Brief for GSDR – 2016 Update

Automation and artificial intelligence – what could it mean for sustainable development?

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Introduction

Concern about the societal implications of automation is nothing new. The textile workers destroying looms in nineteenth century England provided the label – Luddites – for persons regarded as being against technological progress. From the novel *Frankenstein* to the film *2001: A space odyssey*, popular culture has warned of intelligent machines turning against their makers. More recently academic studies and books have variously examined the potential of intelligent machines to disrupt labour markets (Brinjolfsson & McAfee, 2011; Frey & Osborne, 2013; Ford, 2015), re-define social interaction and relations (Carr, 2014), and even detailed, serious-minded study of its potential threat to human existence (Bostrom, 2014).

Automation is of course nothing new; robots have been appearing on assembly lines for decades. The current wave of automation benefits from the ubiquity of cheap computing power, pushing software into new areas, such as language and image processing. One effect is that white collar occupations, unaffected by the hulking, prototypical industrial robot, may become vulnerable to automation by a new generation of machines.

While this brief addresses the potential consequences of automation and artificial intelligence on employment, there are of course also widespread implications for other areas. So the expansion of computing and machine intelligence is likely to affect healthcare, education, privacy and cybersecurity, and energy and environmental management. Already access to cheap bandwidth is changing how learning takes place, seen in the availability of various online learning platforms, such as massive open online courses (MOOCs); as technology advances, not only how, but also what is learnt may also change. In a future where more capable machines can carry an ever greater share of routine tasks, learning that stimulates conceptual and creative capacities would appear increasingly relevant. This could imply an education system shifting from a focus on mathematics and reading to a different set of personal and intellectual skills that facilitate working in tandem with intelligent machines (Brinjolfsson & McAfee, 2014).

A sensor-driven world – the "internet of things" – also holds considerable potential to improve efficiency in a range of process, thus promoting environmental sustainability. On the other hand, ubiquitous data-gathering and storage from social media profiles through to commercial data, raises concerns about privacy. Cybersecurity is also regularly identified as a key area of risk (UBS, 2015).

The impact of automatization is being felt primarily in developed economies. Going forward, it may be that the greater deployment of computers, coupled with other changes in production methods, such as 3D printing, may invert the competitive advantage that emerging markets have had in the form of low-cost labour (UBS, 2016).

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Scientific debate

The debate around the impact of advanced computing on jobs has several strands. The concern that technology would outpace the ability of the economy to absorb labour has long pedigree (Keynes, 1930). One side essentially takes the view that this time it is different: the present and coming wave of artificial intelligence – unlike the industrial, electric and digital revolutions that preceded it - will displace humans faster than we can adapt, through the acquisition of new skills and education (Brynjolfsson and McAfee, 2011; Frey & Osborne, 2013). The robots are going to win the race. On the other hand, there are those who, while perhaps a little less impressed by the march of technology, seek to emphasise that the introduction of technologies – even disruptive ones – tends to lead to aggregate growth in employment, as the economy adjusts and demand is created in new sectors (Autor, 2015). While admittedly there is no guarantee that this relationship will hold for ever, its proponents can point to a strong track record.

There is also a line of thinking, advanced by Gordon, that the unprecedented economic growth and attendant improvement in living standards was a once-off effect of the second industrial revolution, centred around electricity, internal combustion engine, running water, indoor toilets, communications, entertainment, chemicals, and petroleum (Gordon, 2012; Gordon, 2016).

It is worth considering an underlying reason why aggregate employment remains stable, even as sectors are disrupted and replace by new ones. Suppose that the human want for new things – goods or services – is essentially unlimited. The desire for new products drives technological innovation. Taking it further, more technology leads to yet more new possibilities for products and services, entailing as yet unfathomed employment possibilities for workers. Taking it to the level of a thought experiment, imagine that the expansion in consumption possibilities is driven by intelligent machines, which produce like skilled workers but do not consume. The resulting breakdown in demand would disrupt the process of labour absorption.

The following sub-sections seek to capture in summary form selected points in a complex debate.

Substitution and complementarity: Automation does substitute for labour, but it also complements labour and raises output in ways that lead to a higher demand for labour (Autor, 2015). Examining the U.S. labour market, Bessen argues that computers have not been replacing workers on net; instead, workers using computers are substituting for other workers (2015). The expansion in high-skill employment can be explained by the falling price of carrying out routine tasks by means of computers, which complements more abstract and creative services (Frey & Osborne, 2013). Autor argues that experts and others fail consider the impact of complementarity (2015). If it is true that workers are in a race against technology, the question is how long education can keep giving them an edge.

Susceptibility to automation: If jobs as understood as a collection of tasks, some will be more susceptible to being broken down into explicit routines, which can be codified and performed by algorithms or robots, in the case of manual occupations (Autor et al, 2003). This reasoning is supported by the decline in jobs distinguished by well-defined tasks, for instance in manufacturing. By this analysis, jobs with a high share of tasks involving judgement, creativity and persuasion, which are not easily quantified and codifies, are less suitable for automation. At the other end of the skill spectrum, jobs requiring visual and language recognition, adaptability and in-person interactions, are also not susceptible to automation (Autor et al, 2003). In their analysis of jobs susceptible to computerization, Frey and Osborne Hence, concluded that while new developments in the fields of computing and big date will enable many non-routine tasks to be automated, the same is not true for jobs that "…involve complex perception and manipulation tasks, creative intelligence tasks, and social intelligence tasks" (2013, 27).

Polarization of the labour market: Automation changes the types of employment, with significant dislocation in some sectors – a discernible trend is the so-called polarization, with job gains disproportionately going to high-skilled and low-skilled workers, coupled with a hollowing-out of routine middle-income jobs (Goos & Manning, 2007). Autor points out that the polarization documented across occupations is not unique to the United States, with comparable findings for 16 European Union countries (2015). Managerial, professional and technical occupations have benefited from computerization – the surge of technology into their workplaces has complemented the work of those engaged in abstract jobs, with less time on acquiring and calculation and more time on interpretation and application (Autor, 2015). Workers in these abstract-intensive occupations have made wage gains due to: (a) the combination of complementarity of information technology with these occupations, (b) an elastic (growing) demand for their services, e.g. healthcare, and (c) a relatively inelastic (scarce) labour supply. The same has not been true for workers in occupations that are intensive in manual skills, which are only weakly complimented by computerization, do not benefit from a rising demand, and where there is a relatively large labour pool.

It needs to be recognized that the dynamics of employment are also influenced by globalization and trade agreements (Capaldo et al, 2016). Given that capital is highly mobile, but labour is not, employment in tradable sectors can be eroded by unfavourable terms of trade. Polarization and other odd forms of segmentation of the work force could be an effect of the production structure of the economy and the pattern of trade.

Redistribution: The dislocation caused by rapid technological change will pose challenges for social and political systems, in order to ensure that the benefits to society do not exacerbate existing levels of inequality. Automation will continue to put downward pressure on the wages of the low skilled and is starting to impinge on the employment prospects of middle-skilled workers. By contrast, the potential returns to highly skilled and more adaptable workers are increasing.

Issues for consideration by policymakers

A key question posed is whether the task model will hold true for the future, in the face of improvements in computing power, rendering even non-routine task as subject to computerization. Some are more confident that computers will acquire the ability to perform non-routine tasks (Frey & Osborne, 2013; Brynjolfsson & McAfee, 2011), than others (Autor, 2015). Often left out of the debate is the question whether society will – or should – opt for computerization, even if it is technically feasible.

Ultimately, the likelihood that a job will in the future be automated depends on: (a) certain attributes of a job, such as whether it entails creativity or persuasion; (b) the capability of technology, in other words the degree to which machines acquire or can mimic human intelligence; and (c) social and cultural norms. So, for while we may be willing to scan our purchases at the grocery store, we may prefer to chat with a barista when ordering a coffee, or have a human take our blood pressure and explain the implications of a medical diagnosis, even if the diagnosis itself was arrived at by a machine, with sign-off only from a human hand, akin to situation in which computers largely fly today's jetliners, with the pilots assuming control for take-off and landing (Carr, 2014).

The future of automation is difficult to predict, as is society's willingness to guide and steer its adoption. Given these uncertainties, some of the issues that should be considered by policymakers could include: strengthening social protection systems; implementing education policies that foster the skills required for a flexible, computer-literate work force; policies that promote shifting the labour force from low to higher skilled jobs, with enhanced retraining and safety nets for workers adversely affected by trade agreements; and policies that promote investment in R&D, fostering innovation in developed countries and emulation in developing counties.

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