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Adapting industrial policies to a digital world for economic diversification and structural transformation

Note by the UNCTAD secretariat

Executive summary

The fast spread of digital technologies throughout the world is reshaping production processes and business models, with important implications for the economic diversification and structural transformation of countries. Digital technologies may boost the productivity of labour and capital and facilitate connections to global markets by lowering transaction costs and information asymmetries. Yet they also present serious challenges, including to the inclusiveness of development, as robot-based automation risks reducing the traditional benefit of industrialization as an economic catch-up strategy. In addition, the potential winner-takes-all outcomes of many new digital technologies risk concentrating their proceeds both across and within countries and unresolved regulatory issues risk leading to the entry of developing countries into a digital world with global regulatory standards largely set by more advanced countries. However, historical evidence suggests that achieving benefits from the outcomes of technology waves, such as moving towards a digital world, is not an autonomous process, but is shaped by policies. To maximize the contribution of a digital world to economic diversification and structural transformation, policymakers need to adjust, inter alia, their infrastructural, regulatory and industrial policies, in a proactive way.

The second session of the Multi-year Expert Meeting on Enhancing the Enabling Economic Environment at All Levels in Support of Inclusive and Sustainable Development, and the Promotion of Economic Integration and Cooperation, is invited to discuss how the diffusion of digital technologies shifts the traditional boundaries between individual industries and those between industry and services, and how this affects economic diversification and structural transformation. In addition, participants are invited to focus on how policymakers can adapt and change industrial policy pursued to date, to harness the potential of a digital world for economic diversification, structural transformation and greater value addition, as well as to explore the role that South–South and triangular cooperation can have for developing countries in this context.

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I. Introduction

1. Economic diversification and structural transformation, towards a greater reliance on manufacturing as a share in the total output and employment of economies, have been synonymous with development. Developing manufacturing activities has typically provided productivity gains and, at the same time, employment and income opportunities. This unique feature of the manufacturing sector has led Governments to support economic diversification and structural transformation towards manufacturing through a range of measures, in particular through various forms of industrial policy.

2. However, many countries worldwide have recently experienced declines in the importance of manufacturing in their economies, which is a cause for concern in both developed and developing countries, as it may lock economies into lower productivity activities and provide well-paid employment only for a select few. The increasing importance of digital technologies may accelerate the decline in the importance of manufacturing as a creator of well-paid employment; it is often claimed that such technologies may displace manufacturing jobs on a significant scale. At the same time, new digital technologies could provide the greater productivity growth needed for a more rapid and better sustained global economic expansion, which is required to achieve the Sustainable Development Goals of the 2030 Agenda for Sustainable Development. Finally, at the microeconomic level, digital technologies may facilitate connections to global markets, by lowering transaction costs and reducing information asymmetries.

3. The overarching goal of the 2030 Agenda is inclusive prosperity. In developing countries, this may be achieved, inter alia, through economic diversification away from commodity dependence and through structural transformation towards sectors and activities that generate greater value addition. Innovation as a mechanism for economic diversification and structural transformation is reflected in Goal 9, and Goal 17 identifies technology and South–South and triangular regional and international cooperation as important means of achieving the Goals and implementing the 2030 Agenda.

4. Historical evidence suggests that achieving beneficial outcomes from innovation is not an autonomous process, but is shaped by policies, particularly when technology waves are composed of an initial phase of process innovation and job destruction, followed by a second phase of product innovation and job creation, that together result in positive aggregate employment and income effects. From this perspective, the current digital wave may be in a job destruction phase and could eventually create new employment and income opportunities through new products and economic sectors.[1] This means that how people, firms and countries are affected by the advancing digital world, and how they can make digital technologies transformational and able to generate economic and social benefits for all, depends in great measure on policy choices. Given that the effectiveness of national policies is central to achieving the transformative goals of the 2030 Agenda, capturing developmental potential in a digital world presents new challenges for policymakers. These issues are of particular interest for developing countries, as many of them lag behind with regard to adopting and benefiting from digital technologies.

5. Due to its multifaceted and dynamic nature, there is no generally accepted definition of the digital economy. The Oxford Dictionary defines it as “an economy which functions primarily by means of digital technology, especially electronic transactions made using the Internet”.[2] Another dictionary defines it as follows: “a term for all of those economic processes, transactions, interactions and activities that are based on digital technologies. The digital economy is different from the Internet economy in that the Internet economy is

[1] See C Perez, 2016, Capitalism, technology and a green global golden age: The role of history in helping to shape the future, in: M Jacobs and M Mazzucato, eds., *Rethinking Capitalism: Economics and Policy for Sustainable and Inclusive Growth* (Chichester, United Kingdom of Great Britain and Northern Ireland, John Wiley and Sons).

[2] See https://en.oxforddictionaries.com/definition/digital_economy.
Note: All websites accessed 27 December 2017.

based on Internet connectivity, whereas the digital economy is more broadly based on any of the many digital tools used in today's economic world."[3] However, there is a general expectation that the growing use of digital technologies will be a game changer that alters the way companies organize production processes and the business models that they adopt.

6. In this context, the second session of the Multi-year Expert Meeting on Enhancing the Enabling Economic Environment at All Levels in Support of Inclusive and Sustainable Development, and the Promotion of Economic Integration and Cooperation, is invited to discuss the challenges and opportunities faced by the global economy in moving towards a digital world, in particular the following main areas:

(a) Forms of digital technologies that shift the traditional boundaries between individual industries and those between industry and services and thereby affect economic diversification and structural transformation;

(b) The adaptation of traditional industrial policy with a view to harnessing the potential of a digital world for economic diversification, structural transformation and greater value addition;

(c) The role of South–South and triangular cooperation in the digital economy.

II. Digital technology, economic diversification and structural transformation

A. Potential impacts on economic diversification and structural transformation: Robotics

7. A major area of interest in the discussion on the digital revolution is the greater use of industrial robots in production. While robotics is part of a wider process of automation, industrial robots differ from conventional capital equipment as they:

(a) Are automatically controlled and operate on their own;

(b) Are multipurpose, that is, reprogrammable and capable of doing different kinds of tasks rather than repeating the same task;

(c) Have significant dexterity, that is, are operational across several axes.

8. These characteristics also differentiate industrial robots from other forms of digital automation, such as computer numerical control systems, which have allowed for the automation of machine tools since the 1960s, but are designed to perform specific tasks and, even if digitally controlled, lack the autonomy and dexterity of modern industrial robots. These characteristics and differences have attracted particular attention because of the dramatic changes that industrial robots are presumed to bring about. However, in many developing countries, more traditional forms of automation, such as the simple mechanization of heavy duty work, continue to affect production processes beyond those involving robotics.

9. Most of the current debate on the economic impact of robots focuses on developed countries, yet robotics also concerns developing countries. From a development perspective, the main question is whether robots will reduce the familiar benefits of industrialization as an economic catch-up strategy. This may occur if robot-based automation makes industrialization more difficult or causes it to yield substantially fewer manufacturing employment opportunities than in the past.

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[3] See https://www.techopedia.com/definition/32989/digital-economy.
For a more extensive discussion of the new digital economy, see UNCTAD, 2017, 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, and for a more extensive discussion of how it has been expanding, see UNCTAD, 2017, *Information Economy Report 2017: Digitalization, Trade and Development* (United Nations publication, Sales No. E.17.II.D.8, New York and Geneva).

10. At present, the global level of use of industrial robots is low, with around 1.8 million in use in 2016. However, their use has increased rapidly since 2010, and it is estimated that by 2020, over 3 million industrial robots will be at work.[4] The share of developed countries in the global stock of operational industrial robots continues to decline, but in 2016 still amounted to 55 per cent, with three countries – Germany, Japan and the United States of America – making up 40 per cent. By contrast, the recent increase in industrial robot use has been the most rapid in developing countries, but has also been heavily concentrated, and taken place mostly in economies in Asia, in particular in China.[5] The large absolute size of the manufacturing sector in China is in part responsible for its large share in the global stock of industrial robots. Robot density, that is, the number of industrial robots in manufacturing per manufacturing employee, is highest in developed countries and developing countries at mature stages of industrialization. Developing countries with the highest robot density are, in descending order, Thailand, Mexico, Malaysia and China.[6]

11. The use of industrial robots in manufacturing is also heavily concentrated in only five sectors. The automotive industry accounted on average for about 43 per cent of annual deployment in 2010–2016, yet with a decline in 2016 to the level in 2010, or about 39 per cent; followed by computers and electronic equipment at about 15 per cent; by electrical equipment, appliances and components at about 10 per cent, yet with an increase from about 12 per cent in 2015 to almost 19 per cent in 2016; by rubber, plastic and chemical products; and by industrial machinery.[7]

12. Studies indicating the dramatic job displacement potential of robots generally emphasize the technical feasibility of workplace automation.[8] Yet such assessments tend to overestimate the potential adverse effects of robot-based automation, since a substitution of labour by capital, including in the form of robots, that is technically feasible will occur only if it also provides economic benefits. This economic perspective suggests that the cost of automation should be compared with the cost of labour for routine tasks. The former cost is determined by a range of factors, but depends critically on labour compensation, which tends to vary across different economic sectors, as does the prevalence of routine tasks. Linking robot use in manufacturing and the technical feasibility and economic profitability of robot-based automation suggests that, across manufacturing sectors, the technical feasibility of automating workers' routine tasks is highest in the food, beverages and tobacco sector, followed by the textiles, apparel and leather sector. It also suggests that workplace automation is more profitable in relatively skill intensive and well-paid manufacturing jobs, such as in the automotive and electronics sectors, than in relatively labour intensive and low-paid sectors, such as apparel. In addition, economic factors are more important in robot deployment than the technical possibilities of automating worker tasks, and robot deployment has remained limited in manufacturing sectors in which labour compensation is low, even if these sectors have high values on the routine task intensity index.[9] Robot use in the textiles, apparel and leather sector is the lowest among all manufacturing sectors, although this sector ranks second with regard to the technical feasibility of automating the routine tasks of workers.

13. Findings with regard to the gender-related impacts of workplace automation depend on whether only technical feasibility or both technical and economic feasibility are considered. Studies that consider only technical feasibility find that the number of job losses is broadly the same for women and men.[10] However, women are comparatively more affected, as their participation in the labour force is lower and as their jobs are more likely to be cut in areas that are complementary to robot use, such as in science, technology,

[4] International Federation of Robotics, 2017, *World Robotics 2017: Industrial Robots* (Frankfurt am Main, Germany).
[5] Ibid.
[6] UNCTAD, 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).
[7] Ibid.
[8] See Oxford Martin School and Citi, 2016, Technology at work v2.0: The future is not what it used to be, available at https://www.oxfordmartin.ox.ac.uk/publications/view/2092.
[9] UNCTAD, 2017, *Trade and Development Report 2017*.
[10] See World Bank, 2016, *World Development Report 2016: Digital Dividends* (Washington, D. C).

engineering and mathematics. Yet, if economic feasibility and low levels of robot use in light manufacturing, such as apparels, in which women's employment tends to be concentrated, are considered, the gender-related impact of workplace automation is reversed. For example, in the United States, job displacement affects both men and women, yet the adverse effects for men are about 1.5–2 times greater than those for women.[11]

14. Evidence that routine tasks tend to prevail in manufacturing and that robots tend to be used in relatively skill intensive and well-paid manufacturing jobs can be used to assess which countries are currently most exposed to robot-based automation. Given current technological and economic indicators, developed countries and developing countries other than the least developed countries are exposed to robot-based automation in manufacturing to a greater extent than the least developed countries.[12] However, this evidence refers only to exposure to robot-based automation and does not take into account risks to employment from other forms of automation. Yet it suggests that robot-based automation on its own does not invalidate the traditional role of industrialization as a development strategy for lower-income countries. In the short term, low-cost manufacturing and associated exports can continue to play a crucial role in allowing developing countries to grow rapidly while creating jobs. However, the dominance of robot use in sectors higher on the skill and wage ladder implies a greater difficulty for latecomers in attaining sectoral upgrading, and may limit the scope for industrialization to the low-wage and less dynamic – with regard to productivity growth – manufacturing sectors. This could stifle the economic catch up of such countries, leaving them with stagnant productivity and per capita income growth. Such potential adverse effects may be reinforced in the long term as the cost of robots is likely to further decline, leading to their use in lower-wage manufacturing sectors and eventually in lower-income countries.

15. In the meantime, employment and income opportunities in low-wage, labour-intensive manufacturing in developing countries may be adversely affected by the reshoring of manufacturing activities to developed countries. Developed countries may spur reshoring and reorganize production processes by combining robotics with additive manufacturing, that is, three-dimensional printing. One rationale for reshoring concerns the advantages of locating production geographically close to product design, as manufacturing competence is integral to innovation. In the high-end apparel industry, for example, design cannot be separated from manufacturing because design and aesthetic innovation and product quality are affected by how fabric is cut and sewn, and the value of co-locating design with manufacturing is therefore high.[13] From this perspective, reshoring is mainly a means to stimulate innovation and product development by relocating production activities to areas where firms expect that links between production and research and development, and positive impacts on innovation, can be best encouraged.

16. There is only fragmented and anecdotal evidence of the significance of reshoring. Survey results and responses to firm-level questionnaires that aim to provide broader and more systematic evidence indicate that offshoring prevails, but also that some reshoring has occurred at a slow pace and across all industrial sectors, albeit at different intensities and for different motives.[14] One reason for the slow pace of reshoring may be tepid

[11] D Acemoglu and P Restrepo, 2017, Robots and jobs: evidence from [United States] labour markets, National Bureau of Economic Research Working Paper No. 23285.

[12] UNCTAD, 2017, *Trade and Development Report 2017*.

[13] See, with regard to the establishment in developed countries of robot-based factories to produce footwear and leisure wear, which use three-dimensional printing, http://www.economist.com/news/business/21714394-making-trainers-robots-and-3d-printers-adidass-high-tech-factory-brings-production-back. Such usage is unlikely to involve the reshoring of mass production, but is related to the creation of new production lines focused on the personalization of goods for high-income consumers, which may not be economically profitable to produce using the traditional manufacturing processes in the footwear and apparel industries in developing countries.

[14] See K De Backer, C Menon, I Desnoyers-James and L Moussiegt, 2016, Reshoring: Myth or reality? Organization for Economic Cooperation and Development Science, Technology and Industry Policy Paper No. 27, available at http://www.oecd-ilibrary.org/science-and-technology/reshoring-myth-or-reality_5jm56frbm38s-en.

investment and sluggish aggregate demand in developed countries more generally. Moreover, developed countries lack the supplier networks that some developing countries have built to complement labour-intensive assembly activities. In addition, labour and cost differentials remain a factor in the decisions of firms on where to locate production, especially of goods with a high labour content, yet demand factors such as the size and growth of local markets are becoming increasingly important determinants. Many companies that once moved production offshore thus may choose to remain, in order to access growing local demand. This suggests that the production of labour-intensive manufactures destined for rapidly growing markets in large developing countries with domestic production linkages is unlikely to be reshored. Building a dense network of intra-sectoral and cross-sectoral forward and backward linkages and complementarities could further reduce the risk of reshoring, even as the cost of owning and operating robotics systems further declines and the scope of economically feasible automation gradually broadens, to also affect traditional labour-intensive sectors, such as garment making.

17. The further evolution of robotics could also provide new employment opportunities. The development of collaborative robots, which do not replace human work but work alongside and increase the productivity of human labour, is in its infancy. Such co-bots may be particularly beneficial for small enterprises, as they can be easily set up, do not require special system integrators and can rapidly be adapted to new processes and production run requirements. This could help domestic manufacturing enterprises, including in developing countries, to overcome size and quality limits in production and help broaden the range of domestically sourced intermediate goods in global value chains.

B. Potential impacts on economic diversification and structural transformation: Big data, the Internet of things and three-dimensional printing

18. The use of big data and the Internet of things can optimize business operations, for example by increasing the efficiency of logistics, inventory management and equipment maintenance. It can also enable processes such as precision agriculture, which uses data analytics and the Internet of things to allow for variable rate fertilization and irrigation in response to different soil and plant conditions across farmland, including in smallholding plots that have variable soil and plant conditions that make precision agriculture economically profitable. Given that the cost of the technology is decreasing, smallholding farmers in developing countries may use precision agriculture to raise yields while reducing the use of fertilizer and water. The resulting increased provision of domestically produced food could help improve domestic food security, while faster productivity growth in agriculture could spur economic diversification by providing for rural off-farm activities, as well as cheap wage goods for urban manufacturing workers. The latter could, in turn, increase the purchasing power of workers and free up demand for manufactures, or improve the international competitiveness of domestic manufacturers, thereby fostering economic diversification and structural transformation.

19. Big data is fundamental to many other digital technologies, such as artificial intelligence and the Internet of things, and is beginning to play an increasingly large role in sectors, such as health care,[15] in which firms that can use or own big data may have certain advantages, including in terms of appropriately stocking product pipelines or better planning the areas in which to invest with regard to research and development.

20. The most important benefit from the use of big data and the Internet of things in economic diversification and structural transformation may be the increased potential for demand-driven innovation. The combination of increased computer processing power with the development of advanced data analysis techniques, such as text-as-data analysis, allows firms to determine consumer tastes and behaviour and use the ensuing information as inputs

[15] See W Raghupathi and V Raghupathi, 2014, Big data analytics in health care: Promise and potential, *Health Information Science and Systems*, 2(1), available at https://link.springer.com/journal/13755/2/1/page/1.

for product innovation. New digital technologies can thereby give rise to the development of new products and even new economic sectors. Using data analytics as market intelligence can shape investment incentives and entrepreneurial activities, in that it can help domestic firms identify or anticipate demand for specific manufactured products and thereby help them enter sectors they might otherwise not have considered as providing profitable sales opportunities. Using data analytics could also enhance the use of demand for manufactured goods as an actionable variable, as it can help monitor how consumers and demand patterns respond to policy interventions, such as awareness-raising, national branding campaigns, public procurement, mandatory standards and labelling and fiscal incentives.[16]

21. The use of three-dimensional printing can further enhance such benefits, once cost reductions and improved complementarity with cloud computing and computer-aided design techniques makes such printing widely available for industrial production. For example, three-dimensional printing can be used to manufacture complex parts and products in an economically profitable way, even at low-volume production runs, such as for rapid, iterative prototyping.[17] Such uses of digital technology could help compensate in part for the lack of skilled designers and an established machinery industry in developing countries.

22. The increased importance of data intelligence in design and investment-related decision-making also reflects the greater role that services provision has gained in the production stages of the manufacturing process. Data from customer uses of manufactured products can increase the attractiveness of goods not only as they allow for targeted maintenance and other after-sale services, but also because they facilitate the customization of goods, from the design stage to the organization of production processes. The use of digital technologies thus increases the share of value added of services within the entire manufacturing process and shifts the traditional boundaries between industrial and services activities.

C. Digital capabilities and digital infrastructure: Basic conditions for moving towards a digital world

23. In developing countries, and the least developed countries in particular, it may not be easy to move towards digital industrialization. Over the last two and a half decades, many countries have been in the process of developing infrastructure for information and communications technology, which is the basic requirement for digitalization. However, the Internet penetration rate, that is, the percentage of the population that uses the Internet, remains low in most developing countries, in particular the least developed countries. In 80 developing countries, the Internet penetration rate is less than 40 per cent, and over half of these countries have a rate that is less than 20 per cent; 24 countries, mainly in Africa and the Pacific, have a rate that is less than 10 per cent.[18] To progress in digitalization, countries should develop digital infrastructure, comprising information and communications technology infrastructure – access, connectivity and affordability – complemented by digital skills, which will help to build data infrastructure.

24. Data intelligence combines layers of data to form big data and transforms this big data into information that generates value, Data infrastructure has therefore gained additional importance in the process of digitalization. This raises questions of how such data can be transformed into economically valuable information, while addressing concerns

[16] See United Nations Industrial Development Organization, 2017, *Industrial Development Report 2018: Demand for Manufacturing – Driving Inclusive and Sustainable Industrial Development* (Vienna).

[17] See R Ubhaykar, 2015, The emerging world of [three-dimensional] printing, *Outlook Business*, 6 March, available at https://www.outlookbusiness.com/the-big-story/lead-story/the-emerging-world-of-3d-printing-590.

[18] UNCTAD, 2017, *Rising Product Digitalization and Losing Trade Competitiveness* (United Nations publication, New York and Geneva). For further discussion on the importance of hard and soft infrastructure in moving towards a digital economy, and cross-country differences along these lines, see *Information Economy Report 2017* and the UNCTAD rapid eTrade readiness assessments.

related to privacy and security. Future trade-related gains and prospects for trade-led development in developing countries will depend on the level of absorption of such technologies and their application to existing industry. To be trade ready in the future, countries will require the skills, knowledge and technical know-how of particular significance to new digital technologies, including among data scientists, robotic process automation engineers and those specialized in particular sectoral technologies. Over time, industrialization as a whole will face transformational pressures to become digitalized. Thus, it is important to develop interdisciplinary skills that combine technical expertise with specific plant management expertise, to run hybrid production systems. Cloud computing infrastructure is also an essential component of this kind of data infrastructure, as it helps in providing remote computing services as a general utility.

25. The value generated from big data is unique and forms the basis of artificial intelligence, leading to the production of unique products and services that are more efficient and less costly to produce and consume. Policy measures in the area of digital infrastructure development therefore need to aim at enhancing such capabilities, as well as at increasing the use, in manufacturing processes, of digital skills and digital infrastructure, namely information and communications technology and cloud computing infrastructure, big data, artificial intelligence and the Internet of things; and of digital services, namely computer programing, information and telecommunications services. The use of digital infrastructure and digital services can enhance the use of digital technologies and automation in the manufacturing processes, increasing their digital content. Remote additive manufacturing and cross-border electronic commerce (e-commerce) are some of the manifestations of digitalized manufacturing processes that boost the trade competitiveness of manufactured products. For example, in 2000–2014, many advanced economies and some developing countries, such as China and India, experienced a more than 100 per cent rise in value addition through digital services in their manufacturing exports.

III. Making industrial policy fit for a digital world

26. As the international community is pursuing achievement of the 2030 Agenda for Sustainable Development, it is imperative to ensure that effective policy instruments are available for countries, to enable them to achieve the Sustainable Development Goals and advance the 2030 Agenda. Theoretical insights, historical evidence and recent experiences point to the importance of proactive industrial policies, yet how to harness such policies in development strategies remains extensively discussed and debated.

27. Developed countries adopted a variety of industrial policies during their periods of industrialization, and continued to do so after the Second World War, in pursuit of economic growth, full employment and technological change. Subsequently, industrial policy was high on the agenda of many developing countries, which saw industrialization as key to achieving economic diversification and structural transformation and to closing the technological gap with developed economies. After the early 1980s, industrial policy was largely absent from the development agenda of many countries, particularly in Africa and Latin America, partly as a reaction to evidence of specific policy mistakes and abuses, but also due to a more ideologically driven debate that emphasized the role of government failures in slow economic development, as well as the need for market liberalization. In several developing economies, debt crises eroded the ability of States to pursue proactive policies. Furthermore, many observers viewed the period of economic stagnation following debt crises as the inevitable outcome of distortions associated with State-led industrialization, rather than as a consequence of deflationary macroeconomic policies and supply-side shocks due to badly designed adjustment programmes.

28. Interest in proactive industrial policies revived around the turn of the millennium for a variety of reasons. First, overwhelming evidence had accumulated that most successful developing countries – notably the newly industrializing economies in East Asia, followed by China – were those that had systemically followed a pragmatic approach to promoting economic diversification and structural transformation through a combination of macroeconomic and structural policies, with measured protectionism and a gradual opening

up to trade and investment, as well as effective collaboration between the public and private sectors. Second, it was increasingly recognized that the policies associated with the Washington Consensus had done little to support economic diversification and structural transformation. Third, mainstream economists began to accept some of the insights on economic development from classical economics, such as the recognition that economic development has a structural dimension, the importance of linkages and learning in accelerating productivity growth and the key role of demand. For these reasons, discussions have moved to a more pragmatic level, and are focused less on whether industrial policies are needed and more on how best to pursue such policies, and the lessons that can be learned and transferred from success stories.

29. Specific policy measures adopted by countries that have succeeded in economic diversification and structural transformation cannot easily be replicated by other countries, not only because individual success stories are invariably linked to particular economic and institutional conditions that are unlikely to exist in other countries, but also because of changes in the extent to which the economic environment at all levels enables and supports economic diversification and structural transformation. At present, one element of the changing dynamics of the world economy that may be crucial for the effectiveness of industrial policies is the digital wave and its impact on production processes and business models. One such impact is that new digital technologies provide increased possibilities for customization in production and for the availability of real-time data on consumption behaviour and its instant transmission through the industrial Internet for design and production decisions. This may make value chains more demand driven and bring both pre-production and production stages closer to end markets. Ownership of and access to data on consumer preferences and behaviour, as well as data analysis skills, will be key determinants of the distribution of value added in such digital value chains. To the extent that knowledge of consumer preferences and behaviour is an intangible in goods production that gives rise to winner-takes-all market structures, new products that match consumer expectations even slightly better than traditional goods can allow new producers to take over an entire market.

30. A range of policy measures could help developing countries play an important role in such increasingly demand-driven value chains. The provision of soft and hard digital infrastructure, such as digitally skilled labour and broadband Internet connectivity, is a basic requirement for people and enterprises to engage successfully in the digital economy. However, merely increasing connectivity might empower already more productive firms and increase the exclusion of other firms. Appropriate competition and antitrust policies should therefore accompany increased digital connectivity. It may also be necessary to explore what bold demand policies could achieve, along with public procurement, public participation in long-term finance, data localization and policies on standards, in order to maximize the benefits to developing countries in the digital economy. Developing countries can reap such benefits only if consumers have the incomes required to turn their preferences into effective demand, without recourse to debt. There is a virtuous circle in the greater emphasis of new digital technologies on customized consumer demand and the greater involvement of developing countries in manufacturing processes that satisfy such demand.

31. International trade and investment agreements increasingly include rules with regard to digitalized economic activities. There remains wide variation in views on these issues. Some hold that adopting negotiated rules at this stage may prevent regulations from arising through practices and patterns of behaviour that may be unduly shaped by firms that are further advanced in the digital economy. Others consider that adopting rules at this stage in this rapidly evolving area is premature and unduly reduces policy space for digital industrial policies. Both positions note, however, that the existing institutional setup of international trade and investment relationships may be ill-equipped for dealing with issues arising from the use of new digital technologies. The debate recognizes that a key element in the distribution of gains from technological change is the return provided to those controlling knowledge and the machines in which knowledge is embodied. With regard to robot-based automation, for example, the countries and firms that produce robots and those that own the intellectual property embodied in them benefit from robotics more than other countries and firms. The available evidence suggests a strong geographic concentration of

returns, mainly in Germany, Japan and the Republic of Korea, as well as the United States, for which, however, no specific data are available.[19] The strong concentration of intellectual property rights in the knowledge that drives the digital revolution could lead to extreme levels of inequality at both national and international levels.

32. To contain this risk at the national level, all countries need appropriate regulatory frameworks to prevent a few often already wealthy firms and individuals from reaping most of the benefits. Moreover, Governments could engage in more than merely helping to fund new technology. They may acquire stakes in the commercialization of successful new technologies, by establishing "professionally managed public venture funds, which would take equity stakes in a large cross-section of new technologies, raising the necessary funds by issuing bonds in financial markets", and could share profits with citizens in the form of a social innovation dividend.[20] In this way, the benefits of high productivity growth from labour-displacing technological changes could be spread more widely and fuel aggregate demand for output from lower productivity sectors, thereby increasing employment and average productivity at the same time.

33. More generally, an important issue with regard to the impact of new digital technologies on the effectiveness of industrial policies is whether such policies can be adapted to a digital world in a similar way as digitalization needs to be mainstreamed across all policy areas, or whether the nature and ambition of industrial policies need to change. Some observers suggest that fundamental societal challenges require public policies and long-term strategic investments that aim to create markets.[21] A case for such a more ambitious shift towards mission-oriented industrial policies could be made with regard to new digital technologies, given the need to use such technologies for transformational purposes in the form of product innovation that creates and shapes new products and new markets in order to compensate for job destruction that may be caused by the process innovation of such technologies. Such a more ambitious shift involves, for example, institutional changes, including in the nature of public–private partnerships, that allow for more participation by public organizations in the rewards of the commercial success of policies, including in order to cover the losses that experimentation and discovery in policymaking may entail. It also involves using more dynamic metrics in policy evaluation, to assess the degree to which public investment has opened up and transformed sectoral and technological landscapes.

IV. South–South and triangular cooperation in the digital economy

34. South–South digital cooperation is urgently required in order to build the competitiveness of the developing world in manufacturing through digital industrial policies. Each country is responsible for building its information and communications technology infrastructure, yet progress in building digital infrastructure is complex and needs to be supported by regional digital cooperation. This can be an additional element in ongoing regional integration processes, in particular in Africa. The first step towards digital cooperation is to build a data economy within a region, from which countries in the region can benefit with regard to the use of big data and the development of artificial intelligence to manufacture digital and/or digitalized products. To build a regional data economy, countries need to have similar national regulations on the ownership and sharing of data and on protecting personal data. A regional strategy on the ownership of data can provide substantial support for national digital industrialization policies.

35. South–South digital cooperation is also required to benefit from cloud computing. Cost savings from cloud computing can only be realized through the significant pooling of configurable computing resources, which can lead to economies of scale and drastically

19 UNCTAD, 2017, *Trade and Development Report 2017*.

20 D Rodrik, 2015, From welfare State to innovation State, *Project Syndicate*, 14 January.

21 See M Mazzucato, 2016, From market fixing to market-creating: A new framework for innovation policy, *Industry and Innovation*, 23(2):140–156.

reduce the cost of using information technology infrastructure.[22] Cloud computing infrastructure, by allowing remote access to computing services, can provide significant benefits to the public and private sectors in a region with regard to cost, flexibility, efficiency and scalability. However, there is a need to build trust in cloud services providers, such as through a code of conduct at the regional level, which should be supported by regional action on cybersecurity.

36. In addition, regional markets may be served more effectively through the use of digital technologies, such as in e-commerce. For e-commerce to expand the market access of manufactured products within a region, uniform regional cross-border e-commerce rules and regulations are required, to govern consumer protection, intellectual property, competition, taxation and information security, including adequate infrastructure to assist digital payments.

37. Uniform rules are also required to tackle unjustified geoblocking. South–South digital cooperation can have an ambitious agenda, and the sequencing and prioritization of elements on the agenda are important and need to be adapted according to the level and pace of digital development of the countries within a region.

38. The developing world can also greatly benefit from triangular cooperation with the North with regard to learning from the experiences in digital industrialization of more advanced economies. Triangular partnerships and collaborations may be forged with advanced countries to strengthen broadband infrastructure in the South and develop smart cities, which rely heavily on digitalization. For example, the European Commission eGovernment Action Plan 2016–2020 demonstrates a way to enable Governments to embrace digital technologies, to make government processes more efficient, transparent and participatory. The European Union digital single market strategy can also provide key learning on a way forward for regional digital cooperation in the South. There may be important learning opportunities for the South in collaborations with the North to design tools and statistics to benchmark digitalization and trace its progress.

V. Issues for discussion

39. Participants at the second session of the Multi-year Expert Meeting on Enhancing the Enabling Economic Environment at All Levels in Support of Inclusive and Sustainable Development, and the Promotion of Economic Integration and Cooperation may wish to discuss the following issues:

(a) What can countries do to foster economic diversification and structural transformation given that new digital technologies are widely expected to undermine the traditional role of manufacturing output and employment in spurring economic development?

(b) What is the best way to create and harness new digital technologies for job creation, economic diversification and structural transformation?

(c) How can industrial policies be adapted to a digital world?

(d) What conditions would enable the use of industrial policies by Governments to harness new digital technologies for their development challenges?

(e) How can South–South and triangular cooperation contribute to economic diversification and structural transformation in a digital world?

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[22] T Alford and GM Morton, 2009, The economics of cloud computing analysed, Sys-Con Media, 26 October, available at http://tedalford.sys-con.com/node/1147473.