Chapter 7

Digital Transformation: ‘Development for All’?

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June 2022

This chapter should be cited as:

Ing, L.Y., G. Grossman and D. Christian (2022), ‘Digital Transformation: ‘Development for All’?’’ in Ing, L.Y. and D. Rodrik (eds.) *New Normal, New Technology, New Financing*, Jakarta: ERIA and IEA, pp.76-88.

Chapter 7

Digital Transformation: 'Development for All'? *

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1. How Digitalisation Has Changed Our Lives

Technological advances over the last two millennia have generated remarkable improvements in the quality of life. But the gains that come with new technologies are rarely shared by all. Notably, we have witnessed in recent years rising income and wealth inequality in most countries, with greater shares accruing to capital owners and highly skilled workers often at the expense of less skilled workers. By 2020, the richest 1% of the world's population owned almost half of global wealth. In the last 2 years alone, the ten highest earners (eight of whom are technological titans) saw their personal incomes more than double, while the poorest 99% of the global population suffered a decline in their collective income during this period (Hardoon, Ayele, and Fuentes-Nieva, 2016; Ahmed et al., 2022). Might there be a connection between technological progress and income and wealth inequality?

Over the past 3 centuries, we have witnessed various technological revolutions that have changed the way we produce goods, organise our business, communicate with one another, and conduct our daily lives. Previous paradigm-changing innovations included the steam engine and the introduction of electric machinery. Now we are in the midst of a digital transformation (DX) that began with the introduction of the digital computer in the early post-war years and extends most recently to the rapid development of industrial robots and artificial intelligence (AI). These advances already have changed the way many goods are produced and many services are delivered. They are undoubtedly responsible for vast increases in income and wealth. Is DX also responsible for the widening gap between rich and poor? Will the recent trends of growing inequality continue? What can the G20 countries do to ensure that most or all citizens benefit from the ongoing technological advances? These are critical questions that confront us today as the digital revolution proceeds apace.

Industrial robots made their first appearance in the 1950s. Since then, deployment has grown exponentially. The rate of new installations worldwide more than doubled from 2012 to 2019, reaching 373,240 per year by the end of that period. The global stock of operational robots increased from 1 million in 2009 to about 2.7 million in 2019.

* The contents are largely based on Chapter 1 Introduction, Robots and AI: A New Economic Era (eds. Lili Yan Ing and Gene M. Grossman, London and New York: Routledge

China, and to a lesser extent Japan, became the fastest new adopters of industrial robots. Together, they contributed almost two-thirds of the global growth in industrial robots from 2012 to 2019 (Stanford University, 2021). The automotive and electronic industries remain the two heaviest users of industrial robots, absorbing between them about 59% of the new sales of industrial robots in 2019 (IFR, 2020).

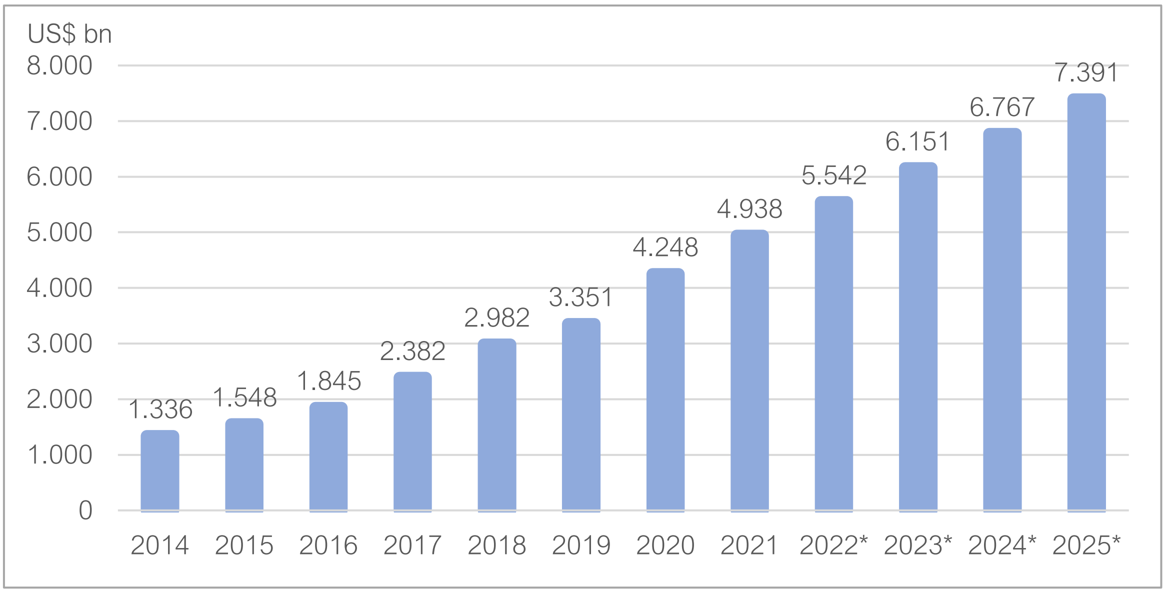
The rapid growth in investment reflects the precipitous decline in prices. The average cost of an industrial robot fell by more than 60% between 2005 and 2017, from US$68,659 to US$27,074. Further price declines to under US$11,000 are expected by 2025 (Ark Invest, 2021). A combination of other factors, such as the increase in robot functionality and flexibility, the improved ease of use and interfaces, and growing awareness of the potential applications of robotic technology are also contributing to the worldwide growth in robot usage (Furman and Seamans, 2019).

Research on AI began in 1956. AI is defined as a non-human system that perceives its environment and takes actions to maximise the probability of achieving its goals. More colloquially, the term AI is used to describe computations that mimic human cognitive functions, such as 'learning' or 'problem solving'. AI has improved massively in the last decade, primarily due to the invention of machine learning techniques that enable computers to have superior predictive power at substantially reduced costs (Agrawal, Gans, and Goldfarb, 2019; Taddy, 2018). Thanks to advances in AI, more responsive and adaptable robots that can better interact with humans, have improved sensory capabilities, and that can better interact with their environment to perform non-routine, uncertain, and more complex tasks, are becoming widely available at ever-lower costs.

Global corporate investment in AI has increased almost sixfold from US$12.7 billion in 2015 to US$67.9 billion in 2020. The United States and China dominate AI investment, with a combined contribution of 76% from 2015 to 2020. However, increased demand for AI-related technologies is being observed across the globe: Brazil, India, Canada, Singapore, and South Africa recorded the fastest growth in AI-related hiring from 2016 to 2020 (Stanford University, 2021). This growth is partly in response to the arrival of a wide range of new technologies, such as Software as a Service (SaaS), robotics, the internet of things (IoT), and virtual reality (VR). Spending on DX of business practices, products, and organisations has continued to grow, even amidst the coronavirus (COVID-19) pandemic. It is estimated that global spending on DX technologies and services grew by 10.4% in 2020 to US$1.3 trillion (IDC, 2022).

DX reduces the cost of sharing information and leads to unprecedented changes, including *what* and *how* we trade (digital trade). The pandemic has accelerated DX, including digital trade. The development of digital trade includes digital payments and digital services delivery. Global retail e-commerce sales in 2020 increased by almost 30% from 2019 levels. In 2020, around 24% of firms received orders online and more than 40% of firms placed orders online (UNCTAD, 2022). Digital trade totalled US$4.9 trillion in 2021 and is projected to reach US$5.5 trillion in 2022 and more than US$10 trillion by 2030 (Statista, 2022).

Figure 7.1: Global Retail E-Commerce Sales, 2014–2025



* Estimated figures.
Source: Statista (2022).

2. DX and Digital Trade: Productivity, Polarisation, and Inequality

2.1. Increasing Productivity

Technological advances raise productivity and drive economic growth. Industrial robots, especially those that apply AI, offer perhaps the greatest scope for technological improvement and productivity gain in the modern industrial era. Robots can increase the speed and precision of industrial processes while making them safer and more reliable. They leverage workers' time, while freeing humans to engage in more conceptual and interpersonal tasks. AI can be used to enhance the quality and variety of products available to consumers, provide new forms of entertainment, and offer solutions to pressing medical and environment problems. Clearly, the potential for robots and AI to improve the quality of life is boundless.

The application of industrial robots and AI brings potential gains of two sorts. First, these technologies reduce production and operational costs. Robots can perform many tasks faster and with much greater precision than humans. AI can be employed to predict problems along the production line and to leverage computation as an input to production, resulting in an optimised production process at reduced cost. Second, and perhaps less obvious, industrial robots and AI can help markets to function more efficiently. AI can be used to learn about human preferences and to allocate goods and services from where they are most readily available to where they are most needed, which in turn leads to enhanced efficiency in logistics and delivery.

2.2. Labour Market Polarisation

Despite their roles in improving productivity, the adoption of industrial robots, automation, and AI has potential concerning implications for employment and wages, especially for less skilled workers performing routine tasks that can be replaced by machines. Baldwin (2019) estimated that one to six out of every 10 jobs is at risk of being replaced by robots in the coming two decades. The estimates vary across countries, ranging from 36% for Finland (Pajarinen and Rouvinen, 2014), 47% for Germany (Brzeski and Burk, 2015), and 47% for the United States (Frey and Osborne, 2013), to as high as 60% globally (Bughin et al., 2017).

While the digital transformation raises productivity and promotes trade, it could potentially generate labour market polarisation and inequality in both developed and developing countries.

Empirical research suggests that increased diffusion of advanced technologies (particularly computerisation and automation) has led to greater labour market polarisation (i.e., job polarisation) in various countries and contexts (Autor, Levy, and Murnane, 2003; Autor, Katz, and Kearney, 2006; Cavenaile, 2021; Harrigan, Reshef, and Toubal, 2021).[1] Technological diffusion creates labour-displacement effects, whereby capital and technology take over tasks previously performed by human labour. At the same time, rising automation seems to have contributed to the decline in the share of labour in value added (Grossman and Oberfield, 2022). Less skilled workers are most at risk of job displacements by robots and AI. The polarisation of the labour market due to automation is also mirrored to some extent in firm dynamics. Recent firm-level studies show widening gaps in productivity between frontier firms and so-called laggard firms (Calvino and Criscuolo, 2017; OECD, 2015; United Nations, 2017).

In developing countries and least developed countries (LDCs), there is a growing concern that greater adoption of skill-intensive technologies will spell a decline in terms of trade in as much as these countries export labour-intensive goods and services. This could potentially exacerbate a phenomenon of premature deindustrialisation whereby DX accelerates the disappearance of manual and routine jobs. Substantial evidence points to the effects that skill-intensive technologies such as robots and AI have on the comparative advantage of trading nations. Korinek, Schindler, Stiglitz (2021) argue, in this vein, that labour-saving technologies and AI will harm the terms of trade of developing countries and erode their comparative advantage in labour-intensive products, especially if it is based on cheap and unskilled labour.

We know that innovation in advanced countries often responds to factor prices there and may result in technologies that are not appropriate for developing nations, with their ample supplies of less skilled labour. Innovation in advanced countries arises in response to their specific circumstances and challenges, which are starkly different from those of developing countries. For example, innovation in seeds and pesticides in advanced countries with particular geographic features might not be applicable for the problems facing developing countries with their different geographies.

[1] However, to date, no robust and direct evidence exists that labour market polarisation *causes* a slowdown in technology diffusion to other firms in the economy.

Given the difference in capital availability between advanced countries and developing countries, productivity-enhancing technologies that rely heavily on capital investments might be of little use and may even be counterproductive in developing countries (Atkinson and Stiglitz, 1969; Basu and Weil, 1998; Stewart, 1987). Acemoglu and Zilibotti (2001) further argue that the technologies used in many LDCs have been designed to make optimal use of the skills available in developed countries. If developing countries lack these skills, there can be a technology-human capital mismatch. Even when there is equal access to the new technologies, the mismatch can lead to a sizeable difference in productivity and output per worker in different parts of the world. While international technological cooperation and diffusion should still generally be encouraged, the research findings serve as a reminder of the need to identify appropriate technologies that can be tailored to the circumstances in developing countries.

2.3. Rising Inequality

The adoption of industrial robots, automation, and AI is likely to have heterogeneous effects on the labour market in developed and developing countries. On the one hand, high-skilled workers employed in technology-intensive sectors and workers performing non-routine tasks may benefit as industrial robots leverage their inputs. On the other hand, workers with less education, especially those performing manual tasks on the production line, are most at risk.

Despite mixed evidence about the net effects of greater adoption of industrial robots and AI on certain segments of the labour market, there is no lack of consensus about the distributional implications of these technologies. Automation has undoubtedly contributed to the decline in the labour share of national income. Amongst workers, workers whose skills are complementary to the new technologies experience greater gains than less skilled workers, who stand to be displaced by industrial robots. The new occupations and tasks that AI will create will also likely benefit the more skilled and better educated members of the labour force. These likely effects of new technologies associated with DX come on the heels of more than 2 decades of wage divergence and threaten to increase the social tensions that the greater dispersion has already ignited.

In the absence of appropriate policies, we cannot always count on the private sector to strike the socially desirable balance in its technological choices, as labour-displacing technologies are in many circumstances preferred to labour-augmenting technologies for at least four reasons. First, innovation creates externalities that are unaddressed by markets. Second, businesses and large tech companies tend to focus on automation and eliminating the fallible human element from production processes. Third, the current policy stance on the use of capital relative to labour (i.e., subsidy on capital and tax on labour) generally distorts firms' technological decisions. Fourth, new technologies might require some critical complementary inputs that may not be currently accessible for some firms. Without appropriate policy intervention to deal with these perils, technological innovation and automation might contribute to wider inequality amongst workers and firms.

3. Key Challenges in DX and Digital Trade

In addition to concerns about inequality and the possibly adverse effects of new digital technologies on the least skilled, we face several other important challenges from DX and digital trade. One challenge relates to privacy. The fact that private individual information and data are exposed to services providers, including pervasive exchange of data, has fuelled concerns about the possible misuse of personal data.

A second challenge is cybersecurity. The expansion of rapid digitalisation and increased use of data by businesses and consumers for communication, digital trade, and as a source of access to information and innovation, comes with increased threats against data, against systems, and against people.

A third challenge relates to competition. Technological advancement, particularly digital technology, enables firms to produce and operate with massive economies of scale, creating opportunities for ‘superstar firms’ that are best able to make the investments. The advantage the technologies give to the largest firms potentially contributes to increased market concentration. In turn, higher concentration often reduce competition, raises markups, and can be a barrier to entry for micro, small, and medium-sized enterprises (MSMEs) and start-ups. Safeguarding competition in the digital era is, therefore, more important than ever before.

The fourth challenge concerns digital divide. Digitalised systems and digitally deliverable goods and services still account for lower shares of total trade in low- and middle-income countries than in other parts of the world. For example, only 2% of the population in low-income countries conducted digital trade in 2019 (UNCTAD, 2022). Countries, firms, and individuals vary greatly in their readiness for digital trade depending on their education, skills, and infrastructure. Bridging the digital divide is key to realising DX benefits in an inclusive manner.

4. Conclusions and Policy Recommendations

Industrial robots, automation, and AI have increased productivity and lowered production costs for many goods. These technologies offer tremendous potential to help realise the benefits of globalisation for otherwise left-behind groups, particularly MSMEs and geographically difficult-to-reach communities. Although these technologies sometimes substitute for less skilled labour in performing certain tasks, research shows that the induced productivity gains and associated expansion in output of firms that adopt the new technologies may more than offset the direct negative effects on less skilled workers. Furthermore, automation and AI can encourage greater international division of labour in global value chains and promote trade in AI-enabled services. But, as with all new technologies, there will be adjustment costs that policymakers must manage.

Despite the great potential offered by the new technologies, there are currently no comprehensive multilateral frameworks or principles for the conduct of innovations, business operations, and digital trade in goods and services;[2] or for dealing with privacy, cybersecurity, and the digital divide. The G20 provides an effective forum to resolve issues arising from automation and to

[2] The digital trade issue has only been discussed in bilateral or plurilateral fora while negotiating recent free trade agreements such as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and the United States–Mexico–Canada Agreement (USMCA).

ensure the best use of it. Along with the development of robots and AI, it is our responsibility to ensure that these technologies are human-centric and designed to generate shared improvements in human welfare. We can identify four important dimensions of the challenges posed by DX that the G20 might seek to address during Indonesia's presidency of the group.

First, the G20 should implement what it has already committed to in the fields of industrial robots, automation, and AI.[3] Instead of developing new work programmes, the G20 might start by following up on prior commitments and identify specific actions that would make the commitments workable. This includes (i) cooperation and support for digitalisation enablers, comprising the development of digital infrastructure and connectivity; (ii) protection of data privacy and the mitigation of digitalisation risks from a consumer protection standpoint; and (iii) the development of mapping and statistical measurement of the digital economy.

Second, to reduce the adoption cost of industrial robots, automation, and AI for businesses especially in the developing world, and to make these technologies commercially viable there, G20 members should cooperate to promote incentives for technological adoption by developing countries. This year, the G20 should update the Examples of National Policies to Advance the G20 AI Principles developed under Saudi Arabia's presidency. In addition, the G20 should continue to accelerate the implementation of global corporate tax reform. Such reform would end the race-to-the-bottom in corporate taxation and potentially help developing countries to receive more foreign direct investment, which may then contribute to their wider adoption of robots and AI technology. Of course, such incentives should be put under a broader supportive innovation and competition policy environment for thriving AI. This calls for better cooperation amongst G20 countries in providing incentives for the adoption of good technologies for developing countries.

Third, the G20 should improve the quality of key digital enablers for the adoption of industrial robots, automation, and AI. This includes digital infrastructure and the necessary technologies (i.e., electricity, broadband, cloud computing, big data, blockchain, IoT, 3D printing, and virtual interaction or production). Furthermore, the G20 should continue to develop a framework to address security and privacy issues. This is a fundamental and crucial enabler for wider adoption of industrial robots, automation, and AI since the development and deployment of robotic technology and AI feed on a massive amount of data transfer and exchange. From a technological perspective, the G20 should continue to strengthen international cooperation, particularly with respect to regulatory policy, the development of an international standard for responsible and trustworthy industrial robots, automation and AI technologies, research and development, and a framework on how to expand trade rules to accommodate robotics and AI technology standards (Kerry et al., 2021). This requires G20 commitments to ensure digital inclusiveness for all.

[3] This includes the G20 Leaders' recognition of the digitalisation wave and adoption of the G20 New Industrial Revolution Action Plan (2016), G20 Roadmap for Digitalisation (2017), G20 Menu of Policy Options for the Future of Work (2018), G20 Repository of Digital Policies (2018), G20 AI Principles (2019), G20 Examples of National Policies to Advance the G20 AI Principles (2020), G20 Roadmap Toward a Common Framework for Measuring the Digital Economy (2020), Policy Options to Support Digitalization of Business Models During COVID-19 (2020), G20 Policy Examples on How to Enhance the Adoption of AI by MSMEs and Start-Ups (2021), and G20 Menu of Policy Options on Digital Transformation and Productivity Recovery (2021).

Finally, we must recognise that the job of implementing and adapting to the massive changes that go along with digital transformation falls on *human capital*. Digital transformation is ultimately a people issue. The G20 should continue to promote efforts to improve preparedness for digital and AI technologies, both amongst the workforce and firms (especially MSMEs, women, and youth) to reduce the digital divide and to promote more inclusive digital participation. We can start by endorsing the implementation of the G20 Policy Examples on How to Enhance the Adoption of AI by MSMEs and Start-ups (G20, 2021). This involves promoting knowledge sharing and mutual learning to accelerate the implementation of industrial robots, automation, and AI for business resiliency. It is crucial for the G20 to further facilitate partnership between the private and public sectors to raise the pool of funds that can be used to reduce digital gaps and improve digital skills worldwide to ensure 'development for all'.

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