UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

UNCTAD

TRADE AND DEVELOPMENT REPORT 2018

POWER, PLATFORMS AND THE FREE TRADE DELUSION

Chapter III

ECONOMIC DEVELOPMENT IN A DIGITAL WORLD: PROSPECTS, PITFALLS AND POLICY OPTIONS

UNITED NATIONS
New York and Geneva, 2018

ECONOMIC DEVELOPMENT IN A DIGITAL WORLD: PROSPECTS, PITFALLS AND POLICY OPTIONS

III

A. Introduction

Digital technologies have already transformed how people communicate, learn, work and shop. They are also changing the geography of economic activity through their impact on corporate strategy, investment behaviour and trade flows. From a development perspective, the promise of digitalization is that it will open new sectors, promote new markets, boost innovation and generate the productivity gains needed to lift living standards in developing countries. Fulfilling this promise of a new digital future will, for many developing countries, require an ambitious programme of infrastructure support and skills training. However, assessing the wider use and impact of these new technologies, particularly with respect to the 2030 Development Agenda, cannot be divorced from the economic environment in which they are nested.

As discussed in previous *Reports*, today's hyperglobalized world has become more unequal, unstable and insecure: rent extraction has become an acceptable feature of doing business at the top of the corporate food chain and unchecked competition has made for precarious working conditions for many at the bottom. As a result, the gains from technological progress and open economies have been captured by a small portion of society, while their costs have been carried by an increasingly frustrated majority. A key question therefore is whether, given this "winner-takes-most" environment, the spread of digital technologies risks further concentrating the benefits among a small number of first movers, both across and within countries, or whether it will operate to disrupt the status quo and promote greater inclusion.

If history is any guide, while skill development and infrastructure provision will be necessary for helping developing countries integrate into the digital economy, ensuring developmental benefits from digitalization will require a more comprehensive strategy and a much fuller range of policy measures. Among the most critical additional policy challenge is that of adopting competition and regulatory frameworks to address potential adverse effects on market structure, innovation and the distribution of gains from digitalization. The combination of network effects and rent-seeking behaviour associated with the digitization of data that transcend borders, must also be closely monitored and carefully managed. Accordingly, developing countries will need to preserve, and possibly expand, their available policy space to effectively manage integration into the global digital economy.

Another critical challenge will be harnessing new digital technologies to local development capacity so that developing countries can enjoy rising shares of value added in manufacturing and service activities. *TDR 2017* examined this challenge with specific reference to robot-based automation; this chapter examines how a broader set of digital technologies, from computer-aided design to big-data analysis, could transform the entire manufacturing process. The chapter uses the value chain framework to explore the potential for, and the risks to, developing countries from using new digital technologies.[1] It argues that digitalization and the associated erosion of the boundary between industry and services may make value chains shorter, customized production possible and smaller production runs more profitable by allowing for the design, production and post-production segments of the manufacturing process to be more closely interwoven. This could either open new manufacturing possibilities for developing countries or reduce some that are currently available. Whether the high value added pre- and post-production segments move to developing countries will depend on the governance of these chains, the structure of markets, the bargaining power of local

firms and policymakers and the policies employed to effect a more strategic pattern of integration into the digital economy.

The wider use of digital technologies is still unfolding, particularly in developing countries, and their precise impacts remain uncertain. A clear understanding of the channels through which these technologies may affect income generation in developing countries is crucial to monitoring and influencing these effects. Contributing to such an understanding and indicating associated policy options are the main objectives of this chapter.[2]

The chapter is structured as follows. The next section examines some of the channels through which digitalization may affect the various segments of the production process, the way it is organized through value chains and the possible distributional consequences. The key takeaway is that by making the various segments of the process more closely interwoven, digitalization alters the distribution of value added in value chains. This may provide developing countries with new opportunities for upgrading towards high value added segments of the manufacturing process, especially if they can leverage data on market demand for design and manufacturing decisions. However, control over both design and marketing processes is required for this, and this has been constrained by monopolies driven by intellectual property rights, as noted in *TDR 2017*. To date, the evidence suggests that both labour and local producers in developing countries are being squeezed, particularly in the production stages of these chains. Section C examines the policy options that might facilitate wide diffusion and adoption of new digital technologies while ensuring an equitable sharing of their benefits. It argues that efforts towards bridging digital divides and building digital capabilities need to be complemented by adapting innovation, industrial and regulatory policies to a digital world, including in an internationally coordinated way through South–South and broader multilateral cooperation. It also cautions against a premature commitment by developing countries to trade and investment rules driven by one-sided interests and with long-term impacts. South–South digital cooperation is suggested as a way forward for developing countries for building their digital capacities. This could be added to their on-going regional integration agendas. Section D summarizes the main findings and policy conclusions.

B. Digital technologies in value chains: Potential opportunities for income generation and upgrading

Digital technologies (table 3.1) are based on information that is recorded in binary code of combinations of the digits 0 and 1, also called "bits", which represent words and images (Negroponte, 1995). This enables very large amounts of information to be compressed on small storage devices that can be easily preserved and transported, and reduces the costs and accelerates the speed of data transmission.

The industrial use of these technologies is currently at different stages of readiness. Industrial robots have experienced rapidly growing deployment, especially since 2010, even though they have remained concentrated in developed and a few developing countries at more advanced stages of industrialization (*TDR 2017*). The use of additive manufacturing (or 3D printing), is at an even earlier stage but is also growing rapidly. But this growth depends on the expiry of some core patents; currently, the more accessible 3D systems use technology that is somewhat dated, whereas frontier 3D systems for professional industrial use remain expensive (Ernst and Young, 2016). Wider accessibility is expected for this technology over the coming decade (WEF, 2015; Basiliere, 2017) as well as for big data and cloud computing (Purdy and Daugherty, 2017) and for AI (WEF, 2015).

1. The distribution of value added and upgrading in traditional value chains

The international division of labour is increasingly structured around global value chains (GVCs) (*TDR 2002*, *2014*; World Bank et al., 2017). Participation in these chains by developing countries is expected to attract more foreign direct investment, provide easier access to export markets, advanced technology and know-how, and generate rapid efficiency gains from specializing in specific tasks, appropriately guided by

TABLE 3.1 Digital technologies

Technology	*Attributes*	*Examples*
Robotics and Artificial Intelligence (AI)	Algorithmic techniques that make it possible for computers and machines embodying computers to mimic human actions.	Software that can make machines perform routine manual or clerical tasks; robots assisting in surgeries; digitally enabled robots with advanced functionality to collaborate with or replace humans.
Additive manufacturing (3D printing)	Building products from numerous cross-sectional layers that are each less than a millimetre thick. This shortens stages of manufacturing like design, prototyping and product layout (all of which are created digitally) and enables production to be tailored to individual design specifications.	Consumer production using plastics, casting moulds, prototype parts for production, machine components.
Industrial Internet of Things	Digitally charged manufactures that can embed themselves into the broader technological ecosystem in which they operate.	Sensors that are embedded into products to provide new features for consumers and to gather data about production and use for data analytics.
Blockchains	Internet-based peer-to-peer network based on a decentralized system of digital ledger-keeping that is transparent and efficient.	Originally created for the Bitcoin currency in 2008 to allow for the issuance and record-keeping of online currency transactions.

Source: UNCTAD secretariat.

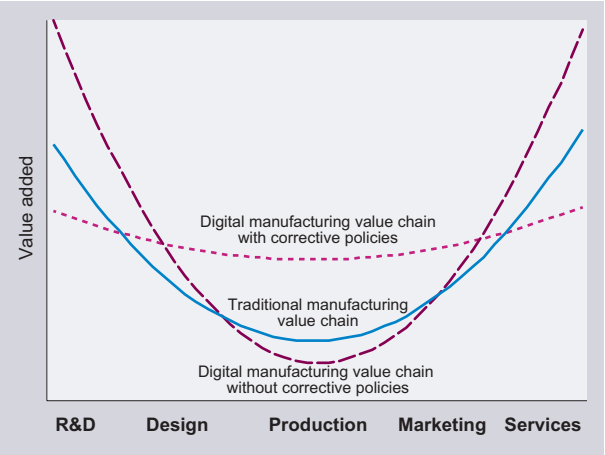
the "lead firm" in the chain. Such participation is seen as particularly important for developing countries with small domestic markets whose firms confront a range of technological and organizational constraints stemming from the fact that the minimum effective scale of production often far exceeds that required to meet their prevailing level of domestic demand.

This has meant that policy objectives are usually focused on providing an attractive business climate for the lead firm (including adequate infrastructure and a sufficiently trained labour force) and avoiding any restrictions on the free flow of goods and finance that connect suppliers along the chain. However, in the absence of solid evidence on significant "spillovers" from participation in value chains (*TDR 2016*),[3] policymakers should also continue to look for ways to establish domestic forward and backward linkages that facilitate a rising share of domestically generated value added, encourage more widespread transfers of technology and diffusion of knowledge, and support economic diversification and upgrading towards higher value added activities that rely on more sophisticated technology and skill sets. The evidence indicates that only a small number of developing countries – mostly in East Asia – have been able to build such linkages and achieve upgrading within GVCs (*TDR 2016*).

Divergence between expectations and outcomes from participation in GVCs is, in part, a reflection of the fact that the private interests of international firms do not necessarily coincide with the developmental interests of the host countries. This disconnect is, of course, familiar to many developing countries from their participation in commodity-based value chains, reflecting, in part, the asymmetric structure of markets and pricing power of firms from the North and South. It also highlights the importance of strategic policies, as countries look to shift towards a greater reliance on manufacturing (and service) activities and exports and is an important reminder that reductions in policy space can hamper industrialization and catching up in late developers (*TDR 2014*).

Since many developing countries have faced difficulties in achieving the policy objectives mentioned above, their place in GVCs has tended to be located on the lower portions of what is sometimes referred to as the "smile curve" (figure 3.1). The smile curve conceptualizes international production as a series of linked tasks and sees international trade organized

FIGURE 3.1 Stylized manufacturing value chain smile curve



Source: UNCTAD secretariat elaboration.

within GVCs as involving trade in those tasks rather than trade in goods. The resulting fragmentation of production carries significant consequences for the spatial division of labour and the distribution of economic power and privilege. Most of the pre-production and post-production segments of the manufacturing process, with their higher return activities, are usually located in advanced economies, with developing countries often left with the lower value added activities of the production segment of the manufacturing process. As Stephen Hymer (1972: 101) recognized over 40 years ago, as international production fragments along these task lines, "output is produced cooperatively to a greater degree than ever before, but control remains uneven"; in particular, the lead firm tends to concentrate its own tasks at the two ends of the smile curve where "information and money" provide the main sources of control and where profit margins tend to be higher. These "headquarter" economies are still located predominantly in the North (now including parts of East Asia) while "factory" economies are, largely, in parts of the South (Baldwin and Lopez-Gonzalez, 2013). Indeed, as these chains have spread across more countries and sectors over the past three decades they have been accompanied by a more and more uneven distribution of those benefits.

In developed countries, the concern is that that low- and medium-skilled production jobs in traditional manufacturing communities have been "outsourced", first to lower-wage regions of the developed world and then "offshored" to developing countries, and wages have stagnated while new jobs created at the ends of the chain have not only been insufficient in number to replace those being lost, but are often out of reach to those "left behind" both geographically and in terms of the skills required. The result is socio-economic polarization and a vanishing middle class (Temin, 2017). Developing countries worry about being stuck in low-value-added activities, unable to upgrade towards higher value added activities in R&D and design, marketing and management, and becoming trapped in "thin industrialization" or experiencing "premature deindustrialization"; here the problem is less one of a vanishing middle class and more one of a receding middle class, as a growing urban labour force (whose incomes may still be rising above the extreme poverty levels found in the rural and urban informal economies) experiences diminishing employment opportunities in higher productivity manufacturing and service sectors.

The critical question is whether and how the new digital technologies might aggravate or assuage these anxieties. In other words, new digital technologies could aggravate the inequalities already apparent across the value chain, as depicted in figure 3.1, or with different national and global policies they could be associated with a flatter curve and more inclusive outcomes. Some of the concerns are elaborated below, while some possibilities for deriving greater benefits for developing countries are noted in section D.

2. Digitalization: Potential impacts on the manufacturing process

Digitalization is often considered a game changer with respect to how the manufacturing process is undertaken and organized in value chains (e.g. De Backer and Flaig, 2017) even though the geographical location of these changes is as yet uncertain and will depend on a range of factors (Eurofound, 2018). This is because digitalization gives intangibles a more prominent role in income generation, including along value chains. Intangibles refer to R&D, design, blueprints, software, market research and branding, databases etc. (e.g. Haskel and Westlake, 2018: table 2.1).[4] The data that embody these intangibles and their codification drive the various new digital technologies which, as a consequence, are often more closely identified with service activities. This means that, in a digital world, services increasingly permeate the goods sector and that the traditional boundaries between goods and services in the manufacturing

process become blurred. By the same token, various segments of the manufacturing process become more closely interwoven. An important part of the data revolution involves sales and other market-related information and the ability to customize production to the increasingly demanding and heterogenous tastes of consumers, including in growing markets in the South (Baldwin, 2016).[5] The increase in the share of intangibles in the production process can have other implications: as noted by Pérez and Marín (2015) these technologies allow materials to be redesigned to make them more closely specified to their use, thereby reducing material use per unit of output, as well as reduce energy consumption and pollutant emissions.[6] What may be most significant of all is that digital technologies enable more decentralized and flexible production and distribution, reducing some of the scale economies that dominated the era of mass production. This can result in a "hyper-segmentation of markets, activities and technologies" (Pérez, 2010: 139) whereby companies of varying sizes can respond to and accommodate multiple demand segments, and small producers can cater to niche markets that need not be in geographical proximity. The use of new digital technologies may, therefore, allow developing countries to add more value in their production stages, whether or not the final product is for export or domestic consumption. However, this depends crucially not only on available infrastructure but on access to data and a supportive ecosystem.

(a) Potential impacts on income generation

(i) The production segment

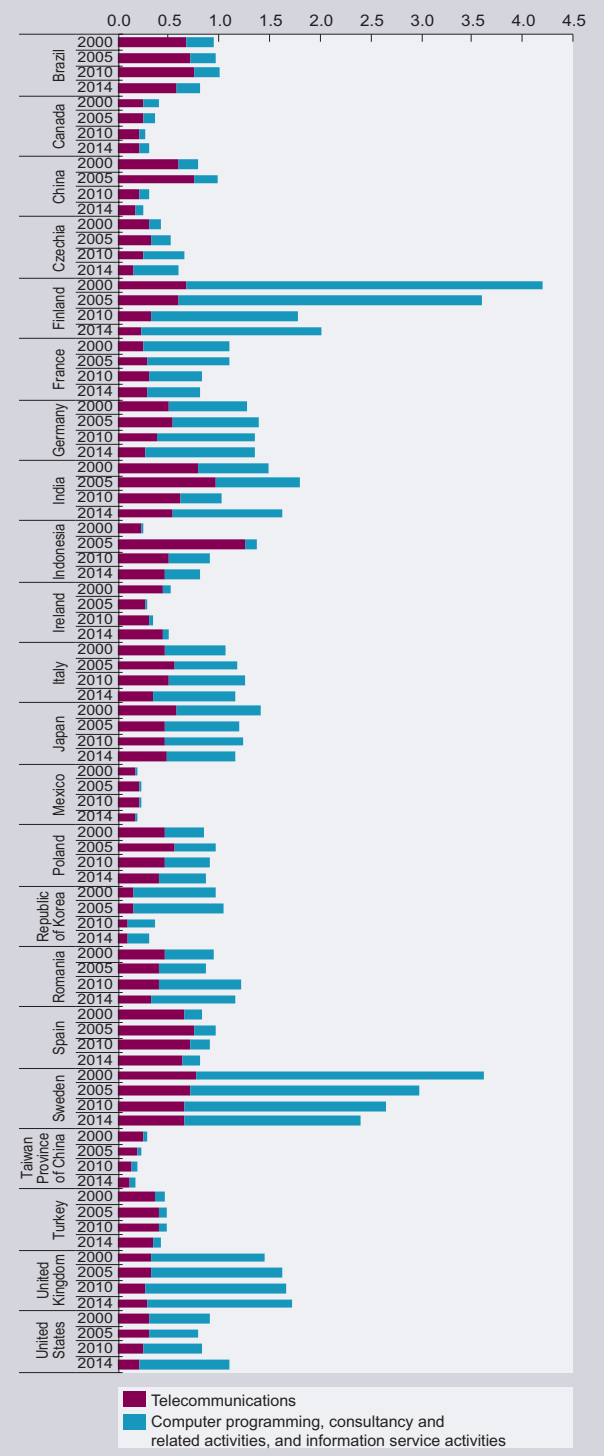
Much of the debate on digitalization has focused on the use of industrial robots in the production segment of the manufacturing process. As discussed in *TDR 2017*, the stock of robots remains concentrated in a few developed countries, and in relatively high-wage sectors, despite its recent rapid increase in some developing countries, especially China. The *Report* suggested that, for now at least, robot-based automation per se does not invalidate the traditional role of industrialization as a development strategy for lower-income countries moving into manufacturing activities (such as clothing and leather sectors) dominated by manual and routine tasks, although in countries already experiencing premature deindustrialization and low rates of investment, the danger of getting trapped in these low-value-added sectors is likely to increase. In the longer run, and even in the absence of reshoring to advanced countries (ILO, 2018), as the cost of robots declines further (and their dexterity increases), their spread to lower-wage manufacturing sectors and eventually to lower-income countries could have significant consequences for employment creation.

The production segment may also be affected by additive manufacturing, combining computer-aided design and manufacturing (CAD/CAM), or any other 3D software that creates digital models, with 3D printers that build products by adding materials in layers. This can also be seen as an opportunity: the likely reduction in the number of assembly stages in the production process, the heightened opportunity to customize production and the increase in the modularity of value chains could ease the integration of remote (and smaller) firms in the world economy. Firms employing digitized processes typically gain in flexibility and so may be better able to cater to increasingly diverse and fragmented consumer preferences in both domestic and external markets.

To assess the extent of digitization of the manufacturing process, the share of telecommunications, computer programming and information service activities in total intermediate consumption in manufacturing may be a useful gauge.[7] Cross-country evidence for the period 2000–2014 (figure 3.2) indicates that this share remains low and accounts for less than 1 per cent for most countries. It also shows wide variation across countries. Sweden and Finland record the largest shares while a few developing countries show very low shares. However, there is no clear divide between developed and developing countries. Among developing countries, it is perhaps surprising that for 2014 the share of India ranks fourth, while that of China remains among the smallest of all countries and even declined by more than half between 2005 and 2014. For most countries, computer programming and information service activities as a share of total intermediate consumption is of significantly greater importance than telecommunications, even though there is no clear pattern either across countries or over time.

Several factors may explain the apparent low importance of ICT services in manufacturing.[8] The small shares across all economies could indicate that digitalization is little more than a media hype. But these small numbers could also be a result of the slack in global demand following the global financial crisis, which has been a key factor holding back productive

FIGURE 3.2 **Selected ICT services as a share of total intermediate consumption in manufacturing, selected economies, 2000–2014**
(Percentages)



Source: UNCTAD secretariat calculations, based on World Input–Output Database (WIOD), University of Groningen, National Supply-Use Tables, 2016 release.

Note: ICT services refer to divisions J61–J63 of the International Standard Industrial Classification (ISIC) Revision 4 and distinguish telecommunications (J61) from computer programming, consultancy and related activities, and information service activities (J62 and J63). Manufacturing refers to ISIC Revision 4 divisions C5–C23. Shares calculated from weighted averages in national currency.

investment. The finding could, alternatively, point to another form of the Solow paradox – you can see the computer age everywhere but in the productivity statistics – in that digitization can be seen everywhere except in the national accounts statistics (Brynjolfsson et al., 2018). One reason for this could be that many digital services come free of charge in monetary terms (Turner, 2018). Accurate measurement of intangibles such as ICT services is difficult. But when estimated as a residual, their importance appears to be large and increasing, currently accounting for about one third of total production value (WIPO, 2017). Measurement issues could play an important role particularly in indicators based on input–output data, such as in figure 3.2, because firms may prefer producing most intangibles in-house, because of concerns regarding intellectual property protection. Intangibles sourced in-house are not reflected in input–output tables, which rely on purchased inputs. The surprisingly small shares for China in figure 3.2 could also reflect such measurement issues, as Chinese companies may have a particularly large degree of vertical integration.

(ii) The pre- and post-production segments

The new digital technologies and especially ICTs associated with the Internet of Things – such as cloud computing and big-data analysis – make the post-production segment of manufacturing more important, as this is where intangible assets are used intensively. Such ICTs tend to reduce coordination costs and increase the efficiency of production schedules, logistics, inventory management and equipment maintenance. Cloud computing and big-data analysis reduce the need for hard digital infrastructure. This makes it cheaper for firms, even in developing countries, to collect data and analyse them for their business purposes, reinforcing the customization and flexibilization possibilities mentioned above. This can occur for intermediate products, which would support functional upgrading and building more integrated industry structures; as well as final products, which would enable intersectoral upgrading and entering new product lines.

These mechanisms, which equally apply to foreign and domestic markets, sharply increase the number of interactions between firms and customers, even if these interactions are not always evident to customers. Firms that own the data from these interactions and possess the required analytical capabilities can identify the heterogeneity of demand patterns both

between and across foreign and domestic markets and customize the characteristics of their products accordingly. This allows for more personalized advertising and distribution campaigns that go beyond traditional marketing, reducing marketing costs while reaching out to more potential customers, and increasing the effectiveness of advertising expenditure.

The economic benefits of owning data in terms of transforming it into a profitable asset increase with the volume of data. This gives an advantage to first movers. They are most easily able to scale up their initial investment in data intelligence and analytics, thereby increasing the value of their data and associated knowledge base. The ensuing increased productivity and profitability also provide additional finance to acquire complementary databases or software and exploit associated spillovers and synergies. Such acquisitions may include start-ups, whose activities may even have been deliberately targeted at being complementary, rather than at being genuinely innovative and providing a substitute for incumbent firms. Such cumulative processes aggravate already existing tendencies towards concentration and centralization. When this occurs, genuine technological progress and competitive pressure may be reduced. Equally significant, the high profitability of incumbent firms also allows for rent-seeking and spending on regulation and lobbying, such as for reduced tax bills or for "blocking" patents or copyrights that keep potential rivals out.[9]

Such first-mover advantages underline both the urgency with which developing countries need to act and the difficulties and associated policy challenges related to their engaging in activities in the post-production segment of digitized value chains.

The greater role of demand-related post-production variables in the manufacturing process may be further enhanced in the pre-production segment, as the new digital technologies tend to make design more flexible and reduce its cost. Digital design simulation reduces the number of work hours required to create new goods.[10] It may also reduce the expertise needed to design goods. The rise in flexibility and the decline in cost of pre-production activities may be further enhanced by additive manufacturing (e.g. Ubhaykar, 2015). It compresses the development cycle of products that may subsequently be mass-produced based on traditional technology and infrastructure (e.g. UNCTAD, 2017b), or be chosen for more customized production based on digital technologies. Using digital technologies in the pre-production phase could at least partly help to compensate developing countries for the lack of skilled designers and an established machinery industry.

It is clear that some developing countries have already moved some way towards digitalization in production. This could provide a stepping stone for additional broader engagement also in the pre- and post-production segments of the manufacturing process where returns are traditionally higher. However, whether this happens depends on the way value chains are governed.

(b) Potential impact on governance and distributional outcomes

Corporate governance involves a mixture of coordination, contracts and control. In the context of value chains, it determines how and where lead firms organize production patterns across a dispersed set of suppliers and tasks, how transactions are made between these contracting parties, the marketing of the final good or service and how the value generated from the final sale of the product or service is distributed across the different actors operating within the chain.

Value chains have a long history, particularly in the exploitation of natural resources (Hopkins and Wallerstein, 1986). While commodity chains were often constructed on the back of the political power and authority of a colonizing state, the economic power of the lead firm in these chains traditionally reflected a combination of technological know-how, scale economies and restrictive business practices which enabled a degree of monopoly control over the extraction, processing and/or distribution of a specific commodity and monopsony control over suppliers of support services, allowing the lead firm to make above-normal profits; Standard Oil is the emblematic case (Lewis, 1881). As these commodity chains involved more and more developing countries, their income losses from rent extraction through monopoly pricing was often compounded by a movement in the terms of trade in favour of manufacturing exporters (Prebisch, 1949).

More recently, as value chains have entered (and reconfigured) manufacturing sectors and as developing countries have provided more links in these chains, the international division of labour has become more fragmented, employment relations

more fractured and governance arrangements more complex. At the same time, large corporations have shifted their attention to "core competencies" and increasingly employed a range of financial instruments, such as share buy-backs and mergers and acquisitions, to increase their "value" while cost containment, through outsourcing, work intensification, segmented labour markets and insecure supplier contracts, has become the principal strategy in managing the production process. These pressures have contributed to, and been reinforced by, growing market concentration across many sectors of the economy which, together with a tighter control over key strategic assets such as intellectual property, has allowed for a rise in super profits through rent-seeking behaviour. These changes in corporate governance have been readily extended to the international level through the working of GVCs.

The interplay of these micro- and macro changes has, in turn, been associated with steadily declining labour shares in national income, albeit with variations across countries, sectors and firms. In this regard, the spread of GVCs over the last 30 years has reinforced an already established trend of weakening bargaining power for labour by augmenting the possibilities of lead firms outsourcing inputs to suppliers operating in highly competitive markets, while strengthening control over strategic assets in the pre- and post-production stages that allows them to capture rents (Milberg and Winkler, 2013).

Digitalization is likely to alter further the governance structure of value chains. On some assessments, digitalization may reduce the control by lead firms and shift relationships away from captive towards more relational and modular types of governance; as discussed earlier, increased possibilities for product customization could move the control of value chains towards customers whose specific desires regarding the functionality and features of products may guide design and production patterns. But reaping these benefits crucially depends on a supplier's digital capabilities. This is because digitalization also satisfies demands for more granular financial and managerial control and contributes to greater flexibility for lead firms in choosing among an increased number of suppliers. This could increase the risk for producers that lack digital capabilities to be marginalized or excluded.[11]

Examining the manufacturing process as a "pipeline" that creates value by coordinating a linear series of activities where inputs enter at one end of the chain and undergo a series of steps that transform them into more valuable products that exit as outputs at the other end of the chain assumes a benign view of the lead firm and downplays the hierarchical division of labour behind the smile curve as well as changes in corporate control more generally over the past three decades. As such, it does not give the full picture of the likely impact of digitization on manufacturing processes.

The lead firm in most GVCs is basically a cosmopolitan extension of a large national firm. As discussed in *TDR 2017*, corporate governance, beginning at the national level, has – over recent decades – been transformed through a combination of financialization, neo-liberal ideology and technological advances in ICTs. As a result, vertically integrated firms have focused on core competencies, outsourcing many tasks (particularly in the production stage) that were previously undertaken in-house. This has coincided with and further encouraged a very different approach to value creation and distribution focused on shareholder value and rent-seeking behaviour.

To assess changes in distribution, it may be useful to disaggregate total value added in manufactured output into the contributions by the four functions that characterize labour activities in the manufacturing process (management, marketing, R&D and fabrication), taking the capital share as a residual, and calculating the domestic shares of the contribution of each of these factors.[12] Doing so indicates that the domestic share of total value added declined in all countries shown in figure 3.3, except China. This reflects the well-known process of globalization during the period 2000–2014, as well as the reduction in the import-intensity of manufacturing in China during those years. Moreover, the domestic share of labour income in total value added declined in almost all the countries shown in the figure, while China experienced a sizeable increase in this share.

The evidence for the domestic part of the capital share is more mixed, but it increased sizably in the United States and to a lesser extent in Mexico, while it declined in Brazil and China.[13] It should be noted that evidence on the domestic part of the capital share is affected by transfer pricing and related practices, which cause returns on capital to show up in low-tax jurisdictions rather than the country where such returns originate. Regarding the four business functions, the domestic share of fabrication declined in all countries, except Canada and China, with the

FIGURE 3.3 **Domestic value added shares in manufactured products finalized in an economy, selected economies, 2000 and 2014**
(Percentages)

Source: UNCTAD secretariat calculations, based on de Vries, 2018.

latter country's share attaining almost 30 per cent of total value added in 2014. The evidence regarding changes for management and marketing activities is mixed, but the domestic share of R&D activities in total value added increased in most developed economies, and particularly in Japan. Developed economies also recorded the highest domestic shares of R&D activities in total value added. But there is also an increase in this share, although from relatively low levels, in a range of developing countries, notably Brazil, China, Indonesia, Mexico, Republic of Korea and Taiwan Province of China. This could be taken to indicate a general increase in the importance of the pre-production segment of the manufacturing process across many countries in the world economy.

A second way in which digitization is impacting distribution is through the emergence of platform monopolies, in which the key strategic asset of the lead firm is control and use of digitized data to organize and mediate transactions between the various actors in the chain, combined with the capability of expanding the size of such ecosystems in a circular, feedback-driven process (e.g. Van Alstyne

FIGURE 3.4 Types of digital platforms

Types of digital platforms

Category	*Type*	*Examples*
Transaction	Market places	Amazon, eBay, Alibaba, MercadoLibre, Google Play, Apple App Store, Airbnb, Uber, Ticketmaster, PayPal, PayU
	Social media and content	Facebook, Twitter, YouTube, Instagram
	Internet search services	Google, Yahoo, Bing, Baidu
	Digital advertising	AdWords, DoubleClick, Tradedoubler
	Funding	Kickstarter, Crowdcube, Startnext
	Talent management	LinkedIn, Monster, CareerBuilder
Innovation	Mobile ecosystems and apps	Android, iOS
	Industrial digital platforms	Google Cloud Platform, IBM Watson IoT, ThingWorx
	Participation and open services	Citadel, CitySDK, Busan Smart City Platform

Source: Adapted from United Nations and ECLAC, 2018.

et al., 2016). Digital platforms are technology-enabled operations that facilitate interaction and exchange between various groups, built on a shared and interoperable infrastructure and driven by data. They operate over a range of activities. Transaction platforms enable interaction between individuals who would otherwise not find each other; innovation platforms provide technological building blocks enabling innovators to develop complementary services or products. Figure 3.4 provides a typology of platforms.

Among marketplaces, there can be peer-to-peer platforms (mainly between private individuals); business-to-consumer platforms, where sellers are firms; and business-to-business platforms, where both buyers and sellers are firms. Marketplaces rely on varied business models. Some act as sellers or resellers of goods and services; some charge a commission for each transaction; some are financed by joining fees. As they collect large amounts of personal and non-personal data, they can increase their incomes by using big-data analytics, or sell these data to others. The largest and most powerful marketplaces are mostly based in the United States, with a few in China. E-commerce platforms have grown steadily and the largest ones have vast numbers of users, such as Alibaba Tmall (400 million but confined to China), Amazon (304 million users globally) and eBay (167 million users worldwide). Similarly, the main services marketplaces are based in the United States or Asia, and deal mainly in finance, housing and accommodation, logistics and transport. Seven out of 11 of the largest payment platforms are based in the United States and the rest in the European Union. The top four marketplaces that have received the largest investor funding include three in the United States (Uber, Airbnb and Lyft) and one in China (DiDi Chuxing). The domination of the United States is also evident in social media and content platforms, with the top seven such firms all originating there. The only exception is China, which has been able to expand its own firms by preventing the global firms from entering its market. Similarly, Internet search platforms are dominated by United States firms, other than Baidu in China and Yandex from the Russian Federation. This is also true for mobile ecosystems, with three United States-based firms completely dominant: Android with 81.7 per cent market share, iOS with 17.9 per cent and Windows with 0.3 per cent of the global market. Internet of Things (IoT) or industrial digital platforms are similarly dominated by companies from the United States and Europe.

The structure of these emerging digital ecosystems is based on data ownership and management, including the reuse or sharing of data for more products or more functions within the manufacturing process. Data, like ideas and knowledge more generally, and unlike most physical private goods and services, are non-rivalrous and can be reproduced at no or minimal cost, although they are excludable and can thus be a source of monopoly. This means that a digital ecosystem's primary source of value is the size of the ecosystem itself. An expanding system could facilitate the entry of new participants. However, firms involved in the production of non-rivalrous goods will tend to seek ways to build fences around them in an attempt to artificially create a degree of scarcity and, in the process, generate rents from the assets they own.

Unlike a true public good, exclusion is possible in the digital ecosystem through a combination of strengthened property rights, scale effects, first-mover advantages, market power and other anticompetitive practices. Data intelligence, which is created by use of algorithms on big data, has helped lead firms to develop unique products and services, extend and coordinate complex supply chains and underpin the world of algorithmic decision-making. The "network effects" through which everyone gains by sharing the use of a service or resource have given rise to "demand-side economies of scale" which allows the largest firm in an industry to increase and lock-in its

FIGURE 3.5 Geographic location of big tech companies, selected companies

Source: UNCTAD database of consolidated financial statements, based on Thomson Reuters Worldscope.

attractiveness to consumers and gain market share. This makes it almost impossible for competitors with declining shares to remain attractive or competitive (Foster and McChesney, 2011).

The raising of legal and financial barriers as well as more informal mechanisms of control by large firms with monopolistic, or near monopolistic, powers has already opened up new avenues of profit-making in the digital economy. The resulting winner-takes-most environment allows lead firms to squeeze suppliers, capture rents created elsewhere in the economy, acquire competitors, and gouge the public purse even when it is reducing prices for consumers.

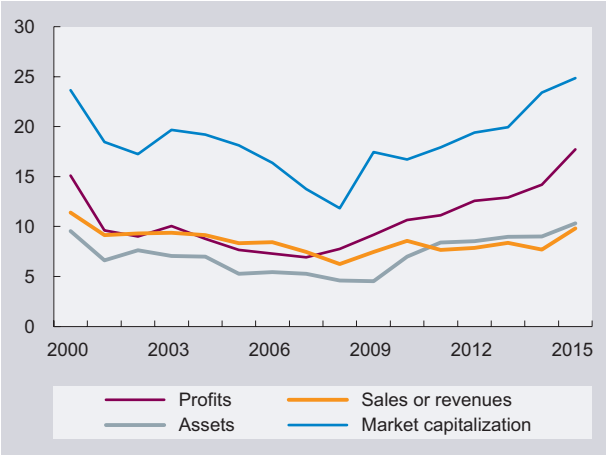
This environment imparts a strong spatial dimension to the distribution of rewards along the value chain. As Hymer, Prebisch and others warned in a pre-digital era, the rise of headquarter firms threatened a further concentration of economic power around heightened flows of information and capital which raised the danger, already visible from the asymmetries in trade and technology flows, of "the drainage of income through the transnational corporations, as they came to play a more and more active part in industrialization, often sheltering behind an exaggerated degree of protection" (Prebisch, 1986: 198). This danger seems likely to be compounded in the digital era and there is already some limited evidence that while markups have been rising significantly for larger firms in advanced economies this is not the case for firms from developing countries.

A simple picture of a North–South digital divide is, however, complicated by polarization and informalization pressures within the advanced countries themselves. These are, as noted earlier, creating dual economic structures, by the increasing dominance of United States corporations over European and Japanese rivals, as well as by the emergence of global companies from developing Asia (figure 3.5).

Still, the drive for scale in the digital world is ubiquitous; "big tech" companies are not only bigger than ever but also increasingly bigger than most "traditional" TNCs, assuming a growing presence in the top 100 global companies in the world. Figure 3.6 shows how the shares of large ICT companies in assets, sales, profits and market capitalization, which fell (albeit slightly) after the bursting of the dot-com bubble in 2000, have been rising after the global financial crisis.[14] By 2015, the 17 ICT companies that were in the top 100 TNCs globally accounted for a quarter of the total market capitalization of these top companies and 18 per cent of their profits, even though their sales revenues amounted to less than 10 per cent of the total.

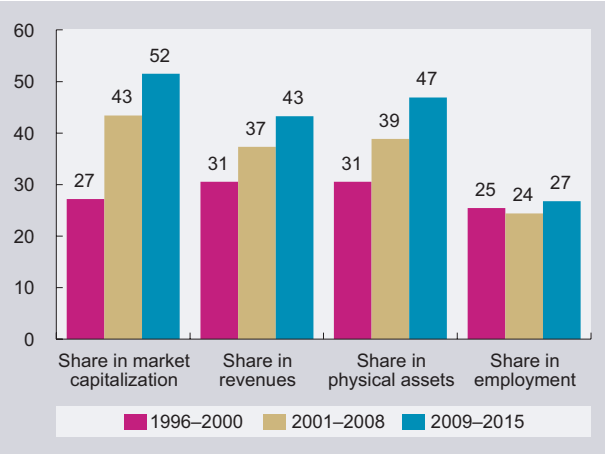
In addition, there has been significant increase in concentration within the ICT industry, as evident

FIGURE 3.6 **Share of "big tech companies" in top 100 non-financial corporations**
(Percentages)



Source: UNCTAD database of consolidated financial statements, based on Thomson Reuters Worldscope.

FIGURE 3.7 **Shares of top 1 per cent companies from technology, software and IT-services sector, 1996–2015**
(Percentages)



Source: See figure 3.6.
Note: Top 1 per cent companies identified by intangible assets in the sector.

from figure 3.7. Within all the ICT companies in the database, the top 1 per cent accounted for increasing and dominant shares of physical assets, revenues and market capitalization – but nearly stagnant shares of employment.

The emergence of some big ICT companies from the Global South, primarily in East Asia (including, most recently, China), indicates that successful late industrialization experiences, can give rise to large firms able to exploit new opportunities in the digital economy. These newcomers not only have access to data but the capability to translate them into economically meaningful knowledge and can target potentially overlapping customer bases with distinctive new offerings, such as links to local innovators, designers or producers that may provide better customized products and create effective competition to an established ecosystem.

Whether such competition becomes a more general feature depends on legal and policy frameworks that determine the extent to which lead firms in digital ecosystems must share some of their data or the value that accrues from data ownership. More generally, the capacity of the different stakeholders along a value chain to appropriate the income generated is also circumscribed by rules and regulations from actors external to the chain, mainly national governments and supranational institutions. Such rules and regulations can mediate value sharing between customers and platforms that own data, on the one hand, and incumbent platforms and competitor platforms, on the other hand, as further discussed in the next section.

C. Adapting economic policies to a digital world

While new digital technologies may provide additional impetus to income generation in developing countries, they also pose challenges because of the potential for greater monopoly control in some areas and the distributional implications of corporate rent-seeking. Experiencing the benefits of moving towards a digital world is obviously contingent upon the appropriate physical and digital infrastructure as well as digital capabilities, but additional policy frameworks and regulations are also necessary to ensure fair and equitable sharing of these benefits. While the precise policy strategy will be distinct for each country and reflect its specific conditions, there are some broad principles that can provide a framework. International cooperation, including in the form of South–South cooperation, is particularly relevant for overcoming digital divides and addressing fiscal and regulatory issues.

1. Facilitating integration into a digital economy and ensuring an equitable sharing of its benefits

(a) Digital infrastructure and digital capabilities: Basic conditions for integrating into a digital world

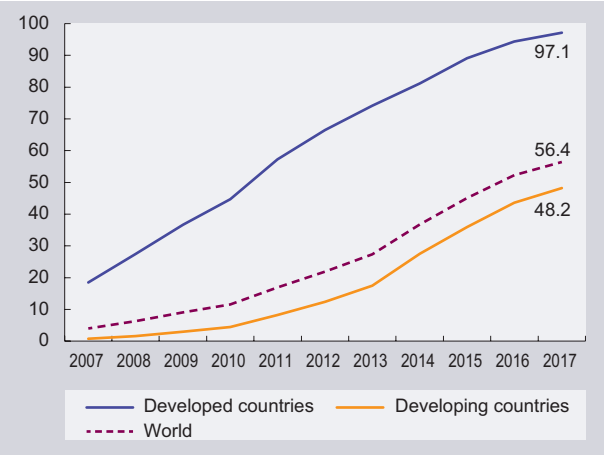
A digital economy is built on digital infrastructure and digital capabilities. Three broad interrelated components of digital infrastructure which can be identified are networks, software and data; and digital capabilities are needed to use them effectively. Over the past two decades, countries have been steadily building their digital networks (i.e. ICT and broadband infrastructure) as the principal tool for collecting and transmitting information flows. This ICT infrastructure forms the base of the digital infrastructure as it provides Internet access to the population, while broadband infrastructure helps in delivering large amounts of data at a much faster speed. Much of the initial work behind ICT infrastructure tends to be undertaken with public funding and through various forms of public and private collaboration to improve network connectivity, affordability and accessibility. Subsequently, Internet access and connectivity through broadband have become dominated by private Internet service providers. However, by the late 2000s it became clear that wired broadband connectivity especially to remote areas was not adequately served by private companies. Since the universality of broadband infrastructure is a prerequisite for a more equitable digital economy, this points to the need for enhanced public investment in broadband infrastructure in most developing countries.

The second interrelated component of digital infrastructure is software and its use across a full range of economic activities, with increasing emphasis on access through a cloud computing infrastructure. Cloud computing provides computing services remotely as a general utility to Internet users. It can be just sterile infrastructure like storage, means for processing, networking and servers (infrastructure as a service, or IaaS), or also provide operating software and platforms for building custom applications (platform as a service, or PaaS) or consist of remote provision and management of the whole range of computing needs right up to fully functional applications and data-based processes (software as a service or SaaS). Cloud computing therefore combines software power with network power allowing quick, wide and deep global spread of relatively inexpensive cutting-edge technologies. However, cloud applications provide its owners immense power, as dependencies increase from IaaS through PaaS to SaaS models: for example, global cloud applications have provided Google, Facebook, Uber, etc. the power to become the virtual control panels for reorganizing entire sectors. This creates a policy challenge for developing countries whose national antitrust legislation may not be adequate to address the cross-sectoral market power increasingly held by such multinational companies.

The third interrelated component of digital infrastructure is data, which provide platforms with the raw material they need to operate. This is, arguably, the most important component of the digital infrastructure, providing the basis for generating huge profit streams and potentially changing the relative positions of countries in terms of their shares in global production, consumption, investment and international trade. Many observers have termed "data" the "new oil", not only because they have to be extracted and processed from an initially unrefined state, but because processed data can also give monopolistic powers to its owners. Indeed, because (unlike oil) data are not a finite resource, the ability to exclude competitors from access can generate even more monopoly power and rent-seeking behaviour.

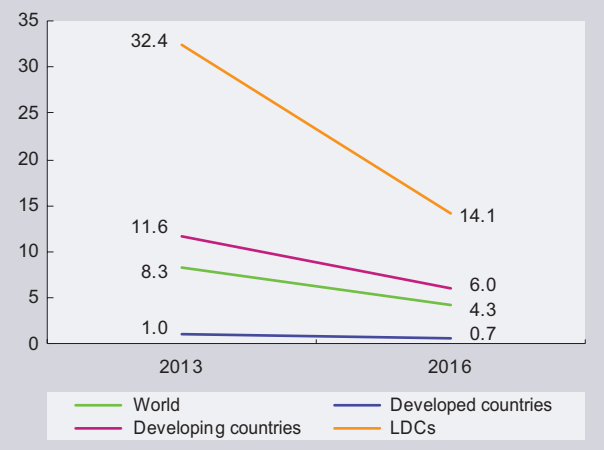
The challenges faced by developing countries in ensuring such digital infrastructure are evident from the still large gaps in most developing countries. Fixed broadband subscriptions in developing countries are still less than one quarter of the number in developed countries in per capita terms, while in least developed countries (LDCs) the number has barely increased and the penetration rate is less than 1 per cent. Mobile-broadband subscriptions were around 78 per 100 population in the United States and Europe in 2016, but only 20 per cent in Africa. Two thirds of the population of developing countries – around 4 billion people – remained offline in 2015/16.[15] Mobile-broadband subscriptions have grown more rapidly in the developing world recently, but figure 3.8 shows that they are still only around half of the per capita levels in the developed world. One reason for this is the high price: figure 3.9 indicates that despite recent declines, broadband prices in the developing world are on average over eight times those in developed countries (and over 20 times in LDCs) when seen in relation to per capita income. While Internet access has increased everywhere, the coverage in Europe is nearly four times that of Africa (figure 3.10).

FIGURE 3.8 **Active mobile-broadband subscriptions, 2007–2017**
(Per 100 inhabitants)



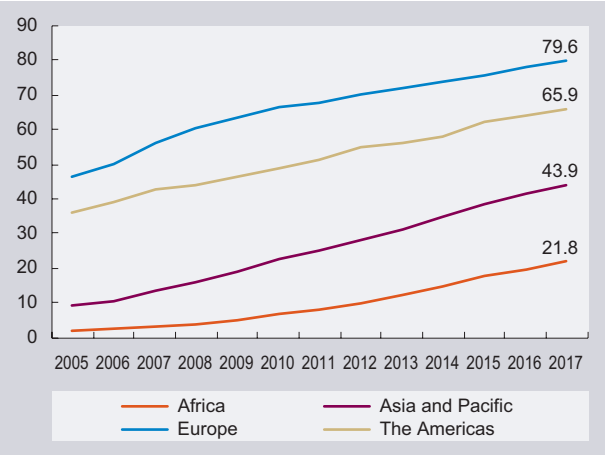
Source: ITU, ICT Facts & Figures, The world in 2017. Available at: https://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2017.pdf.

FIGURE 3.9 **Mobile-broadband prices, 2013 and 2016**
(Percentages of gross national income per capita)



Source: See figure 3.8.

FIGURE 3.10 **Individuals using the Internet, 2005–2017**
(Individuals per 100 inhabitants)



Source: See figure 3.8.

Broadband speed is a crucial determinant of the potential for digitalization and related business, and it remains relatively much slower in most developing countries. Reducing these large infrastructure deficits is a huge task that will require large investments.

In addition to digital infrastructure, building a digital economy obviously requires the presence of supportive physical infrastructure and institutions, of which continuous power connections and access to banking and financial institutions are obviously crucial. While these are taken for granted as necessary preconditions for other digital policies in advanced economies, they are still significantly underprovided in much of the developing world, and not addressing these issues would further add to digital divides. Similarly, the digital capabilities discussed below also require minimum levels of education across the society. In their absence, much of the talk of digital "leapfrogging" is highly exaggerated.

Digital capabilities are also referred to as digital skills or digital competence. They cover information management, collaboration, communication and sharing, creation of content and knowledge, ethics and responsibility, evaluation and problem solving, and technical operations (Ferrari, 2012). ILO-ITU (2017) describe four kinds of such skills: (1) basic digital skills, related to the effective use of technology, including web research, online communications, etc.; (2) soft skills necessary to ensure collaborative work among professionals; (3) advanced digital skills related to technology development such as coding, software and app development, etc.; and (4) digital entrepreneurship which includes digital skills required by entrepreneurs for strategic planning, market research, business analysis, etc. Due to rapid advancement of digital technologies there is a growing "digital skill gap" which is being felt by both developed and developing countries. To develop digital skills, efforts have to be made by the developing countries at various levels: introducing digital education in schools and universities, upskilling the digital

skills of the existing workforce, running special basic and advanced skill development programmes for the youth and older persons, including digital skill training programmes in existing professional development programmes, and providing financial support to develop digital entrepreneurship. All these should ideally be part of an overall national strategy of building digital skills for the twenty-first century.

(b) Industrial policy

Successive *Trade and Development Report*s have consistently argued for proactive industrial policies to manage structural transformation; *TDR 2016* concluded that an "active" industrial policy is key to building the backward and forward linkages that can sustain productivity growth and rising living standards through a process of structural transformation. Two elements of the changing dynamics of the world economy may be crucial for the effectiveness of industrial policies: (1) the move towards a digital economy and its associated increased systemic interactions between innovation, education, production and services activities; and (2) the increased weight of developing countries in the global economy, which may allow for a rebalancing of external and domestic markets as destinations of developing countries' production activities.

The previous discussion of the infrastructural needs of the digital economy has already specified the supply-side interventions that are necessary parts of contemporary industrial policies, to ensure bandwidth and connectivity, as well as universalizing Internet access and other measures. Similarly, the development of digital capabilities also requires public investment and government support, for example in digital education and training, ensuring access to banking systems and credit, and so on (Vijayabaskar and Suresh Babu, 2014). In addition, demand-driven policy instruments can be key determinants for the creation of demand for domestic innovation and the potential creation of entirely new sectors (Saviotti and Pyka, 2013; Salazar-Xirinachs et al., 2014; Santiago and Weiss, 2018). A government can do this in several ways: (1) as a direct consumer and investor, it can act through government procurement; (2) as a regulator, it can affect competition, and hence the level of demand enjoyed by individual firms, by determining the number of licences for certain activities or by imposing certain industry standards; (3) it can steer the direction of innovation by taking the lead in undertaking innovation activities or incentivize firms and other players to form research consortia; (4) it can promote private demand, such as through tax incentives and subsidies, to stimulate investment and innovations by domestic firms; (5) as a knowledge broker, it can link innovators, producers and consumers (for more detailed discussion, see Elder, 2013; and Chang and Andreoni, 2016).

Industrial policies for digitalization must seek to exploit the potential of using new technologies for transformational purposes to create and shape new products and new markets, as well as to compensate for the job destruction that the application of such technologies may cause. The strong synergies between supply-side and demand-side pressures in establishing a "digital virtuous circle" (of emerging digital sectors and firms, rising investment and innovation, accelerating productivity growth and rising incomes, leading to expanding markets) speaks to the need for moving towards a mission-oriented industrial policy in a digital world.

This involves using more dynamic metrics in policy evaluation to assess the degree to which public investment can open and transform sectoral and technological landscapes. Moreover, governments could engage in more than just helping to fund new technology. They could become investors of first resort regarding digital innovation by investing directly in corporate equity (Mazzucato, 2017). One way of doing so would be for governments to acquire stakes in the commercialization of successful new technologies by establishing professionally managed public funds, which would take equity stakes in new technologies, financed through bond issues in financial markets, and which would share its profits with citizens in the form of a social innovation dividend (Rodrik, 2015). In this way, the fruits of high productivity growth from technological change could spread more widely and fuel aggregate demand also for output from lower productivity sectors, thereby increasing employment and average productivity at the same time. Empirical evidence suggests that companies with large shareholders, such as publicly held companies and sovereign wealth funds, tend to invest more in innovation than companies with dispersed equity ownership (Edmans, 2014). This is because such shareholders typically base buying and selling decisions on the company's long-term prospects, including those built on intangible capital. Such investment could ensure long-term thinking across the digital ecosystem and enable benefits from the spillovers and synergies that intangible

assets may generate across companies (Haskel and Westlake, 2018).

A digital strategy must also adapt to the changed structure of finance for investment in the digital economy. Contrary to tangible assets – such as buildings, machines or particular plots of land – intangible assets, such as data, software, market analysis, organizational design, patents, copyrights and the like, tend to be unique or most valuable within narrowly defined specific contexts. Therefore, they are difficult to sell or value as collateral. This makes it cumbersome to finance investment in intangibles from traditional sources, such as bank loans and marketable bonds, and, in addition to private equity finance, increases the role of retained profits as a source of finance for investment. However, the profit–investment nexus has seriously weakened over the past two decades, especially through the increased emphasis that corporate managers have given to norms, metrics and incentives from the financial sector, increasing the distribution of dividends, buy-backs of stocks and other speculative financial operations in the process. As a result, supporting investment in intangibles may well imply an increased role for development banks as sources of finance or of specialized financing vehicles – such as the guidance funds attached to the new industrial strategy of the Government of China (Kozul-Wright and Poon, 2017) – as well as policy measures designed to strengthen the profit–investment nexus, such as changing financial reporting requirements or imposing restrictions on share buy-backs and dividend payments when investment is low, or preferential fiscal treatment of reinvested profits (e.g. *TDR 2008* and *TDR 2016*).

In addition, regulatory measures (discussed in more detail below) such as data localization requirements, Internet filtering and technology transfer requirements (i.e. disclosure of source code) can serve as important industrial policy tools to promote domestic digital firms and allow them to catch up with the leading multinational firms.

(c) Innovation policy

The acquisition and adoption of technology, as well as its adaptation to local circumstances, is a costly process. To speed up and support this process, developing countries were advised to ensure appropriate absorptive capacity, including in terms of the skill level of the labour force and institutional structures to facilitate technology development and transfer (see also section B.1 above). Recently, proactive innovation policy has also found a prominent place on the agenda of developing country policymakers.[16] One reason for this is the improvement in some developing countries' technological capabilities and technology-related institutions, reflected in higher educational attainments and enhanced R&D expenditure and patent filings. The World Intellectual Property Organization's global innovation index shows that a few developing countries have caught up on certain innovation variables, even though significant divides remain (Cornell University et al., 2017; UNCTAD, 2018a). An additional element of the changed environment that is of particular importance in the context of digitalization regards the increased spending power and emerging middle classes in some developing countries, particularly in Asia, which is creating new markets and thereby generating new potential for innovation to meet this growing demand. As a result, developing countries are being seen not merely as recipients but also as sources of innovation, particularly innovations aimed at developing customized goods and services catering to specific markets at relatively low cost.[17]

Such customization of new digital technologies can be related to the idea of frugal innovations, which are those that provide "new functionality at lower cost" (Leliveld and Knorringa, 2018: 1; see also Zeschky et al., 2014).[18] These rely on developing country residents both as consumers and producers, by focusing on the specific opportunities for innovation, production and consumption in a particular geographical location. Unconstrained by developed country demands, developing country firms can benefit from local cost advantages, better local sourcing conditions and better knowledge about local circumstances, preferences and needs. They can use these elements to design goods and services with new functionalities and features that are customized for local firms and for local low-income or middle-class consumers. Such local innovations also help to reduce foreign exchange outflows by shifting domestic demand towards domestically produced customized goods. Digitalization may provide specific opportunities for frugal innovation by developing country firms because they tend to reduce the cost of innovation.

Similarly, the digital economy may also open up new possibilities for more reverse innovation, which refers to ideas, technologies and products that may be generated in developing countries but are subsequently used by firms from developed countries

(Immelt et al., 2009; Zeschky et al., 2014). These do not have to be "frugal" but can include sophisticated and expensive products and processes. Reverse innovation may be done by affiliates of developed country firms that face sluggish overall demand in their head firm's home markets and, as a reflection of growing distributional inequality, a shift in the composition of this demand towards simpler and cheaper products. It may also be part of the internationalization strategy of local firms in some large developing countries that initially respond to growing domestic demand, but later attempt to tap into lower-income segments of developed country markets. Such reverse innovation tends to achieve economies of both scope and scale by enabling customized production for smaller domestic and larger foreign markets.

Such innovations, however, increasingly rely on big-data analytics and other digital technologies. Greater interaction between innovators, producers and consumers is important from the supply side for design and production decisions, while product-specific marketing and distribution based on digital media could help customers in their spending decisions. In developing countries, using these digital devices could allow reducing or even removing the long chains of intermediation that often characterize user–producer interactions (e.g. Foster and Heeks, 2014), thereby making them both more flexible and more cost-effective. Obviously, this is only possible if firms and innovators within developing countries have access to such data that are typically collected by multinational platform companies. Therefore, policies designed to prevent monopolistic control and to ensure that small and medium producers and potential innovators have affordable access to such data, are obviously important.

While intellectual property rights (IPR) rules do constrain technology transfer, the more so as these have been tightened in the context of free trade agreements, some recent success stories suggest that it is still possible to overcome the obstacles that they pose.[19] Cross-industry surveys have led some observers to conclude that design-related IPR are considered relatively ineffective, as also illustrated by firms' often significant additional investment in brand image and other reputational assets intended to increase value capture from their designs (Filitz et al., 2015).[20] Given that digitalization may bring about entirely new products, as well as enable new functionalities and ways of use, it would appear that existing IPR protection still leaves some scope for active design-oriented innovation policy in developing countries. Nevertheless, maintaining this scope will also require containing practices such as interlocking patents and patent trolls, which have become important features of competition mainly in the smartphone and pharmaceutical industries (see also *TDR 2017* and section C.1.d below).

Moving towards a digital world may also broaden the scope for developing country firms to engage in cross-licensing arrangements with developed country firms. At least some of these firms may privilege protecting their designs through trade secrets but others could still be interested in licensing, and thereby disclosing, their designs to developing countries. They could wish to do so in exchange for innovative design features regarding functionality and ease of use that firms in developing countries have developed for their domestic customers, which could also appeal to the lower-income groups in developed countries. IPR owners may also wish to create new revenue streams by commercializing template CAD files or software that purchasers can subsequently customize.

To boost digital skills and capabilities, many developing countries are encouraging digital start-ups. Digital start-ups differ from IT start-ups that provide core technical services in the form of SaaS, in that the former aim at digitally transforming specific sectoral services like education, health, transport, etc. (Singh, 2017). These digital start-ups represent a new wave of entrepreneurship, which, if appropriately harnessed, could usher in some highly efficient digital solutions as well as boost digital capacities, becoming a primary source of digital innovation in a country. However, instead of being used for expanding digital technology frontiers in a country, these innovations are increasingly being bought and used by big tech companies to expand their operations. For example, AI start-up acquisitions increased by 155 per cent in the period 2015–2017, rising from 45 to 115. The digital start-ups therefore need to be supported by national policies and regulatory measures in order to nurture and advance national digitization efforts.

In addition to a sizeable increase in R&D spending and the size of in-house design departments, enhanced skilled labour migration in the form of both intellectual returnees and skilled expatriates from developed countries could provide substantial support to developing countries' more active innovation policy. While returnees appear to have played a crucial role for example in the development of the

photovoltaic industry in China (Luo et al., 2017), expatiates have been instrumental in creating the designs for automobile production in developing countries such as Brazil, India and Morocco, as well as in Romania. There, designers have focused on the functionalities and price ranges that would appeal to customers in developing countries, as well as to relatively low-income customers in developed countries (Midler et al., 2017).

(d) Regulatory policies

The digital economy creates significant new regulatory policy challenges because the network effects and economies of scale associated with digitalization can cause rising inequality and generate barriers to market entry. As noted above, first-mover advantages in the form of benefits from controlling and scaling large volumes of data tend to create a few highly profitable large firms and "winner-takes-most" concerns. Such advantages can also become self-reinforcing, as data gleaned from one market can facilitate entering new markets or even new business lines. The resulting increases in market concentration may sizeably augment the financial power of a few leading firms and cause increased rent-seeking, anticompetitive practices and attempts to block actual or potential competitors. This means that established competition and antitrust policies may be unsuited to the digital economy.[21]

The overwhelming control over digital platforms by a few firms, mostly based in the United States, the United Kingdom and some other European countries, points to the need for active consideration of policies to prevent anticompetitive behaviour by such firms, as well as potential misuse of data that are collected in the process. It also provides an inkling of the difficulties associated with developing countries wishing to break into these areas. Even when innovators based in developing countries come up with new products and processes, they may be unable to reap the benefits in an oligopolistic environment, or may be taken over by the dominant firms. There are other ways in which such digital platform companies can slip through regulatory cracks. The concerns about lack of labour standards associated with supposedly peer-to-peer platforms that are effectively business-to-consumer platforms (such as Uber) are now well known. But for developing countries an additional concern could be the concentration of profits generated in such platforms by the companies that are largely based in the North. Such super-platforms (companies that dominate the digital landscape like Google, Apple and Amazon) are increasingly using algorithms based on big data to drive away competition. According to Ezrachi and Stucke (2016) algorithms can foster tacit collusions when each firm programs its algorithm with a strategy to maximize profits. The algorithms monitor the price changes and swiftly react to competitor's price reduction, similarly it also follows price increases when sustainable, such as when others follow in a timely manner, so that all competitors raise prices and profit together leading to an outcome not much different from that arrived by collusion. But unlike humans, the computers do not fear detection! Further, these computers have no specific commands that may trigger collusion. This makes it extremely difficult to hold the super-platforms liable for the pricing decisions of their self-learning algorithms, which may transfer wealth from consumers to sellers.

Although the super-platforms compete, they can also become "frenemies" to maximize joint profits and drive away competition.[22] This interdependence of super-platforms can severely hinder innovations as companies know that they cannot effectively reach consumers unless admitted by super-platforms. On the other hand, platforms need an ecosystem to flourish and contest other platforms. A platform will therefore attract independent application developers to build solutions to attract users. More users in turn will attract more application developers and this feedback loop makes the platform grow bigger, with the subsequent economies of scale further increasing its market power. The bigger the super-platform, the greater will be the network effects and more difficult it will become for competitive forces to displace it.

These growing collusions and anticompetitive practices of the super-platforms pose new challenges for competition and antitrust policies. AI determines independently the means to optimize profits and leads to an anticompetitive outcome, with no evidence of any anticompetitive agreement or intent. Further, the new market dynamism injected by technological advances leads to a transfer of wealth from consumers to super-platforms with consumers being unaware of the underlying mechanisms; it eradicates competition from small firms through acquisitions or exclusionary practices; and it promotes network effects to grow and assimilate further market power.

Competition agencies need to understand the changing contours of competition and the underlying

market mechanisms that help the "big" get "bigger", and to prepare themselves for regulating these super-platforms. This will require new tools and regulations as the existing language of antitrust laws may not allow the regulators to fully address the growing challenges. This is better understood in the developed countries, where the enforcers are intervening in some scenarios to regulate the activities of super-platforms.[23] However, most developing countries are yet to understand and adapt their regulations to address the anticompetitive practices of the super-platforms.

While anticompetitive practices have traditionally been addressed by antitrust and competition policies, the goal of these policies has increasingly shifted from a concern with market structure and market behaviour to an emphasis on maximizing consumer welfare.[24] Moreover, the remit of these policies has generally been confined to national boundaries. Recent concerns regarding regulation of the digital economy have also focused on consumer welfare, particularly regarding the preservation of data privacy[25] and Internet security, as well as avoidance of undesirable changes in how societies function. By contrast, the extraction of economic rent has received insufficient attention from policymakers despite its central role in the functioning of hyperglobalization.

One form of rent extraction is aggressive tax optimization by locating a firm's tax base in low-tax jurisdictions.[26] According to estimates by Tørsløv et al. (2018: 2), "close to 40% of multinational profits are artificially shifted to tax havens in 2015". The digital economy may exacerbate tax-base erosion because a multinational enterprise (MNE) whose main assets are intellectual property or data can easily offshore such assets. While the OECD's Base Erosion and Profit Shifting (BEPS) initiative has taken some useful steps towards safeguarding fiscal revenues, critics have called for wider and more inclusive discussion and argue that the reform proposals "have failed to ensure that profits are taxed where activities take place …, in favour of where the companies that receive income are based", mainly because "the revisions to transfer pricing rules continue to cling to the underlying fiction that a MNE consists of separate independent entities transacting with each other at arm's length" (ICRICT, 2018: 5).[27]

Taxing where activities are done rather than where firms declare as being headquartered redistributes rents and can help build the tax bases of developing countries. But it does not tackle the anticompetitive features that give rise to rents. Price-based measures of competition may well prove inadequate in a digital world where control and use of data is of paramount importance, where competition strategies and pricing decisions may be determined by the algorithms of machine learning, and where consumers often receive services in exchange for data, at zero nominal prices.[28] Established competition policy assumes that actors pursue a strategy focused on profit maximization whereby unjustifiably high prices are judged as harming consumer welfare. In a digital economy, by contrast, actors tend to privilege scale and market-share strategies. This may involve slashing prices, even to the extent of being willing to sustain losses, and/or increasing spending to expand capacity, including by acquiring firms and expanding into multiple business lines.

In the case of digital platforms, scale and market-share strategies may involve cross-subsidization, which implies that while one side of the platform benefits from a lower cost of service or free access, the other side pays higher costs for access. For example, Facebook services may be provided free of cost to the users, but the advertisers pay higher costs to access the users. Increasingly platforms start to organize the markets. These digital platforms have natural monopolistic tendencies which emerge from large economies of scale, large network effects and control over sectors' data which leads to the creation of private digital intelligence leading in turn to technological and institutional barriers to new entry. This results in very high asymmetry of information between the platform owner and all other actors in a sector which is then used to extract profit both from the sellers and the buyers (e.g. Singh, 2017).

Although the growing monopolistic powers of the digital platforms are being increasingly recognized, there have been few efforts by developing countries to design antitrust policies to combat their anticompetitive practices. Many challenges are faced in designing antitrust policies to regulate the data-based platforms comprising multiple customer groups with interdependent demand that offer products and services in many countries. These include the difficulty associated with defining the "market" involved and the power of companies within that market. The market is defined for a product or service; however, for platforms the data act as an intermediary product, are not sold or traded and have no identifiable demand and supply (e.g. Graef, 2015). This would

imply that it is not possible to assess the market power of the platform in terms of raising the prices above the competitive levels for one side of the market and below competitive levels for the other side.

However, since the existing digital platforms are changing the competitive landscape, there is a need to regulate the digital platforms in order to provide developing countries' firms/platforms with an opportunity to compete with the existing platforms and avail themselves of new opportunities in the digital world. Some developed countries are using policy instruments to check the growing market powers of the digital platforms. For example, in 2013, the Dutch Data Protection Authority and the Canadian Privacy Commissioner's Office found that WhatsApp "did not delete non-users' mobile numbers once a user's phone contacts were transmitted to WhatsApp, which violated Dutch data protection law"[29] and therefore forced WhatsApp to make relevant changes for better protection of data and privacy. In 2017, the European Commission (EC) fined Google €2.42 billion for breaching European Union antitrust rules. According to EC, "Google abused its market dominance as a search engine by promoting its own comparison shopping service in its search results, and demoting those of competitors … It denied other companies the chance to compete on the merits and to innovate. And most importantly, it denied European consumers a genuine choice of services and the full benefits of innovation".[30]

One way of addressing rent-seeking strategies in a digital world would be through tighter regulation of restricted business practices, with strong monitoring and administration at the international level.[31] Another approach would be to break up the large firms responsible for market concentration (Foroohar, 2017). This takes literally the often-made comparison between oil in the analogue and data in the digital economy, in that Standard Oil was broken up in 1911 and required by law to split into multiple pieces. Forcing firms into joint ventures with certain majority rules could avoid market concentration arising and might be a feasible option for economies with nascent digitalization, including many developing countries. Closer monitoring of vertical integration, including by adding the scope and scale of data at stake as criteria for merger control, would be another policy strengthening competition.

An alternative would be accepting a digital world's tendency towards market concentration but regulate these tendencies with a view to limiting a firm's ability to exploit its dominance (Warren, 2017). Given that a country's data may have public utility features, one option could be regulating large firms as a public utility with direct public provision of the digitized service. This means that the digital economy would be considered similarly to traditional essential network industries, such as water and energy. The dominance of neo-liberal ideology has meant that public policy discussion has tended to have a negative approach to more state regulation, but increasing concerns with growing concentration in the digital economy, and potential misuse of personal data, are encouraging greater social acceptance of the need for regulations in this regard.[32]

For developing countries, as noted above, the regulatory concerns may be even greater if they are not to miss out on the benefits of the fourth industrial revolution. For example, it has been noted that disclosure of the source code of a software program may be necessary not only for security reasons, but also for developing software coding skills, as it would allow new software to be created, customized to suit local preferences and sensitivities, and even adapted to be used in local languages. It is obviously important to support developing countries' producers wishing to enter e-commerce activities at domestic, regional and international levels. Similarly, the localization of servers can be required for regulatory purposes, and such regulation can also operate to assist in the promotion of domestic providers of a range of goods and services.

In addition to scaling data and chasing market share, patent trolls and interlocking patents are widely used forms that can favour rent-seeking and act as barriers to market entry (e.g. *TDR 2017*). Moving towards a digital economy requires the right balance between stimulating innovation and ensuring technology diffusion. This in turn implies weakening, rather than strengthening, the rules governing IPR (see also Haskel and Westlake, 2018), including bolstering technology diffusion to developing countries.

Internet sovereignty is another key issue that requires much more international discussion and negotiation, since it is now clear that a supposedly "free and open Internet" is one that can be subject to hidden regulation by powerful states as well as manipulation by large private players like some multinational platform companies. Developing country governments need to be aware of these concerns before signing

on to agreements that could effectively reduce their national sovereignty and policy space in the digital world.

(e) Control and use of data

All companies, and not just digital platforms, need to be able to collect and analyse data for innovation and efficiency gains.[33] However, access to and control of data can be, indeed has long been, a source of market power and can create barriers to entry for new players. Policymakers have had to strike a balance between these conflicting pressures. Perhaps the single biggest difference with firms and platforms in the digital economy is that controlling data is the business model. For countries to be able to build their data infrastructures and use their data to provide efficient public goods and services to their citizens, it is important for the countries to control their data and be able to use/share their data and regulate its flow. Doing so help them design policies for developing data processing skills in the pre-production and post-production stages as well as encourage customized production.

Data is not a homogeneous product and there is a need, from the outset, to have a clear distinction between personal and non-personal data. The former relates more specifically to data on the consumers' behavioural patterns or education data, transport data or health data of a country. Of course, there are also balancing acts required with respect to concerns about privacy of personal data and fears of monitoring and surveillance through the combination of corporate and state control over data, all of which need to be addressed in country-specific contexts. Although non-personal data needs to be allowed to flow freely within the country, ensuring protection of personal data is extremely important, especially in building trust within the country. The laws regarding personal data depends largely on personally identifiable information (PII), which is used to link data to individuals. However, it is argued that there is no uniform definition of PII and in many cases using advanced software non-PII can be linked to individual's data, which can be re-identified (Schwartz and Solove, 2011).

To build digital capacities and particularly big-data analytics capabilities, many countries have initiated policies for dealing with data. For example, Rwanda has designed a "Data Revolution Policy"[34] which is based on the principle of national data sovereignty, whereby Rwanda retains exclusive sovereign rights and power on its national data (see box 3.1).

Developing countries need to retain their data sovereignty to build their digital skills and avoid rules which restrict their ability to monitor the flow of their national data. Classification of data into personal and non-personal data and designing respective data policies are important steps towards building digital infrastructure. There is a need to ensure protection of personal data, and the recent European Data Protection Regulation offers some interesting guidance on how to achieve that. Aside from personal data, there are many other forms of data depending on the way they are collected, and the skills invested into deciphering them – data can be analysed (analytics), it can be inferred (codified), it can be converted into databases of the kind that derive information. Protecting data effectively will call for more serious consideration by policymakers, especially in the developing world.

To encourage domestic linkages of foreign investments and to develop domestic digital capacities and digital infrastructure to upgrade in value chains, many governments are using localization measures, akin to what they used when they designed their FDI policies. Localization policies are not entirely new, having been in use in developed and developing countries since the start of the Internet. In the context of the digital economy, localization measures include requirements such as locating servers and/or computing facilities within the national boundaries which can encourage foreign firms to invest in domestic digital infrastructure and allow local authorities to enforce national laws and regulations. For example, the Decree on Information Technology Services 2013 in Viet Nam required every digital service or website to locate at least one server in Viet Nam. In Indonesia, strict local content rules are being phased in on new smartphones, laptops, etc. (USTR, 2016). In the Philippines, a draft administrative order in 2014 required government agencies to buy cloud services from the Philippine Government's cloud. In some cases, data processing and/or storage must conform to unique national standards, or data transfers must be routed largely or solely within a national or regional space when possible. Such policies can be adopted to promote local digital capabilities; infant industry protection; avoiding long-term dependency on foreign-owned and located digital infrastructure; and/or to protect privacy of the citizens, their legal jurisdictions and national cybersovereignty (e.g. Hill, 2017).

BOX 3.1 The Data Revolution Policy of Rwanda

With a vision to build an innovation-data-enabled industry to harness rapid social economic development, Rwanda has launched a Data Revolution Policy (DRP) which will be executed in a span of five years from 2017 to 2022. With the objective of building big data and analytics capabilities, the DRP focuses on establishing standards and principles for data management; establishing a framework to develop human capital in data science; defining the framework for data creation–anonymization–release; conducting big data analytics and business intelligence; fostering data-enabled technology innovations; establishing an institutional governance framework for data; addressing concerns of security/privacy and data sovereignty; defining the role of the private sector and partnerships; and establishing a data portal warehouse. The National Institute of Statistics is responsible for implementing the DRP alongside other development partners.

To implement DRP, Rwanda has already enacted legal, policy and regulatory regimes guiding access to information in general and personal data protection, privacy and confidentiality matters. The organic law on statistics No. 45 of June 2013 stipulates mechanisms for coordination of statistical articles in regard to production, access and dissemination of data while the Penal Code (arts 286 and 287), and Law No. 18/2010 of 12 May 2010 relating to Electronic Messages, Electronic Signatures and Electronic Transactions, specifies data confidentiality matters. Regarding hosting, a Ministerial order No. 001/MINICT/2012 of 12 March 2012 law provides that all critical information data within Government should be hosted in one central national data centre.

The DRP embraces the principle of national data sovereignty whereby Rwanda retains exclusive sovereign rights on her national data with control and power over her own data. In conformity with this principle, Rwanda, however, remains open under agreed terms and governed by Rwandan laws, to host her sovereign data in a cloud or a collocated environment in data centres within or outside of Rwanda. Further, the DRP recognizes the importance of building a strong collaborative framework between Government and private sector players at local, regional and international levels.

Source: http://statistics.gov.rw/publication/rwanda-national-data-revolution-and-big-data.

2. *Trade and investment rules in the digital era*

In order to design targeted economic and industrial policies, as discussed in the preceding section, countries require policy space in their trade and investment agreements, especially those that seek deep integration. This was emphasized in *TDR 2014* where policy space was referred to as "the freedom and ability of governments to identify and pursue the most appropriate mix of economic and policies to achieve equitable and sustainable development in their own national contexts, but as constituent parts of an interdependent global economy" (vii). Contemporary trade agreements which seek deep integration among nations by going much beyond trade restrictions at the border and increasingly focusing on domestic rules and regulations, not only reduce policy space but are also likely to produce welfare-reducing outcomes (Storm and Kohler, 2016). The rules negotiated under these agreements are shaped to a significant extent by rent-seeking, self-interested behaviour on the export side and empower politically well-connected firms (Rodrik, 2018). This section highlights some of the binding trade and investment rules in contemporary trade agreements which could severely impinge on countries' policy space to design the required policies needed in the digital world.

Localization rules, as discussed in the previous section, have been extensively used by the developed countries in the earlier phase of digitalization and are still being used (Bauer et al., 2016, identify 22 data localization measures still being used by European Union countries); some of the rules in existing trade agreements, as well as those under negotiation, restrict the flexibilities of the signatory governments to adopt these localization measures for encouraging upgrading in the production value chains. Under some agreements like the Trade in Services Agreement (TiSA), which is being negotiated, there is a proposal that for transferring data outside the national boundaries the operator simply needs to establish a need to transfer data offshore "in connection with the conduct of its business".[35] Other agreements, like the Trans-Pacific Partnership (TPP),

include binding rules on governments' ability to restrict use or location of computing facilities inside the national boundaries (art. 14.13). Some of the proposals on e-commerce in the WTO include binding rules on cross-border data transfers and localization restrictions.[36] Such rules, being put forward as part of progressively expanding e-commerce chapters in free trade agreements (FTAs), may limit the ability of the governments to gain from FDI to build their national digital technological capacity and skills (Gehl Sampath, 2018).

To keep up in the ongoing technological revolution, developing countries are in urgent need of international technology transfers (ITT) from the developed countries and other developing countries which have been able to develop advanced digital technologies. The new digital technologies using AI, robots and IoT can potentially help developing countries to upgrade in value chains by increasing the digital content in the production stages. However, technology transfers from foreign firms by hosting FDI has rarely happened automatically and developing countries have always used targeted policies to encourage technology spillovers, through joint ventures, technology licensing, technology transfer clauses in their investment agreements, training arrangements, etc. These have been successful in generating ITTs (e.g. Newman et al., 2015). However, ITT have become much more complicated in the digital economy where technology and data analytics are being equated to trade secrets (e.g. Kowalski et al., 2017). These inputs, which are increasingly being protected in trade and investment agreements, further restrict governments from using the traditional FDI policies for encouraging technology transfers. One such binding rule applies to source-code sharing. Source code is a collection of computer instructions which are processed and executed, and whose human-readable version (called source code) is usually protected by copyright and often kept confidential to protect proprietary information. Recently negotiated trade and investment agreements place binding rules, namely the non-disclosure rule, which prohibits governments from designing policies requiring source-code sharing except for national security reasons (e.g. TPP, art. 14.17). For digital technology transfers in developing countries, policies around source-code sharing can play an important role in encouraging ITT and developing national digital skills.

A concept closely related to technology transfers in the digital world is technology neutrality which broadly means that the same regulatory principles should apply regardless of the technology used. It has also been interpreted as a restriction on governments in terms of favouring local technologies. With the ever-evolving technologies in the digital world, technology neutrality can have far-reaching implications. This would imply that if a country commits to allowing the supply of a service then the service provider can apply any technology to supply that service, including future technologies like driverless vehicles or drone deliveries. Many countries have taken commitments on the cross-border supply of services under The General Agreement on Trade in Services (GATS), which with technology neutrality commitment can limit their choice of technology in the future as well as their ability to restrict or regulate new means of delivering a service. Some of the FTAs, like Japan–European Union FTA (chap. 8, sect. F, art. 1.3) and e-commerce proposals at the WTO (e.g. US, JOB/GC/94) include technology neutrality as a core principle. Whether technology neutrality applies to the GATS commitment of the countries in the WTO is debatable (e.g. Wunsch-Vincent, 2006). Binding rules on adopting technology neutrality can reduce the regulatory flexibility of the countries in the digital world given the rapidly evolving digital technologies.

While technology transfers need to be encouraged, developing countries should be proactive in increasing the digital content in their production processes, by supporting more domestically produced digital services like ICT services and telecommunication services in their manufacturing or by using digital technologies to digitalize their production. Digitalized products refer to those products which were earlier exported physically but are now being electronically transmitted, for example, films, printed matter, sound and media, software and video games. While there is a lack of clarity on the scope of electronic transmissions defined in the WTO (e.g. whether it includes CAD files used for 3D printing or not), rules are being negotiated on electronic transmissions (ET). The WTO has a moratorium on custom duties on ET since 1998, which has been renewed for two years at every Ministerial Conference since then, including at the eleventh Ministerial Conference in 2017. However, as more products are being digitalized and exported electronically and as 3D printed products pose new challenges as these products can be exported as software and CAD files and printed in the host countries, zero custom duties on all such ET would imply a significant loss of tariff revenue,

especially for the small island countries and least developed countries. UNCTAD (2017c) reports that in 2015, 101 developing countries were net importers of these digitalized products and a permanent moratorium can further increase their imports.

While many developing countries are striving to develop their national e-commerce policies/strategies for linking their domestic producers and consumers to e-commerce platforms, there is a need to recognize the associated risks, especially if these platforms are international. Not only do the countries expose their consumers to new products and producers and risk reducing domestic market shares of their domestic producers but also in the process lose out on valuable data that is generated by the transactions of consumers and producers. The "network effects" of these platforms allow them to gather huge data of the connected economies, which can then be used by these international platforms to predict market trends, flood the consumers with products associated to their tastes and preferences based on their personal data analytics, and effectively reorganize national production and sales. Many of the proposals in the WTO if accepted, will not allow the governments to restrict the outflow of the data of their producers and consumers in the future.

Gains from e-commerce for developing countries can become a reality only if they protect their "national e-commerce platforms" with the objective of improving the domestic and international market access of their producers. Public–private partnerships could be encouraged to form national e-commerce platforms to boost domestic as well as cross-border e-commerce and use the data analytics of the engaged customers to forecast future demand, and changing tastes and preferences. Linking domestic producers to the national e-commerce platforms should be a part of national trade promotion schemes. Chinese e-commerce platform policies can provide rich learnings to developing countries. For example, a Chinese e-commerce platform called KiKUU operates in six African countries, selling only Chinese goods.[37]

The bottom line is that the potential for development provided by digital technologies can be easily eclipsed if developing countries are not given the flexibility and policy space to design their economic and industrial policies and national regulatory frameworks to promote digital infrastructure and digital capacities.

3. South–South and triangular cooperation for a digital world

As discussed, a precondition for developing countries to be able to grasp the rising opportunities in the digital world is the building of their digital infrastructure as well as digital capabilities. However, given the speedy digitization of manufacturing production and exports in the developed world, the rise of monopolistic practices by lead firms and digital platforms across GVCs and the growing digital divide, it may be extremely difficult for developing countries, especially LDCs, to leapfrog into digital industrialization on their own. The previous section has suggested the need to rethink trade and investment agreements as one necessary step but South–South digital cooperation at the regional level can also play an important role. Digital cooperation at the regional level can be added to the ongoing regional integration initiatives in the South, including in Africa.

UNCTAD (2018b) has suggested a ten-point South–South digital cooperation agenda which includes:

- building a data economy
- building cloud computing infrastructure
- strengthening broadband infrastructure
- promoting e-commerce in the region
- promoting regional digital payments
- progressing on single digital market in the region
- sharing experiences on e-government
- forging partnerships for building smart cities
- promoting digital innovations and technologies
- building statistics for measuring digitization.

An important step towards digital cooperation is to build a regional data economy among neighbouring countries. This can help each country as they can use the big data of the region to develop AI for manufacturing customized digital products. However, to build a regional data economy, countries first need to "own" their data. Ownership of data at the national level by governments will allow the countries to decide with whom to share their data. Sharing data at the regional level will allow the pooling of regional data and digital capacities, and the use of existing digital infrastructure within the region to process the regional data. Similar national rules and regulations on ownership of data in countries within the region can also help in faster flow of data within that region. Further, free flow of non-personal data

within the region can strengthen the regional integration process.

Regional strategies in data cooperation need to be discussed along with the ways to classify data and decisions need to be taken on what data can be shared regionally. A regional strategy around the ownership and sharing of data can provide substantial support to national digital industrial policies.

Along with building the data economy, South–South digital cooperation is needed for maximizing the benefits of cloud computing. Cost savings from cloud computing can only be realized through significant pooling of configurable computing resources which will lead to economies of scale and can drastically reduce the cost of using IT infrastructure (Alford and Morton, 2009). Cloud computing infrastructure at the regional level can provide significant benefits to the public as well as the private sector in the region in terms of cost, flexibility, efficiency and scalability. Such infrastructure should be accompanied by initiatives to build trust in local cloud service providers and a Cloud Code of Conduct that specifies the terms of data usage through the cloud. This needs to be supported by regional action for cybersecurity.

For all countries in a region to have a level playing field in terms of access to opportunities arising from cloud computing, it is important that all countries within a regional bloc have a similar broadband ecosystem. Broadband networks can be regarded as an interconnected multilayered ecosystem of high capacity communication networks, services, applications and users and are the foundation of digital economies. Bigger developing countries in a region can provide key support to other developing countries through investing in the development of their broadband infrastructure. Countries within regional blocs can undertake similar reforms in telecom rules to attract investments in broadband infrastructure in the region. Regional cooperation arrangements and the sharing of regulatory experiences and practices can help in developing this key infrastructure in the regions.

Further, regional markets can be served more effectively using digital technologies like e-commerce. However, for e-commerce to expand the market access of manufactured products within a region it is important that there are uniform cross-border e-commerce rules and regulations in that region. Uniform rules are needed for governing consumer protection, intellectual property, competition, taxation and information security. Uniform rules are also required for tackling unjustified geo-blocking. A regional e-commerce strategy needs to be developed which supports the national e-commerce strategy.

Regional e-commerce needs to be supported by protected digital payment infrastructure capacities within the region. Obviously, this depends on sufficient physical infrastructure and connectivity being available, which is an important prerequisite. Digital payments are more transparent and traceable and are essential for e-commerce. But success in widespread use of digital payments requires a strong regulatory framework to supervise commercial banks, financial institutions and other e-money institutions and rules around consumer data protection and competition issues as well as legal provisions around payment clearing and settlement systems. Developing countries need to be extremely careful in their trade negotiations as well as investment treaties for preserving their policy space for regulating their digital payment platforms. This makes regional cooperation in digital payments challenging, but there exist some examples in the South. Southern Africa Development Community (SADC) members have developed an Integrated Regional Electronic Settlement System (SIRESS) at the regional level to facilitate financial transactions and cross-border payments. National and regional clearing houses have been set up to facilitate payments between financial institutions.

In the digital world, regional markets can be truly integrated only if they progress towards a single digital market in the region. A regional single digital market (RSDM) could move towards seamless access to online activities by all consumers and producers in the region, irrespective of their nationality and country of residence. This is an extremely difficult goal for the South, given the existing limited digital infrastructure and capacities, but should be the ultimate objective.

South–South (and triangular) cooperation is also needed for assisting countries to build smart cities in the South. Although the financial resources needed to create smart cities are huge from the perspective of small economies, moves in this direction can also help to generate financial resources in the future by increasing the returns to investments. Triangular partnerships and collaborations can be forged with advanced countries to strengthen broadband

infrastructure and develop smart cities in the South, which rely heavily on digitization.

Another area of regional digital cooperation is digital innovations and technology. Many developing countries are in a process of incentivizing digital start-ups to encourage innovations. Small and medium enterprises are the main beneficiaries of these low-cost high-returns innovations. However, it is a challenge to retain successful digital innovations for furthering national digitalization efforts because of a high rate of acquisitions of these start-ups by the big tech firms, who pick out the most successful innovations. This is an area where South–South cooperation can greatly contribute. Development banks like the New Development Bank, the Asian Development Bank and the African Development Bank can play an important role in financially supporting these start-ups and encourage them to develop software and digital technologies for use at the regional level. A regional strategy can be designed that encourages start-ups that cater to providing innovative digital solutions at the regional level. Intraregional investments in digital technologies can foster technology transfers and innovations if they allow source-code sharing and encourage tailoring of the digital technologies from open source codes to their needs and requirements. There can also be enormous learning opportunities for the South in its collaboration with the North for designing tools and statistics to benchmark digitization and trace its progress.

While South–South digital cooperation should adopt an ambitious agenda, realities on the ground mean that sequencing and prioritizing elements of that agenda will be important and need to be adapted according to the level and pace of digital development of the countries within the region.

D. The way forward for developing countries

Moving towards a digital economy holds both more and less potential for income and employment creation in developing countries than often thought. This is because many existing studies overestimate the potential adverse employment and income effects of some digital technologies, such as robots, as argued in *TDR 2017*. At the same time, there is an equally exaggerated tendency, bordering on digital utopianism, that attributes boundless opportunities for developing countries, through further rounds of liberalization, to leapfrog in to high value added and job-creating activities in all segments of the manufacturing process as well as services (IMF, 2018). But whatever position one takes, the rapid pace of digitalization is leaving many policymakers unprepared. Depending on a country's level of development, unpreparedness can take several forms – from skills and infrastructure deficits to inexistent or fragmented policy adjustment – and can have numerous adverse consequences, including falling further behind the technological frontier, stalled economic catch-up or even marginalization from the global economy. The tendency for market concentration and the emergence of a vicious Medici circle of reinforcing economic and political power in the digital world compounds that threat.

The simple truth for the governments of developing counties is that realizing the potential benefits from a digital world will be difficult, and that ensuring those benefits have a wide social reach will be more difficult still. It requires ambitious policies in a wide range of areas that must be employed in a coherent way. Engaging in digital trade is a promising first step, and will spur the provision of hard and soft digital infrastructure, which is a basic requirement for people and enterprises to engage successfully in the digital economy. Digital preparedness in many developing countries will require international support and cooperation; UNCTAD's eTrade For All initiative provides one possible model for such partnerships (UNCTAD, 2017d).

Digital trade is not an end itself. Narratives of the benefits of digital trade often take a consumer perspective, coached in dollar terms. But digitized exchanges are generally paid for in data: goods and services are delivered, often free of charge in dollar terms, in exchange of the customers' data. Looked at from a development perspective, merely increasing connectivity might empower larger and already more productive firms and sharpen the exclusion of other firms. Moreover, providing customer data to

international platforms tends to result in a concentration of corporate power that may make it difficult for developing countries to get access to, own and use data regarding their economies and their citizens for their own economic development. Polarization is just as much, perhaps more, a threat in a digital world as an analogue world.

This means that policy changes in a wide range of areas should accompany increased digital connectivity. Policies that govern the access to and use of data are crucial, and should focus on making access to non-personal data as open as possible. Access to, ownership of and capabilities to analyse and transform data into economically meaningful knowledge will be central to reaping the benefits from a digital world. While ensuring that data governance frameworks appropriately address privacy and digital security considerations, policies should also encourage investment in data that have synergies both within and across industries.

Regarding competition and antitrust measures, policies on standards, public participation in long-term finance, public procurement, etc. may be necessary to increase the benefits to developing countries in the digital economy. Also required are bold demand-side policies, as developing countries can reap such benefits only if their consumers have the income required to turn their preferences into effective demand without recurring to debt. It must be understood that digitalization will not deliver against a backdrop of fiscal retrenchment and austerity.

In this sense, establishing a virtuous circle between the new digital technologies' greater emphasis on customized demand on the one hand, and greater involvement of developing countries in manufacturing processes that satisfy such demand on the other will require the adoption of more expansionary macroeconomic policies and reconnecting wage and productivity growth.

Some of the key policies that can help developing countries face the challenges posed by the digital revolution and increase their developmental gains from GVCs are briefly noted here.

1. *Building digital infrastructure*

   ICT infrastructure, is a necessary condition for progressing in a digitalized world. But this in turn presupposes the availability of the necessary physical infrastructure, such as, most obviously, power connections. In addition to supportive physical infrastructure, it is important to develop strong banking and financial institutions providing substantially enlarged access to the entire population; this is still hugely underprovided in many developing and least developed countries. When laying the ground for the digital infrastructure, existing internal imbalances, such as rural–urban differences, should be addressed so that rural areas do not suffer a widening digital divide and can benefit from enhanced connectivity.

2. *Devising national data regulatory policies*

   To the extent that data is the fuel of the digital age, its control, much like with oil in the Fordist era, opens huge profit opportunities to its owners (Tarnoff, 2018). It therefore becomes critical for countries to devise national data policies to ensure equitable distribution of gains arising from data which is generated within the national boundaries. Currently, such a policy does not exist in most of the developing countries and, de facto, data are owned by the one who gathers and stores data, mainly digital super-firms, who then have full, exclusive and unlimited usage property rights on it. National data policy should be designed to address four core issues: who can own data; how it can be collected; who can use it; and under what terms. It should also address the issue of data sovereignty which relates to what data can leave the country and are thereby not governed under domestic laws. The Data Revolution Policy of Rwanda can provide a good learning opportunity for developing countries.

   But data, unless processed, may be of little value. Big-data analytics using algorithms have revolutionized production as well as distribution services. The limited ability of the developing world to transform data into economically meaningful knowledge has fuelled the growth of highly profitable digital platforms, which through "network effects" have been able to glean more data and use it to facilitate entry into new markets and new business lines. The rising rents of these super-platforms and their ability to kill competition from national platforms remains unchecked because of a lack of regulatory policies. This has not only restricted development of national platforms but has also closed a window of opportunity for the developing countries to

develop their data analytics and upgrade to post-production higher value added activities.

3. *Regulating digital platforms and developing national marketing platforms*

   Regulation is essential for developing countries to gain from e-commerce, else linking into existing platforms will only provide the super-platforms with more data, strengthening them further and facilitating their greater access to domestic markets. Tighter regulation of restricted business practices; break-up of large firms responsible for market concentration; regulating digital platforms as a public utility with direct public provision of the digitized service; and strong monitoring and administration at the international level are some of the options to regulate super-platforms.

4. *Taxing the super-firms*

   Taxing these firms where their activities are based rather than where they declare their headquarters will help in redistributing their rents and increase government revenues.

5. *Drawing up digital industrial policies*

   Once policies around data ownership and regulations for checking anticompetitive practices of super-platforms are in place, developing countries will be able to prepare themselves for the digital world. Digital industrial policies are needed to enhance the use of digital technologies and digital services in production as well as to build digital competencies in all sectors.

6. *Harnessing digital start-ups*

   Innovations are key to digital industrial development. While many developing countries are encouraging digital start-ups as the primary source of digital innovations, there is a need for a more comprehensive policy with respect to digital start-ups, which prevents the gains of innovations flowing out of the country. Direct investment by governments in corporate equities can sustain digital innovations, enhance use of advanced technology and promote reverse innovations.

7. *Developing digital competencies*

   Developing digital competencies to fill the digital gap will require efforts at various levels including introducing digital education in schools and universities, upskilling the digital skills of the existing workforce, running special basic and advanced skill development programmes and funding digital entrepreneurship.

Developing countries will not be able to digitally leapfrog on their own. They will need support both at the regional as well as international level. Regional integration agendas need to include regional support for building a data economy; building cloud computing infrastructure; strengthening broadband infrastructure; promoting e-commerce in the region; promoting regional digital payments; progressing on a single digital market in the region; sharing experiences on e-government; forging partnerships for building smart cities; promoting digital innovations and technologies; and building statistics for measuring digitization.

Given that large-scale use of digital technologies is still unfolding and that related impacts are still not fully understood, international cooperation to fill data gaps and develop comparable metrics needs to accompany policy efforts at the national level. The international community is just beginning a dialogue on what rules and regulations can harness the productivity and developmental potential of the digital economy. Agreement needs to be reached on what part of the issues around the digital economy are in the realm of the WTO and what part in that of other international organizations. A premature commitment to rules with long-term impacts in this fast-moving area where influential actors might be driven by narrow business interests should be avoided. It is perhaps worthwhile, here, recalling the conclusion of the respected Canadian development economist, Gerald Helleiner (2000: 12) in his Raúl Prebisch Lecture at UNCTAD just five years after the establishment of the WTO:

> I doubt whether there is any longer much dispute over the fact that many developing countries signed the Marrakesh Agreement without sufficient appreciation of its implications and/or in the expectation of considerably more change in industrial country protectionist practice than has so far materialized. Nor, I suspect, is there much disagreement that industrial countries vastly overestimated developing countries capacities (and, as it turns out, willingness) to implement all of its elements within the agreed timetables.

To avoid any such repetition, it is important to retain freedom and space to design digital policies which

help in increasing developmental gains from trade and foreign investments, like policies around localization, restrictions on free flow of data, technology transfers and custom duties on electronic transmissions. Developing countries will need appropriately inclusive and comprehensive venues, such as UNCTAD's intergovernmental expert group on e-commerce and the digital economy, to discuss the complex issues involved and to help shape coherent development-oriented policies. ■

Notes

1 Parts of UNCTAD (2017a) also addressed the digitalization of value chains but focused on implications for foreign direct investment and related policymaking, which complements the discussion in this chapter. The broad perspective of UNCTAD (2018a) regarding links between a wide range of frontier technologies and sustainable development further complements the focus on digital technologies and the manufacturing process in this chapter.

2 Beyond the questions examined in this chapter, the new digital technologies also raise macroeconomic issues. Digitalization and the associated greater importance of intangibles may well lead to a decline in the demand for physical capital goods. This raises issues of measuring output and inflation. It might also contribute to an ongoing decline in the price of physical capital goods and the long-term decline of fixed capital formation as a share of GDP, which has traditionally been considered the major driver of economic and productivity growth. The growing importance of intangibles also raises distributional issues. These issues are beyond the scope of this chapter, but distributional effects from robot-based automation and from drivers of market power and concentration were discussed in *TDR 2017*.

3 Fu et al. (2011: 1204) also conclude that "[s]tudies largely fail to provide convincing evidence indicating significant positive technology transfer and spillover effects of FDI on the local firms". De Marchi et al. (2018), provide similar evidence for the more recent period.

4 For discussion and further empirical evidence regarding the greater role of intangibles in economic activities, see e.g. WIPO, 2017.

5 While this aspect has been a mainstay in development economics and structural change analyses following Chenery and Syrquin (1975), in trade theory, Markusen (2013) revived attention to heterogeneous demand patterns.

6 The ratio of material use (measured in tonnes of raw ore or crops) to GDP has fallen in almost all regions of the world in the last three decades, most of all in Europe and the United States, and to a lesser extent in Africa, Oceania and Latin America (SERI/WU Global Material Flows Database).

7 This measure most likely underestimates the inputs from the digital sector to manufacturing. Some parts of the digital sector are probably classified in other categories than in ISIC Revision 4 divisions J61–J63. Only data referring to these divisions are used here because available data do not allow for disaggregation of data in divisions that may cover more than digital services that affect manufacturing.

8 According to IMF, 2018: 1, 7: "Available evidence suggests that the digital sector is still less than 10 percent of most economies if measured by value added, income or employment", even though "Estimates of the size of the digital sector can be sensitive to the choice of definition". Bukht and Heeks, 2017, estimate the digital economy to make up around 5 per cent of global output and 3 per cent of global employment. It should also be noted that the database used here is the only one available for assessing the role of digital services in manufacturing but that its country sample covers only 43 individual economies with the remainder comprising a rest-of-the-world aggregate.

9 Bessen, 2016, provides evidence for such rent-seeking strategies of firms in the United States. For further discussion, see also *TDR 2017*.

10 Such cost reductions may even apply to entire factories in that digital design simulation of factories can anticipate and resolve operational problems even before the facility exists physically.

11 For case-study evidence suggesting that digitization of value chains may hurt small African producers, see Foster et al. (2018). For more general discussion see e.g. Foster and Graham (2017).

12 Capital income represents the remainder when wages are subtracted from value added in exports. It is not further analysed as it cannot be allocated to business functions in the same way as labour income. For the rationale of defining business functions in this way and related measurement issues, see de Vries et al., 2018.

13 Data for some other developed and developing countries are provided in the online Appendix.

14 "Big tech companies" are defined here as companies of the "digital economy" (defined as sectors of "Technology Equipment" + "Software and IT services"

of the Thomson Reuters Business Classification) that reached the top 100 of non-financial corporations by market capitalization.

15 Source: ITU, ICT Facts & Figures, The world in 2017. Available at https://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2017.pdf.

16 One reflection of this is the string of Science, Technology and Innovation Policy (STIP) Reviews that UNCTAD has undertaken for developing countries and economies in transition. See http://unctad.org/en/pages/publications/Science,-Technology-and-Innovation-Policy-Reviews-(STIP-Reviews).aspx.

17 This contrasts with the traditional view, based on the product life-cycle theory (Vernon, 1966). As noted by von Zedtwitz et al. (2015: 12), who also discuss other departures from Vernon's initial notion, "[a]ccording to this traditional view, new products and technologies are first developed and launched in advanced countries, and only later introduced and commercialized in less developed countries when they have become increasingly mature, out-of-date, and obsolete. The flow of innovation, from a market point of view as much as from a technological perspective, is thus from advanced to developing countries".

18 For examples of frugal innovation see, for example, Laperche and Lefebvre, 2012. For additional discussion, see also UNCTAD, 2018a: chap. IV.

19 For example, the Chinese company Huawei developed its smartphone business by outcompeting main incumbent firms not simply through low-cost advantage but by relying on recent scientific knowledge and the integration of ensuing new technologies in its innovation strategies (Joo et al., 2016). Starting by producing low-end phones for the domestic market, its continued focus on local R&D and reverse engineering of foreign technology allowed it to become a global leader in telecommunications networks by 2012 (Kang, 2015).

20 For a succinct discussion of how intellectual property law affects 3D-printing see, for example, Malaty and Rostama (2017). For more detailed discussion see, for example, Osborn (2016: 270) who concludes: "perhaps the innovations most impacted by 3D printing should be removed from certain IP protections altogether. This argument is perhaps strongest in patent law, where the utilitarian nature of the inventions urges their introduction into the public domain".

21 For detailed discussion, see the literature on "two-sided markets". There is no accepted definition of "two-sided markets", but digital platform businesses are generally considered a crucial element that makes a market two-sided (see, e.g. Rysman, 2009; Gürkaynak et al., 2017), as these platforms have two distinct user groups that offer each other network benefits.

22 For example, iPad and Amazon's Kindle although competitors, collaborated and Amazon developed a Kindle Reader app for iPads, which Apple approved. Consumers can now read e-books they purchase on Amazon on either a Kindle Reader or iPad, which eliminates any competition from small application developers and drives them out of the ecosystem.

23 For example, in 2016 the European Union announced the antitrust case against Alphabet for imposing licensing conditions for the Android OS that favoured Google's products and apps for its rivals, making it difficult for other operators to develop alternative operating systems.

24 See *TDR 2017*. Lynn, 2017, provides an account of this shift in the United States, with a divergent view in Atkinson and Lind, 2018. For more general discussion see, e.g. Khan, 2017; and Vezzoso, 2016.

25 See, for example, the Human Rights Council HRC Resolution 34/7 adopted on 23 March 2017, http://ap.ohchr.org/documents/alldocs.aspx?doc_id=28120; and the European Union's General Data Protection Regulation (https://www.eugdpr.org/), which entered into force on 25 May 2018, requiring firms to give customers more control over their online information, and may be an important first step towards a better understanding of how companies themselves value data.

26 Davies et al., 2018, provide an account of the economic size of tax avoidance through tax havens.

27 For further discussion, see also *TDR 2017*: chap. VI.

28 One policy problem that this business model poses is difficulty in identifying when a market price is below cost, i.e. a criterion required to establish a case of predatory pricing on which established competition policy could act.

29 See https://autoriteitpersoonsgegevens.nl/en/news/canadian-and-dutch-data-privacy-guardians-release-findings-investigation-popular-mobile-app.

30 European Commission: Statement by Commissioner Vestager on Commission decision to fine Google €2.42 billion for abusing dominance as search engine by giving illegal advantage to its own comparison shopping service (see http://europa.eu/rapid/press-release_STATEMENT-17-1806_en.htm).

31 As further discussed in *TDR 2017*, a starting point for any such policies might be the Set of Multilaterally Agreed Equitable Principles and Rules for the Control of Restrictive Business Practices adopted by the United Nations General Assembly in 1980. Available at: http://unctad.org/en/docs/tdrbpconf10r2.en.pdf.

32 The European Union's new data protection laws provide a case in point.

33 See UNCTAD, 2018b, for detailed discussion on importance of data in the digital economy.

34 Available at: http://statistics.gov.rw/publication/rwanda-national-data-revolution-and-big-data.

35 Proposal in TiSA, art. 2.2, Annex on Electronic Commerce, undated (November 2016). See Kelsey, 2018.

36 United States and European Union proposals – US, JOB/GC/94; and para. 20, JOB/GC/97.

37 https://www.prnewswire.com/news-releases/kikuu-quietly-positioning-itself-to-become-africas-first-mobile-commerce-unicorn-300358163.html.

References

Alford T and Morton G (2009). The economics of cloud computing analyzed: Addressing the benefits of infrastructure in the cloud. Available at: http://tedalford.sys-con.com/node/1147473.

Atkinson RD and Lind M (2018). Commentary: Who wins after U.S. antitrust regulators attack? China. Available at: http://fortune.com/2018/03/29/commentary-who-wins-after-u-s-antitrust-regulators-attack-china/.

Baldwin R (2016). *The Great Convergence: Information Technology and the New Globalization*. Harvard University Press. Cambridge, MA.

Baldwin R and Lopez-Gonzalez J (2013). Supply-chain trade: A portrait of global patterns and several testable hypotheses. Working Paper No. 18957. National Bureau of Economic Research.

Basiliere P (2017). Gartner predicts 2018: 3D Printing changes business models. Available at: https://blogs.gartner.com/pete-basiliere/2017/12/12/gartner-predicts-2018–3d-printing-changes-business-models/.

Bauer M, Ferracane MF and van der Marel E (2016). Tracing the economic impact of regulations on the free flow of data and data localization. Global Commission on Internet Governance Paper Series No. 30. Available at: https://www.cigionline.org/publications/tracing-economic-impact-regulations-free-flow-data-and-data-localization.

Bessen JE (2016). Accounting for rising corporate profits: Intangibles or regulatory rents? Law and Economics Working Paper No. 16–18. Boston University School of Law. Available at: https://www.bu.edu/law/files/2016/11/Accounting-for-Rising-Corporate-Profits.pdf.

Brynjolfsson E, Eggers F and Gannamaneni A (2018). Using massive online choice experiments to measure changes in well-being. Working Paper No. 24514. National Bureau of Economic Research.

Bukht R and Heeks R (2017). Defining, conceptualising and measuring the digital economy. Development Informatics Working Paper No. 68. Global Development Institute. University of Manchester.

Chang H-J and Andreoni A (2016). Industrial policy in a changing world: Basic principles, neglected issues and new challenges. Cambridge Journal of Economics 40Years Conference. Available at: http://www.cpes.org.uk/dev/wp-content/uploads/2016/06/Chang_Andreoni_2016_Industrial-Policy.pdf.

Chenery H and Syrquin M (1975). *Patterns of Development 1950–70*. Oxford University Press. Oxford.

Cornell University, INSEAD and WIPO (2017). *The Global Innovation Index 2017: Innovation Feeding the World*. Ithaca, Fontainebleau and Geneva.

Davies RB, Martin J, Parenti M and Toubal F (2018). Knocking on tax haven's door: Multinational firms and transfer pricing. *The Review of Economics and Statistics*. 100(1): 120–134.

De Backer K and Flaig D (2017). The future of global value chains: Business as usual or "a new normal"? Science, Technology and Innovation Policy Papers No. 41. Organisation for Economic Co-operation and Development. Available at: http://dx.doi.org/10.1787/d8da8760-en.

De Marchi V, Giuliani E and Rabellotti R (2018). Do global value chains offer developing countries learning and innovation opportunities? *The European Journal of Development Research*. 30(3): 389–407.

de Vries GJ (2018). Global value chain and domestic value added export analysis using the World Input-Output Database: Methods and an illustration. Background material prepared for the *Trade and Development Report 2018*.

de Vries GJ, Miroudot S and Timmer MP (2018). Functional specialization in international trade: An exploration based on occupations of workers. Mimeo. University of Groningen.

Edmans A (2014). Blockholders and corporate governance. *Annual Review of Financial Economies*. 6(1): 23–50.

Elder J (2013). Review of policy measures to stimulate private demand for innovation: Concepts and effects. National Endowment for Science, Technology and the Arts Working Paper No. 13/13. Manchester Institute of Innovation Research. Available at: https://www.nesta.org.uk/report/review-of-policy-measures-to-stimulate-private-demand-for-innovation-concepts-and-effects/.

Ernst and Young (2016). How will 3D printing make your company the strongest link in the value chain? EY's global 3D printing report 2016. Available at:http://www.ey.com/Publication/vwLUAssets/EY-3d-druck-studie-executive-summary/$FILE/ey-how-will-3d-printing-make-your-company-the-strongest-link-in-the-value-chain.pdf.

Eurofound (2018). *Game Changing Technologies: Exploring the Impact on Production Processes and Work*. Publications Office of the European Union. Luxembourg.

Ezrachi A and Stucke ME (2016). *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy*. Harvard University Press. Cambridge, MA.

Ferrari A (2012). *Digital Competence in Practice: An Analysis of Frameworks*. European Commission. Joint Research Centre. Institute for Prospective Technological Studies. Seville. Available at: http://dx.doi.org/10.2791/82116.

Filitz R, Henkel J and Tether BS (2015). Protecting aesthetic innovations? An exploration of the use of registered community designs. *Research Policy*. 44(6): 1192–1206.

Foroohar R (2017). Release big tech's grip on power. *Financial Times*. 18 June.

Foster C and Graham M (2017). Reconsidering the role of the digital in global production networks. *Global Networks*. 17(1): 68–88.

Foster C and Heeks R (2014). Nurturing user-producer interaction: Inclusive innovation flows in a low-income mobile phone market. *Innovation and Development*. 4(2): 221–237.

Foster C, Graham M, Mann L, Waema T and Friederici N (2018). Digital control in value chains: Challenges of connectivity for East African firms. *Economic Geography*. 94(1): 68–86.

Foster JB and McChesney RW (2011). The Internet's unholy marriage to capitalism. *Monthly Review*. March. Available at: https://monthlyreview.org/2011/03/01/the-internets-unholy-marriage-to-capitalism/.

Fu X, Pietrobelli C and Soete L (2011). The role of foreign technology and indigenous innovation in the emerging economies: Technological change and catching-up. *World Development*. 39(7): 1204–1212.

Gehl Sampath P (2018). Regulating the digital economy: Are we moving towards a 'win-win' or a 'lose-lose'? Working Paper No. 5. United Nations University. Maastricht Economic and social Research institute on Innovation and Technology.

Graef I (2015). Market definition and market power in data: The case of online platforms. *World Competition*. 38(4): 473–505.

Gürkaynak G, İnanılır Ö, Diniz S and Yaşar AG (2017). Multisided markets and the challenge of incorporating multisided considerations into competition law analysis. *Journal of Antitrust Enforcement*. 5(1): 100–129.

Haskel J and Westlake S (2018). *Capitalism without Capital: The Rise of the Intangible Economy*. Princeton University Press. Princeton, NJ.

Helleiner G (2000). Markets, politics and globalization: Can the global economy be civilized? Tenth Raúl Prebisch Lecture. 11 December. UNCTAD. Geneva. Available at http://unctad.org/en/Docs/prebisch10th.en.pdf Hill R (2017). Second contribution to the June–September 2017 Open Consultation of the ITU CWG-Internet: Why should data flow freely?. Available at: www.apig.ch/CWG-Internet%202017-2bis.pdf.

Hopkins TK and Wallerstein I (1986). Commodity chains in the world economy prior to 1800. *Review (Fernand Braudel Center)*. 10(1): 157–170.

Hymer S (1972). The internationalization of capital. *Journal of Economic Issues*. 6(1): 91–111.

ICRICT (Independent Commission for the Reform of International Corporate Taxation) (2018). A roadmap to improve rules for taxing multinationals: A fairer future for global taxation. February. Available at: https://www.world-psi.org/sites/default/files/attachment/news/icrictunitarytaxationengfeb2018.pdf.

ILO (2018, forthcoming). *Robotics and Reshoring*. International Labour Organization. Geneva.

ILO-ITU (2017). Digital skills for decent jobs for youth campaign to train 5 million youth with job-ready digital skills. International Labour Organization and International Telecommunication Union. Available at: https://www.itu.int/en/ITU-D/Digital-Inclusion/Youth-and-Children/Pages/Digital-Skills.aspx

IMF (2018). Measuring the digital economy. International Monetary Fund. Washington, D.C. Available at: http://www.imf.org/en/Publications/Policy-Papers/Issues/2018/04/03/022818-measuring-the-digital-economy.

Immelt JR, Govindarajan V and Trimble C (2009). How GE is disrupting itself. *Harvard Business Review*. October: 56–65.

Joo SH, Oh C and Lee K (2016). Catch-up strategy of an emerging firm in an emerging country: Analysing the case of Huawei vs. Ericsson with patent data. *International Journal of Technology Management*. 72(1/2/3): 19–42.

Kang B (2015). The innovation process of Huawei and ZTE: Patent data analysis. *China Economic Review*. 36: 378–393.

Kelsey J (2018). How a TPP-style E-commerce outcome in the WTO would endanger the development dimension of the GATS acquis (and potentially the WTO). *Journal of International Economic Law*. 21(2): 273–295.

Khan LM (2017). Amazon's antitrust paradox. *Yale Law Journal*. 126(3): 710–805.

Kowalski P, Rabaioli D and Vallejo S (2017). International technology transfer measures in an interconnected world: Lessons and policy implications. OECD Trade Policy Papers No. 206. OECD Publishing. Paris. Available at: https://www.oecd-ilibrary.org/trade/international-technology-transfer-measures-in-an-interconnected-world_ada51ec0-en.

Kozul-Wright R and Poon D (2017). Learning from China's industrial strategy. *Project Syndicate*. 28 April. Available at: https://www.project-syndicate.org/commentary/china-industrial-strategy-lessons-by-richard-kozul-wright-and-daniel-poon-2017-04?barrier=accesspaylog.

Laperche B and Lefebvre G (2012). The globalization of Research & Development in industrial corporations: Towards "reverse innovation"? The cases of General Electric and Renault. *Journal of Innovation Economics & Management*. 10(2): 53–79.

Leliveld A and Knorringa P (2018). Frugal innovation and development research. *The European Journal of Development Research*. 30(1): 1–16.

Lewis HD (1881). The story of a great monopoly. *The Atlantic*. March. Available at: https://www.theatlantic.com/magazine/archive/1881/03/the-story-of-a-great-monopoly/306019/.

Luo S, Lovely ME and Popp D (2017). Intellectual returnees as drivers of indigenous innovation: Evidence from the Chinese photovoltaic industry. *The World Economy*. 40(11): 2424–2454.

Lynn BC (2017). The consumer welfare standard in antitrust: Outdated or a harbor in a sea of doubt? Testimony before the Senate Committee on the Judiciary: Subcommittee on Antitrust, Competition,

and Consumer Rights. Available at: https://www.judiciary.senate.gov/imo/media/doc/12-13-17%20Lynn%20Testimony.pdf.

Malaty E and Rostama G (2017). 3D printing and IP law. *WIPO Magazine*. February. Available at: http://www.wipo.int/wipo_magazine/en/2017/01/article_0006.html.

Markusen JR (2013). Putting per-capita income back into trade theory. *Journal of International Economics*. 90(2): 255–265.

Mazzucato M (2017). Mission-oriented innovation policy: Challenges and opportunities. Institute for Innovation and Public Purpose. University College London. Available at: https://www.thersa.org/globalassets/pdfs/reports/mission-oriented-policy-innovation-report.pdf.

Midler C, Jullien B and Lung Y (2017). *Rethinking Innovation and Design for Emerging Markets: Inside the Renault Kwid Project*. CRC Press. Boca Raton, FL.

Milberg W and Winkler D (2013). *Outsourcing Economics: Global Value Chains in Capitalist Development*. Cambridge University Press. Cambridge.

Negroponte, N (1995). *Being Digital*. Vintage Books. New York, NY.

Newman C, Rand J, Talbot T and Tarp F (2015). Technology transfers, foreign investment and productivity spillovers. *European Economic Review*. 76:168–187.

Osborn L (2016). 3D printing and intellectual property. In: Olleros FX and Zhegu M, eds. *Research Handbook on Digital Transformations*. Edward Elgar Publishing. Cheltenham: 254–271.

Pérez C (2010). Technological dynamism and social inclusion in Latin America: A resource-based production development strategy. *CEPAL Review*. 100: 121–141.

Pérez C and Marín A (2015). Technological change and sustainable development in a world of opportunities for the region. Available at: http://www19.iadb.org/intal/icom/en/notas/39-6/.

Prebisch R (1949). Introduction: The economic development of Latin America and its principal problems. *Economic Survey of Latin America 1948*. ECLA. Santiago: xvii–xx.

Prebisch R (1986). Address delivered at the twenty-first session of ECLAC, Mexico City, 24 April. *CEPAL Review*. 29: 13−16.

Purdy M and Daugherty P (2017). How AI boosts industry profits and innovation. *Accenture*. Available at: https://www.accenture.com/t20171005T065812Z__w__/us-en/_acnmedia/Accenture/next-gen-5/insight-ai-industry-growth/pdf/Accenture-AI-Industry-Growth-Full-Report.pdfla=en?la=en.

Rodrik D (2015). From welfare state to innovation state. *Project Syndicate*. Available at: https://www.project-syndicate.org/commentary/labor-saving-technology-by-dani-rodrik-2015-01.

Rodrik D (2018). What do trade agreements really do? *Journal of Economic Perspectives*. 32(2): 73–90.

Rysman M (2009). The economics of two-sided markets. *Journal of Economic Perspectives*. 23(3): 125–143.

Salazar-Xirinachs JM, Nübler I and Kozul-Wright R (2014). Introduction. In: Salazar-Xirinachs JM, Nübler I and Kozul-Wright R, eds. *Transforming Economies: Making Industrial Policy Work for Growth, Jobs and Development*. International Labour Office. Geneva: 1–38.

Santiago F and Weiss M (2018). Demand-driven policy interventions to foster sustainable and inclusive industrial development in developing countries. Inclusive and Sustainable Industrial Development Working Paper No. 17. United Nations Industrial Development Organization.

Saviotti PP and Pyka A (2013). The co-evolution of innovation, demand and growth. *Economics of Innovation and New Technology*. 22(5): 461–482.

Schwartz PM and Solove DJ (2011). The PII problem: Privacy and a new concept of personally identifiable information. *New York University Law Review*. 86(6):1814–1894. Available at: https://scholarship.law.berkeley.edu/facpubs/1638/.

Singh PJ (2017). Digital industrialisation in developing countries: A review of the business and policy landscape. Available at: http://www.itforchange.net/sites/default/files/1468/digital_industrialisation_in_developing_countries.pdf.

Storm S and Kohler P (2016). CETA without blinders: How cutting "trade costs and more" will cause unemployment, inequality and welfare losses. Global Development and Environment Institute Working Paper No. 16-03. Tufts University. Medford, MA.

Tarnoff B (2018). Big data for the people: It's time to take it back from our tech overlords. *The Guardian*. 14 March. Available at: https://www.theguardian.com/technology/2018/mar/14/tech-big-data-capitalism-give-wealth-back-to-people.

Temin P (2017). *The Vanishing Middle Class: Prejudice and Power in a Dual Economy*. MIT Press. Cambridge, MA.

Tørsløv TR, Wier LS and Zucman G (2018). The missing profits of nations. Working Paper No. 24701. National Bureau of Economic Research.

Turner A (2018). Capitalism in the age of robots: Work, income and wealth in the 21st-century. Lecture at School of Advanced International Studies. 10 April. Johns Hopkins University. Washington, D.C. Available at: https://www.ineteconomics.org/research/research-papers/capitalism-in-the-age-of-robots-work-income-and-wealth-in-the-21st-century.

Ubhaykar R (2015). The emerging world of 3D printing. *Outlook Business*. 6 March. Available at: https://www.outlookbusiness.com/the-big-story/lead-story/the-emerging-world-of-3d-printing-590.

UNCTAD (2017a). *World Investment Report 2017: Investment and the Digital Economy* (United Nations publication. Sales No. E.17.II.D.3. New York and Geneva).

UNCTAD (2017b). The "new" digital economy and development. UNCTAD Technical Notes on Information and Communications Technology for Development No. 8. Available at: http://unctad.org/en/PublicationsLibrary/tn_unctad_ict4d08_en.pdf.

UNCTAD (2017c). *Rising Product Digitalisation and Losing Trade Competitiveness*. UNCTAD/GDS/ECIDC/2017/3. New York and Geneva.

UNCTAD (2017d). *Information Economy Report, 2017: Digitalization, Trade and Development* (United Nations publication. Sales No.E.17.II.D.8. New York and Geneva).

UNCTAD (2018a). *Technology and Innovation Report: Harnessing Frontier Technologies for Sustainable Development* (United Nations publication. Sales No. E.18.II.D.3. New York and Geneva).

UNCTAD (2018b). *South–South Digital Cooperation: A Regional Integration Agenda*. UNCTAD/GDS/ECIDC/2018/1. New York and Geneva.

UNCTAD (*TDR 2002*). *Trade and Development Report, 2002: Global Trends and Prospects, Developing Countries in World Trade* (United Nations publication. Sales No. E.02.II.D.2. New York and Geneva).

UNCTAD (*TDR 2008*). *Trade and Development Report, 2008: Commodity Prices, Capital Flows and the Financing of Investment* (United Nations publication. Sales No. E.08.II.D.21. New York and Geneva).

UNCTAD (*TDR 2014*). *Trade and Development Report, 2014: Global Governance and Policy Space for Development* (United Nations publication. Sales No. E.14.II.D.4. New York and Geneva).

UNCTAD *(TDR 2016*). *Trade and Development Report, 2016: Structural Transformation for Inclusive and Sustained Growth* (United Nations publication. Sales No. E.16.II.D.5. New York and Geneva).

UNCTAD (*TDR 2017*). *Trade and Development Report, 2017: Beyond Austerity: Towards a Global New Deal* (United Nations publication. Sales No. E.17.II.D.5. New York and Geneva).

United Nations and ECLAC (2018). *Data, Algorithms and Policies: Redefining the Digital World*. Economic Commission for Latin America and the Caribbean. Santiago (LC/CMSI.6/4).

USTR (Office of the United States Trade Representative) (2016). Request for public comments to compile the National Trade Estimate Report (NTE) on foreign trade barriers. Federal Register. 19 July. Available at: https://www.federalregister.gov/documents/2016/07/19/2016-16985/request-for-public-comments-to-compile-the-national-trade-estimate-report-on-foreign-trade-barriers.

Van Alstyne MW, Parker GG and Choudary SP (2016). Pipelines, platforms, and the new rules of strategy. *Harvard Business Review*. 94(4): 54–60.

Vernon R (1966). International investment and international trade in the product cycle. *Quarterly Journal of Economics*. 80(2): 190–207.

Vezzoso S (2016). Competition policy in a world of big data. In: Olleros FX and Zhegu M, eds. *Research Handbook on Digital Transformations*. Edward Elgar Publishing. Cheltenham: 400–420.

Vijayabaskar M and Suresh Babu M (2014). Building capabilities in the software service industry in India: Skill formation and learning of domestic enterprises in value chains. In: Salazar-Xirinachs JM, Nübler I and Kozul-Wright R, eds. *Transforming Economies.: Making Industrial Policy Work for Growth, Jobs and Development*. International Labour Office. Geneva: 239–266.

von Zedtwitz M, Corsi S, Søberg PV and Frega R (2015). A typology of reverse innovation. *Journal of Product Innovation Management*. 32(1): 12–28.

Warren E (2017). America's monopoly moment: Work, innovation, and control in an age of concentrated power. Speech, 6 December. Open Market Institute. Washington, D.C. Available at: https://openmarketsinstitute.org/events/americas-monopoly-moment-work-innovation-and-control-in-an-age-of-concentrated-power/.

WEF (2015). *Deep Shift: Technology Tipping Points and Societal Impact*. World Economic Forum. Available at: http://www3.weforum.org/docs/WEF_GAC15_Technological_Tipping_Points_report_2015.pdf.

WIPO (2017). *World Intellectual Property Report 2017: Intangible Capital in Global Value Chains*. World Intellectual Property Organization. Geneva.

World Bank, IDE-JETRO (Institute of Developing Economies, Japan External Trade Organization), OECD (Organisation for Economic Co-operation and Development), UIBE (University of International Business and Economics) and WTO (World Trade Organization) (2017). *Global Value Chain Development Report 2017: Measuring and Analyzing the Impact of GVCs on Economic Development.* World Bank. Washington, D.C.

Wunsch-Vincent S (2006). The Internet, cross-border trade in services, and the GATS: Lessons from *US–Gambling*. *World Trade Review*. 5(3): 319–355.

Zeschky MB, Winterhalter S and Gassmann O (2014). From cost to frugal and reverse innovation: Mapping the field and implications for global competitiveness. *Research-Technology Management*. 57(4): 20–27.