



South-South Digital Cooperation for Industrialization: A Regional Integration Agenda





South-South Digital Cooperation for Industrialization: A Regional Integration Agenda



© 2018, United Nations

The designations employed and the presentation of the material do not imply the expression of any opinion on the part of the United Nations concerning the legal status of any country, territory, city, or area or its authority, or concerning the delimitation of its frontiers and boundaries.

Photocopies and reproductions of excerpts are allowed with proper credits.

This publication has not been formally edited.

United Nations publication issued by the United Nations Conference on Trade and Development.

UNCTAD/GDS/ECIDC/2018/1

NOTE

This report was prepared by Unit on Economic Cooperation and Integration among Developing Countries, Division on Globalization and Development Strategies, UNCTAD. The report was authored by Rashmi Banga and Richard Kozul-Wright with helpful comments from Joerg Mayer and Piergiuseppe Fortunato.

Material in this publication may be freely quoted or reprinted, but acknowledgement is requested, together with a notification of the publication to be sent to the Division on Globalization and Development Strategies, UNCTAD, Palais des Nations, CH-1211 Geneva10; email: gdsinfo@unctad.org.

All references to dollars (\$) are to United States dollars, unless otherwise stated.

ACKNOWLEDGEMENTS

The author would like to thank M.J. Kisiri (Head, ACP Geneva Office), Jörg Mayer (Senior Economic Affairs Officer, UNCTAD) Elizabeth Jane Kelsey (Professor of law, University of Auckland) and Parminder Singh (Executive Director, IT for Change).

SOUTH-SOUTH DIGITAL COOPERATION FOR INDUSTRIALIZATION: A REGIONAL INTEGRATION AGENDA

ABSTRACT

This paper discusses the various components of digital infrastructure to de-mystify digital economy and examines the reasons for growth of big-tech firms and the source of their rent-seeking powers. The extent of digitization of manufacturing is estimated for identified developed and developing countries using world input-output database. The estimated value-added by digital services to manufacturing exports show wide variation between developed and developing countries, indicating the growing digital divide in manufacturing exports. The paper proposes a ten-point South-South digital cooperation agenda which can help the developing countries to build their digital capacities and digital skills. The importance of ownership of data by the national governments is highlighted along with developing regional digital strategies for supporting national digitalization efforts of the developing countries.

1. INTRODUCTION:

The pace of digitization has picked up with the onset of Industry 4.0 or the fourth industrial revolution and with the growing use of digital technologies in traditional manufacturing and service activities. Decisions along the entire value chain of production and distribution have been affected as well as impacting consumer behavior and factor markets, i.e., what to produce, how to produce, where to sell and who to reward. Digital linkages are intensifying as digital services add a competitive edge to manufactured products by being bundled into their production as well as being increasingly used in their distribution. Corporations are transforming their business models: companies are becoming global leaders in providing car services without owning a single car (UBER); accommodation services without owning a single hotel (AirBnB); and retail services without holding any stocks (Alibaba). Disruptions in the existing patterns of production, consumption and investments are invariably affecting international trade and foreign direct investment (FDI) patterns and governments are under increasing pressure to act in order to sustain economic growth, preserve jobs and ensure their firms retain shares in global production, investments and trade.

Like previous technological revolutions, digitization has the potential to tear at the economic and social fabric through destructive and disruptive adjustments (Rotman, 2013; Galbraith, 2014). It also provides new opportunities for wealth creation to countries at all levels of development. But, the benefits of digitization will not be automatic, especially for the developing and least developed countries (LDCs). Technological catch-up has, of course, been a longstanding development policy challenge with the threat of widening gaps from first-mover advantages and the protectionist instincts of technological leaders weighed against the cost and learning advantages to latecomers from being able to import frontier technologies. Still, and whether or not on balance digital technologies pose greater or lesser challenges than in the past, the principle lesson that developing countries, and particularly LDCs, should draw from previous technological revolutions is that it will not be easy to absorb the new technologies in a manner consistent with, and in support of, wider development goals, let alone to leapfrog in to a digital future (Abramovitz, 1986; Cimoli, et al, 2009). Digital asymmetries and divisions will need to be addressed; significant investment in digital capabilities will be needed to use and develop the new technologies which will in turn require a sound and extensive digital infrastructure. As a result, economic policies in general, and industrial policies in particular, will require a digital dimension to make them more conducive to the changing environment and, as in the past, a more integrated policy framework will be needed to respond effectively to shocks and ensure the gains are widely shared (UNCTAD, chapter VI, 2016). To meet the challenge, developing countries will need support and cooperation not only from traditional development partners but also from regional neighbours. South-South digital cooperation for industrialization can boost the ability of the South to digitally industrialize and successfully gain from the new opportunities and avenues that digitization offers. It can also help countries mitigate the downside risks. There is therefore a need to add a digital cooperation agenda to the on-going regional integration initiatives in the South, especially in Africa.

This study aims to take a first step in this direction by de-mystifying the digital economy and examining step by step the various layers of digital infrastructure on

which it will build; assessing the extent of digitization that has taken place in different countries/sectors by estimating the contribution of digital services to manufacturing output and exports of developing and developed countries; and highlighting the importance of giving the ‘ownership’ of data to national governments in order to enable them to decide with which countries/regions they want to share this data. The study further provides a possible 10-point agenda on south-south digital cooperation for industrialization which can be initiated at the regional level in order to build digital capacities of the countries and promote regional integration. This agenda will also help the developing countries to prepare for the upcoming challenges which may arise due to digitization.

Section 2 begins by demystifying the digital economy and examining different components of digital infrastructure on which the digital economy is based; section 3 provides estimates of the total size of the existing digital economy; section 4 reports results of the estimations of use of digital services to manufacturing output and their contribution to manufacturing exports in 43 developing and developed countries, using World Input-Output database and national input-output tables; section 5 puts forward a progressive 10-point agenda for south-south digital cooperation, which needs to be initiated at the regional level in order to enhance digital industrialization in developing countries and promote regional integration in the South. Section 6 concludes.

2. DE-MYSTIFYING THE DIGITAL ECONOMY

For many developing countries, understanding the digital economy and its potential impact on development prospects is a daunting challenge, in particular, “the impact that the lack of digital and technological capabilities would have in cementing and widening the technology divide” (WTO, 2017). The digital economy goes well beyond the headline grabbing rise of robots or the growth of internet shopping to describe the emergence and interconnection of new technologies built around the generation, processing and dissemination of information and ideas. Although the computer launched this new technological wave, it is advances in the integrated circuit that have given it revolutionary impetus and the internet that has given it global reach. Subsequent technological developments emerging from sizeable advances in computing power, increasingly sophisticated audiovisual products and artificial intelligence (AI) include the spread of Big Data, the Internet of Things and online sharing platforms. The combination of these different information and

communication technologies (ICTs) makes up the digital revolution which is already “transforming our economies and societies by changing the ways people interact, businesses function and innovate, and governments design and implement policies” (OECD, 2017, p. 25).

This emerging digital economy is built on digital infrastructure (DI), comprising three closely interrelated components: **communication networks; software packages and related capabilities; and data platforms**. Countries have, over the past two decades, been steadily building their digital **communications network** around the institutions, skills and practices of the internet as the principle tool for collecting and transmitting information flows. While much of the initial work behind the internet was undertaken with public funding and through various forms of collaboration between public and private institutions, subsequent internet access and connectivity has been dominated by private internet service providers. One of the key technological innovations which has emerged is the interconnection of devices and objects embedded with sensors and software and network connectivity, which enables them to communicate with each other. This interconnection of devices is called ‘Internet of Things (IoT)’. IoT enables the connecting of data and therefore greatly improves the efficiency of products and services, generating additional value attached to its use.

The second component is the development and use software across a full range of economic activities with increasing emphasis on access through a cloud computing infrastructure. This is a soft infrastructure, which can remotely provide computing services as a general utility to all internet users, including mass market ‘internet software’ (e.g., operating systems, office suites, etc) and ‘internet applications’ (e.g., search engines and social media). Cloud computing infrastructure can provide firms with computer-related services like storage, networks, computing, running softwares and applications, loading their own software and applications on the cloud, etc. These services provided by cloud computing can be further divided into three main categories, i.e., Software as a Service (SaaS), Infrastructure as a Service (IaaS) and Platform as a Service (PaaS). SaaS eliminates the need to install applications on individual computers, for example emails or Google Apps. IaaS are self-service models for managing remote datacenter infrastructures, e.g., networking services like firewalls. PaaS allows developers’ customization and reduces the amount of coding required. Users can create apps through software components that are made available by PaaS, e.g., “Heroku” which operates on top of the

Amazon Web Services IaaS system. Cloud computing infrastructure, by providing remote infrastructure, has the potential to greatly reduce the need for hard infrastructure like storage disks, etc. and drastically cut costs of computing and software in a country.

The final component in establishing an integrated digital economy involves **data platforms**, which provide the means to mine and analyze data. 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, investments and international trade. Many observers have termed 'data' the 'new oil', which powers the digital economy in the same way as oil powered the mass production economy that emerged at the start of the last century. Unlike oil, data is not, however, a finite resource; everyone using the internet generates data, be it as producers or consumers or people and businesses using social media; but like oil, much of this data comes in an "unrefined" state, and is of limited use unless "processed". Data platforms collect, collate and combine layers of data to form 'Big Data' and transforms this for commercial use by processing, analyzing and exploiting it.

The extrapolation of information from (big) data and the transformation of this information, and of the new ideas which build on it, into sources of profit, is at the heart of the digitization story. Data flows have catalyzed the outsourcing revolution, helped lead firms extend and coordinate complex supply chains and underpin the world of algorithmic decision making. They also empower a handful of big companies to create and dominate markets for digital products (Lynn, 2012; The Economist, 2016; Stiglitz, 2016; Kurz, 2017). However, understanding this transformation has proved a challenge for pundits and policy makers, in no small part because meeting it represents, according to Joseph Stiglitz, who won a Nobel prize for his efforts, "a fundamental change in the prevailing paradigm within economics" (Stiglitz, 2001, p.1). Essentially this is because information and ideas have both an intangible and public quality which makes them different from the tangible and private goods and factors of production which have been the building blocks of conventional economic analysis.

Given that the value of ideas and information (whether as an input into production or as a final product) are difficult to gauge without actually using them but that using them can mean giving their value away, there are likely to be significant issues of market failure inherent in any attempt to profit from their use (Anderson,

et al, 2007). In particular, like the so-called "public goods", using an idea or piece of information does not deprive others from doing so ("non-rivalrous"), while it can also be difficult to prevent non-paying customers from consuming it ("non-excludable"). The value of a non-rival goods depends critically on the size of its market, resulting in an incessant drive to expand the market for information, but at the same time, the larger the market for information, the greater the threat from copying; the more so, the lower the marginal cost of reproducing and distributing it. Under these circumstances, firms involved in the production of non-rivalrous goods will tend to seek ways to build fences around their markets in an attempt to artificially create a degree of scarcity and, in the process, generate rents from the assets they own.

In the presence of these features, market concentration and noncompetitive pricing are likely to accompany the spread of activities which are information intensive (Haskel and Westlake, 2017; Sandbu, 2018). Indeed, the construction of legal and financial barriers as well as more informal mechanisms of control by large firms, with monopolistic or near monopolistic powers, has opened up new avenues in the digital economy for rent seeking behavior at the expense of new entrants, public authorities and consumers.

The Internet has augmented these challenges exponentially. Digital content can be spread instantly, at the push of a button, and at no charge, while its sharing and cooperative potential appears to be more resilient in the face of legal, economic and political barriers. At the same time, new avenues have opened to create artificial scarcity and erect fences wherever possible. For example "network effects" through which everyone gains by sharing the use of a particular service or resource give rise to the capture of consumers and "demand-side economies of scale" which allow the largest firm in an industry to increase and lock-in its attractiveness to consumers as its gains market share and makes it almost impossible for competitors with declining shares to remain attractive or competitive (Foster and Chesney, 2011; European Parliament, 2015). Content providers have also been able to tighten copyright enforcement, through lobbying for strengthened protection by broadening the scope of patents, allowing discoveries to be patented, extending the lives of patents and covering new areas. Although this is a more general trend, two particular practices are worth highlighting in the digital context: patent thickets (the acquisition of overlapping patents to cover a wide area of economic activity and potential downstream inventions) and patent fencing (excessive patenting with the intention of cordoning off areas of future research). Both of these lead to

expanded patent protection over entire technological domains, and guarantee continuing economic advantages to incumbent firms in technology sectors. In a well-known case, Google bought Motorola solely for its patent portfolio. Although it incurred a hefty loss from the resale of parts of the Motorola business, Google clearly thought that a cost of an estimated \$2.5 billion–\$3.5 billion for Motorola’s collection of patents was a worthwhile investment (OECD, 2015a: 30). Another way to limit access has been the development of digital rights management (DRM) technologies that set artificial limitations on the functionalities of digital devices and software. Corporate consolidation through mergers and acquisitions of actual or potential rivals has provided another means of making information a scarcer, and thereby a more valuable, commodity.

The combination of digital market expansion and heightened barriers to entry has given rise to superstar firms, in a position to generate huge rents from relatively small investment which, in turn give them the financial muscle to further strengthen their position through other strategies such as aggressive pricing, mergers and acquisitions, and political lobbying. Autor, et al (2017) suggest that the emergence of such superstar firms is due more to their technological nature than to institutional or regulatory factors. Indeed, high-productivity superstar firms are mostly located in high-technology industries, suggesting that large economies of scale and large network effects of information-intensive goods make it difficult for newcomers to compete with few and fast-growing incumbents (Autor et al., 2017b: 2; Council of Economic Advisers, 2016). It would, however, be misleading to attribute market concentration of high-tech markets solely to technological developments and related barriers to entry that produce “natural monopolies” (Katz and Shapiro, 1999). In reality, both technological and institutional barriers to entry interact over time. Large firms can use patent protection (both through in-house research and by acquisition) to raise barriers to entry in an industry and bolster their own market power. Thus, superstar firms benefiting from erecting initial technological barriers to entry can use this advantage to further expand their market power in other ways, for example through pricing strategies that make new entrants non-viable, by systematically buying start-ups with new ideas, and by using their growing lobbying power to prevent regulatory authorities from intervening. More generally, technological progress can facilitate institutional and organizational changes that enhance firms’ market power, such as with advances in ICTs as well as transportation technologies that have facilitated the emergence of global value chains (GVCs) and the formation of global control networks.

These corporate giants can use their market power to make expeditions to conquer new areas in the Internet, especially those in proximity to their monopoly undertaking. Apple, Google and Microsoft held a total of \$464 billion in cash at the end of 2017, according to Moody’s Report in 2017,¹ with Apple reporting more than \$256 billion in cash and marketable securities; Microsoft with \$126 billion in cash and equivalents, Alphabet, the Google parent, has \$92 billion in cash. As of January 2018, Apple is publicly known to have acquired 70 companies, while Alphabet (Google) had acquired over 200 companies by December 2016,

The struggles around the ownership of data and its transformation into profitable products and services are as likely to give rise to monopolistic or duopolistic market structures as to a flourishing competitive culture, in which the generation of super-profits is used to further reinforce the dominant position of incumbents (UNCTAD, 2017; Farooq, 2017; Allen, 2017), unless new disruptive technologies emerge or the large companies are broken up to allow new rivals to enter. According to Kurz (2017), in the case of the United States over the past 30 years “as IT industry developed, monopoly wealth rose dramatically; it reached 82 per cent of total stock value -- equivalent to some \$23.8 trillion - in December 2015. This is extra wealth gained by rising monopoly power, and it is continuing to grow”. This provides a huge financial war chest for these companies to consolidate and extend their dominant market positions.

The parallel with oil is, in this respect, not an innocent one, given the way in which a small number of companies, such as Standard Oil, dominated the oil market in the early 20th century until anti-trust legislation shifted the balance of economic power. For developing countries, with a long experience of losing out from highly concentrated international commodity markets these dangers with the digital economy pose potentially very serious policy challenges. Raúl Prebisch, UNCTAD’s first Secretary-General, argued (in the pre-digital era) that concentration effects had hampered catching up in the South after the end of the Second World War, and had systemically tilted the gains from international trade and investment in favour of the North, and warned about “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). Prebisch was already aware, in the 1980s, that large international banking and financial corporations were beginning to

¹ Moody’s Investor Service, July 2017.

replicate that same pattern and there is little reason to expect large international digital companies to behave any differently in the 21st century.

3. MEASURING THE DIGITAL ECONOMY

Given the rapid changes in the use of digital technologies, it is perhaps not surprising that there are no official figures that capture the true size of the digital economy. Countries have not yet been able to grasp the extent of digitization in their economies and have therefore not designed the statistical tools and databases to quantify it. This lack of consistent statistical tools has resulted in a wide variation in the estimates of different components of digital economy. This section presents estimates of some parts of the digital economy, which are available, like the size of digital products markets; size of global e-commerce market; and size of AM market.

Along with traditional products and services, digital industrialization has led to production of 'Digital Products (DPs)'. Literature² has classified DPs into three categories- (a) *e-commerce products* -those tangible goods which are ordered through the internet, these fall under the goods framework of the WTO; (b) *Electronic Transmissions* or ET Products- ET products are defined at the WTO as those "content-based products that were formerly delivered in tangible form but now can be delivered in electronic form via internet download" and (c) *AM products* -remote additive manufacturing products which are produced by applying consecutive layers of a specific material onto a flat surface until those layers form a three-dimensional object (one of the forms of additive manufacturing is commonly referred to as 3-D printing). AM products now include both high-tech and low-tech manufactured products like textile products, plastic products, motor vehicles, aerospace, machinery, electronics, and medical products³. Digitization therefore goes much beyond ICT, e-commerce and automation.

According to UNCTAD's Information Economy Report (2017) global e-commerce was estimated at \$25 trillion in 2015, up from \$16 trillion in 2013. Other estimates include those by the Accenture study (Digital Disruption: the Growth Multiplier), launched in World Economic Forum in Davos in 2016, according to which the digital economy is sized around \$16.2 trillion amounting to 22% of global GDP (estimated

at around \$ 74 trillion by UN and the World Bank)⁴. Similarly, Banga (2017)⁵, estimates the market in digital products as approximately \$ 22.5 trillion in 2015, of which, around \$21 trillion is estimated to be domestic e-commerce and \$1.6 trillion is estimated as cross-border e-commerce, i.e., international trade in e-commerce products where the products cross the national boundaries. Of \$1.6 trillion, around \$66 billion is international trade in ET products.

As discussed earlier, the rapid growth of the digital infrastructure is fast changing the nature of production, consumption and distribution in all sectors, going much beyond the ICT sectors. Industrial production is rapidly becoming digitalized. Production in this phase is much more informed by the data and customized by consumer preferences. Automation and use of robotics and AI are all combined to produce more precise, efficient and low cost products which are produced at a faster speed and made available quickly. Digitization has also made possible Remote Additive Manufacturing (AM), generally known as 3D printing, where 3D printers are used to remotely print products which were earlier manufactured at the site. The list of 3D products include cars, a working gun, guitar, camera lens, i-phone case, i-pad cases, lamps, clocks, coffee cups, high heel shoes, printed fabrics, etc.⁶. A Chinese company based in Suzhou has built 10 full-sized eco-friendly houses in just one day using 3D printing, costing \$4,800 USD each. The Architectural plan was in a CAD file. The use of cloud based CAD system allows more flexibility in customizing the designs and 3D printer allows quick delivery of customized products using different colors, shapes, sizes and materials. AM is therefore enabling a paradigm shift in designing and production. The AM industry, comprising all AM products and services worldwide, grew by 25.9% CAGR and reached \$5.2 billion in 2015. The CAGR for the previous three years was 33.8%. Over the past 27 years, the CAGR for the industry is an impressive 26.2%⁷.

Along with production of goods and services, digitization has also effectively changed the distribution services with the growing role of e-commerce and digital platforms. Buying/selling of products and services or transmitting of funds or data over electronic network is termed as e-commerce. This may take place in

² See Fleuter, Sam (2016)

³ See Wohlers, Terry (2012) "Additive Manufacturing and 3D Printing State of the Industry." Wohlers Associates, Inc.

⁴ Accenture's estimates are based on 11 advanced economies, where estimations are focused largely on technology used in sectors like infrastructure, IT and communications, e-commerce, and broadband penetration rates.

⁵ Banga (2017), Rising Product Digitalisation and Losing Trade Competitiveness, UNCTAD

⁶ source: <http://www.hongkiat.com/blog/3d-printings>

⁷ Wohler Reports (2017)

Table 1: Size of Additive Manufacturing Industry (3D Printing)

	Size of AM Industry (in Billion \$)*	Growth of AM Industry (Revenues from AM products and services)*	Number of Manufacturers of Industry Grade 3D Printers (more than \$5000)*	Number of Desktop 3D printers sold (under \$5000)*
2010		24.1%		900
2011	1.71	29.4%	31	1500
2012	2.20	28.6%		3000
2013	3.07	34.9%		8000
2014	4.2	35.2%	49	160,000
2015	5.16	25.9%	62	278,000
2016	6.06	17.4%	97	455,772**

Source; *Various Wohler Reports (2010 to 2017)** Gartner Statistica 2017

various forms like business-to-business transactions (B2B), business to consumers (B2C), consumers to consumers (C2C) or business to governments (B2G)⁸. E-commerce can be either domestic e-commerce or cross-border e-commerce (where goods or services are traded between countries and jurisdictions). Although no official comprehensive statistics are available which encompasses all forms of Cross Border E-Commerce (CBEC), what emerges from the available statistics is that CBEC is rapidly expanding. The average annual growth rate of CBEC is expected to outstrip that of the global GDP as well as the growth rate of domestic e-commerce. According to Universal Parcel Services' forecast, while annual growth rate of global GDP will be 3.7%, retail will grow at 5.8% and domestic e-commerce by 16.5%, CBEC will grow at the rate of 26.6% in the period 2013 to 2020.

Apart from the e-commerce and digital products, there are some estimates available on the size of additive manufacturing industry. Additive Manufacturing (or 3D printing) technology was invented in 1980s but it remained a niche technology due to patents. The expiry of some key patents in 2009 and 2014 allowed a spurt in growth of 3D printers, especially the cheap printers costing less than \$5000. According to Wohlers Report (2016) the AM industry, comprising all AM products and services, has grown at an annual rate of 26% in last the 27 years. In 2016, 97 manufacturers sold industrial-grade AM systems (valued at more than

\$5,000), compared to 49 in 2014, and 31 in 2011. The expiry of patents in 2014 increased the number of desktop printers sold from 160,000 in 2014 to 455,772 in 2016, a rise of 184% in two years. (Table 1).

Thirty years into its development, AM may soon become a mainstream manufacturing process. Based on computerized 3D solid model, AM is able to build products by adding layers of material one over the other. One of the features of AM is that it enables customized manufacturing without the use of cutting tools, fixtures and other traditional manufacturing resources. The use of cloud based CAD system allows more flexibility in customizing the designs and therefore leading to product differentiation. Ability to use 3D printing to expedite delivery of customized products (which can use different colors, shapes, sizes and materials) has the potential to revolutionize manufacturing processes. 3D printing may also digitize the construction sector with the coming of 3 D printing mini-builders, which use robotics and AM to add layers to build houses. In the next five years, it is estimated that AM can reduce manufacturing costs by 50% and increase the speed of manufacturing by 400%.⁹

4. THE USE OF DIGITAL SERVICES IN MANUFACTURING OUTPUT AND ITS CONTRIBUTION TO MANUFACTURING EXPORTS

To estimate the extent of the rise in digitization of manufactured products, we examine the rise in the use of digital services (Computer programming & Information Services and Telecommunication services)

⁸ B2B can involve online versions of traditional transactions related to goods that are subsequently sold to consumers via retail outlets. It can also involve the provision of goods and services to support other businesses, for example because of outsourcing and offshoring. B2C involves sales by e-commerce enterprises to consumers and by retail or manufacturing firms that add an online sales channel. C2C e-commerce covers online marketplace platforms (e.g. eBay), and sales within online communities, consumer blogs and chat rooms. B2G transactions are similar to B2B, except that the buyer in this case is a government entity, such as when it makes requests to bid through public e-procurement.

⁹ Siemens' 3D Printing Facts and Figures (<https://www.siemens.com/innovation/en/home/pictures-of-the-future/industry-and-automation/Additive-manufacturing-facts-and-forecasts.html>)

in the production of manufactured products and the change in the value added contributed by digital services (DS) in exports of manufactured products in different countries in the period 2000-2014.

To arrive at estimates of the use of DS in manufacturing output and its contribution to exports, we use national input-output tables (derived from World Input-Output Tables) and World Input-Output dataset (WIOD). Two kinds of estimates are made, firstly, the amount of DS used as inputs in manufacturing output. For inter-country comparisons, this is taken as a percentage of total inputs used by manufacturing sectors; and secondly, value added by DS in manufacturing exports. The estimates are undertaken for 43 countries¹⁰,

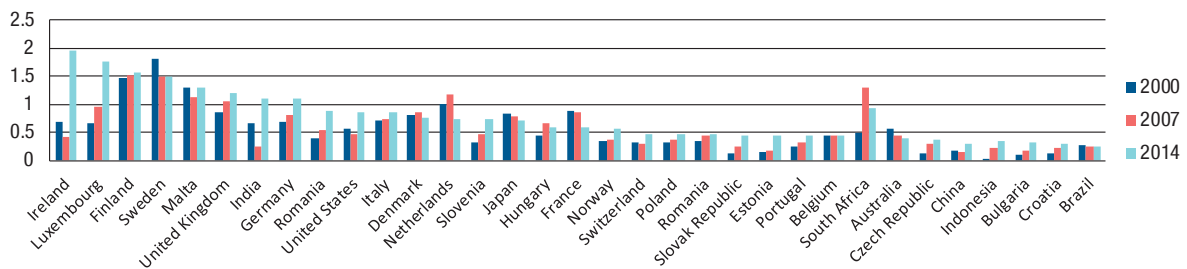
which include BRIC countries, Indonesia and some East Asian NICs, for which the input-output tables are available in WIOD. While use of digital services in manufacturing output is directly estimated from national input-output tables, contribution of value-added by digital services to manufacturing exports is estimated by using Leontief decomposition (using the R package). The details of this methodology are provided in Appendix 1.

Using the National Input-Output tables, we compare DS used as input in manufacturing output as a percentage of total inputs used in manufacturing output in 43 countries in the period 2000-2014. It can be seen from Figure 1 that the use of DS in manufacturing

¹⁰ Australia, Austria, Belgium, Brazil, Bulgaria, Canada, China, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, India, Indonesia, Ireland, Italy, Japan, Korea, Rep., Latvia, Lithuania, Luxembourg,

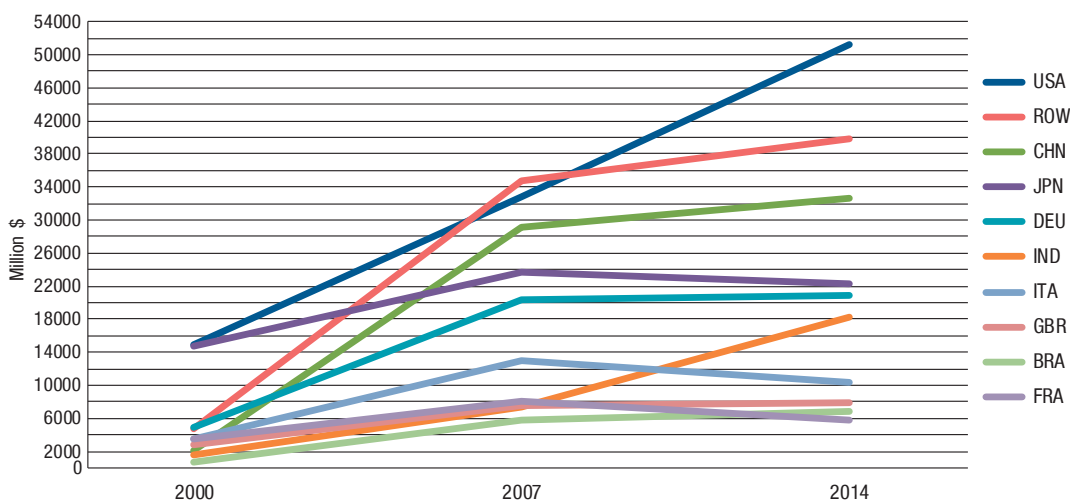
Malta, Mexico, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Taiwan, China, Turkey, United Kingdom, United States and ROW (rest of the World).

Figure 1: Intermediate Consumption of Digital Services as a Percentage of Total Intermediate Consumption in Manufacturing Output: 2000-2014



Source: National Input-Output Tables derived from World Input-Output Tables, World Input-Output Database (WIOD)

Figure 2: Intermediate Consumption of Digital Services (Telecommunications and Computer Programming & Information Services) in Manufacturing Output: 2000-2014



Source: National Input-Output Tables derived from World Input-Output Tables, World Input-Output Database (WIOD)

output has increased for almost all countries in the period 2000-2014. This is an empirical evidence of increasing digitization of manufacturing products in the past one and a half decades in advanced countries and selected developing countries. Although in terms of ratio, use of digital services as a percentage of total inputs used is a small with many countries below 0.5%, in absolute terms the digital services purchased for manufacturing production crosses \$ 50 billion in some countries.

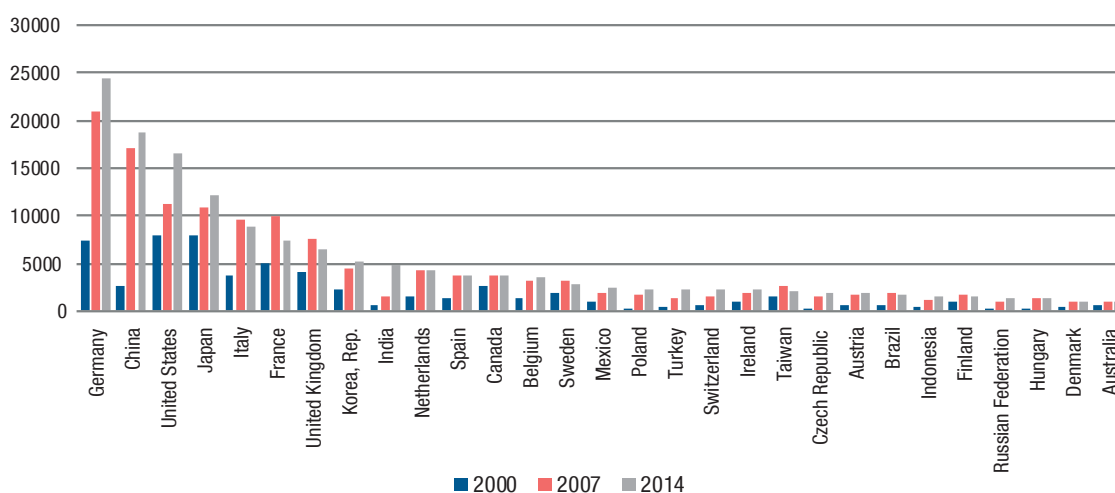
The maximum consumption of digital services in manufacturing production in absolute terms was done by USA in 2014, where it surpassed \$50 billion, followed by China (\$ 30 billion) and Japan (\$20 billion). Out of 43 countries, only 6 countries consumed more than \$10 billion of DS as intermediate inputs in their manufacturing production. For 20 countries this is less

than \$1 billion. This highlights the digital divide (Figure 2). In USA, the consumption increased from \$15 billion in 2000 to \$ 51 billion in 2014 and in Germany from \$ 5 billion to \$ 20 billion.

While intermediate consumption of digital services in manufacturing output has grown in almost all countries, the contribution of digital services in manufacturing exports has been more concentrated in just a few countries. Using the Leontief decomposition, as explained in Appendix 1, the value added contribution of digital services in manufacturing exports has been estimated for 43 countries for the period 2000-2014.

Figure 3 depicts value-added by digital services (domestic as well as imported) in manufacturing exports in absolute terms. In 2014, the value-added by digital services in manufacturing exports is found

Figure 3: Value Added by Digital Services in Exports of Manufactures



Source: Author's estimations using R based on World Input-Output Tables

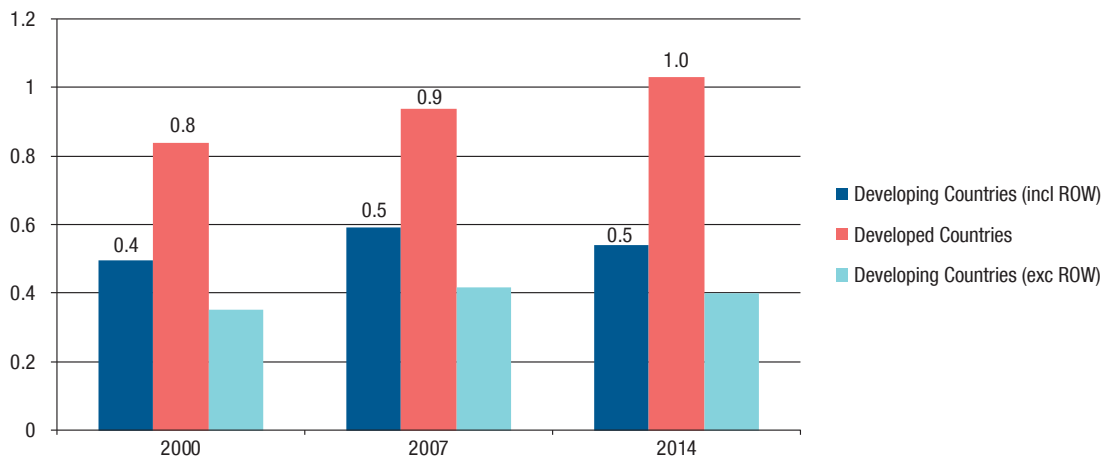
to be highest in Germany, followed by China, USA and Japan. The share of these four countries in total value added by digital services in manufacturing exports of 43 countries is around 50%. This share increases to 61% if Italy, France and UK are added. This highlights that although all countries are experiencing digitization of their manufacturing exports, the scales are very different. Some advanced countries like Germany, USA, and Japan and developing countries like China have experienced an unprecedented digitization of their manufacturing exports post 2000.

The estimates highlight the growing digital divide in manufacturing exports. The value added by computer programming services in manufacturing exports of developed countries has increased

much faster as compared to the developing countries. Figure 4 shows the sum of value added by computer programming in manufacturing exports in developed and developing countries as a share of total manufacturing exports. This has increased consistently for developed countries in the period 2000 to 2014, but has declined for developing countries in the period 2007 to 2014.

Table A.1 in the Appendix reports the extent of digitization of manufacturing in 43 countries in the years 2000, 2007 and 2014 by reporting three estimates, i.e., the exports of DS as a percentage of total exports; value added by DS in manufacturing exports; and value added by computer programming in manufacturing exports. The estimates show that

Figure 4: The Growing Digital Divide in Manufacturing Exports



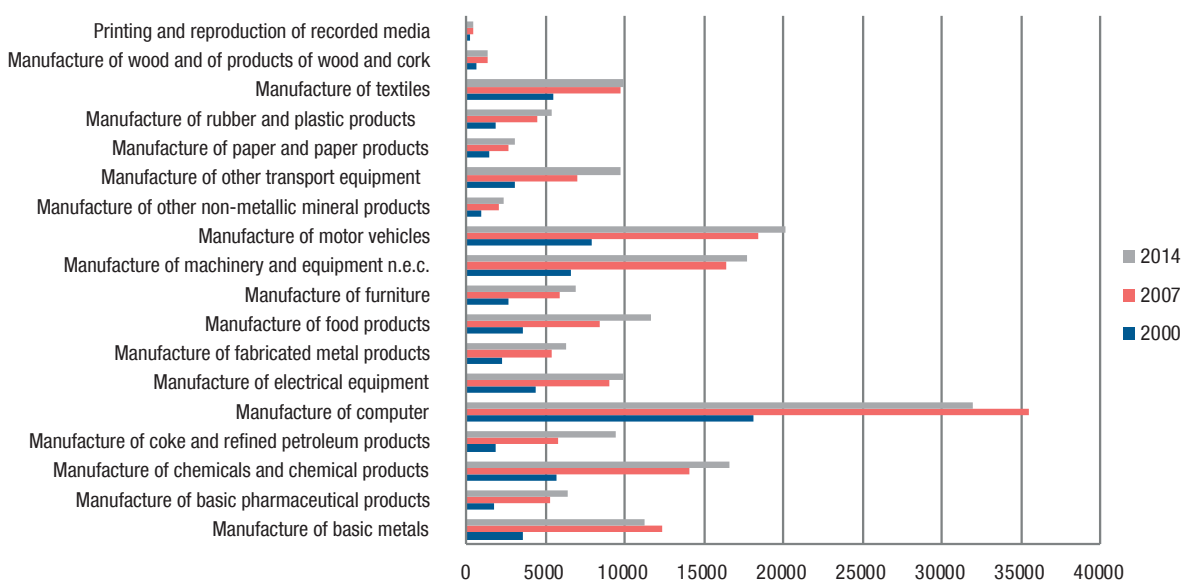
Source: Author's estimations using R based on World Input-Output Tables

in four countries the share of DS in total exports in 2014 was higher than 5% (Luxembourg -10%, Ireland-18%, India-14% and Sweden-5%). Although this reflects higher trade competitiveness of these countries in digital services in terms of share of exports of digital services in total exports, except for Luxembourg, these countries have not experienced a consistent rise in digitization of manufacturing exports, which is reflected by a rising share of value added by DS in manufacturing exports. Countries which are found to have experienced a consistent rise in digitization of manufacturing exports in terms of contribution of DS to manufacturing exports are

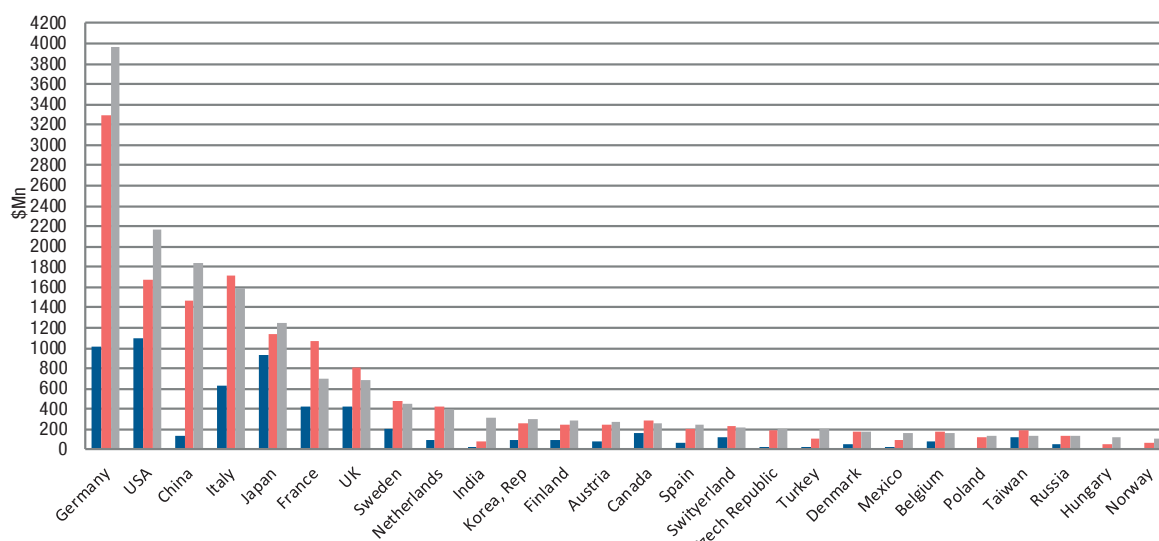
UK, Germany, USA and Belgium, Luxembourg and Norway.

Similar analyses can be conducted at the industry level as well. The industry level estimations of value added by digital services in industry's exports show the extent of digitization an industry has experienced over time. Industries where value-added by digital services in industry's exports has grown faster in the period 2000-2014 are computers; motor vehicles; machinery and equipment; chemicals and chemical products; transport equipment; textiles and electrical equipment (Figure 5).

Figure 5: Industry-Wise Value-Added by Digital Services in Exports of Industries (Mn \$): 2000-2014



Source: Author's estimations using R based on World Input-Output Tables

Figure 6: Value Added by Digital Services in Exports of Machinery and Equipment: 2000-2014

Source: Author's estimations using R based on World Input-Output Tables

The rising automation in exports has become a much debated issue in the recent past, including the growing use in robots and IoT (UNCTAD, 2017). Value added by digital services in exports of machinery and equipment can to some extent capture this growth. Figure 6 compares the value added by digital services in exports of machinery and equipment. This is found to be highest in Germany followed by USA, China, Italy and Japan where the value added by digital services is greater than 1 billion\$.

The widening digital divide in manufacturing exports between developed and developing countries makes it urgent for the developing countries to step-up their efforts on digitizing their competitive sectors. As discussed earlier, this may not be possible for developing countries and LDCs to do it on their own. South-south digital cooperation and efforts at the regional level are needed to address the growing digital divide in industrial production.

The above analysis highlights the growing importance of digital services in manufacturing trade, especially in some advanced countries where the value addition of digital services to manufacturing exports dwarfs that in most developing countries and least developed countries. The value-added by digital services in manufacturing exports of Germany in 2014 in absolute terms was higher than the value-added by digital services in manufacturing exports of the rest of the world (ROW), as seen from WIOD. This growing digitization of manufacturing exports can adversely impact export competitiveness of developing countries in manufacturing products in near future.

5. NEED FOR SOUTH-SOUTH DIGITAL COOPERATION FOR BOOSTING INDUSTRIALIZATION

For developing countries, especially least developed countries, it is extremely difficult to enter and adapt to digitized industrialization on their own. They will first have to develop their digital infrastructure and incorporate a new component in their existing industrial policies which focuses on digitization of manufacturing processes. This digital industrial policy, as a part of the existing industrial policy, needs to focus on building digital infrastructure that includes ICT infrastructure along with digital skills; data infrastructure and cloud computing infrastructure. This will allow the countries to progress towards building AI that can assist them in increasing digitization in their manufacturing as well as help them to develop more efficient and cost effective manufactured products using robots, 3D printers and IoT. This entire process of industrial digitization in a country cannot happen on its own, especially given the limited existing digital capacities of developing and least developed countries. South-South cooperation, in the form of regional digital cooperation, is essential for digital industrialization of the South. This regional digital cooperation can be an additional element in the on-going regional integration processes.

For South-South digital cooperation within the regional blocs, the following 10-point agenda is suggested, where the sequencing and prioritizing needs to be adapted according to the level and pace of digital development of the countries within the region.

South-South 10-point Digital Cooperation Agenda for boosting Industrialization:

- i. Building a Data Economy.
- ii. Building Cloud Computing Infrastructure
- iii. Strengthening Broadband Infrastructure
- iv. Promoting E-Commerce in the Region
- v. Promoting Regional Digital Payments
- vi. Progressing on Single Digital Market in the Region.
- vii. Sharing Experiences on E-Government.
- viii. Forging partnerships for building Smart Cities
- ix. Promoting Digital Innovations and Technologies
- x. Building Statistics for measuring Digitization

5.1 South-South Digital Cooperation for Building a data economy

The first step towards S-S digital cooperation is to build a data economy within the region from which the countries of the region can benefit in terms of using 'Big Data' and developing AI to manufacture digital/digitized products. For developing and least developed countries, this may be extremely difficult. Since the last two and a half decades, many countries have been in the process of developing their ICT infrastructure. However, the internet penetration rate (the percentage of population that uses internet) has still remained low in most of the developing countries, especially LDCs. 80 developing countries in the world still have less than 40 percent internet penetration rate (IPR), of which half of the countries have IPR lower than 20%. 24 countries, mainly African and Pacific countries, have IPR below 10%¹¹. To progress on digitization, countries will need to first develop their digital infrastructure which comprises developing their ICT infrastructure (access, connectivity and affordability) complemented with digital skills.

To build data infrastructure, where data analytics combine layers of data to form 'Big Data' and transforms this big data into AI that generates value, countries need to first 'own' the data. Ownership of data at the national level by the governments will allow the countries to decide with whom to share their data with. Sharing data at the regional level can be more productive for countries within the regional blocs, given the economies in scalability. This will allow pooling of regional data and digital capacities and use of existing digital infrastructure within the region

to process the regional data in order to develop Big Data and AI and more efficient products, which can be customized.

Regional pooling of data will be more beneficial for the countries, especially for small developing countries, than the existing 'free flow of data' which allows the big tech firms to take the data outside the country for free. Similar national rules and regulations on ownership of data in countries within the region will help in faster flow of data within the region. Free flow of non-personal data within the region can help to further the regional integration process. But there is a need to have a clear distinction between personal and non-personal data. Although non-personal data needs to be allowed to flow freely within the region, ensuring protection of personal data is extremely important, especially in building trust within the region. 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 computer science non-PII can be linked to individual's de-identified data, which can be re-identified¹². Regional strategy in data cooperation needs to be discussed along with the ways to classify data and decisions need taken on what data can be shared regionally.

EU has adopted EU wide General Data Protection Regulation, which will come into force from May 2018, which strengthens and unifies data protection for all European citizens. It allows data portability, i.e., switching of service providers along with their portable data and also the right to erasure where individuals can request erasure of personal data related to them on specified grounds. More importantly, this regulation also applies to organizations based outside the EU if they process personal data of EU citizens. Such regulations regarding the ownership of data and protection of personal data at the regional level can help in harmonizing the existing national laws within the region and furthering regional digital cooperation.

5.2. South-South Cooperation for Building Cloud Computing Infrastructure

As discussed in the earlier section, important components of digital infrastructure are ICT infrastructure, digital skills, data infrastructure and cloud computing infrastructure which is complemented with AI, IoT and other innovations to advance digitized manufacturing which uses automation, robotics, 3

¹¹ Banga (2017), 'Rising Product Digitalisation and Losing Trade competitiveness', UNCTAD

¹² See Schwartz and Solove (2011).

D printing, etc. Regional support is a must for many developing and least developed countries, especially for small and vulnerable economies, for enhancing their digital infrastructure. Big developing countries like India, South Africa and China can play the role of digital growth poles in their regions and assist the countries within the region to progress in developing their digital infrastructure. This will in turn be beneficial for the big economies as well and help in developing more cost effective regional value chains.

Cloud computing infrastructure at the regional level can provide remote access to computing services in all the countries within the region. This can provide significant benefits to public as well as the private sector in the region in terms of cost, flexibility, efficiency and scalability. Cloud computing can enable storage of data, softwares and e-solutions on remote computers, which can then be accessed by the users over the internet in different countries. This can greatly improve the regional competitiveness in their manufacturing as well as agricultural products and generate additional employment.

Regional blocs in the South, e.g., the RECs in Africa need to incorporate regional cloud computing strategy in their regional integration programs. This strategy can play a key role in integrating African regional markets and will also improve the competitiveness of the suppliers of manufacturing products. It will help in building a competitive data and knowledge economy in the region and allow suppliers to use advanced computing programs to enhance their knowledge about the products and markets.

A good example of a cloud computing strategy at the regional level is the EU's Cloud Computing Strategy which is expected to deliver net gains of 2.5 million jobs in EU and an annual contribution of EUR 160 billion to EU GDP. This strategy includes three key areas, which are developing model contracts to regulate cloud providers; coordination of cloud standards; and establishing European cloud partnership. The model contracts aim at regulating issues like data preservation after termination of contracts, data disclosure and integrity, data location and transfer; and direct and indirect change in the liability on change of cloud service providers. Cloud standards coordination involves uniformity in standards pertaining to some key areas like cloud security, interoperability, data portability and reversibility. The European cloud partnership brings industry and government representatives together to provide way forward on development of cloud computing in Europe.

5.3 South-South Cooperation for Strengthening Broadband Infrastructure

Broadband networks are the foundation of digital economies and need to be upgraded constantly. Broadband can be regarded as an interconnected multilayered ecosystem of high capacity communication networks, services, applications and users. In order for all countries in the region to have a level playing field in terms of access to opportunities arising from digital economy, it is important that all countries within the regional bloc have similar broadband ecosystem.

The economic impact of broadband has been well recorded in the literature.¹³ Increased availability and use of broadband services can improve social inclusion and productivity in the economies. Studies have shown that in low and middle income countries, every 10 percentage point increase in broadband penetration accelerates economic growth by 1.38 percentage points¹⁴. Many developing countries are making efforts in this area and have designed national broadband policies. Providing support at the regional level to build national broadband infrastructure can help in boosting the regional competitiveness. However, many regional blocs, especially in Africa and Pacific, lag behind other developing regional blocs, especially in Asia, in their broadband infrastructures.

Bigger developing countries like India and China are progressing fast in developing their broadband networks and services. Some of these countries are also benefiting from triangular cooperation, for example, China and Brazil have signed agreements with EU to develop 5G mobile technology. These countries can provide a key support to other developing countries through investing in development of their broadband infrastructure. This would require a stable and predictable regulatory framework in the host countries. Countries within the regional blocs can undertake similar reforms in telecom rules to attract investments in broadband infrastructure in the region. Regional cooperation arrangements and sharing of regulatory experiences and practices can help in developing this key infrastructure in the region.

The Digital Agenda for EU may be difficult to replicate in the South but it provides an important learning for the regional integration efforts. This Agenda aims at

¹³ Christine Qiang, Carlo Rossotto & Kaoru Kimura (2009), — Economic impact of broadband, Information and Communication for Development—, World Bank, 2009, pp. 35-50

¹⁴ World Bank (2009), —Information and Communication for Development: Extending reach and increasing impact”

harmonizing the national broadband policies across 27 European countries allowing for quantitative targets for broadband coverage and speed to differ across countries. Harmonization is sought more in terms of a common regulatory framework, consistent competition laws and enforcement institutions. This has encouraged regional broadband networks addressing the issue of regional digital divide. The Agenda also aims at overhaul of EU telecom rules for including more effective spectrum coordination and encouraging investments in high-speed broadband. EU also provides financial incentives, e.g., EURO 3.2 billion were invested in broadband projects from European Fund for Strategic Investments. Further a new Connecting Europe Broadband Fund is being prepared.

5.4 South-South Cooperation for Promoting E-Commerce in the Region

Building data economy and digital infrastructure in the region can give rise to unique opportunities within the region which will promote regional integration as well as boost intra-regional trade and help in fostering regional value chains. One such opportunity will be in terms of regional e-commerce. As discussed in the previous section, cross border e-commerce market is monopolized by few countries. Many developing countries as well as LDCs are unable to gain much from these new emerging trade portals. Lack of ICT infrastructure, low digital capacities and lack of e-commerce related regulations and infrastructure has increased the risk of losing even domestic market share to the growing cross-border e-commerce giants.

Building regional data economy and regional digital infrastructure, especially cloud computing infrastructure will enable producers and suppliers of manufacturing and agricultural products to have easy, affordable and fast access to the regional markets. Regional e-commerce strategy needs to be developed which supports the national e-commerce strategy. National e-commerce strategies aim at developing the e-commerce sector in the country by providing the required infrastructure, developing complementary skills and putting in place rules and regulations governing e-commerce. An e-commerce strategy at the regional level would imply harmonizing the national rules and regulations on e-commerce. EU's initiatives on harmonizing national rules and regulations regarding e-commerce include a number of areas. Some areas which can be explored for cooperation within the regions in the South are:

- i. Cross border contract rules for consumers and businesses
- ii. Regulations on consumer protection
- iii. Measures in area of parcel delivery
- iv. Rules regarding tackling geo-blocking
- v. Rules on digital content
- vi. Measures for enhancing cybersecurity.

Regional cooperation on cross border contract rules and regulations for consumer protection can greatly built the trust between buyers and sellers within the region. This needs to be supported by building protected digital payment infrastructure capacities within the region. Digital payments are more transparent and traceable and essential for e-commerce. Regulations on consumer protection need to be harmonized within the region and their enforceability improved.

Cost of parcel delivery is an important element of total costs in trade through e-commerce. Within many regions in the South, especially Africa, intra-regional transport cost is found to higher than from outside the region. More efficient and affordable parcel delivery within the regions has to be supported. Regional cooperation is essential for addressing the issues related to geo blocking and cyber security. Geo blocking, i.e., re-routing or blocking particular web sites may imply differential and discriminatory price regimes within the region which can adversely impact on intra-regional trade.

Although promoting cybersecurity culture and preventing IT crime benefits all countries in the region, putting in place similar national laws may not be easy. In 2016, EU adopted a directive on security of network and information systems which gave member states 21 months to transpose the directive into their national laws. Countries are required to appropriately equip computer security incident response team and a competent national competent authority. While such a step can be taken by EU, regional blocs in the South can make progress towards promoting cyber security culture by developing a network at the regional level which may provide support and information to the member countries on improving their cyber security.

5.5 South-South Cooperation on Digital Payments

Digital payments are fast emerging as the cornerstone of successful digitization. They are not a single instrument but a term applied to the many ways of making cashless payments, using digital technology.

Rapidly growing e-commerce has further accelerated the advancement of countries from cash payments to digital payments. Many governments have now adopted digital payments for social security contributions which have lowered their costs, increased their transparency as well as traceability of the payments. Recipients have also benefited in terms of lower costs and increased numbers, as this has led to an expansion of the pool of eligible beneficiaries. Digital payments are also being increasingly used in remittances which are important sources of revenue for many developing countries.

However, advancing the economy from cash to cashless payments is not easy, especially for countries which do not have well-regulated financial sectors. 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, 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 exists 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.

Box 1 elaborates on the working of SIRESS. Other regional blocs in the South can cooperate on financial payment settlement systems in order to progress of digitization.

BOX 1: SADC's Integrated Regional Electronic Settlement System (SIRESS)

SADC comprises 15 Member States: Angola, Botswana, Democratic Republic of Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. In 2013, SADC launched a high-value, bank-to-bank payments system across border, i.e., the SADC Integrated Regional Electronic Settlement System (SIRESS). This system allows real-time settlement among banks and their customers, who hold settlement accounts in SIRESS for intra-regional cross border transactions. South Africa Reserve bank operates SIRESS on behalf of SADC and all payments are settled in Rand. This system reduces the currency risk by using the most used regional currency but it can also add additional costs for a remittance between countries where Rand is not widely used, for example between Botswana and Tanzania. In spite of this, in 2017, 14 countries with 83 financial institutions participated in SIRESS, which settled total payment of \$245 billion USD.

Source: McQuerry and Northup (2017).

5.6 South-South Cooperation for Progressing on Digital Single Market in the Region

Regional integration processes have concentrated on integrating regional markets and making them easily accessible to all stakeholders in the countries within the region. However, in the digitized world, regional markets can be truly integrated only if they progress towards a digital single market in the region. A regional digital single market (RDSM) would imply seamless access to online activities by all consumers and producers in the region, irrespective of their nationality and country of residence. Efforts for advancing Cloud computing and broadband infrastructure at the regional level can greatly further the progress towards RDSM. However, this goal may be extremely difficult to achieve with the existing digital capacities in the regional blocs of the South. This has to be seen as the ultimate goal for digital integration within the regional blocs of the South.

The EU's initiative on 'Digital Single Market strategy' (DSM), which was adopted in 2015, can provide rich learnings for the South, although may not be immediately replicable given the lack of digital capacities in the South. It is estimated that DSM can contribute EUR 415 billion per annum to Europe's economy and create jobs and transform public services. DSM has 16 initiatives and aims at better access for all to digital goods and services; creating a level playing field for digital networks and maximizing growth potential of the digital economy. This includes ambitious plans of launching European Cloud initiative and a new e-government national plan. The progress made by advanced countries on digitization and regional digital integration implies that the North-South digital divide may widen in the future if developing countries do not make extensive efforts at the national as well as regional level to progress on digitization.

5.7 South-South Sharing of experiences on E-Government

E-Government in simple terms refers to the use of information technologies by government agencies to deliver services to citizens (G2C), business enterprises (G2B), government employees (G2E) and other government agencies (G2G). The growing digitization in every sphere of economic activity has also encompassed government activities. Increased use of ICT in government activities is expected to increase the efficiency of government operations as well as enhance good governance making it more transparent and effective. According to UN E-Government Survey of 2016, the number of countries using e-government to provide services has increased sharply. In 2003, only 45 countries had a one-stop-platform, and only 33 countries provided online transactions. In 2016, 90 countries offered one or more single entry portal on public information or online services, or both and 148 countries provided at least one form. While e-government has the potential to contribute substantially to the economic growth of the country, it may not come without a cost. Initial phases of e-government may involve high costs, especially for LDCs and given that IPR in LDCs is low, not all may have equal access to the e-government services leading to widening of inequalities, in the long term e-government can greatly help in reducing the cost of providing government services and addressing corruption.

South-South cooperation agenda can greatly benefit from sharing of experiences on e-government. The processes put in place to enable e-government may not be easy to understand and implement by many developing countries. Sharing of experiences on e-government can help in identifying most cost-effective practices and avoid wastage of limited public resources. In many countries government procurement is used as a tool to build the capacities of SMEs. Progress towards e-Government in the area of government procurement can foster higher competition and improve the efficiency and productivity of SMEs along with addressing the non-transparency and corruption issues in government procurement.

Some of the developing countries, like India, can share its experience of launching initiatives under the National E-Governance Plan (NeGP). This is a progressive plan of India which promotes e-Governance in a holistic manner. There are various policy initiatives and projects initiated to develop core and support infrastructure. The major core infrastructure components are State

Data Centres (SDCs), State Wide Area Networks (S.W.A.N), Common Services Centres (CSCs) and middleware gateways i.e. National e-Governance Service Delivery Gateway (NSDG), State e-Governance Service Delivery Gateway (SSDG), and Mobile e-Governance Service Delivery Gateway (MSDG). The important support components include Core policies and guidelines on Security, HR, Citizen Engagement, Social Media as well as Standards related to Metadata, Interoperability, etc. New initiatives include G-I cloud, an initiative which will ensure benefits of cloud computing for e-Governance projects. These initiatives are sustained efforts at multiple levels to improve the delivery of public services to the citizens and simplify the process of accessing them.

5.8 Forging South-South and Triangular Partnerships for Building Smart Cities

The fast progressing digitization and internet of things has enabled development of smart cities, where extensive use is made of digital technologies, including sensors and inter connected physical devices, to provide key services like transportation, water supply, energy, law enforcement, education, medical, etc. more efficiently. A growing number of countries in the North and a few developing countries in the South are progressively building their smart cities. These cities are viewed as sustainable, inclusive and prosperous cities of the future.

South-South and triangular cooperation is 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 but such cities will also help these economies to save financial resources in the future by increasing the returns to their investments. Given the challenge of fast growing urbanization in the developing countries, smart cities can help in overcoming the limitations of traditional urban development by using digital technologies and digital infrastructure. Innovative approaches are needed to develop smart solutions. Sharing knowledge and innovations by attracting investments from other developing countries and advanced countries into building smart cities can have high technology spillovers and can give boost to the digital industrialization process in developing countries.

EU is already implementing an initiative to help countries build their smart cities within Europe. The European Innovation Partnership on Smart Cities and Communities (EIP) initiative, launched in 2012, aimed

at 'smarting' the cities, improving the efficiency of existing city initiatives by aligning them, and building strategic partnership between industry, innovative SMEs and other stakeholders. A large scale exercise of mapping of smart cities in the EU is also being undertaken.

Amongst the developing countries, smart city initiatives are being undertaken by some countries like India and Malaysia, which can share their experiences with other developing country as well as jointly build smart cities in other developing countries.

5.9 South-South Cooperation on Promoting Digital Innovations and Technologies

The rapidly advancing digital technology can pose serious challenges for the South. The growing use of robots, AI, IoT, 3-D printing and electronic platforms are giving rise to new products and services. Innovations are at the heart of these rapidly evolving digital technologies. Many developing countries are in a process of incentivizing digital start-ups to encourage these innovations. Small and medium enterprises are the main beneficiaries of these low cost high returns innovations which are stimulated by the digital start-ups by young entrepreneurs. This is an area where South-South cooperation can greatly contribute by pooling human and financial resources to stimulate and share innovative ideas and develop digital technologies.

Development banks like BRICS Bank, Asian Development Bank and African Development Banks can play a major role in financially supporting these innovations and start-ups which develop digital softwares and technologies for use at the regional level. South-South 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.

Technology cooperation at the regional level can greatly benefit the countries as the new digital technologies are rapidly transforming the world. Many studies have estimated that these technologies can have disruptive impact on employment, both in the developed as well as in the developing countries¹⁵. Regional cooperation can help in 'catching-up' process of the member countries and also build capacities in the region for the new jobs which may emerge from the use of disruptive new digital technologies.

¹⁵ UNCTAD (2017) and Chang and Phu (2016)

5.10 South-South Cooperation for Building statistics for measuring Digitization

One of the main limitations to the progress of digitization is lack of statistical tools to measure and trace the growth of digitization in different sectors. The contribution of digitization to GDP is difficult to measure and compare across countries. Digital technologies lead to increase in manufacturing productivity both directly (through digitalization of manufacturing products-e.g., 3-D printing) as well as indirectly (through developing softwares using AI), however statistical tools are still unavailable which can capture the use of digital technology in manufacturing. This becomes important as digital competitiveness is what will determine manufacturing competitiveness of countries in the future. Developing countries urgently need to develop statistical tools to capture the extent and progress towards digitization.

EU has designed a composite digital economy and society index (DESI) that uses different indicators on EU's digital performance. Using this index it is possible to track and compare digital competitiveness of EU member states. Similar index is needed to be developed for the countries in the South. Research in Universities should be encouraged in the field of economic and social impact of rising digitization. South-South and triangular cooperation can lead the way for developing countries to develop statistical tools and capture data and information of their progressively digitizing economies.

6. SUMMARY AND CONCLUSION

Growing digitization has raised the anxiety of the developing world which stems from lagging digital capacities, weak supportive digital infrastructure and lack of comprehensive knowledge of the digitization process. This study demystifies the digital economy by explaining the various components of digital infrastructure as well as highlighting the unique and inherent features of digital economy that promotes monopolies. The digital economy is built on digital infrastructure (DI), comprising three closely interrelated components: communication networks; software packages and related capabilities; and data platforms. This digital infrastructure has led to development of artificial intelligence which has enabled advanced world to produce more efficient and competitive products, giving rise to big tech firms. Automation, use of robotics, IoT, cross-border e-commerce and remote additive manufacturing (3D printing) are all manifestations of the growing strength of digital infrastructure and rising digital industrialization.

Further, the study estimates the extent of rise in the use of digital services (computer and information services and telecommunication services) as inputs in production of manufacturing products in 43 countries, using world input-output database and national input-output tables. This is an indicator of rising digitization of manufacturing output. Statistical package 'R' is used to arrive at Leontief decomposition in order to estimate the value added by digital services in manufacturing exports in the period 2000-2014. The analysis is also undertaken for dis-aggregated services. The results show although almost all countries have experienced rising digitization of manufacturing output in the period 2000-2014, but there is a wide variation between developed countries and developing countries. The maximum consumption of digital services in manufacturing production in absolute terms in 2014 was done by USA, which surpassed \$50 billion, followed by China (\$ 30 billion) and Japan (\$20 billion). Out of 43 countries, only 6 countries consumed more than \$10 billion of digital services as intermediate inputs in their manufacturing production. For 20 developing countries this is less than \$1 billion. This highlights the digital divide in manufacturing production.

Value added by digital services in manufacturing exports is found to vary widely between developed and developing countries, with the developed countries experiencing a steady rise in value-added by computer programming services in manufacturing exports and developing countries experiencing a fall in 2014 as compared to 2007. This is indicative of a growing digital divide in manufacturing exports. The estimates for 43 countries show that countries which have experienced a consistent rise in digitization of manufacturing exports in terms of contribution of DS to their manufacturing exports are UK, Germany, USA and Belgium, Luxembourg and Norway. In 2014, in absolute terms, the value-added by digital services in manufacturing exports has been highest in Germany, followed by China, USA and Japan. The share of these four countries in total value added by digital services in manufacturing exports of 43 countries is found to be around 50%. This share increases to 61% if Italy, France and UK are added.

The industry level estimations of value added by digital services in manufacturing exports show that in some industries, like computers; motor vehicles; machinery and equipment; chemicals and chemical products; transport equipment; textiles and electrical equipment, the value-added by digital services has grown much faster in the period 2000-2014. These are the industries where the trade competitiveness will be affected in the coming years with countries using

higher digital services in their exports becoming more competitive.

The growing digital divide in manufacturing exports can have far reaching implications for trade competitiveness of developing countries. Digitization, as noted earlier, is increasingly giving rise to monopolies and has the potential to weaken the regulatory powers of nation states (UNCTAD, 2017). The growing market power of GAFA-A (Google, Apple, Facebook, Amazon and Alibaba) is posing new challenges for anti-trust and competition policies of both developing as well as developed countries. In this scenario of widening digital divide and growing monopolies, the study suggests that it may not be possible for developing countries, especially least developed countries, to leapfrog into digitization on their own. Regional cooperation and efforts at the regional level are needed to build their digital capacities and promote their digital infrastructure.

For South-South digital cooperation within the regional blocs, the study proposes a ten-point regional integration agenda, where the sequencing and prioritizing can be adapted according to the level and pace of digital development of the countries within the region. This agenda includes south-south regional cooperation to (i) build a data economy (ii) build cloud computing infrastructure (iii) strengthen broadband infrastructure (iv) promote e-commerce in the region (v) promoting digital payments (vi) progress on single digital market in the region (vii) share experiences on e-government (viii) forge partnerships for building smart cities (ix) promoting digital innovations and technologies; and (x) build statistics for measuring digital progress.

The study also highlights the need for countries to 'own' their data as opposed to the existing 'free flow of data', which is benefiting mainly the big tech firms. Ownership of data by the governments at the national level will allow the countries to decide with whom to share the data. Sharing data at the regional level can be more productive for countries within the regional blocs. This will allow pooling of regional data and digital capacities and use of existing digital infrastructure within the region to process regional data in order to develop Big Data and use artificial intelligence for creating more efficient and customized products. Sharing of the data regionally can help in developing anti-trust regional strategies to overcome the entry barriers erected by the global superstar firms and also help the countries to face regulatory challenges posed by the growth of these big tech firms.

Regional cooperation is also required for developing digital infrastructure like cloud computing infrastructure, which can greatly reduce the cost of using softwares in the countries within the region as well as allowing the suppliers to customize their services. The study shares the experiences of EU, which has advanced considerably in promoting regional digital infrastructure. Regional e-commerce strategy is suggested for enhancing intra-regional

trade, especially in Africa. This south-south regional digital cooperation agenda, as suggested by the study, can greatly further the on-going regional integration efforts of the developing countries, help the regions to make substantive progress in digital industrialization as well as prepare developing countries for the fourth digital revolution and improve their abilities to take advantage of the rising opportunities in this new phase of industrialization.

REFERENCES

- Abramovitz, M., 1986. Catching Up, Forging Ahead, and Falling Behind. *Journal of Economic History* 46, 386-406.
- Allen J (2017), *Technology and Inequality: Concentrated Wealth in a Digital World*, Palgrave Macmillan.
- Anderson, B, Z. Kozul-Wright and R Kozul-Wright (2017), Rents, rights n’rhythm: Cooperation, conflict and capabilities in the music industry, *Industry and Innovation*, vol. 14, 5
- Autor D, Dorn D, Katz LF, Patterson C and Van Reenen J (2017), “The fall of the labor share and the rise of superstar firms” Discussion Paper No. 1482, Centre for Economic Performance, London School of Economics, London
- Banga, Rashmi (2017), “Rising Product Digitalisation and Losing Trade Competitiveness”, *Economic Cooperation and Integration among Developing countries*, UNCTAD/GDS/ECIDC/2017/3.
- Chang, Jae-Hee and Huynh, Phu. (2016). “ASEAN in transformation: How technology is changing jobs and enterprises”, Bureau for Employers Activities Working Paper No. 9. Geneva, International Labour Office.
- Cimoli M, G. Dosi and J. Stiglitz (2009) *The Political Economy of Capabilities Accumulation: The Past and Future of Policies for Industrial Development*, in *Mario Cimoli, Giovanni Dosi, Joseph E. Stiglitz, eds, Industrial Policy and Development: The Political Economy of Capabilities Accumulation*, Oxford, Oxford University Press.
- European Parliament (2015) *Challenges of competition policy in a digitalised economy*, Study for the ECON Committee, July
- Fleuter Sam (2016) “The Role of Digital Products Under the WTO: A New Framework for GATT and GATS Classification,” *Chicago Journal of International Law*: Vol. 17: No. 1, Article 5.
- Foroohar R (2017) “Release Big Tech’s grip on power”. *Financial Times*. 18 June
- Foster JB, McChesney RW and Jonna RJ (2011) “Monopoly and competition in twenty-first century capitalism”. *Monthly Review*
- Galbraith, J (2014). *The End of Normal: The Great Crisis and the Future of Growth*, New York, Simon and Schuster
- Haskel J and S. Westlake (2017) *Capitalism Without Capital: The Rise of the Intangible Economy*, Princeton, Princeton University Press
- Information Economy Report (2017), *Digitalization, Trade and Development*, UNCTAD
- Katz ML, and Shapiro C (1999) “Antitrust in software markets”. In: Eisenach JA and Lenard TM, eds. *Competition, Innovation and the Microsoft Monopoly: Antitrust in the Digital Marketplace*. New York, NY, Springer Science and Business Media: 29–81.
- Kurz, M (2017) *The new monopolists*, Project Syndicate, September 22
- Lynn, B (2012) *Killing the competition*, Harpers Magazine, February.
- McQuerry, E & Northup, C. (2017), “Regional Payments Integration, Financial Inclusion, and Remittances in the Southern African Development Community (SADC): Reflections on a Work in Progress”, Glenbrook, SADC Banking Association
- OECD (2015). *Enquiries into Intellectual Property’s Economic Impact*. Paris, OECD Publishing
- OECD (2017) *Digital Economy Outlook 2017*, Paris, OECD Publishing
- Prebisch R (1986). Address delivered at the twenty-first session of ECLAC, Mexico City, 24 April. *CEPAL Review*, 29: 13–16.
- Quast, B, and V Kummritz (2015), “decompr: Global Value Chain decomposition in R”, CTEI Working Papers 2015-01, Centre for Trade and Economic Integration, Geneva.

- Qiang, C, C Rossotto & K Kimura (2009), "Economic impact of broadband, Information and Communication for Development", World Bank, 2009, pp. 35-50 ,
- Rotman R (2013). How technology is destroying jobs, MIT Technology Review, June 12.
- Sandbu M (2018) The market failures of big tech, Financial Times, February 19
- Schwartz, Paul M. and Solove, Daniel J., "The PII Problem: Privacy and a New Concept of Personally Identifiable Information" (December 5, 2011). New York University Law Review, Vol. 86, p. 1814, 2011; UC Berkeley Public Law Research Paper No. 1909366; GWU Legal Studies Research Paper No. 584; GWU Law School Public Law Research Paper No. 584. Available at SSRN: <https://ssrn.com/abstract=1909366>
- Stiglitz, J (2016) Monopoly's new era, Project Syndicate, May 13
- The Economist (2016) The problem with profits, March 26th
- UNCTAD, Trade and Development Report (2017), "Beyond austerity: Towards a global new deal", United Nations.
- UNCTAD, Trade and Development Report (2016), "Structural transformation for inclusive and sustained growth", Chapter VI, Industrial Policy Redux, United Nations
- Wohler Reports (2017), "3D Printing and Additive Manufacturing State of the Industry", Annual Worldwide Progress Report, Wohlers Associates, Inc.,
- Wohlers Report (2016), "3D Printing and Additive Manufacturing State of the Industry", Annual Worldwide Progress Report, Wohlers Associates, Inc.,
- Wohlers, Terry (2012) "Additive Manufacturing and 3D Printing State of the Industry." Annual Worldwide Progress Report, Wohlers Associates, Inc. 2012.
- World Bank. 2009. "2009 Information and Communications for Development : Extending Reach and Increasing Impact". World Bank.
- WTO (2017) Report on Panel Discussion on Digital Industrial Policy and Development, Communication from the Africa Group, 20 July.
-

APPENDIX 1: METHODOLOGY FOR ESTIMATING VALUE ADDED BY DIGITAL SERVICES IN EXPORTS OF MANUFACTURES

The value added by digital services (Computer programming & Information Services and Telecommunication services) in exports of manufactures is estimated using data from World Input- Output Dataset (WIOD) for the period 2000-2014. This dataset provides input-output data for 43 countries, including 15 developing economies, and 56 sectors. Using gross flows from WIOD and the 'decompr' package in R, developed by Quast and Kummritz (2015), Leontief's decomposition (1936) is applied, wherein the gross exports are decomposed into value added flows between industries across countries.

The Leontief's decomposition, based on national input-output data, proposes that output of industry X requires inputs from other industries as well as X's own value added. While X's own value-added is the direct value-added, the inputs from other industries form the first round of X's indirect contribution to VA since these inputs generate VA in the supplying industries. These inputs from supplying industries further depend on inputs from other industries, and therefore a second round of creation of indirect VA in supplying industries of suppliers is created. This chain continues till VA is traced back to the original suppliers. Mathematically, this can be expressed as

$$V B = V (I-A)^{-1}$$

where V is a NxN matrix with the diagonal representing the direct value added contribution of N industries, A is the Input-Output coefficient matrix with dimension NxN, i.e. it gives the direct input flows between industries required for 1\$ of output, and $(I-A)^{-1}$ is the Leontief inverse. VB gives a NxN matrix of called value added multipliers, which denote the amount of value added that the production of an industry's 1\$ of output or exports brings about in all other industries (Quast and Kummritz, 2015).

Applying this to world input output tables, becomes the vector of direct value added contributions of all industries across different countries, with C denoting number of countries and N denoting number of industries. gives the industry flows including cross border relations. Since we are interested in the value added origins of exports, A and V are multiplied by whose diagonal constitutes each industry's exports. This gives us the output of the Leontief's decomposition, mathematically expressed as $V (I-A)^{-1} E$.

'Decompr' implements this algorithm into R to derive the matrix. The output is CNxCN matrix that gives for each country and industry the value added origins of its exports by country and industry.

Table A.1

	Exports of Digital Services as a percentage of Total Exports (%)			Value Added by Digital Services in Manufacturing Exports (%)			Value Added by Computer Programming in Manufacturing Exports (%)		
	2000	2007	2014	2000	2007	2014	2000	2007	2014
Australia	1.0	0.7	0.8	1.8	1.4	1.5	0.9	0.7	0.8
Austria	1.2	1.2	2.2	1.1	1.3	1.3	0.5	0.7	0.9
Belgium	1.6	1.5	2.6	1.4	1.5	1.6	0.7	0.8	1.0
Brazil	0.2	0.2	0.2	1.4	1.5	1.2	0.6	0.6	0.7
Bulgaria	0.3	1.1	4.0	0.9	1.1	1.4	0.2	0.4	0.7
Canada	0.8	1.9	1.6	1.3	1.4	1.3	0.6	0.6	0.7
China	0.4	0.5	0.6	1.3	1.6	0.9	0.3	0.4	0.3
Croatia	3.0	2.4	2.9	1.2	1.3	1.3	0.3	0.5	0.6
Cyprus	1.4	3.0	4.0	0.6	0.6	0.6	0.2	0.2	0.2
Czech Republic	1.8	1.1	1.5	1.1	1.6	1.5	0.4	0.8	1.0
Denmark	1.8	2.2	2.9	1.4	1.6	1.5	0.7	1.0	1.0
Estonia	0.3	1.6	3.0	1.3	1.3	1.6	0.3	0.4	0.9
Finland	0.6	2.3	3.8	2.2	2.1	2.1	1.3	1.3	1.5
France	0.5	0.7	1.7	2.0	2.1	1.6	1.2	1.3	1.0
Germany	0.9	1.2	1.9	1.6	1.8	1.9	0.9	1.1	1.4
Greece	0.7	1.0	0.9	1.3	1.2	1.2	0.2	0.3	0.3
Hungary	1.1	1.1	1.7	1.6	1.9	1.5	0.8	1.0	1.1
India	10.5	18.0	14.3	2.0	1.5	2.1	0.7	0.4	1.3
Indonesia	0.1	0.4	0.5	0.8	1.3	1.1	0.2	0.3	0.4
Ireland	4.4	7.1	19.0	1.7	1.6	2.0	0.8	0.8	1.1
Italy	2.3	1.9	1.8	1.9	2.2	1.9	0.9	1.0	1.2
Japan	0.4	0.3	0.3	2.0	1.8	1.8	1.0	1.0	1.0
Korea, Rep.	0.2	0.3	0.5	1.4	1.3	0.9	0.8	0.7	0.5
Latvia	1.0	1.2	2.8	1.0	1.0	1.3	0.3	0.3	0.7
Lithuania	1.0	0.5	0.8	0.8	0.8	0.7	0.1	0.2	0.3
Luxembourg	3.0	6.0	10.2	1.3	1.4	1.5	0.7	0.8	0.9
Malta	0.5	0.8	2.3	1.7	1.6	1.7	1.1	1.0	1.0
Mexico	0.2	0.1	0.0	0.8	1.0	0.9	0.3	0.4	0.4
Netherlands	1.4	1.7	2.4	1.5	1.7	1.7	0.9	1.0	1.1
Norway	0.7	0.7	1.4	1.1	1.3	1.4	0.5	0.7	0.9
Poland	1.2	1.0	1.7	1.2	1.5	1.5	0.5	0.7	0.9
Portugal	0.8	1.6	1.7	1.1	1.3	1.3	0.4	0.6	0.7
Romania	1.9	3.2	5.4	1.6	1.5	1.6	0.6	0.7	1.0
ROW	1.8	1.8	2.4	1.7	2.0	1.5	0.6	0.9	0.8
Russian Federation	0.3	0.4	0.2		1.1	1.0		0.1	0.1
Slovak Republic	0.1	0.4	2.4	1.0	1.3	1.3	0.4	0.6	0.9
Slovenia	0.2	0.7	1.6	0.9	1.3	1.4	0.5	0.7	1.0
Spain	2.6	2.9	3.6	1.4	1.8	1.5	0.5	0.6	0.6
Sweden	1.6	2.5	5.4	2.3	2.1	2.0	1.4	1.4	1.4
Switzerland	1.8	2.2	3.2	1.1	1.1	1.2	0.6	0.6	0.8
Taiwan	0.1	0.2	0.3	1.1	1.1	0.7	0.4	0.5	0.4
Turkey	0.3	0.2	0.1	1.2	1.3	1.1	0.2	0.3	0.3
United Kingdom	1.3	2.1	3.1	1.8	2.0	2.2	1.0	1.3	1.5
United States	1.5	1.6	2.1	1.4	1.5	1.6	0.6	0.7	1.0

Source: Author's estimations using R based on World Input-Output Tables

