FROM DIGITAL DIVIDE TO DIGITAL DISPLACEMENT: RECONSIDERING THE FUTURE OF WORK IN DEVELOPING COUNTRIES

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INTRODUCTION

Two decades ago, in a monograph on the "Digital Divide", the eminent political scientist Pippa Norris (2001) wondered about the impact of digital technologies on the developing world. Would digitisation be a boon or a bane for the Global South? Norris saw the landscape of opinions split between optimists and pessimists. First, she laid out arguments for digitisation leading to a deepening of global inequality, citing a range of reasons for why "the emerging Internet age may reinforce disparities between post-industrial economies at the core of the network and developing societies at the periphery" (ibid). If digitisation increases economic productivity, she argued, then countries of the Global North may be better placed to mobilise the necessary investment, thus widening the global technological gap. Poorer societies, in turn, might "fail to catch up" (ibid). Concerns like these were echoed by the Organisation for Economic Co-operation and Development (OECD 1999) and the United Nations Development Programme (UNDP 1999) at the time.

Norris went on to examine a set of optimistic counter arguments. If technology diffused into the economic periphery, great opportunities could ensue, among them faster economic growth, global integration and exchange, and democratization. The Internet "may allow societies to leapfrog stages of technological and industrial development" (Norris 2001: 7) and may foster cultural developments like the emergence of a global civil society and a mass-educated public. The latter idea became central to the 'One Laptop per Child' initiative, which promoted computers in the developing world in the hope to revolutionize education.[1] Norris further pointed to the cross-country statistical relationship between Internet use and Gross Domestic Product (GDP) per capita, which suggested that digitisation and development go in lockstep.

Today, two decades after the publication of 'Digital Divide', digital technologies are no longer in their 'adolescence', as Norris considered them to be. The share of Internet users has increased to roughly 50 % of the world population compared to under 7 % at the turn of the millennium (World Bank 2020). Dot.com-startups like Amazon and Google have grown into multinational enterprises with billions of dollars in market capitalization and hundreds of thousands of employees. A variety of labour-saving digital technologies from spreadsheet software to automatic ticket vending to self-checkout machines are now taken for granted at the workplace and in public life. In the meantime, the Internet and mobile phones have diffused into even the remotest areas of the world. In developing countries from Burkina Faso to Bangladesh more than 90 % of the population have a mobile cellular subscription nowadays (ibid.). Digital technology is pervasive throughout an ever-increasing range of economic activities from commerce to education to medicine and the COVID-19 pandemic has done its part to further accelerate this trend by ushering in tele work, videoconferencing, distant learning and other digitally mediated forms of social interaction.

So, what has become of Norris's concern about the impact of digitisation on the developing world? Have optimists or pessimists been correct? This paper revisits the debate and advances two arguments: First, the promise of technology diffusion has to some extent materialized – in some respects even drastically so. Technology use, even technology leadership, is no longer unconditionally confined to high-income OECD countries; leapfrogging has happened in some domains. Despite global diffusion, inequalities do, however, persist both within and across societies and new gaps have opened.

Second, the concern about unequal *access* to technology ("digital divide") is giving way to a concern about adverse effects of *exposure* to technology. In particular, the rapidly changing nature of work, has brought to the forefront worries about the redundancy of human labour ("digital displacement"). Optimists argue that exposure to new technology is complementary to human work; that such technology brings productivity gains; and that

it creatively disrupts obsolete businesses. Skeptics, in contrast, implicate technology in wage stagnation and a falling labour share, the spread of irregular forms of work and adverse structural employment change. Technology discourse thus remains as polarised as twenty years ago – or, indeed, as ever since mechanization commenced with the Industrial Revolution (see e.g. Mokyr et al. 2015).

The remainder of the article is structured as follows. Section 2 gives an overview of recent trends in digitisation in the developing world with a focus on the digital economy. Section 3 considers the impacts of catch-up digitisation for structural employment change and wage development, the structure of trade and economic development pathways. Section 4 concludes.

CATCH-UP DIGITISATION

The developing world has caught up in the use of digital technology. China alone now has twice as many Internet users – defined as individuals who used the Internet in the last three months – than all countries of the European Union combined.[2] In Latin American countries, typically one half to two-thirds of the population use the Internet at least occasionally; in India it is about a third of the population. Africa has lower rates of Internet use – from under 10 % in Central Africa to around 50 % in South and North Africa. While broadband cable Internet and fixed landlines are relatively scarce, mobile phones are widespread also on the African continent, with mobile phone penetration rates in countries of South and West Africa of close to 100 % of the population. In Latin America and Asia, the number of mobile phone subscriptions even surpasses that of the population due to multiple subscriptions per head.

Phone ownership has also brought about a revolution in digital money transfers. In 2018, 400 million registered mobile money accounts existed in Sub-Saharan Africa, making it the region with the largest number of such accounts (GSMA 2020). Mobile money services allow convenient transfers and payments via mobile phone. The mobile money service best known in Africa is M-Pesa, which caters to 20 million users, according to company reports (see Bateman in this volume for a critical discussion of M-Pesa and the fintech trend). Safaricom, the network operator providing M-Pesa, is currently one of the most profitable companies on the continent.

At the same time as digital communication technologies have spread around the world, there is an increasing uptake in labour-saving digital and robotic technologies, particularly in Asia. The International Federation of Robotics (IFR) reports that Asia is currently the "strongest growth market" in a "significant rise in demand for industrial robots worldwide" (IFR 2016: 11). A double-digit growth trend includes not only established industrial powerhouses like China, Korea, and Japan but also emerging economies in South East Asia. The IFR estimates that by 2019, more than 250,000 units of multipurpose industrial robots will be installed in Asia on a yearly basis, with the main industries driving demand in robots in the automotive, electrical/electronics, metal, and machinery, as well as the rubber and plastics industries. In some domains of both service and industrial automation, emerging economies are even leading ahead of OECD countries, as the opening of Beijing's first driverless subway line in 2017 illustrates (Yan 2017).

Some features of digital service automation familiar from high-income economies, are also dispersing into the Global South, following a logic of 'Late Development, Early Adoption' (see Schlogl 2020). Multinational chains like McDonald's and Burger King have rolled out their novel e-kiosk ordering system to cities like Bangkok or Jakarta, where one can now order food via a touchscreen just like in fast-food restaurants in London or New York. The platform-based 'gig economy' is also well under way in Southeast Asia. Indicative of this trend is the rise of Gojek, an on-demand multi-service platform company with 170 million users in the region. Alongside its core business of app-based taxi services, Gojek now offers an 'e-wallet' digital payment service, on-demand delivery of food, groceries and goods (including medical deliveries), online ticket sales, an app-based courier and cleaning service, and video streaming.

Consider also, indicatively, the recent spread of automatic tolling systems in a number of South and Southeast Asian countries. The handling of payments on toll roads provides the kinds of labour-intensive, manually repetitive, low-skilled jobs which tend to be at risk of technological displacement. In Indonesia an automated toll-booth system with contactless charge cards was rolled out on a nationwide scale by the state-owned road operator in 2017. Formerly each toll gate had required several employees working in shifts to ensure road toll was checked. Now, a cashless system runs virtually without human operators. This has placed a question mark over

20,000 jobs, according to media reports, coinciding with an announcement by the Indonesian Minister of Finance that automation could create a case for a future universal basic income in Indonesia. However, to this date, the toll road operator has not carried out any mass layoffs (see Schlogl/Sumner 2020 for a more detailed discussion).

The current COVID-19 pandemic is further accelerating some of the long-term developments in catch-up digitisation. China illustrates this: not only are robots and drones used in pandemic control; Chinese firms have rushed to automate due to staff shortages and public health regulations. In the current crisis, humans are vulnerable while machines are immune. Kaushik Basu, the World Bank's former chief economist, therefore warns that COVID-19 causes a "technological shift" which could further weaken the bargaining power of labour (Arirang News 2020). Those working in low-skilled, automatable routine jobs with regular customer contact – from checkout operators to ticket sellers – are at additional risk of losing their job due to tighter public health regulations of face-to-face interactions. The COVID-19 crisis is thus forcing the automation of interpersonal services which have long been considered a safe refuge for low-skilled human labour.

While the adoption of technology is thus growing globally, the design and production of such technology remains highly concentrated. Friederici, Wahome and Graham (2020: 74) consider Africa to be "far behind the rest of the world in digital production" and argue that divides in this regard "are growing further and further, even if growth is happening". In recent years, only around 5 % of manufactured exports from Sub-Saharan Africa were high-technology exports compared to around 20 % from upper-middle and high-income economies. The latter two country groups currently account for practically all worldwide patent applications as well as journal articles in science and engineering. The most competent R&D (Research and Development) technicians are currently attracted by high-income tech hubs tied to world-class universities – a model which is hard to replicate as success depends on economies of scale and scope, skills complementarity, network effects, and a history of technical learning. Without a notable semi-conductor and electronics industry, technology adoption in the developing world, especially in Africa, retains a somewhat consumptive nature. This includes the success story of mobile phone penetration: production of phones is dominated by Asian manufacturers and it is only very recently that companies like the Rwanda-based Mara Group have rolled out smartphones 'made in Africa'.

In sum, digital catch up has unfolded at an increased pace in recent years, which will likely continue. There have been signs of convergence and leapfrogging in technology adoption. While this means that the digital divide has narrowed in some respects (e.g. regarding mobile phone and Internet penetration), the unequal race of technological innovation has certainly not come to a halt and productive capabilities remain very limited in low-income economies. New forms of stratification are emerging around the speed of Internet access (e.g. 5G networks) but also across regions within the developing world. Artificial intelligence, technology patents and the control of critical server infrastructure are key to industrial development as well as to military capability. New frontiers like quantum computing are predicted to become commercially viable, with R&D concentrated in the United States, Europe and China. Though developing countries thus have not "failed to catch up" altogether, new divides are opening up as old ones are closing. Technological divides and dependencies not only persist between the non-Western world and OECD countries, but also between Asia and Africa.

WORK IN THE AGE OF DIGITAL DISPLACEMENT

A research group at the University of Oxford recently conducted a survey of experts on low- or middle-income countries including government officials, researchers and members of international organisations (Phillips et al. 2020). The survey polled respondents about the policy priorities for developing countries in the digital era. The top priority, that emerged from the survey, was "jobs and skills" – trumping issues of privacy, technological infrastructure, cybersecurity, intellectual property and other concerns. In short, the labour-market impact of technological change is salient to the development policy community.

Labour market economists conceptualise technological change as the "introduction of new products and production techniques as well as changes in technology that serve to reduce the cost of capital (for example, increases in the speed of computers)" (Ehrenberg/Smith 2012: 116). Technology expands the possibilities of production, i.e. it increases the productive output for a given set of inputs. Viewed through a labour-market lens, technological change is another term for gains in factor productivity. The employment impact of technological change

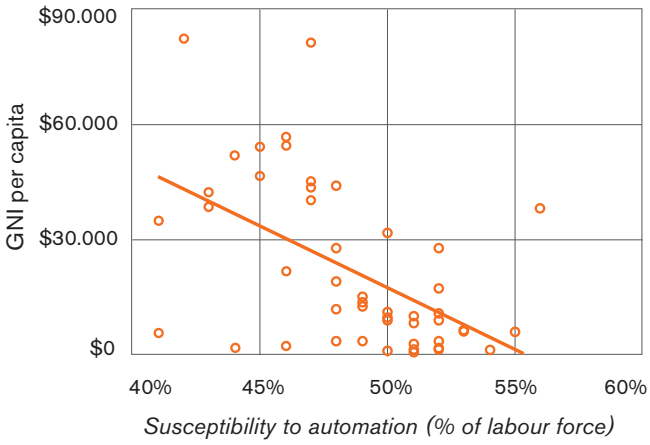
can be either 'substitutive' or 'complementary' to human labour depending on the skills mix of labour. Technological change thus brings with it shifts in skills demands and changes in the remuneration of different skills. With a view to developing economies, digitisation and automation raise a set of questions, among them: (i) questions about *job creation*: how can developing economies generate quality employment in sufficient quantity? (ii) questions about *income distribution*: who benefits how much from productivity gains?, and (iii) questions about *development pathways*: what implications and requirements do new technologies have in terms of industrialisation, trade and the interplay of economic sectors?

Modern thinking on automation and digitisation can crudely be split into an optimistic and a pessimistic camp. Optimists stress that 'modern economic growth' (Kuznets 1966) is driven by disruptive innovation and the 'creative destruction' of jobs (Schumpeter 1943). Optimists usually concede that specific, exposed segments of the labour market can end up on the losing end of technological modernisation. Yet, the emphasis remains on the *net* benefits in the *long-term* and in the *aggregate*. Pessimists, on the other hand, worry either about the labour market impact of future technologies (e.g. Artificial Intelligence), which might depart from historical experience; or they are concerned about the historical/existing socio-economic impacts of technological change. In regard to the latter, income concentration and labour market polarisation, uneven regional development, premature deindustrialisation, irregular work arrangements and a backlash against innovation or globalization, are issues which are often raised. The optimistic and pessimistic camps overlap to some extent with neoclassical (or neo-Schumpeterian) schools, on the one hand, and heterodox (e.g. institutionalist or developmentalist) schools on the other hand (for a review see Schlogl/Sumner 2020). The following sections bring together selected evidence and arguments from both the pessimistic and the optimistic camps.

AUTOMATABILITY, DEINDUSTRIALISATION, AND "DISRUPTED DEVELOPMENT"

First, mounting evidence suggests that the majority of labour susceptible to automation is located in the developing world (see Figure A). Though recent empirical studies have focused on high-income countries where high-quality labour market data is available (e.g., Frey/Osborne 2013), some estimates have been replicated for countries of the Global South. In a comparative perspective, these suggest a linear negative relationship between the level of development and the share of automatable work: the poorer a country, the more jobs are susceptible to automation. The reason for this is a greater proportion of agricultural and manual work in developing economies (see Schlogl/Sumner 2020).[3] Due to lower capital use, even the *same* occupations are more routine-intensive in developing countries than in high-income economies (Lewandowski/Park/Schotte 2020).

Figure A: Automatability and Level of Development (GNI per capita)



Source: Author's calculations based on World Bank (2020) and McKinsey Global Institute (2017)

Following Schlogl and Sumner (2020), we can picture a developing economy undergoing technological change by borrowing W. A. Lewis' idea of a 'dual economy'. In the Lewis (1954) model, a transfer of unproductive labour from the traditional/rural to the modern/urban sector takes place during the process of development. In the digital age, we can picture a dual economy divided up into an automation-prone sector, which consists of jobs that are easy to perform by machines, and an automation-resistant sector, which consists of jobs that are hard to perform by machines. The former, for instance, includes manual and cognitive routine tasks like lifting, drilling, data entry and so forth and the latter includes creative work involving face-to-face interaction, among other tasks. Schlogl and Sumner (2020), with reference to the Lewis model of economic development, posit that automation creates 'unlimited supplies of artificial labour' in the automation-prone sector or a 'robot reserve army'. This reserve army gradually push-

es the labour force from the automation-prone sector into the automation-resistant sector in a process that could be called 'digital displacement'.

What is the effect of such digital displacement? According to Schlogl and Sumner (2000), the typical result, rather than technological unemployment, is a novel, technology-driven form of structural change. Automation acts as a supply shock which reduces wages in the automation-prone sector where machines substitute humans. If the cost of automated production falls below the reservation wage of workers, a labour surplus is created. Automation thus frees up resources for the completion of non-automatable work, which tends to be located in the service sector. The surplus can either be absorbed by the automation-resistant sector or, in case that is not possible, can lead to technological un(der)employment. Like in the Lewis model, the functional distribution of income changes in favour of capital owners. In other words, the 'robot reserve army', which in a globalised economy may be stationed overseas, limits the bargaining power and nominal wages of labour. It does so both in the automation-prone sector, where workers face competition from a robot reserve army, and in the automation-resistant (predominantly service-based) sector, where workers face competition from digitally displaced surplus labour. Even the capacity alone to deploy robots might exert a downward pressure on wages.

We should note that digital and automation technologies are rarely directly labour-displacing in the sense of mass lay-offs. If they are displacing, then in the form of a reduced intake of labour in a given profession and so-called 'jobless growth' (see e.g. Jaimovich/Siu 2018). Further, as mentioned above, technological change also goes hand in hand with rising employment in the automation-resistant sector where complementarities exist. The key question for developing economies is, though, about the capacity for high-quality employment generation in the automation-resistant sector – relative to the automation-prone sector and to historical experience; and about the implications for income distribution.

This is where pessimists' concerns become relevant. Consider, for instance, that today's tech companies like Google or Amazon employ considerably fewer workers for a dollar of output then did Ford or General Motors during the heydays of American manufacturing while ranking similarly on the Fortune 500 list of largest US corporations by revenue (Madrigal 2017). Similarly, the aforementioned African network operator Safaricom, which is the provider of the M-Pesa mobile payment system, only employs about 6,500 workers and generated a revenue of close to 2 billion € in 2019. Compare this to a relatively low-tech business like retail: The South African supermarket chain Pick n Pay reports an annual revenue roughly twice that of Safaricom but employs an eight-fold labour force of over 50,000 people. M-Pesa disrupts the traditional banking sector (Muhatia 2019; Ngugi/Komo 2017) while offering relatively few jobs – this is, of course, the very point of a digital labour-saving technology.

A concern related to this is that automation pushes labour into a low-skilled, low-productivity – typically informal – service sector including professions like street vending, domestic work or taxi services. These professions are not automatable yet, but it is debatable if they offer high-quality decently paid work for a large labour force. Least-developed countries, in particular, do not offer the necessary skills and training programmes or job matching infrastructure to make a smooth transition from digitally displaced jobs into high-quality automation-resistant work plausible. A further concern is the concentration of economic benefits from automation among capital owners. Guerriero (2019) finds a global trend for the labour share of income, i.e. the part of GDP captured by wages, to have fallen since the mid-1980s – a trend, which has been associated with automation (Schwellnus et al. 2018). A falling labour share of income increases economic inequality and lowers social mobility.

RESHORING

A related issue, which attracts increasing scholarly interest, is the impact of digital and automation technologies on the structure of trade and its employment effects. In their seminal book *The Second Machine Age*, Brynjolfsson and McAfee (2014: 184)[3] argued that the "biggest effect of automation is likely to be on workers not in America (…) but rather in developing nations that currently rely on low-cost labour for their competitive advantage". They reasoned, that "off-shoring is often only a way station on the road to automation" (ibid.). In a recent talk on the future of work, the economic historian Robert Skidelsky, similarly speculated, that "we may have reached peak globalization" because of automation.[4] The impact of robots, Skidelsky warned, "would be a very substantial reduction in supply chain trade" and an overall falling trade share (for an in-depth discussion see Avent 2017).

To what extent reshoring is a threat to developing economies, remains empirically contested. Baldwin (2016: 283) argues in contrast to the aforementioned concerned voices that the future of globalization allows workers from low-income countries "to offer their labour services in advanced economies without actually being there". The negative impact on jobs in developed, rather than developing, countries "could be shocking", according to Baldwin. He argues that Information and Communication Technology (ICT) and trade costs will continue to fall, enabling communication and face-to-face interaction across a distance, and thus fostering telepresence and tele-robotics. Empirically, there is some evidence supporting the idea that automation technologies benefit developing countries' trade. Banga (2019) finds for India that manufacturing firms by expanding their digital capabilities managed to upgrade their product portfolio, making it more sophisticated and thus more internationally competitive. Artuc et al. (2018), based on a theoretical model, find that an increase in the adoption of robots in high-income countries leads to a rise of imports in intermediate goods from developing countries and a rise of exports of manufactured final goods to developing countries. They predict moderate gains in real wages and in welfare in the Global South as consumer prices of final goods drop and demand for developing country exports rises. Caraballo and Jiang (2016), on the other hand, find that there is a "value added erosion" for countries which become integrated into the lower-stream parts of global value chains (GVCs) while "high value-adding activities [are] performed by foreign lead firms in the upper stream of the GVCs". In a more recent empirical paper, Artuc et al. (2019) find that robotisation in the US lowered growth in exports from Mexico to the US, which is in tension with the optimistic theoretically-modelled predictions of Artuc et al. (2018).

The current COVID-19 pandemic could add fuel to the reshoring dynamic, as the crisis has laid bare risks of the global division of labour to high-income economies. A dwindling capacity in Europe to produce basic medical supplies from ventilators to protective equipment led to temporary shortages during the pandemic, which may have eroded trust in economic interdependence. Calls in developed countries for the national self-sufficiency of key industries are a likely result and could add fuel to the technologically driven reshoring trend.

PRODUCTIVITY, POSTINDUSTRIALISATION, AND LOW ENTRY COST

We have, so far, discussed a set of risks of catch-up digitisation for employment in the developing world. There are, of course, important opportunities, too, associated with adopting digital technology. These include

i) productivity gains and a fall in production costs and thus – potentially – a rise in real wages. Automation can help make an economy more inclusive by providing cheaper and more widespread access to goods and services. M-Pesa again serves to illustrate this: mobile money systems require no formal bank account and give people easy and affordable access to financial services (see Bateman in this volume for further discussion). A reduction in the prices of consumer goods and durables could compensate digitally displaced workers for nominal wage stagnation.

   Technological upgrading is, however, no guarantee for falling prices. If markets are uncompetitive, a fall in nominal wages means higher returns to capital ownership rather than low-cost consumption. Carlos Slim, the chairman of Mexico's quasi-monopolistic Telecommunications provider Telmex, long ranked as the world's richest person – profiting from technological progress combined with concentrated market power (see e.g. OECD 2012 on the "excessive pricing" of Internet services in Mexico). Oil production provides a further example for a highly automated capital-intensive industry with concentrated profits. Examples of politically entangled cartels, private monopolies and ineffective antitrust regulation are numerous throughout the developing world. The result is that productivity gains from technological change often get distributed unequally.

ii) The trend towards post-industrialisation, which automation and digitisation stimulate, could provide healthier and greener jobs than other development pathways. Work in the extractive and agricultural sectors, still prevalent in the developing world, is often tedious and dangerous with workplace injuries and detrimental long-term health effects in the mining sector and beyond well documented. To the extent that catch-up digitisation makes 'industries without smokestacks' possible (see Newfarmer/Page/Finn 2018), this promises an expansion of white-collar

work. Tourism is one labour-intensive and automation-resistant sector that some developing countries have developed in recent years, which offers relatively decent jobs.

iii) Digital growth models potentially offer job creation at low entry costs and with easy access to global markets. China's e-commerce company Alibaba demonstrates how a developing-country multinational can penetrate global markets, competing with giants like Amazon. The example of Indonesia's Gojek further shows that, to put it bluntly, a group of software engineers plus a fleet of motorcycles, can add up to a business valued at a double-digit billion-dollar figure. The capital necessary in the automotive sector dwarfs such investment. Again, Gojek employs only 3,000 people directly, a fraction of what, for instance, an automotive business of the same valuation would employ. It should be noted, though, that Gojek depends on goods provided by the automotive industry (motorcycles), the oil industry (fuel), the electronics industry (mobile devices) as well as other sectors.

Digital opportunities do not offer themselves to all economies in the developing world in equal measure. As Parschau and Hauge (2020: 2) point out, particularly in the manufacturing sector there remain many "industry-specific conditions/barriers to implementing automation technologies" in developing countries. Technology opportunities can be seized by stable countries with a critical mass of skilled labour, effective supply chains and a somewhat functioning capital market. Countries experiencing basic problems with the operation of political and economic institutions, as is more common in least-developed and post-conflict contexts, struggle with establishing basic technological capabilities in the first place. For them, the absence of digital catch-up poses more of a problem than any 'robot reserve army'.

CONCLUSION

The point of departure of this article was Norris' (2001) concern about the impact of the digital technology on developing countries. It was shown that the much-discussed 'digital divide' has closed in some respects thanks to catch-up digitisation and technological leapfrogging. The COVID-19 crisis is further accelerating a trend towards robotization and digitisation by pushing tele-work, distant learning, the platform economy and other digitally mediated economic activities. Concerns about unequal access and deprivation from technology are now partially superseded by concerns about exposure to technology and in particular about digital displacement of human labour. Analogous to earlier iterations of technology discourse, the thinking on technology exposure remains split into an optimist and a pessimist camp. The digital economy offers low entry costs to some developing countries with a critical mass of appropriately skilled labour; it offers decent and high-productivity white-collar jobs and, potentially, a drop of price levels if a competitive market exists. However, there are risks of low job creation and of adverse structural changes. Wage pressures and labour market polarisation as well as the long-term threat of reshoring are also among the challenges of technological transformation.

Catch-up digitisation also raises questions about the sequencing of development pathways. According to an optimistic consensus in parts of the policy-prescriptive literature, the diffusion of cutting-edge technology into developing countries is a win-win situation. Historically, this idea can be traced back to economic historian Alexander Gerschenkron (1951) who argued that a lack of industrialisation could be an advantage as it allows countries to skip stages in the development process by borrowing foreign technology. Arguments in that vein are seeing a revival in the flourishing discourse on technological leapfrogging (e.g. jumping straight into M-Pesa's mobile-phone-based e-payment systems without first building an ATM infrastructure).

This article raised some concerns over the benefits of a leapfrogging strategy. It was discussed how the impact of technologically disruptive structural change depends on labour absorption in the automation-resistant sector. Along with deindustrialisation, developing countries face an 'import' of wage stagnation and polarisation characteristic of the skills-biased labour markets in high-income countries. In contrast to the latter, developing countries, however, lack the social safety infrastructure insuring the labour force against the inevitable economic risks of digital displacement.

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1 'One Laptop per Child' (OLPC) was an ambitious non-profit project, initiated by the founder of the Massachusetts Institute of Technology (MIT) Media lab, Nicholas Negroponte, in 2005. Its goal was to distribute to children in developing countries low-cost portable computers specifically designed to be used in schools. OLPC was supported at the time by major tech companies including Google. Due to higher than expected costs and limited demand from developing country governments, the OLPC project shut down in 2014, having sold a few hundred thousand laptops. For a critical review see Warschauer and Ames (2010).

2 The estimates cited in this section are based on the World Development Indicators database (World Bank 2020). They are originally provided by the International Telecommunications Union (ITU).

3 According to one line of argument, first advanced by Autor et al. (2003), automation leads to a 'polarisation' of the labour market. Polarisation means that mid-skilled jobs such as clerical routine tasks have the greatest potential for computerization while both low-skilled and high-skilled jobs are less structured and thus less automatable. There is, to date, not enough data on the task content of occupations in developing countries to assess whether this kind of polarization applies to the developing world (see Lewandowski et al. 2020). What is clear, however, is that many jobs exist in developing countries which have long been automated in OECD countries, particularly jobs related to farming. Further, both the level and quality of tertiary education in the developing world are drastically lower casting doubt on whether high-skilled non-automatable jobs exist in any sizeable quantity. Regardless of whether polarization exists, the available evidence suggests that more jobs in developing countries are automatable with existing technology.

4 In a public lecture on "Technology and Utopia" given by Robert Skidelsky on 12 June 2019 at the Institute for Advanced Studies, Vienna.