms, even if they have been granted a compulsory license

Even with a compulsory license, countries can still face considerable challenges. A key challenge revolves around the issue of "data exclusivity", through which protection of clinical trial data is granted to the original patent holder (Kamperman Sanders, 2018).[7] In the case of pharmaceutical products, the existence of data exclusivity imposes constraints on non-patent owners' access to clinical trial data, which are costly and time-consuming to generate, but central to establishing the safety and efficacy of generic products.[8] Lack of access to such data therefore poses significant challenges to other firms with respect to reproducing a technology, even if they have been granted a compulsory licence.

The international community would require a multi-pronged flexible approach, granting developing countries sufficient latitude in determining their national patentability standards, maintaining or even expanding patent exemptions for LDCs and other countries far away from the global technological frontier, creating conditions that make compulsory licensing more feasible and effective, and making access to technology data more inclusive.

Ensure national policy space for indigenous innovation

Despite the long-standing stalemate at the Doha Development Round, strengthening multilateralism offers the best option for developing countries with respect to addressing the issue of reduced policy space and exercising their collective power to ensure that trade liberalization fosters sustainable development. In its 2018 report, the Inter-agency Task Force on Financing for Development (IATF) has called on WTO members to show col-

4 Countries that have recently changed patentability standards include India (in 2005) and the contracting States of the European Patent Convention (in 2010). Effectively, these practices allow authorities to reduce the number of patents that do not facilitate significant innovation, but rather serve mainly as a hindrance to technology transfer. See Ali and Rajagopal (2017); Beatty (2011).

5 See www.wto.org/english/news_e/news15_e/trip_06nov15_e.htm.

6 The case of the pharmaceutical industry of Bangladesh attests to the potential of compulsory licensing in advancing domestic technological development (Gay, 2018). In effect, room to engage in compulsory licensing — a vital global support measure for the industry — has allowed Bangladesh to pursue an industrial policy that has successfully promoted its pharmaceutical sector through import substitution and, increasingly, export promotion.

7 Typical examples of such data include clinical trial data that are submitted by patent owners in the process of obtaining marketing authorization for pharmaceutical products (ibid.).

8 For example, European Union legislation for medicines grants the originator of an innovation exclusive rights over data regardless of the reasons for the licence and even in emergency situations ('t Hoen, Boulet and Baker, 2017).

lective leadership by reiterating their commitment to open, fair and mutually beneficial trade, which is crucial for supporting technology transfers, economic growth and prosperity (United Nations, 2018a, chap III.D, recommendation 1).

In addition to the global IPR regime, traditional bilateral and regional international trade agreements (RTAs) and international investment agreements (IIAs) have had restrictive effects on domestic policy space and innovation (United Nations, 2011) which extend beyond the scope of WTO. There has been an evolution of the focus of RTAs from tariffs and rules of origin to the removal of impediments and the reduction of costs and risks associated with the operations of international production networks. In this context, RTAs continue to restrict policy space, leading to competitive liberalization in developing countries and to the premature adoption of policies not necessarily compatible with their development needs (Cortez and Arda, 2015, pp. 155–156).

Traditional international investment agreements often constrain countries' regulatory space and increase their vulnerability to financial penalties from investor-State disputes

In turn, application of traditional IIAs has often had unintended impacts, such as constraining regulatory space and increasing countries vulnerability to financial penalties levied by arbitration panels set up to settle investor-state disputes, including disputes related to intellectual property rights (Kamperman Sanders, 2018).[9] To align IIAs with the SDGs, countries have embarked on a reform process whose aim is to create a new generation of IIAs (United Nations, 2018a, p. 124). This process encompasses the need to preserve regulatory space, including for industrial policy, and improvements to, or omissions of, investor-state dispute settlement (UNCTAD, 2018, p. 96). Member States are also undertaking efforts to reform outdated IIAs, progressively increasing their coherence with their country's national development strategy. Policy space for supporting innovation should be at the centre of such efforts.

Harmonize national and international technology standards

Technology standard-setting is a crucial process within the domain of technology innovation and diffusion. For example, the introduction of the Global System for Mobile Communications (GSM) standard, which describes the protocols for second-generation digital cellular networks used by mobile devices, illustrates how standard harmonization has been instrumental in diffusing mobile communication technology (Gruber and Koutroumpis, 2010). A widely accepted standard can also help to close the technology divide by reducing users' adoption cost (Hall, 2006).

A unified national strategy for setting technology standards can help prevent the problem of duplicative efforts and conflicting standards from arising

The existence of standards can promote innovation by facilitating new products' interoperability and marketability. In practice, standard-setting processes are complex and very often involve competitors who would like to steer the direction of the standard towards their own interest (Burrone, n.d.). As multitude of entities are involved in setting technology standards, it is important that a country has a unified national standards strategy which can help prevent the problem of duplicative efforts and conflicting standards from arising.

In setting standards, patent holders are moving away from formal standardization bodies towards flexible standard-setting organizations, where terms of use, the essential

9 Intellectual property is recognized as an investment under bilateral investment treaties, leading to a situation where investors can take national Governments to task over issues of expropriation of property, in breach of fair and equitable treatment (FET) obligations, but also over diminishment of the value of an investment, in breach of legitimate expectations of the investor (ibid., p. 20).

character of patents and royalty rates can be negotiated more freely (Kamperman Sanders, 2018). As standard-setting is increasingly carried out by informal standard-setting organizations led by the private sector, Governments need to strengthen their participation and that of all relevant stakeholders in the processes involved so as to ensure transparency and accountability. It is important to consider that, while standards can exert significant positive impacts, they may also have a negative effect on social welfare by restricting how goods and services are produced. They could also serve as non-tariff barriers, by necessitating excessive testing and even redesigns of products (National Institute of Standards and Technology, 2000).

Global collaboration should aim at establishing internationally accepted principles on developing standards and ensuring consistent interpretation and application of such principles

At the global level, countries should collaborate on establishing internationally accepted principles on developing standards and on ensuring consistent interpretation and application of those principles (United States Standards Strategy Committee, 2016), identifying how technology standards unfairly disadvantage competition and reduce social welfare. There should be a clear international understanding of how standards developed by informal standard-setting organizations can be used in regulation. International cooperation could help to establish a broad acceptance of the use of such standards, reducing the possibility of ending up with conflicting national and regional standards.

Identify and provide technologies as global public goods

Advances in several frontier technologies can help humanity confront many existential threats, including rising sea levels as well as droughts and floods. These challenges make identification and provision of certain emerging technologies as global public goods — i.e., goods that confer quasi-universal benefits on different countries, peoples and generations and whose consumption at the global level is characterized by non-rivalry and non-excludability — an important consideration for the international community.[10]

Provision of an emerging technology as a global public good requires that it be freely accessible globally

Many emerging technologies — notably those that could help to reverse climate change, enhance environmental sustainability or combat pandemics — could be provided as global public goods, by making the knowledge that underpins them more freely accessible at the global level. Provision of such technologies as global public goods would maximize the benefits they produce, supporting our common purpose of ensuring a liveable planet for present and future generations.

An institutional framework is needed to ensure that choices of global public goods reflect stakeholders' aggregated preferences

While the motivation underlying the provision of certain technologies as global public goods is clear, implementation can be complicated. Some have suggested that it should begin with a multi-stakeholder participatory process for the purpose of determining what technologies should be considered global public goods and how they should be produced and distributed (Kaul and others, 2003). An institutional framework would be needed to support this deliberative process. Such a framework should support stakeholders in making choices that are balanced with regard to global public goods — that is to say, sufficiently reflective of aggregation of stakeholders' preferences — and surmounting selected global challenges efficiently, which requires a better understanding of available solutions and of their conditions of implementation (Brousseau, Dedeurwaerdere and Siebenhüner, 2017).

The Intergovernmental Panel on Climate Change (IPCC), for example, whose central objective is to provide climate change assessment and policy options for adaptation and mitigation, could constitute such a framework. It is an organized process that is both global and centralized and, and which at the same time requires considerable coordination among

10 This is the definition provided by Kaul, Grunberg and Stern (1999).

the contributors to its assessment reports who hail from around the world. While the ability of the IPCC assessment reports to identify climate-related challenges is widely acknowledged, their efforts to generate context-specific solutions have generally been less effective.

In practice, the international community faces a major challenge in facilitating flow of technologies and knowledge which can be made functionally excludable by the entities in the private sector that own them (Taylor, 2016), owing perhaps to the significant commercial value that accrues to firms by controlling these technologies or the constraints associated with contractual rights and property claims, e.g., with respect to data sharing. For efficient provision of technologies as global public goods, the aforesaid incentive-related and legal obstacles would need to be addressed.

Efficient provision of technologies as global public goods would need to address incentives and legal obstacles

Overcome constraints on technology adoption

As emphasized at the beginning of this section, technology use is determined jointly by supply- and demand-side factors. While improving access to new technologies is important, their potential benefits clearly cannot be realized if there is no demand for such technologies. Still, there is considerable room for the international community to facilitate both access to and use of relevant new technologies.

One key step is to promote a dual focus by international development projects — on addressing both supply- and demand-side constraints on technology adoption. This would require acquiring a deeper understanding of the domestic formal and informal institutions — including social and cultural norms and structures of social networks — and how they affect technology adoption behaviour, rather than simply imposing new technologies on communities. One mechanism that is addressing demand-side constraints is the newly established Technology Bank, which aims at helping LDCs obtain more complete information on new technologies and how they can be applied within the context of country-specific circumstances.

A dual focus of international development projects — on addressing both supply- and demand-side technology adoption constraints — should be promoted

Foster technological trust

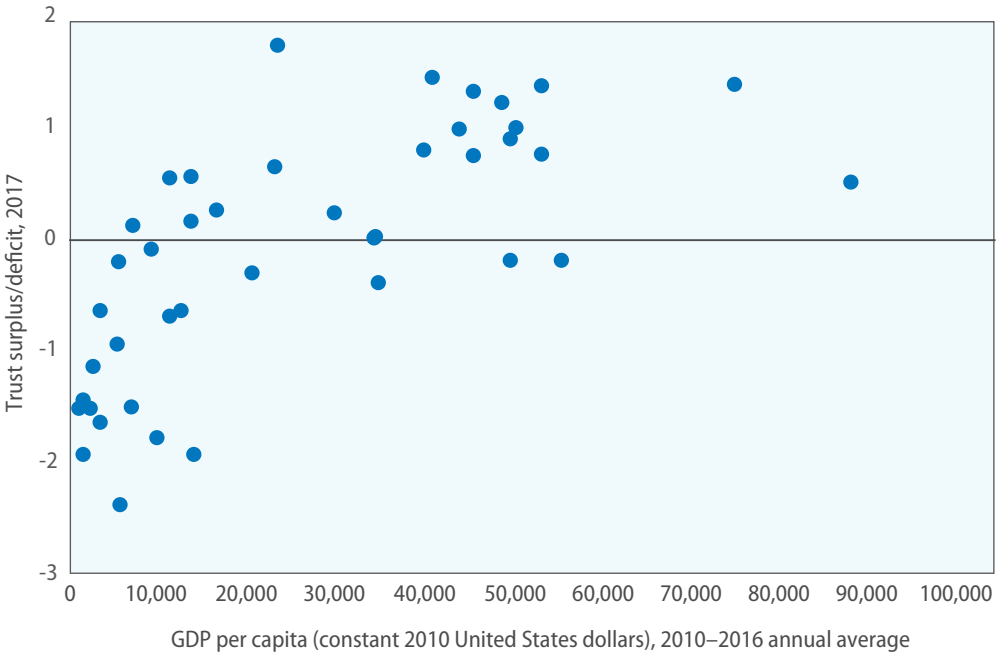
Among the many factors that drive demand for technologies, trust in technology is arguably one of the most important. Building technological trust is particularly important for developing countries, as they tend to experience lower levels of trust in a new technology (see figure V.1). Chakravorti and Chaturvedi (2017) argue that building trust in digital technology would require proper protection of privacy, security and accountability. Ultimately, it is all about protecting fundamental human rights in the digital environment, an issue introduced in chapter II. The expanding scope of harms perpetrated in the digital sphere, which do not respect national borders, calls for multilateral action to proactively define and protect human rights within the digital context (see section on big data below). Developing a definitive global standard on data governance needs to be a crucial component of multilateral efforts, given the pervasiveness of data in the modern technology environment.

Public trust in technologies would also most likely be strengthened if it could be shown that they improve public sector performance. Indeed, digitalization has already contributed to an increase in public sector efficiencies and a reduction of the costs of public finance management. Such gains are accruing from the generation of more and better data, better data management systems and higher-level computer processing power, which can also lead to better policy design (Gupta and others, 2017).

Digitalization has contributed to an increase in public sector efficiencies and a reduction of costs in public finance management

Given that the potential of many of these technologies is still not fully understood, one of the very first steps towards optimizing their use would be to take stock of the ongoing related technology initiatives around the world. The international community can build a database that systematically documents the results of those initiatives, which can then be used to inform future application and regulation of the technology. The establishment of the Technology Facilitation Mechanism platform is an important step in that direction.

Figure V.1
Digital trust surplus/deficit across countries



Source: UN/DESA calculation, based on data from Chakravorti and Chaturvedi (2017) and World Bank, World Development Indicators.

Note: Trust surplus/deficit is defined as the gap between users' digital trust environment experience and their tolerance for friction of digital commerce engagement. A higher trust surplus level suggests that users are more patient online and willing to engage with new technologies. Both the level of the digital trust environment experience and that of the tolerance for digital commerce engagement friction are placed along a score scale ranging from 0 to 5, with 5 being the most positive score. As the trust surplus/deficit variable is defined as the difference between the two variables, it runs from -5 to 5, with 5 denoting the highest level of trust surplus. There are 42 countries in the sample.

Addressing the concentration of market power in frontier technologies

An important facet of the technology divide is the gap, among firms, in innovation output and market power. Certain emerging sectoral features — notably the existence of network effects — and global economic integration have contributed to the rise of the "winner-take-most" phenomenon, which allows a small number of firms to dominate their respective industries at the global level and earn growing rents. Firms developing many frontier technologies in the digital domain are increasingly global, controlling an ever-increasing share of their market.

The present section emphasizes the need for international cooperation, given that competition policy has gone global in the last 20 years (OECD, 2014). A rapidly increasing number of competition cases currently have an international dimension, which can be attributed partly to increasing international trade and investment and the growth of global supply chains. This section examines specific developments that have led to the rapid concentration of market power worldwide and particularly in new sectors, including frontier

technologies in the digital domain. Specifically, it discusses how the rise of big data and algorithms, and certain shortcomings of the patent system, could pose further challenges to promotion of fair competition.

Increasing market concentration raises concerns

There are concerns that rising market concentration reflects not only leading firms' higher productivity, but also network effects, economies of scale and economies of scope

As discussed in chapter IV, there is a broad trend towards higher market concentration across different industries and, notably, the technology sector around the world. Autor and others (2017) have shown that—in the case of the United States—the rise in market concentration is correlated with a growing number of patents per worker. They also show that that rise in concentration was faster in sectors where labour productivity rose faster. There are, however, deep concerns that such market power concentration also reflects factors other than the superiority of the leading firms' products and services. In fact, the consensus is that many of the world's most dominant technology firms—as early winners in the current technological landscape—have benefited from technology externalities (or network effects), economies of scale and economies of scope (OECD, 2017b). These effects could potentially allow them to remain dominant, without necessarily being more innovative than their competitors.

While the work of Autor and others (2017) suggests that market concentration has not yet produced a notable adverse impact on overall economic productivity, the authors do raise the possibility that firms that initially capture a high market share owing to their superior productivity or innovations later use their dominant position to erect barriers to entry which deters competition. If rising market power concentration is accompanied by a more frequent engagement in anticompetitive behaviours, it could hurt the industry's overall innovation efforts and eventually hamper productivity growth.

There are also growing concerns regarding "regulatory capture", which generally refers to a situation where policymakers or enforcement agencies are in a constant state of "being persuaded" or influenced by powerful firms (Hempling, 2014). The recent ramp-up of major technology companies' spending on lobbying has raised concerns that those firms may acquire unfair advantages through political means.[11]

Big data and algorithms have radically changed market competition

The rise of big data and algorithms, which has become an important feature of the competition landscape, present a new challenge to traditional competition policies. Big data and algorithms transcend national boundaries. They can be designed in one jurisdiction with implications for the rest of the world. This means international cooperation is a must for managing big data algorithms and their potential anti-competitive impact on social welfare within and across national boundaries.

The rise of technology firms that control a key digital platform and wield significant market power creates multiple development concerns

As data and the ability to process them emerge as key competitive factors, Stucke (forthcoming) argues that the rise of technology firms that control a key digital platform and significant market power raises multiple issues, including with respect to (a) degraded

11 For example, Google alone spent more than $17 million in lobbying in the United States in 2017, whereas Facebook spent more than $11.5 million; other tech giants such as Amazon and Apple also set company records in lobbying in 2017 (Brody, 2018).

service quality in the form of lower privacy protection and excessive collection of personal data; (b) possible government overreach, as Governments could seek to gain access to the massive personal data trove possessed by platform companies; (c) wealth transfer from consumers to platform companies, as the latter could extract personal data or creative content without paying for their fair market value; and with access to detailed consumer data and powerful algorithms, firms can also engage in "near perfect" price discrimination and/or "behavioural discrimination" which would allow them to extract more revenues from consumers;[12] (d) deadweight welfare loss, resulting from the forgoing by consumers of the use of new technologies as privacy degrades and technological distrust grows; (e) political issues as platform companies gain considerable ability to affect public debate; and (f) less innovation, as platform companies can use big data and algorithms to engage in anticompetitive behaviours.

Firms could use big data and algorithms to deter market entry, raise consumers' switching cost, unfairly favour their own products and facilitate collusion

Ezrachi and Stucke (2016) argue that there are several transmission channels through which big data and algorithms can flow to hurt competition. First, given the importance of data in the initial training and fine-tuning of algorithms, early incumbents who have amassed a huge quantity of data could wield their data ownership as a barrier to entry, as new entrants would find it costly and/or time consuming to collect the same amount of data accumulated by those incumbents.

Second, firms' accumulation of detailed personal user data could effectively increase consumers' switching cost, especially when it is difficult to transfer personal data across platforms. Google offers a case in point: Through the constellation of products and services that Google provides, ranging from its search engine to its digital personal assistant device, the firm has created a digital ecosystem, rather than a mere assortment of independent products. For any given service within the Google ecosystem, customers will be less inclined to switch to another provider — even if the alternative is superior as a standalone product — since such a move would mean not being able to fully enjoy the positive complementary effect arising from use of other Google services.[13]

Third, and related to previous points, hosting a powerful digital ecosystem could potentially allow a firm to engage in anticompetitive practices by unfairly favouring its own apps over rival apps.

The increasing use of big data and algorithms poses significant challenges to the assessment of anticompetitive behaviours

Fourth, smart algorithms could also help facilitate collusion among firms, as they can be used to monitor behaviours of all firms in the market and stabilize price competition. Under certain market conditions, each algorithm can adopt a strategy that fosters interdependence among operators, entailing, e.g., following price increases by competitors and punishing deviations from the new equilibrium. Another possible means of collusion would be the use of a single algorithm by numerous competitors to establish a hub-and-spoke alignment of prices.

The increasing use of big data and algorithms also pose significant challenges to competition authorities in their efforts to assess anticompetitive behaviours. For example,

12 With access to detailed information on customers' socioeconomic characteristics and purchasing behaviour, firms can establish full consumer profiles, including on their alternative options and reservation prices for different products. This allows firms to engage in "near perfect" price discrimination. Moreover, firms can also engage in "behavioural discrimination", by tailoring their marketing efforts to individual consumers so to maximize the chances that targeted consumers will purchase the advertised products.

13 For example, using a unified Google login allows customers to download all of the apps purchased on one Google device to all other Google devices. This clearly would not be possible if customers utilized devices from different firms.

the increasing use of pricing algorithms which allow firms to establish individualized prices complicates competition authorities' efforts to define relevant markets, which is central to the identification of the types and levels of competition faced by firms.[14]

Moreover, the emergence of big data also affects how authorities assess the implications of mergers for competition, given that combining data — initially collected for different purposes — could potentially allow the new firm created by the merger to gain an insurmountable advantage over other competitors in respect of securing an understanding of customers. As data become increasingly important for competition, regulators need to closely examine mergers that bring large sets of data together.

International cooperation must entail consideration of how to develop preconditions for healthy market competition

It is an imperative that international cooperation entail consideration of appropriate measures to mitigate the negative effects that big data and algorithms may have on competition, including ex post measures that target specific incidences of anticompetitive behavior and ex ante ones that focus on developing the necessary preconditions for healthy market competition. Moreover, for these measures to be truly effective, competition authorities would need to coordinate with other regulators such as privacy and consumer protection officials. Regulators should also consider the distributional effect of different regulatory measures, ensuring that smaller firms will be subject to compliance requirements that are proportionate to the size of their operations and will therefore not be overburdened.

Regulators need to take a broader view of the harms that anticompetitive behaviours can inflict, including a lowering of privacy protection

Specifically, regulators should first consider taking a broader view of the harms that anticompetitive behaviors can inflict. The traditional antitrust focus has been on quantifiable harms such as excessive prices and reduction of consumer welfare. However, firms could also compete on the basis of other features of the products and services they provide, including by lowering privacy protection (Stucke and Grunes, 2016).

Second, in ensuring data that will not be effectively used as a barrier to market entry or as a means of increasing consumers' switching costs, Governments should consider introducing a right to data portability, which would give a data subject the right to receive and transfer his or her personal data that were initially collected by one organization. The General Data Protection Regulation, agreed by the European Parliament and the Council of the European Union (see chap. II and section on appropriate standards and ethical boundaries below), has already included such a right and is expected to foster competition among digital services and interoperability of platforms.

Third, there is the need for a clear international understanding on rendering algorithms more transparent and accountable for their effects (OECD, 2017a). In practice, this would require tackling daunting challenges such as making complex algorithms comprehensible to the public.

Fourth, international cooperation should also entail adoption of rules to govern algorithm design. For example, regulations could be introduced to restrain algorithms from

14 A key traditional analytic tool for defining relevant markets is the Small but Significant and Non-Transitory Increase in Price (SSNIP) test, which essentially determines whether a market — comprising a selected set of products — is relevant in an antitrust investigation through identification of the price elasticity of those products. If a hypothetical small but significant, and permanent rise in prices of these products does not lead to a switch by a sufficient number of customers to alternative products, a market could be considered relevant. While in this case, the ability of competition authorities to accurately observe prices charged by firms is crucial, the prevalence of pricing algorithms that change individualized prices rapidly makes this exercise highly difficult. See OECD (2017a).

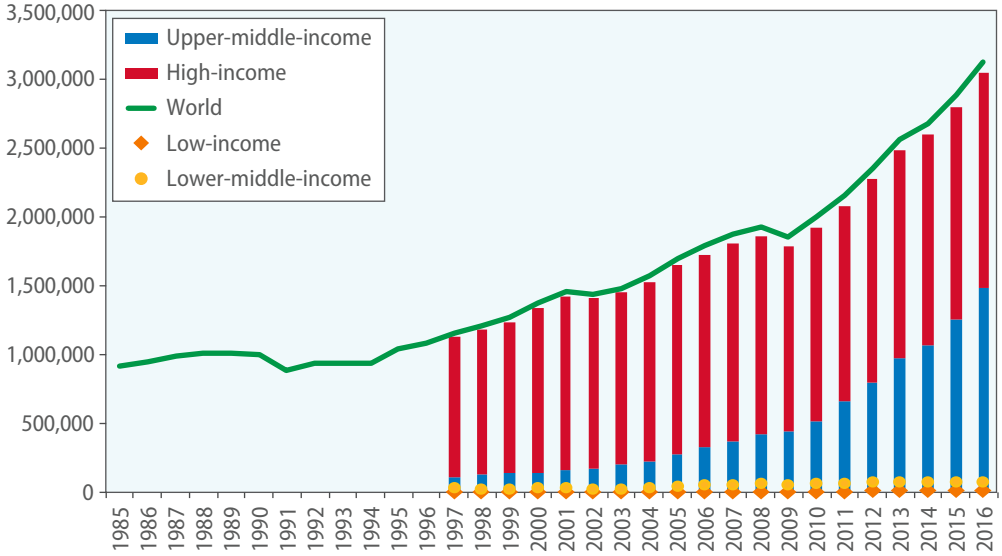
adjusting to certain changes in market variables, such as prices charged by other firms — a practice that is essential to sustaining collusion.

Patents are increasing the possibilities for anticompetitive behaviour

Greater patent application backlogs and longer pendency periods increase possibilities for anticompetitive behaviour

Over the past two decades, mirroring rapid technological advancement, there has been a significant increase in the number and complexity of patent applications filed around the world (see figure V.2), resulting in a greater backlog and substantially longer pendency periods (OECD, 2010). Longer pendency periods result in greater uncertainty regarding which inventions are and will be protected by patent rights, which has implications for competition.

Figure V.2
Total patent applications, by income group, 1985–2016



Source: UN/DESA elaboration, based on World Intellectual Property Organization (WIPO) statistics database.

Note: The disaggregated data indicate where, among the income groups, the patent applications were filed. Disaggregated data before the year 1997 are not available.

Firms also have been engaged in the strategic use of the so-called divisional patent application.[15] In essence, a set of divisional patent applications all derive from an earlier, related application, but each of them is examined separately and has a separate publication schedule. The use of such an application allows firms to keep their pending patents hidden from the public for an extended period of time, which also helps them engage in anticompetitive behaviours. A dominant firm, for example, can keep patent applications pending through a divisional patent application until a rival launches a new product. The dominant firm can then make a modification in the patent in an additional filing so that

15 It should be noted that the practice using the divisional patent application is much more common in the United States than in Europe.

the patent, in describing the new product perfectly, will allow the firm to sue its rival for infringement.

Stronger international cooperation is needed now more than ever

Competition law has become a policy concern in an increasing number of countries over the last two decades (OECD, 2014). The number of jurisdictions with competition law enforcement rose from fewer than 20 in 1990 to about 120 in 2014. At the same time, with many firms operating in multiple countries, many competition cases now have an international dimension.[16]

International cooperation among competition authorities is important

The international dimension of competition policies continues to expand. This intensification is a development that naturally calls for greater international cooperation among competition authorities. Such international cooperation is particularly important considering that — owing to factors such as differences in regulatory and judicial philosophies and the set-up of competition authorities — there is a persistent divergence in terms of antitrust enforcement between the European Union and the United States, arguably the two most influential jurisdictions in the area of competition policy.

Importantly, this divergence also extends to their approach to dealing with big data. While authorities in the European Union have openly maintained that big data should be subject to the abuse of dominance provision under article 102 of the Treaty on the Functioning of the European Union, the United States has resisted the idea of treating big data as an "essential facility", which would require that a firm with possession of those data must share them with its competitors (Lugard and Roach, 2017). Given that other jurisdictions often look to the two for guidance concerning antitrust jurisprudence, the divergence could also develop globally.

Blair and Sokol (2013) argue that when different jurisdictions have different levels of regulatory stringency, the most stringent antitrust system may produce the global standard. For example, two firms that operate in multiple jurisdictions would not be able to merge if one national competition authority, applying a tougher standard to the merger, does not approve it, even if it is cleared by all other relevant competition authorities. Therefore, if the antitrust rules are being too rigidly applied in a certain jurisdiction, they could hurt customers both within and outside the jurisdiction.

Without cross-country harmonization of competition law, high capital and technology mobility could discourage full enforcement

A second point is that insufficient cooperation could impact national competition authorities' ability to enforce their national laws. High capital and technology mobility allows firms to engage in regulatory arbitrage with relative ease, which could discourage Governments from fully enforcing their competition laws. This issue is particularly salient for small economies where sales of international firms in those economies account for a small portion of the firms' total revenues, but a significant portion of these economies' output (Gal, 2013). If the competition authorities of such economies are to impose a significant regulatory burden, it would likely drive firms away.

Third, repeated submission of the same information to multiple competition authorities is costly and time consuming for firms and competition authorities (OECD, 2014). With more firms engaging in cross-border economic activities and more countries

16 For example, more than 90 per cent of fines imposed by the United States authorities on cartels have been international; and the number of cartel cases investigated by the European Union involving a non-European Union participant increased by more than 450 per cent during the period 1990–2014.

introducing competition laws, the implications of insufficient cooperation among competition authorities are going to be felt only more acutely in the future.

Considering the need to tackle cross-border competition cases, there needs to be greater harmonization in competition law across countries. Furthermore, there needs to be stronger international cooperation on ensuring competition enforcement, which would require addressing such challenges as differences in legal systems, special procedures for gathering evidence and related limitations, trust issues and the implementation of leniency and immunity programmes (UNCTAD, Trade and Development Board, 2017).

While effective formal cooperation on tackling cross-border competition cases is rare, authorities should still seek informal cooperation

Only a few competition authorities engage in effective formal cooperation. Owing to limitations in resources and enforcement experiences, recent and smaller authorities typically find it difficult to participate in meaningful cooperation with other national competition authorities. Nevertheless, in the absence of formal cooperation, authorities should still seek informal cooperation through regional groupings and other cross-national arrangements. The United Nations Conferences to Review All Aspects of the Set of Multilaterally Agreed Equitable Principles and Rules for the Control of Restrictive Business Practices (the UN Set, which is the only multilateral agreement on competition policy) provide an opportunity for competition authorities around the world to establish contacts and exchange views on competition-related issues. Moreover, the International Competition Network and OECD also provide similar specialized venues which should continue to be utilized.

Digitalization and international tax cooperation

Digitalization is transforming conventional notions of how businesses are structured, how firms interact and how consumers obtain services, information and goods

Governments in both developed and developing countries face growing challenges with respect to collection of adequate revenues to finance sustainable development-related expenditure. The digitalization of the economy is transforming conventional notions regarding how businesses are structured, how firms interact and how consumers obtain services, information and goods (Muro and others, 2017). E-commerce, for example, is transforming global business and opening up international markets, including possibilities for inclusive trade growth in developing countries (United Nations, 2018a).

Digitalization is also posing new challenges for the international tax framework—a system devised almost a century ago at the League of Nations, based on criteria that rely primarily on the physical presence of companies in foreign countries (Falcão, 2018a). Understanding the consequences of digitalization for international taxation is important, as it creates opportunities for multinational enterprises to engage in base erosion and profit shifting (BEPS).[17] Digitalization allows large firms to centralize their functions in certain jurisdictions, often in very low- or no-tax jurisdictions, thus leading to base erosion and profit shifting concerns. The importance of highly mobile intellectual property in the digitalized economies has only exacerbated these risks.

17 Base erosion and profit shifting (BEPS) are tax planning strategies that exploit gaps and mismatches in tax rules in order to artificially shift profits to low- or no-tax locations where there is little or no economic activity. Although some of the schemes used are illegal, most are not. In 2013, OECD and G20 countries adopted the 15-point Action Plan on Base Erosion and Profit Shifting to address BEPS. The full BEPS package was endorsed by the G20 leaders in November 2015, and more than 110 countries and jurisdictions have committed to its implementation, as members of the Inclusive Framework on BEPS, which was established in June 2016.

International tax rules are not ready for the digitalized economy

Technology has allowed companies to do business (i.e., to buy, sell and provide access to services) through Internet and mobile apps, without their needing to be physically present in the country. In the current tax framework, this represents a substantial handicap with respect to the capacity to tax associated income, as a country is allowed to tax only the income that is derived from the activities that occur physically in its jurisdiction.

Under existing rules, digital companies often have no tax liability in jurisdictions where they have users and customers

Physical presence — typically defined as the existence of a permanent establishment for a set period of time[18] for corporations, or a fixed place of business for individuals — is key. Crafted for the brick-and-mortar economy, the current international tax law presumes that if there is not enough substantial activity to justify the establishment of a branch or a subsidiary in the source State, the source State is not entitled to tax (Falcão, 2018b). Under existing rules, digital companies often have no tax liability in jurisdictions where they have users and customers. In this framework, countries in which digital activities are carried out are unable to tax the income generated in their own territories, even though those activities benefit from their consumer base, their infrastructure or their commercial resources. For example, a digital platform providing free or paid services will most likely be taxed only in the country where it is resident, regardless of where the activity occurred or the value was created. Box V.1 illustrates the issue with a recent example.

Box V.1

The Google case: France

The problems faced by national tax systems in their efforts to tackle the impacts of the digital economy are perfectly illustrated in a case decided on 12 June 2017 by the French Administrative Court of Paris. The case concerns the taxation of Google's activities in France, where as in most countries around the world, Google is the market leader in online advertising. French individuals and companies that wish their products to be advertised online sign contracts with Google and Google advertises their brand names in their search engine pages and in other online Google products. Google has a sizable physical presence in France: Google France — a subsidiary company of Google Ireland — employs hundreds of people whose task is to streamline the advertisement activities performed for its French customers. Those customers do not, however, sign formal advertisement agreements with Google France but rather with Google Ireland, which subcontracts Google France to assist in providing tailor-made advertisement services to French customers. The activities performed by Google France are remunerated by Google Ireland at a transfer price of 8 per cent cost-plus, i.e., Google France receives 8 per cent of profits on top of the expenses it incurred in performing its services. The other 92 per cent of the business profits are taxable in Ireland.

France, just like Belgium, Italy and the United Kingdom of Great Britain and Northern Ireland, was rather displeased with the low level of profits attributed to Google France, believing that, in reality, the activities of Google France were much more substantial than what was reflected in the profit margin assigned to Google France in the transfer pricing agreement. The French tax authorities therefore issued a series of corrective tax assessments of the Google group for its activities in France. While respecting the cost-plus arrangement between

(*continued*)

18 Determined through tests concerning certain agreed thresholds in international tax treaties.

Box V.1 (*continued*)

the two legal entities, they concluded that on top of that, Google France was to be considered to have provided activities for the benefit of Google Ireland that went beyond the inter-company agreement. This being the case, the tax administration in France argued that besides the activities of its subsidiary company, Google Ireland had a "permanent establishment" in France to which part of the profits of the online advertisement business in France had to be attributed.

However, the French Court rejected the claim made by the tax authorities. Even though Google France did carry out important functions of the advertisement business in France, like marketing and sale of online services, it did not have the power to legally bind Google Ireland or to sign contracts in its name, even if many elements showed that Google France's employees were de facto negotiating the contracts and involved in the signings, and even if Google Ireland was merely rubber-stamping the pre-made agreements. Under the current rules, the presence of actual economic activities in France and the creation of value as a result of Google's access to the French consumer market was held not to be sufficient to establish that Google Ireland's activities in France had passed the permanent establishment threshold and that more of the profits of the business were taxable in France.

The appeal by the tax authorities to the Administrative Court of Appeals is currently pending.

Source: France: Tribunal Administratif Paris, 12 June 2017, Judgment No. 1505178/1-1.

The digital economy has raised questions concerning the appropriate characterization of income that results from digital access to goods or services

Taxation of search engines and social media platforms, which not only provide free services to users across borders but also gather data that enable them to sell targeted advertisements and earn revenues without physical presence, poses additional challenges to tax authorities. The digital economy has also raised questions concerning the appropriate characterization of income that accrues from digital access to goods or services. For example, the concept of the traditional sale of goods can now be expanded to include a licence for downloading a digital file and the concept of a manufacturing activity can now be expanded to include digital manufacturing via 3D printing. The utilization of "cloud" transactions raises similar questions, to the extent that the location of the cloud is unclear, undisclosed or scattered through multiple jurisdictions.

Digitalization in the framework of BEPS

Digitalization of business models makes international taxation more challenging because of the difficulty of defining and measuring the value of intangibles and deciding where such value is being generated (United Nations, 2018a). Digitalization also facilitates large firms' centralization of their functions in what are often very low tax or no-tax jurisdictions, raising additional concerns related to base erosion and profit shifting. Action 1 of the Action Plan on BEPS aimed at identifying the main issues related to the taxation of the digital economy, including the application of indirect taxes to its activities.

To ensure efficient and fair allocation of taxing rights across countries, the international tax system might need to undergo fundamental changes

BEPS Action 1 was intended not to establish a forum on revisiting the international tax framework for the digital economy (Falcão, 2018b) but rather to analyse those transactions that gave rise to BEPS-related considerations as a result of the use of a digital interface. However, discussions on the new ways of doing business in light of digitalization have inaugurated a broader debate on the allocation of taxing rights and attribution of income between the residence and source countries. There is also disagreement on how user-generated value should affect taxing rights (United Nations, 2018a).

Some analysts have noted that tax avoidance opportunities associated with the scale of growth in online business may be putting too much pressure on current tax arrangements.

Therefore, it has been suggested that, in order to ensure efficient and fair allocation of taxing rights across countries, the international tax system might need to undergo fundamental changes (United Nations, 2018a). From the perspective of international corporate tax policy, the question how to treat cross-border digital transactions has become highly contentious. Alternative rules for determining permanent establishment (PE) status based on the maintaining of a significant digital presence, as opposed to a significant physical presence, for a certain period of time are being discussed (Falcão, 2018b).

Unilateral measures

Several countries have resorted to equalization levies, diverted profits taxes and withholding taxes on digital transactions to capture income from digital activity

Neither the final report on action 1 of the Action Plan on BEPS nor the interim report prepared by the Task Force on the Digital Economy, a subsidiary body of the OECD-housed Inclusive Framework on BEPS (OECD, 2018b), has addressed the possibility of a long-term multilateral resolution to the issue of digitalization in international taxation. The interim report suggests policy considerations for countries wishing to introduce short-term measures for dealing with the effects of digitalization.

Several countries have resorted to equalization levies, diverted profits taxes, and withholding of taxes on digital transactions to capture income from digital activity. OECD broadly groups unilateral measures into four categories: (a) alternative application of the permanent establishment (PE) thresholds (alternative digital PE definition); (b) withholding taxes; (c) turnover taxes; and (d) specific regimes to deal with large multinational enterprises (MNEs). Table V.1 illustrates how the taxes are categorized.

So far, only India ("significant economic presence concept"), Slovakia ("expanded definition for fixed place of business") and Israel ("significant economic presence test") have proposed rules which aim at diluting the requirement for permanence and physical presence at a specific location to establish nexus for net taxation (OECD, 2018b, p. 135). However, other countries (including Austria, Indonesia, Thailand and Turkey) have announced that they are considering similar rules, or have proposed draft legislation to that effect.

The aim of the measures is to overcome the absence of physical presence in the source country and establish liability to tax based on other factors, such as "digital" or "online" presence, as unilaterally identified by the nation proposing the new legislation. In broad terms, these measures would correspond to the formulation of a "digital permanent establishment" concept applicable only at the national level.

Table V.1
Classification of uncoordinated unilateral measures

Alternative PE thresholds	Withholding taxes	Turnover taxes	Specific regimes for large multinational enterprises
Significant economic presence test (e.g., Israel, India) Virtual service PE (e.g., Saudi Arabia)	Broader royalty definitions Technical service fees Online advertising	Sectoral taxes, such as for advertisement (e.g., Hungary) Levy on Digital Transactions (e.g., Italy) Equalisation levy (e.g., India)	Diverted profits tax (e.g., United Kingdom, Australia) Base erosion and anti-abuse tax (e.g., United States)

Source: Falcão (2018a), based on OECD (2018a).

Unilateral measures do not address the core concerns of digitalization

Unilateral measures in international taxation should be viewed as loophole-closing instruments only. While they can tackle tax competition, deter aggressive tax planning and avert the erosion of the tax base at a macrolevel, they generally tend to increase complexity and are unlikely to lead to a more stable tax system. In short, they are only short-term fixes which do not address the core concerns of digitalization.

Moreover, in its latest report, the Inter-agency Task Force on Financing for Development reiterates the affirmation of Heads of State and Government and High Representatives in the Addis Ababa Action Agenda of the Third International Conference on Financing for Development (para. 28)[19] that efforts in international tax cooperation should be universal in approach and scope, while fully taking into account of countries' different needs and capacities (United Nations, 2018a, chap. III.A, recommendation 1).

The need for long-term multilateral solutions

As digitalization expands, international tax systems should be reoriented towards taxing profits at the locations where activity is conducted and value is added

As digitalization expands, international tax systems should be reoriented towards taxing profits at the locations where activity is conducted and value is added. This principle was agreed by Heads of State and Government and High Representatives in the Addis Ababa Action Agenda. The discussion concerning the digitalization of the economy is particularly important now, because of the momentum gathered to revisit international tax rules and to reinstate the origin of wealth principle (OECD, 2018b)[20] and the concept of economic allegiance. A reinstatement would suggest that a taxpayer should be liable to tax in the jurisdiction where it is economically active, because that is the jurisdiction where the taxpayer enjoys the benefits of public infrastructure (BEPS Monitoring Group, 2017) and public goods (Schön, 2018).

Importantly, this may be the first time that the source versus residence split would not be synonymous with a split between developing and developed countries, or between industrialized and emerging economies, since all countries have an interest in averting the erosion of their respective tax bases and capturing a new revenue source (Falcão, 2018b) The prevalence of digitalized markets is occurring at a time when countries are rethinking their tax policies and reforming corporate income tax principles; there is therefore potential momentum for re-discussing the concepts introduced in the 1920s by the League of Nations.

There are different views on how to adapt international tax rules to the digitalization of the economy. Some experts doubt the desirability—or even the possibility—of ring-fencing digital companies for the purpose of designing special tax treatment. However, in recent policy debates, other experts have raised the prospect of adopting tax rules that would be restricted to specific business lines (United Nations, 2018a).

The challenge is how to align taxable profits with real economic activities and value creation in a digital economy

The challenge is how to align taxable profits with real economic activities and value creation in a digital economy. The objective is not to tax companies that are incidentally doing business in a foreign country, but rather to tax those that are undertaking substantial

19 General Assembly resolution 69/313, annex.

20 The origin of wealth principle was enunciated in a 1923 report commissioned by the League of Nations. In that report, the economists took a view that the place where the income is produced should be assigned a preponderant share of the tax revenue because that place should be considered the place of origin. See Report on Double Taxation submitted to the Financial Committee: Economic and Financial Commission Report by the Experts on Double Taxation—Document No. E.F.S.73.F.19 (5 April 1923). Available at http://adc.library.usyd.edu.au/view?docId=split/law/xml-main-texts/brulegi-source-bibl-1.xml;chunk.id=item-1;toc.depth=1;toc.id=item-1;database=;collection=;brand=default.

economic activity while engaging with the consumer market, making use of the country's local infrastructure, developing an interactive relationship with customers, or gathering data that can add value to the business.

The Committee of Experts on International Cooperation in Tax Matters has shown leadership on the taxation of cross-border services provision in international tax cooperation (Falcão, 2018b). The Committee of Experts has also established a subcommittee to consider necessary revisions to the United Nations Model Double Taxation Convention between Developed and Developing Countries as well as to provide revised guidance within the context of the digital economy (United Nations, 2018a). The Task Force on the Digital Economy is expected to present a final report by 2020. Any changes made to the provisions of either the United Nations or OECD model conventions as a result of this work will not automatically change the existing base of over 3,000 tax treaties or domestic practices unless Member States take action to incorporate them (United Nations, 2018a).

Current discussions and agreements on effective tax coordination at OECD and in the Committee of Experts can play an important role

Current discussions and agreements on effective tax coordination at OECD and in the Committee of Experts can play an important role in ensuring that global benefits accruing from new technologies are effectively harnessed to ensure progress towards achieving sustainable development in all countries. Currents debates in academia and not-for profit organizations can provide these discussions with food for thought.[21]

Developing countries may be especially hard hit by the complexities and revenue risks arising from digitalization as a result of constraints on human resources and limited access to technological resources. Strengthening national capacities to tax large technology firms, particularly in developing countries, could enable countries to fund national initiatives aimed at facilitating adoption and diffusion of relevant technologies. Strengthened national capacities — to analyse the increasing and accelerating flow of information and the calls for greater provision of such information would also be required.

Setting the appropriate standards and ethical boundaries

There is an opportunity to shape new technologies in ways that promote the common good

The rapid evolution of emerging and frontier technologies has created a unique opportunity to support the achievement of the SDGs. There exists a window of opportunity to shape new technologies in ways that promote the common good, prosperity and human dignity and protect the environment. A common message in the 2018 *Survey* is that technology is not an exogenous force. Instead, it can and should be guided by societal needs and policy prerogatives.

Thus far, it is the more advanced economies that have served as the sphere for many of the prominent ethics-related discussions on, and existing efforts to respond to the chal-

21 The BEPS Monitoring Group, which is an active contributor to the work of the United Nations and OECD, has contributed a public opinion on the criteria that it deems most suitable for the characterization of nexus and substantiality within the context of digitalization. The Tax Justice Network, the Independent Commission for the Reform of International Corporate Taxation (ICRICT) and the BEPS Monitoring Group are long-term supporters of formulary apportionment in substitution for traditional transfer pricing rules. Formulary apportionment rules would attribute to each country its appropriate share of profits from a transaction, based on a previously agreed mathematical formula that derives profit allocation from engagement in activity in a source State. The rationale is that multinational entities should be treated as a single economic group, which should not be separated into its constitutive branches.

lenges posed by, emerging technologies. However, the outcomes of many of these discussions and efforts are likely to affect all countries. Indeed, as the reach of the Internet and the importance of digital society continue to expand worldwide, these ethical discussions will be particularly crucial for the developing world (LaPointe, 2018).

Challenges for governance of emerging technologies

Governance of emerging technologies encompasses the laws, regulations and other rules to which they are subject. The questions how these rules are established and maintained, who is involved in the process of governance and how governance is executed have myriad ethical implications. The examples presented in this section complement the discussion presented in Chapter II.

Privacy and data governance

GDPR is an example of a regulation that increases privacy and data protections for citizens of the European Union

As discussed in chapter II, the General Data Protection Regulation (GDPR), which was agreed by the European Parliament and the Council of the European Union in April 2016, attests to the significant dimensions of technology governance. This sweeping regulation contains an array of increased privacy and data protections for European Union citizens, including breach notification and the introduction of the right to access, to be forgotten (through erasure of personal data) and to data portability (EUGDPR, n.d.). While the views are mixed on the possible societal and ethical implications of the GDPR, supporters of the regulation, such as the United States-based consumer advocacy group Consumer Action, argue that the GDPR will have a positive impact on consumer protection even beyond the EU (Susswein, 2018).

An extended—and heated—debate has been unfolding in the United States over the issue of network neutrality (familiarly referred to as "net neutrality"), and how the United States Government should regulate Internet service providers (LaPointe, 2018, p7). Supporters of net neutrality have argued that it is critical for free and open speech, whereas its critics have argued that it will put a damper on Internet innovation and investment (Knowledge@Wharton, 2017). The emotions stirred up by the issue of net neutrality prove just how significant the ability to codify or disrupt power dynamics through the rules governing emerging technologies is perceived to be.

Cybersecurity

There are significant challenges for Governments and law enforcement agencies in assuring a level of safety and security for citizens and entities with respect to cybercrimes

In the digital realm, there are significant challenges for Governments and law enforcement agencies in assuring a level of safety and security for citizens and entities with respect to cyber-crimes that is equivalent to that for other types of crime (Police Executive Research Forum, 2014). Cybercrimes are increasing worldwide, with developing countries facing particular challenges in combating both international and domestic attacks (Kshetri. 2010).

Ransomware attacks are a form of cyberattack which have been perpetrated successfully by hackers around the globe. In a ransomware attack, a hacker takes control of an individual's or an organization's computer system and data and prevents the victim from regaining access to and control over that data until a ransom is paid. In 2017, over 75,000 ransomware attacks occurred in 99 countries using the "WannaCry" ransomware (Larson, 2017). Government entities from across the globe have been attacked with ransomware as well. In 2018, the city of Atlanta, Georgia (United States) was held hostage by a ransomware

strike for over a week, causing massive disruptions of government processes and services (Newman, 2018). Overall, whether they involve accessing private data or using ransomware to hold data hostage, cyberattacks on data and technology can have devastating ethics-related impacts.

Autonomous systems, human augmentation and cloning

Greater international cooperation is needed to prevent regulatory arbitrage

Ensuring the safe and predictable operation of physical autonomous systems is an important challenge (Zgrzebnicki, 2017). The challenge will amplify as these technologies proliferate and interactions between humans and robotic and autonomous systems increase (LaPointe, 2018, p. 16). Disparate legal and regulatory regimes in different jurisdictions and countries can drive the field-testing of such systems to locales with fewer testing restrictions, thereby transferring the risks of this testing to certain populations. Hence, greater international cooperation on the prevention of regulatory arbitrage will be required.

Human augmentation technologies — such as that underpinning the Hybrid Augmented Reality Multimodal Operation Neural Integration Environment (HARMONIE), a semi-autonomous hybrid brain-machine interface developed at Johns Hopkins University (Baltimore, Maryland), which uses a combination of eye tracking, computer vision and brain control to operate robotic upper-limb prosthetics — raise ethical considerations regarding increasingly integrated human-machine augmentation technologies (McMullen and others, 2014). Similarly, the advancing technological ability to clone species raises a host of ethical questions, especially as regards safety.

The United States National Human Genome Research Institute (2017) identifies three different types of cloning: gene cloning, reproductive cloning and therapeutic cloning. Gene cloning produces copies of genes or segments of DNA, while reproductive cloning produces copies of whole animals. Therapeutic cloning, on the other hand, produces embryonic stem cells for experiments aimed at creating tissue replacements for injured or diseased tissues (ibid.). Each type of cloning raises its own set of ethical issues and has its own set of implications. Notwithstanding the occasional spurious claims to the contrary, there is no proof that humans have ever yet been cloned (Ball, 2018). However, the debate over the potential of human cloning was reignited in 2018 after the cloning of two macaque monkeys in China (ibid.).

Unintended environmental impact of digital technologies

While emerging technologies hold promise for sustainable development, they can also create a complex web of negative environmental impacts

While emerging technologies hold promise for the achievement of sustainable development and, in particular, mitigating the environmental impacts of development, they can also create a complex web of negative environmental impacts (LaPointe, 2018). In an increasingly electronic- and digital-driven society, requirements for power as well as the demand for rare earth elements will increase. Rare earth materials and specialized metals are required for the production of many emerging technology devices such as mobile phones, laptops and electrical cars (Graedel and others, 2015). From mining to disposal, these materials can exert severe negative impacts on people.

In 2014, the United Nations University/StEP Initiative (2014) identified electronic waste containing hazardous or toxic substances as "one of the fastest growing waste streams globally". The volume of this waste and its handling and disposal in developing countries are the source of significant environmental and health hazards, particularly among vulnerable populations (Heacock and others, 2016). Increasing global digital inclusion is likely to exacerbate these environmental challenges.

International initiatives for governance of emerging technologies

Complementing various national efforts, international efforts and initiatives are emerging to address the challenges of data protection and privacy, algorithmic accountability, and autonomous systems and AI (LaPointe, 2018).

IEEE Global Initiative for Ethical Considerations in Artificial Intelligence and Autonomous Systems

The IEEE Standards Association launched its standards development initiative in 2016 in order "to move beyond both the fear and the uncritical admiration regarding autonomous and intelligent technologies", as well as align technologies both to foster innovation in the field and to diminish fear in the process (Karachalios, 2017). In addition to creating a recommendation guide entitled *Ethically Aligned Design: A Vision for Prioritizing Human Well-being with Artificial Intelligence and Autonomous Systems, Version 2* (IEEE Global Initiative for Ethical Considerations in Artificial Intelligence and Autonomous Systems, 2018), it has launched a series of standardization project working groups (ibid.; Karachalios, 2017).

Association for Computing Machinery (ACM) US Public Policy Council (USACM) statement on algorithmic transparency and accountability

The initiative adopted the set of seven principles (Association for Computing Machinery (ACM) US Public Policy Council (USACM, 2017)) to support algorithmic decision-making while addressing concerns regarding the inherent barriers to transparency in some algorithms and analytics and any resulting algorithmic bias and potential harmful discrimination. The seven principles comprise awareness, access and redress, accountability, explanation, data provenance, auditability and validation and testing.

Partnership on AI to benefit people and society

The Partnership on AI to benefit people and society (Partnership on AI)[22] was founded by a coalition of major technology companies including Amazon, Apple, DeepMind, Facebook, Google, IBM and Microsoft and now includes more than 50 members from industry, academia and the non-profit sector. The goals of the Partnership on AI include developing and sharing best practices, providing an open and inclusive platform for discussion and engagement, advancing public understanding, and identifying and fostering aspirational efforts within AI for socially beneficial purposes.

Opportunities for international cooperation and the role of the United Nations

There are significant opportunities for international engagement and cooperation on embedding an ethical approach in the design, deployment, implementation and governance of emerging technologies.

22 See www.partnershiponai.org.

Digital rights and data governance

The Internet and the digital economy are fundamentally altering the manner in which people connect across society. Therefore, it is important that the definition of fundamental human rights evolves within the digital context—an issue that is being addressed by the United Nations in various forums. However, with the increased scope of the exposure of individuals to harm in the digital space leveraging multilateral action to proactively define and protect digital human rights has become a matter of urgency.

The definition of fundamental human rights in the digital context is being addressed by the United Nations

With the increasing abundance of digital data and their importance to people and communities, international cooperation would be helpful in developing uniform standards for data governance, which should address data collection, verification, provenance, maintenance, ownership, control and security (LaPointe, 2018). As a patchwork of various laws, regulations, principles and guidelines exists across the globe, multilateral cooperation is necessary for developing a definitive global standard which will guide actions of data professionals and any entities interacting with data. The creation of universal professional ethical standards or a code of conduct for data professionals could be included as a component of the data governance standards development process.

Principles for ethical development of technology

Multilateral cooperation could build on the previous work carried out by standards organizations and coalitions of stakeholders to develop comprehensive and widely accepted principles for the ethical development of technology in the digital era. The United Nations can leverage its convening power to bring Member States and all relevant stakeholders together to adopt a global consensus on legal and ethical standards for guiding research on and development of frontier technologies. Technological advances must include a respect for universally held ethical and human rights standards. The United Nations—given its universal membership and unwavering commitment to human values—is uniquely positioned to facilitate a dialogue among all stakeholders and the development of a global ethical compact for managing the advances in frontier technologies.

The United Nations can leverage its convening power to bring Member States and all relevant stakeholders together to adopt a global consensus on legal and ethical standards for guiding research on and development of frontier technologies

Forging global collective action: the role of the United Nations

While many frontier technologies present immense opportunities for fostering sustainable development, they also pose considerable risks. A global dialogue, involving all stakeholders, is needed to identify those risks and opportunities. The United Nations can serve as an impartial facilitator among Governments, the private sector and civil society organizations for the presentation of objective assessments of the impact of emerging technologies on sustainable development outcomes, including on employment, wages and income distribution.

Existing initiatives

The multi-stakeholder forum on science, technology and innovation for the SDGs is a platform dedicated to forging a common understanding among scientists, policymakers and the private sector and promoting tangible development results. It is playing an increasingly important role in fostering an understanding of emerging technologies and bridging the technology divide. The quinquennial United Nations Conferences to Review All Aspects of

The United Nations is playing a leading role in forging an understanding of emerging technologies and bridging the technology divide

the Set of Multilaterally Agreed Equitable Principles and Rules for the Control of Restrictive Business Practices (the UN Set) is an important United Nations initiative designed to facilitate an exchange of views on competition-related issues. The Committee of Experts on International Cooperation in Tax Matters is an important forum for consensus building on international taxation between developed and developing countries.

Both the Commission on Science and Technology for Development and the Technology Bank, which helps the least developed countries navigate the domain of new technologies, address the challenges associated with bridging the technology divide. The World Summit on the Information Society Forum and the Artificial Intelligence for Good Global Summit, both organized by the International Telecommunication Union, constitute other important United Nations initiatives whose aim is to facilitate an understanding of relevant technologies and their sustainable development impact, which includes addressing some of the dimensions of the technology divide.

The United Nations is invested in enhancing capacity development for science, technology and innovation

Several United Nations agencies have also invested considerably in enhancing capacity development for science, technology and innovation. Some of those agencies have developed guidelines and e-learning tools, created new training mechanisms such as academies and virtual institutes, implemented pilot projects in volunteering and capacity-building, and carried out technical assistance initiatives to enhance capacities in the field of technology and innovation (United Nations, 2018a). Table V.2 provides an overview of efforts in this regard up until 2017.

Table V.2
Overview of engagement by United Nations system entities in "frontier" domains

Categories	Subcategories	Number of initiatives
Digital technology initiatives	Artificial intelligence	35
	Nanotechnology and virtual reality	26
	Internet of things	2
	E-government	4
	Digital finance	7
	Cloud computing	3
	General digital technology/data-related issues (data collection)	112
	Transportation and mobility systems	3
	Climate tech and data	3
	Combinations of frontier technologies	13
Health and biological technologies initiatives	Biotechnology and genomics	10
	Health and drug delivery	14
Energy and material technology initiatives	Renewables and energy storage	12
	Innovation, tech and manufacturing	4
Other technologies	Nuclear	5
	Space	8
	Basic Internet, ICT and cybersecurity	39
	E-commerce	3
Total number of initiatives overall:		287

Source: UN/DESA, based on United Nations System Chief Executives Board for Coordination secretariat (2017).

Note: Initiatives may be double-counted when they belong to more than one category.

Harnessing new technologies: a vision for the future

The United Nations supports Member States and other stakeholders in addressing the challenges that they confront in harnessing new technologies to achieve the SDGs

As indicated in the report of the Secretary-General entitled "Harnessing new technologies to achieve the Sustainable Development Goals" (United Nations, Economic and Social Council, 2018), the United Nations has an important role to play in supporting Member States and other stakeholders in addressing new policy and normative challenges, in particular those directly affecting the central purposes and principles of the Organization and for which collective global responses are necessary.

In this context, the Secretary General has identified five elements central to guiding efforts towards strengthening the engagement of the United Nations system with new technologies in the years ahead:

The Secretary-General has identified five elements central to the engagement of the United Nations system with new technologies

(a) *Protection and promotion of global values*. United Nations engagement with new technologies and the policy issues they raise will be anchored in the values and obligations defined by the Charter of the United Nations and the Universal Declaration of Human Rights[23] and through the realization of the SDGs. At the heart of these standards are values such as equality and equity. These should be the guiding principles in every action undertaken with regard to new technologies;

(b) *Fostering of inclusion and transparency*. Our engagement must ensure that the United Nations remains a trusted venue within which Governments, industry, academia and civil society, among others, can come together to make collective choices regarding new technologies openly, transparently and based on shared values. There must be a greater openness to new ideas and new voices, which challenge institutional business-as-usual reflexes and allow the United Nations to engage credibly with partners. This will include a significant role for youth, who have a unique interest in these choices, building on the work of the Secretary-General's Envoy on Youth;

(c) *Working in partnership*. Effective engagement on new technologies clearly requires close partnership with a range of government, industry, academic and civil society partners. This is especially true, as the private sector is driving much of the progress on development of those technologies;

(d) *Building on existing capabilities and mandates*: Engagement with new technologies should be viewed as a necessary component of successful mandate implementation – not as a new mandate. For this to be achieved, the significant efforts currently under way across the system must be added to and reinforced, alongside ongoing reform efforts;

(e) *Practising humility and engagement in continuous learning*: For many in industry, some in civil society and some Governments, the United Nations is not an obvious interlocutor within the context of emerging technologies. As our collective engagement is broadened and, indeed, even as all actors are being reminded of their shared commitments and obligations, we must be prepared to acknowledge what we do not know in this complex field. We must learn to incentivize an innovative culture in which both successes and failures arising from exposure to new technologies are a source of understanding and a guide to our contribution to policy dialogues. With this goal in mind, we will constantly adjust our actions as we go about learning how we can best engage with technology in support of Member States' technological transformations.

23 General Assembly resolution 217 A (III).