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Policy Brief

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Overview

Automation, digitisation and other new technologies that are shaping the future of work have begun to catch the interest of scholars of economic development. This policy brief discusses a set of key issues and debates in this area and highlights selected recent empirical contributions.

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Automation, Industrialisation and Development

Automation, digitisation and other new technologies, which shape the future of work, have begun to catch the interest of scholars of economic development. If the economies and labour markets of high-income countries are being 'disrupted' at an unprecedented pace, what technological ramifications should the developing world be preparing for?

Concerns about the replacement of labour by machinery are not new. Mokyr *et al.*. (2015) document that 'technological anxiety', meaning worries about displacing or destabilising effects of new technologies, has been a persistent social phenomenon since the Industrial Revolution (see also Frey 2019). A look into the economic history books further suggests that mechanisation and automation have been at the heart of the scholarly debate on economic development since the economic classics, including seminal contributions by Ricardo, Marx, Keynes, Schumpeter and Leontief to name but a few.

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 and Smith 2012, 116). Economists understand technology as an expansion of the possibilities of production, i.e. a catalyst increasing output for a given set of inputs. Viewed through that lens, technological change is thus another word for gains in factor productivity. The employment impact of such change is typically considered to be either (net) substitutive or (net) complementary to human labour and is associated with shifts in skills demands and changes in the income distribution.

With a view to developing economies, automation raises a set of related questions, among them: (i) questions about job creation: how can developing economies generate quality employment in the age of automation? How many and what kinds of jobs are emerging? (ii) Questions about income distribution: who benefits how much from productivity gains? (iii) Questions about development pathways: what implications do new technologies have for industrialisation, trade and the differential growth of economic sectors? (iv) Questions about politics and policy:

what optimal policy options are there? What social protection infrastructure is required? What political knock-on effects for democracy, inclusiveness and political stability does automation have?

Is Automation Good or Bad for Development?

Modern thinking on automation can crudely be split into an optimistic camp and a pessimistic camp. Optimists stress that 'modern economic growth' (Kuznets 1966) is inherently driven by disruptive innovation and the 'creative destruction' (Schumpeter 1943) of jobs. Optimists usually concede that specifically 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 future – and thus speculative – prospects of new technologies (AI, 3D printing, Industry 4.0, etc.) or are critical of the historical track record of technological change in terms of its socio-economic impacts. Frequently income concentration and polarisation, uneven regional development, deindustrialisation, irregular work arrangements and a backlash against innovation or globalisation, are issues addressed in this context.

The optimistic and pessimistic camps overlap to some extent with neoclassical (or neo-Schumpeterian) schools, on the one hand and so-called 'heterodox' (e.g. institutionalist or developmentalist) schools on the other hand (for a review see Schlogl and Sumner 2020). Gollin (2018, 3), in a neoclassical vein, argues that "growth theory and empirics are relatively agnostic as to the sectoral pathways of development", which would imply that sectoral biases of technology should not per se be a cause for concern. In some contrast, Rodrik (2018) argues, that "new technologies present a double whammy to low-income countries": first, they are biased towards high skills and thus reduce the low-cost and low-skill labour advantage of developing countries; second, developing countries are integrated into GVCs, which make it harder to compete via a low-skill advantage. Rodrik aruges that, on balance, the disadvantages offset the advantages for developing economies on the path to industrialisation.

Recent empirical studies have largely focused on the labour markets in high-income countries where high-quality labour market data is available (e.g. Acemoglu and Autor 2011; Acemoglu and Restrepo 2017; Autor and Dorn 2013; Autor, Katz, and Kearney 2004; Frey and Osborne 2013). Some of this research has, though, been replicated in or extrapolated to countries of the Global South.

Two general, stylised findings with regard to the developing world can be summed up as follows: the extent of automation, measured e.g. by the incidence of industrial robots, is higher in more economically advanced economies (see Figure 1). And the jobs that are principally susceptible to automation in light of existing technological capabilities are predominantly located in developing countries (see Figure 2).

From Offshoring to Reshoring?

One issue, which has received particular scholarly interest, is international trade. In their seminal book The Second Machine Age, Brynjolfsson and McAfee (2014, 184)‖ argued that the

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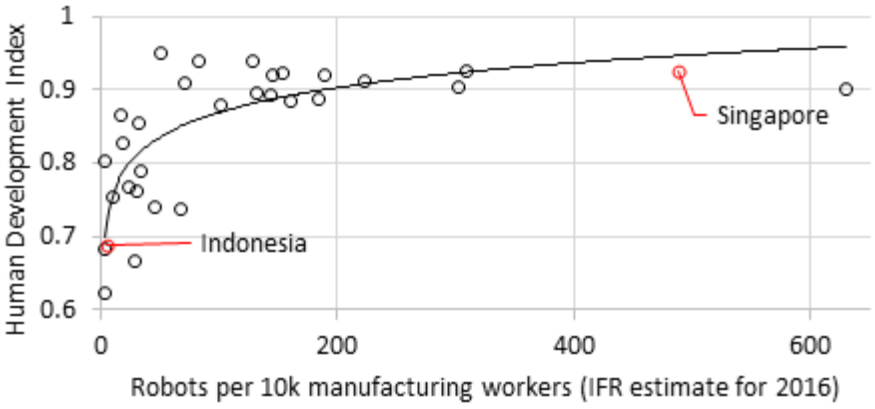
"biggest effect of automation is likely to be on workers not in America (…) but rather in developing nations that currently rely on low-cost labor for their competitive advantage". They reasoned that "off-shoring is often only a way station on the road to automation" (*ibid.*).

In a recent talk on the future of work, the economic historian Robert Skidelsky openly speculated that "we may have reached peak globalisation" because of automation (2). The impact of robots, Skidelsky argued, "would be a very substantial reduction in supply chain trade" and an overall falling trade share. Avent (2017) is similarly concerned with the risk of 'reshoring', meaning the return of off-shored processes to OECD countries. Adidas' Speedfactory, which, until recently, used to produce millions of 3D-printed shoes in the US and Germany rather than in Vietnam or India, has often been cited as an example of this trend.

To what extent reshoring is a plausible threat to developing economies remains controversial. In a forward-looking view, Baldwin (2016, 283) argues in contrast that the future of globalisation allows people from low-income countries "to offer their labor services in advanced economies without actually being there" and that the negative impact on jobs in developed, rather than developing, countries "could be shocking". He argues that ICT and trade costs will continue to fall, enabling communication and face-to-face interaction over distance and thus fostering telepresence and tele-robotics.

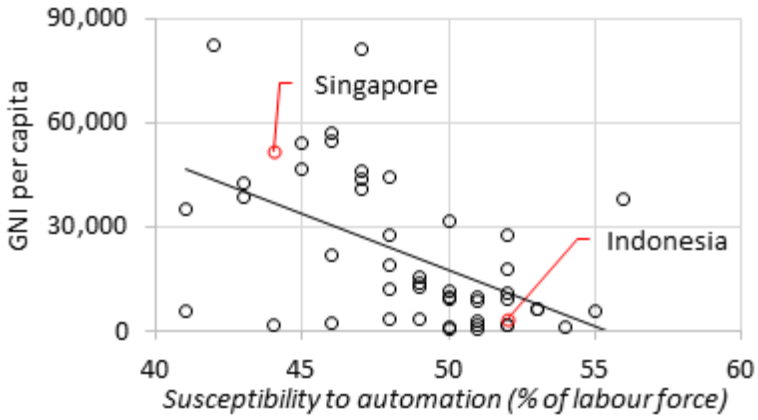
Empirically, there is some evidence suggesting that automation technologies could benefit developing countries. Banga (2019) argues for India that manufacturing firms by expanding their digital capabilities managed to upgrade their product portfolio, making it more sophisticated and thus more internationally competitive. Artuc *et al.* (2018) argue,

Figure 1. Robot Density and the Level of Development (HDI)



Source: Author's calculations based on UNDP and IFR data

Figure 2. Automatability and Level of Development (GNI per capita)



Source: Author's calculations based on World Bank and McKinsey data

Automation and Development: A Primer

In a new monograph, Schlogl and Sumner (2020) examine the future of inequality, work and wages in the age of automation with a focus on developing countries. The authors argue that the rise of a global 'robot reserve army' has profound effects on labour markets and economic development, but, rather than causing mass unemployment, new technologies are more likely to lead to stagnant wages and premature deindustrialisation. The book illuminates the debate on the impact of automation upon economic development, in particular issues of poverty, inequality and work. It highlights public policy responses and strategies – ranging from 'containment' to 'coping' mechanisms — to confront the effects of automation.

based on a task-based Ricardian model 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. For the South, Artuc *et al.*. predict moderate gains in real wages and welfare as consumer prices of final goods drop and demand for developing country exports rises. Moreover, regarding the case of Adidas' famous Speedfactory, the company has recently decided to relocate, for logistical reasons, its automated production back to Asia – a case of 're-offshoring', so to speak. Hallward-Driemeier and Nayyar (2019), who pick up this example, find that robotisation in HICs has generally been associated with growing greenfield foreign direct investment (FDI) to developing countries.

Caraballo and Jiang (2016), on the other hand, find empirically that there is a "value added erosion" for countries getting integrated into the lower-stream parts of GVCs while "high value-adding activities [are] performed by foreign lead firms in the upper stream of the GVCs". Further, in a more recent empirical paper, Artuc *et al.*. (2019) find that robotisation in the US lowers growth in exports from Mexico to the US, somewhat contradicting the optimistic modelled predictions of Artuc *et al.*. (2018). Empirically, Guerriero (2019) also finds a global trend for the labour share of income to have fallen since the mid-1980s – a trend associated with automation (Schwellnus *et al.*. 2018).

Leapfrogging or Prematurity?

In the 1950s, the economic historian Alexander Gerschenkron (1951) posited that a country's 'economic backwardness', i.e. its relative lack of industrialisation, could in some respects be an advantage. By importing modern technologies from leading industrialised countries and investing in cutting-edge machinery and equipment, 'late comers' to the development process could skip stages of modernisa-

tion that previous scholars like Rostow had deemed necessary in the path to economic development. This should allow late-developing economies to generate faster and more capital-intensive industrial growth, unhindered by societal constraints or a strong dirigiste state (for a recent discussion see Mathews 2006).

jumping straight into mobile-phone-based e-payment systems without first building an ATM infrastructure) can be heard across the board of international development organisations. However, systematic empirical evidence on this developmental asynchronicity remains scarce.

"The idea that less developed countries could reap the benefits of 'skipping' certain stages in technological progress... can be heard across the board of international development organisations."

Gerschenkron's thesis about the supposed benefits of backwardness for catch-up development has been a subject of debate ever since. Empirically, his original research focused on the newly-industrialised countries in Eastern Europe and Russia, which the data of the time matched. Later research on economic convergence, in contrast, has long struggled to find much evidence in support of (unconditional) economic convergence (e.g. Pritchett 1997). China's rapid industrial catch-up thanks in part to aggressive borrowing and copying of foreign technologies, on the other hand, might lend some credibility to Gerschenkron's optimistic thesis. The neoclassical standard theory of growth, the Solow-Swan model, also suggests faster growth potential during catch-up than at the technological frontier.

Arguments in the vein of Gerschenkron are currently seeing a revival with a flourishing discourse on technological 'leapfrogging'. The idea that less developed countries could reap the benefits of 'skipping' certain stages in technological progress (e.g.

Automation and digitisation thus also raise fundamental questions about the appropriate sequencing and stages of development pathways. That borrowing foreign-developed cutting-edge technology is advantageous for economic development always and everywhere is an emerging consensus that will need to face empirical scrutiny going forward.

Footnotes

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

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Recent empirical contributions

An international workshop on the 'Future of Industrial Work' co-organised by UNU-MERIT and held in September 2019 in Vienna discussed new research on automation and development. Below are some highlights:

Alonso *et al.* (2019) put forward a divergence hypothesis about the global ramifications of automation. They develop a two-region model with three factors of production (labour, capital and robots) and show that, under assumptions of labour substitution, robotisation can lead to a drop in output levels in developing economies despite higher productivity as well as to an overall divergence in income levels between advanced and developing economies.

Domini *et al.* (2019) explore employment dynamics followed by spikes in investment in automation-intensive goods. They take data from French manufacturing firms over the period 2002-2015 and analyse the relationship between imports of intermediates embedding automation technology and flows of workers. The authors find that spikes in automation adoption are positively correlated with growth in employment in these firms, with little difference between various types of workers. The authors thus consider technological change to be 'labour friendly' in the affected firms.

Beverelli *et al.* (2019) study exposure to automation, Global Value Chains (GVCs) and Chinese import competition as drivers of US labour market polarisation, i.e. an increase in the share of both high-wage and low-wage jobs at the expense of middle-paid jobs. They explore trade-related shocks to local labour markets, based on the source of value added and find that employment polarisation is predominantly driven by exposure to automation. Trade, on the other hand, has a similar, but overall weaker polarising effect.

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INSIDE:

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