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No automation please, we're British: technology and the prospects for work

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Abstract

This paper assesses the impact and likely limits of automation. It looks, in particular, at the case of the UK economy. The prospects for automation are seen as necessarily uncertain and potentially regressive in their effects, with technology likely to sustain a large number of low quality jobs. The deep-seated problems of the UK economy – low investment, low productivity, and low real wages – are seen as key impediments to forms of automation that work for all in society. It is argued that, without wider institutional reform, the UK will be unable to reap the full potential of automation.

Keywords: automation, robots, work, investment, technology

JEL classifications: O33, J81, J88

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1. Introduction

Debate on the nature, impact and potential of automation has recurred in social and economic thought through time (see Autor, 2015; Mokyr et al., 2015). Different, often conflicting, responses to automation have been expressed. While some authors and activists have worried deeply about the job-destroying effects of automation, others have seen in the latter the potential to gain liberation from work (see Srnicek and Williams, 2015). The Luddites, at one extreme, smashed machines out of fear of losing their jobs through the introduction of new machinery. For the Luddites, the loss of their jobs – and with it their livelihoods – in the short-run eclipsed any potential longer-term benefit from technology in the form of higher growth and higher real wages. Key economic thinkers such as Marx and Keynes, from a different standpoint, have seen in automation the possibility for a future of greater free time, without any compromise in material living standards (see Spencer, 2018; Mokyr et al., 2015). While holding to radically different ideological perspectives, both Marx and Keynes believed that a better future for society depended on the harnessing of technology and the automation of work. The broader vision of a superior automated future –

one based on less work and more free time – has continued to inspire generations of scholars as well as reformers.

In economics, automation has been linked to widening inequality as opposed to liberation in society. In response to evidence of declining job and wage prospects of low-skilled workers in late twentieth century industrialised economies, economists identified a skill-bias to technological change. It was argued that automation was replacing low-skilled human labour but complementing and raising demand and wages for high skill workers (see Berman et al., 1998). This, in turn, evolved into a more nuanced view that modern, computer-based technology was 'polarising' labour markets with jobs growth concentrated at both the high and low skill ends, due to technology hitting middle skill, routine jobs the hardest (Autor et al., 2006; Goos and Manning, 2007).

In more recent years, concern has focused on the potential for technology to wipe out jobs across the skill and wage spectrum (Brynjolfsson and McAfee, 2014; Turner, 2018). Rapid and seemingly unstoppable progress in new digital technology, it is claimed, could make deep inroads into the labour market, destroying jobs with high skill as well as low skill. The prospect for the 'end of work', in this context, is taken seriously. Once again views on the consequences of automation have diverged. For techno-pessimists, the fear is of rising joblessness and with it, greater inequality (Ford, 2015). Luddite-like concerns of job displacement have been revived

in modern debate and used to paint a bleak picture of a 'world without work' (see Thompson, 2015). Techno-optimists, by contrast, take the view that automation should be encouraged – and indeed accelerated – in the pursuit of a world of greater leisure and freedom. Indeed, for some modern radical writers, advances in technology present the possibility for a 'post-work' world, wherein humanity lives better, without work (Srnicek and Williams, 2015).

This paper intervenes in the modern debate on automation. It so does by considering the possibilities for – and likely barriers to – the automation of work. Focusing in particular on the example of the UK, it is argued that the debate on automation raises certain paradoxes and contradictions. The most obvious is the persistence of paid work – despite all the talk of jobs disappearing through automation, employment remains high in capitalist economies. Indeed, in the UK, the employment rate now stands at record levels (ONS 2019A), this in spite of huge technological transformations in society over recent decades (Haldane, 2015). Average hours of work in the UK, while lower than in previous decades, remain amongst the highest in Europe for full-time employees (Skidelsky, 2019). UK workers are also working harder, faster and to shorter deadlines than in the past (Felstead and Green, 2017). In addition, data – to be addressed further below – show how low skill and low paid work continues to dominate in the UK economy. While UK workers have suffered economic hardships in recent years (see

Coulter, 2016), this reflects more the decisions of policy-makers – particularly the embrace of austerity policies in the wake of the global financial crisis – than the effects of new forms of automation. In particular, the squeeze on public spending has been a drag on investment and growth in the economy, inhibiting both productivity and real wage growth (Clarke et al., 2017; Bell and Blanchflower, 2018).

The pressing issue for the UK at present is not the shortage of jobs, driven by automation, but instead the inability of the economy to generate higher pay and improved job quality. Two points can be stressed here. One is the tendency for technology to add to the volume of work in society. The other is the tendency for technology to erode the quality of work. While UK workers may not face an imminent threat of technological unemployment, the prospect that technology will impair the quality of their jobs is real. Beyond the hyperbolic rhetoric about 'robots taking all the jobs' (BBC, 2014; Elliott, 2017; Daily Mail, 2019), it is argued below that there is a more sober picture of paid work persisting, but on terms that are less favourable for many workers. The key story here is how lower paid and lower quality work is reproduced, and potentially entrenched, alongside technological progress.

The paper also highlights the importance of considering the context in which automation is occurring. The UK has long-standing structural barriers to investment (Michie and Kitson, 1996). At one level, this highlights the

fact that the UK lacks the dynamic forces that would likely be needed in the drive to mass automation. UK manufacturing, for example, remains a laggard in the use of robots (see IRF 2018a). At another level, a tendency towards low skill, low productivity employment in the UK suggests that, to the extent that automation does develop, opportunities to use technological advancement to reconfigure job tasks and reformulate occupations in a progressive way may be missed. Some existing, narrowly focused jobs may well be rendered as obsolete in the UK, given their existing focus on routine, low skill tasks but, in many others, there is the risk that technological advance means that human labour will become an even more tightly controlled, deskilled adjunct to largely automated processes rather than disappear completely. Again in the latter case, jobs may remain plentiful, but with low skill and poor prospects for workers. Indeed, data to be presented below show how – despite claims of exponential growth in the capabilities of new technology – many millions of UK workers continue to be employed in low skilled and low paid work.

Given this context, it is argued that the UK will have to embrace deep-seated structural reforms if it is to harness technology in progressive ways. The hope for a better future of work remains, though not without significant change in prevailing institutions within the UK.

The paper has six sections. Section 2 addresses some key aspects of the modern debate on automation. Section 3 offers criticisms of the above

debate by exploring limitations in current projections and, more broadly, the limits to automation. Section 4 focuses on the UK, highlighting the barriers to investment and hence automation in the UK economy. Section 5 considers possible policy interventions. Section 6 concludes.

2. Technology, automation and the loss of employment

There is an established debate in economics that suggests advances in technology are 'hollowing out' the labour market (see Autor, 2015; Goos and Manning, 2007). Key to this debate is the idea that the impact of computerised technology depends on the nature of jobs. Where jobs are dominated by routine cognitive or manual processes, computers and robots are able to substitute for human labour. By contrast, where jobs are rich in non-routine cognitive activity, computers form productivity-enhancing complements providing analysis and information to aid and assist decision-making, problem-solving and communication. Empirical studies have shown how, in recent decades, technology has been biased against routine, middle-skill jobs (see Autor et al., 2006). These include jobs in services as well as in manufacturing. Bank tellers, for example, have declined through the evolution of, first, cash machines, and latterly, online banking. Administrative roles relating to record-keeping have similarly diminished whilst production line and picking jobs in manufacturing and distribution have also increasingly been replaced by robots. However, technology is not able to substitute for non-routine, manual-focused jobs such as hair-

dressing, care work or catering and, along with high skill roles, some of these low skill jobs have also seen an increase in recent years (see data in Section 4, below). Hence technology has impacted mostly on jobs in the middle of the income distribution. The removal of these jobs, in turn, has fuelled greater inequality (see Goos and Manning, 2007). Studies like that of Goos and Manning (2007) confirm the fact that the labour market is becoming more divided, with the growth of 'lousy' jobs at the bottom and the growth of 'lovely' jobs at the top, with computer-based technology a fundamental driving force.

More recently, concern has been rising that technology is reaching a point where jobs in general are at risk from automation. Developments in robotics and artificial intelligence (AI) are at the point, it is said, where they will be able to substitute for many non-routine, cognitive as well as manual activities, threatening jobs of all skill levels (see Brynjolfsson and McAfee, 2014; Ford, 2015). Academic research, as we discuss below, remains somewhat circumspect on the potential number of job losses; however, as noted above, this circumspection has not stopped hyperbolic headlines in the media about the possible extinction of work as we know it (e.g. BBC, 2014; Elliott, 2017; *Daily Mail*, 2019). Notions of the 'Second Machine Age' (Brynjolfsson and McAfee, 2014) and the 'Fourth Industrial Revolution' (Schwab, 2016), indeed, have fuelled a broader anxiety that society is

entering a world where human workers, regardless of their skills, will be surplus to requirement.

An oft-cited example of the automation potential is that of driverless cars. Once thought of as impossible, driverless cars are now being tested on public roads and their wider use in the future threatens to replace many driving-based jobs, from truck driver to taxi driver (see Harris and Ennis, 2016). AI technologies capable of diagnosing diseases and writing news articles also threaten to take some middle-class jobs in health and journalism, respectively, and some roles within the legal profession are at risk of replacement by algorithms (Susskind and Susskind, 2015). Within low-skilled occupations in retail and catering, which might otherwise be thought to be relatively insulated from technological advances due to their non-routine elements, it is noted that self-checkout systems and automated food ordering services are already reducing jobs and their wide use will lead to further job losses in the future (West, 2018). There is even the possibility for robots (aka 'carebots') to replace some caring jobs (Donnelly, 2018). The possibilities for automation, in short, are viewed as seemingly boundless (see Turner, 2018).

The loss of jobs, it is recognised, will create hardship in society. If those left behind by technology cannot find alternative sources of income, then levels of poverty will likely increase, with potentially destabilising effects on economy and society (Ford, 2015). The loss of paid work will also present

social and personal costs. In a society that gives value to work and where dignity comes from performing work, automation can be expected to undermine the quality of life in general.

There is also the threat posed by automation to levels of inequality in society. As noted above, technological progress has itself been linked to higher inequality in capitalist economies (Autor, 2015). Some now predict the evolution of a 'winner takes all' society, with a minority elite gaining from the ownership of technology, at the expense of an increasingly impoverished majority (Brynjolfsson and McAfee, 2014). Such a scenario, in turn, is seen to present the danger of social breakdown and even disorder (Ford, 2015).

Wider interest in the topic of robots and the future of work has been encouraged by various empirical studies predicting the automation of a large number of jobs in the near future. Frey and Osborne (2017), in a highly cited study, state that 47 per cent of all existing jobs in the US are at high risk of automation in the next two decades. This headline number, while heavily caveated in the original article (see below), has been repeated countless times in the printed and online media (see e.g. BBC, 2015). In the UK, it has been estimated that 15 million jobs could disappear through automation, a similar proportion to Osborne and Frey's estimate for the US (Haldane, 2015). Further, a World Bank (2016) study suggests that up to 60

per cent of jobs in the OECD are under threat from automation in coming years.

These estimates are not without controversy. A key issue is the methodology used to arrive at automation risk, and within that, how the impact of computerisation and automation on jobs is conceptualised (see ONS (2019B) for a brief review). Accordingly, as explored in more detail below, estimates of potential job losses from automation vary widely between studies, with no clear consensus emerging.

The potential for automation has elicited different responses at a policy level. Brynjolfsson and McAfee (2014), for instance, advocate policies designed to augment the skills of workers. If workers can up-skill through better education and training, they will be better placed to complement the intelligent machines of the future. Others such as Ford (2015), who see the decline in jobs as highly likely even with improved investment in human capital, support a 'basic income guarantee'. The latter will ensure that people have access to income when jobs disappear. Finally, radical commentators such as Srnicek and Williams (2015) support a programme of 'full automation'. These writers favour an industrial policy that accelerates the move to a 'post-capitalist' future, in which work is abolished.

These different policy responses, however, share a common assumption, namely that, on a broad spectrum, jobs are at risk and liable to decline in the

future. The question is not if jobs will reduce, but when and in what number (see Turner, 2018). This assumption, however, can be contested. As argued in the next section, there are strong reasons to believe that the evolution of automation is not pre-ordained and that important countervailing pressures need to be considered, together with the institutional context. On this reading, mass employment will persist into the future, despite – and even because of – continued rapid technological progress.

3. The limits to automation

The idea that modern technological developments present a high risk of large-scale job losses and mass unemployment is based on some critical assumptions. It assumes, for example, that jobs will disappear in greater numbers than those that are created. This would suggest a reversal in the historical trend towards employment growth within capitalist economies, a trend driven by the tendency of technological developments to create new jobs as they eclipse the old and raise real incomes that support the overall demand for labour in all sectors. To justify this break, the combined potential for robotics, AI and other 'smart' technologies to substitute for labour in non-routine manual and cognitive tasks are commonly highlighted. However, in moving from the potentialities of these technologies to the calculation of actual risks to jobs, it is implicitly assumed that the investment process occurs smoothly and swiftly. Indeed, given the relatively short timeframe over which the risk to jobs is calculated, firms are

effectively seen to adopt the latest technology automatically and fully as and when it becomes available. Even if this was the case, we would have to assume firms face the same incentive to invest in technology across all sectors and regions and that the cost of capital is falling faster than the cost of labour across the economy for the high risk of job losses to be realised.

These assumptions are, of course, too strong. The incentives to automate, reflected in the relative efficiency of new forms of capital and labour and their relative cost, will vary across production *tasks* which, in turn, vary across firms and industries. From this starting point, the impact of new computer and AI technologies would be expected to be much more uneven across industries and, indeed, across countries. The importance of thinking about the impact of technology on employment in terms of tasks rather than jobs has been highlighted recently by Acemoglu and Restrepo (2019A; 2019B). They argue that automation has several potential effects. Firstly, it has a displacement effect. The greater ability and wider applicability of technologies leads to a loss of tasks performed by workers – in this case, automation is labour-saving, the aspect focused upon in estimations of jobs at risk. However, it is also important to consider offsetting factors. These include a 'productivity effect' in which automation reduces the costs of production, leading to potential increased demand – including labour demand – within both automated and non-automated sectors. Yet this effect is not to be taken as universal: its strength will depend on the 'broader

labour market context' (Acemoglu and Restrepo 2019A: 11). High wages and labour scarcity will act as a spur to automation, leading to a strong productivity effect and higher labour demand. Low wages and labour abundance, by contrast, reduce the potential cost savings from substituting capital for labour yielding a relatively small productivity effect from the adoption of 'so-so technologies' (ibid.: 10). Given the weak productivity effect in the face of displacement, this leads to a potential net decline in labour demand. Germany, Japan and South Korea are said to fit the former case with labour scarcity incentivising productivity-enhancing change, whereas the US – and, we argue below, the UK – fits more closely with the second case (ibid. 11).

A further consideration, as highlighted by Acemoglu and Restrepo (2019A), is the potential for a 'reinstatement effect' in the wake of automation, whereby new tasks are created in which labour has a comparative advantage. This can follow from the implementation of automation itself, with a rising demand for complementary human-dominated tasks (e.g. to monitor or interpret the output of automated systems) and endogenously, through the potential depressive effect of displacement on wages and hence on the relative cost advantage of automation.

It is the strength of this reinstatement effect that is key to the ultimate effect of new technologies on employment. Frey and Osborne (2017: 258-9) express concern that AI and smart technologies provide scope to replace

labour in an increasing array of jobs hitherto relatively untouched given their focus on cognitive ability. In other words, they question the continued power of the historically important reinstatement effect. Acemoglu and Restrepo (2019A: 25-6; 2019B) also note a recent slowing in the strength of the reinstatement effect, but they point to the importance of institutional factors over a secular trend towards inevitable automation. For example, they note that in industrialised economies, tax systems typically favour the substitution of capital for labour through subsidies for the former and payroll taxes for the latter. This skewing of relative profitability is likely to impact on automation research as much as automation itself, further deepening moves towards labour-shedding technologies (Acemoglu and Restrepo, 2019B). Beyond purely economic incentives, large tech companies also have a crucial role in shaping the nature and trajectory of research. In particular, their innovation strategies and business models are focused on removing the human element of production. The dominance of these companies in innovation clusters shapes the industry and, through collaboration with universities, the research agenda, leading to a risk of lock-in to a particular path of development of AI and machine learning technologies (Acemoglu and Restrepo, 2019B: 8-9). As state funding for, and influence on, the direction of innovation has receded, and private sector objectives have taken the lead, a further boost has been given to research that delivers short-term profits (and labour-shedding) over social welfare

objectives, such as the development of technologies that complement labour and encourage employment sustenance or creation (Acemoglu and Restrepo, 2019A,: 25-6). We can add here how broader changes in corporate governance mechanisms – specifically the rise of the shareholder value model – have deepened this push to automate for short-term gain (see Slater and Spencer, 2015). Together, these institutional factors suggest reasons for the possible slowing of the 'reinstatement effect'. They also help explain why, despite the application of new technologies, productivity performance has been poor in the last decade – it appears that too many 'so-so' innovations have been adopted in the search for short-term gains and that this search has persisted even while the productivity effect has been low (Acemoglu and Restrepo, 2019A: 26).

The wider point here is that we cannot assume that automation will lead inexorably to the elimination of work. Rather, the impact of automation is, in theory, ambiguous and, in practice, subject to institutional structures and incentives. These subtleties are often acknowledged but underplayed in existing research, with the predictions of high job automation risk instead grabbing the popular imagination.

For example, Frey and Osborne's (2017) influential analysis does acknowledge that the adoption of new technology will not be immediate and that there may be constraints on the pace of job losses. Three key 'engineering bottlenecks' are identified which may slow the replacement of

labour by computer capital due to challenges in the following areas: i) perception and manipulation tasks; ii) creative intelligence tasks; and iii) social intelligence tasks. These are aspects of existing jobs that it is currently difficult for robots and digital technologies to deal with. Yet, Frey and Osborne note that, by reconfiguring jobs and production systems to simplify tasks and reduce variability, some of the hurdles could be reduced and the adoption of new technology sped-up. Indeed, whilst bumps in the road are noted, the underlying basis for their analysis is the contention that '[b]eyond these bottlenecks… it is largely *already* technologically possible to automate *almost any* task, provided that sufficient amounts of data are gathered for pattern recognition' (Frey and Osborne, 2017: 261; emphasis added). This is a strong claim. But the notion that limits to computerisation are temporary and finite is key to their method and to their high estimates of potential job losses in the near future.

Frey and Osborne's estimates of job loss risk are grounded in the judgement of machine learning experts about whether each of a sample of 70 occupations drawn from the US occupational classification can or cannot be automated. These binary judgements are then compared to the characteristics of each occupation in relation to nine variables representing the bottleneck factors taken from the US O*NET database of occupational task composition. Finally, for the remaining occupations not judged directly by the experts, the information from this exercise is used to assess the

probability that an occupation is automatable based on its characteristics in relation to the bottleneck variables.

The high estimates of automation risk generated by this approach are, however, problematic for several reasons. Firstly, the underlying assessment of automation risk is derived from the views of machine learning experts. This is to ignore questions of organisational and job design – i.e. how feasible is it to reorganise and redesign work to accommodate new technology? It also overlooks the issue of relative factor cost and implies that if a (current) job can be automated, it will be. Yet, the views of computer scientists and engineers tend to overlook alternative choices in the nature and degree of integration of new technology within organisations and are often over-optimistic about the practical application of actual technologies (Totterdill, 2017; see also Autor, 2015). Secondly, even if one assumes that the experts captured fully the organisational possibilities for and constraints on the automatability of US jobs in their assessments, there is no reason that these will be the same in different countries. In this case, there is a need for something more than a simple mapping of risk between national occupational classification systems. Thirdly, as Arntz et al. (2016; 2017) examine in detail, the Frey and Osborne approach overlooks intra-occupational heterogeneity even though it may limit the automation potential.

All this highlights a simple, but very important point: there is a wide degree of choice facing organisations in how they design jobs and how technology is introduced into them. The Frey and Osborne approach assumes implicitly that the task composition of an occupation is identical across all jobs within an occupational class and within, and as noted above, between countries. But clearly task composition is a matter of organisational choice and will be driven by managerial decisions, sectoral context, workforce skills availability, existing technological investments and lock-in, industrial relations considerations and, in a cross-country context, additional legal and social as well as institutional factors. These different variables, in turn, can be expected to impact on the level and extent of automation within and across occupations, undermining any neat prediction of large scale job losses derived from estimates of the automatability of representative jobs.

An indication of how important taking these differences into account is given by the much lower automation risk reported by Arntz et al. (2016; 2017). Although they retain the basic assessment of occupational automatability potential from Frey and Osborne, this is then mapped to variables from the OECD's Programme for the International Assessment of Adult Competencies (PIAAC) database which provides a much richer, micro-level dataset containing information on job tasks and job-related characteristics as well as individual skill and socioeconomic data. By calculating the probability of job automatability according to the distribution

of these characteristics across individuals, task heterogeneity within and between occupations is taken into account, in contrast to Frey and Osborne. The rationale for this approach is that only certain *tasks* are at risk from automation and on this basis, only 9 per cent of US jobs are found to be at 'high' risk of automation (i.e. greater than 70 per cent) compared to Frey and Osborne's estimate of 47 per cent. Since the PIAAC database is available for several countries, Arntz et al.'s method is also able to take into account further national sources of occupational task composition variation, although it remains rooted in the initial expert judgements regarding automatability from Frey and Osborne (2017). This limitation notwithstanding, the difference is stark: Arntz et al. report that around 10 per cent of UK jobs are at high risk compared with an estimate of 35 per cent based on a translation of Frey and Osborne's method to the UK (BBC, 2015). Using a modified version of this approach, the UK Office for National Statistics also arrives at a much lower figure of around 7-8 per cent of jobs in England at high risk of automation (ONS, 2019B).

Arntz et al.'s method is not without its critics. For example, Berriman and Hawksworth (2017) contend that the results are sensitive to the precise predictive methodology used, although their own estimation adjustments are not spelled out clearly. More fundamentally, however, whatever the arguments over precise estimates, these estimates are all still rooted in the initial expert, technical view of automatability, which ignores economic,

organisational, and social barriers to automation. Upon further inspection, the limits to this method become apparent. Take the case of bartenders. These jobs have a 77 per cent risk of automation according to Frey and Osborne (2017). Whilst this estimate is based on the largely routine nature of the occupation as described by O*NET data, it is difficult to square the high automation risk with issues of social and practical acceptability. Although it might be technically possible to envisage automated dispensing of some standard drinks – and, whilst there have been trials in the UK, this technology has not taken off (Smithers, 2016) – it is not easy to see how machines might mix your favourite cocktail or pour you the perfect pint of real ale. Further, the role of bartender is not limited to dispensing drinks. Social interaction is an important part of the role, including engaging with customers and keeping order, in addition to the more routine tasks of collecting glasses and cleaning up.

Taken together, this discussion highlights the problems in many contemporary accounts of the automation threat. By ignoring important social, legal, and organisational limits to the adoption of AI, computer and digital technologies and compounding this with a tendency to assess automatability at the level of occupations rather than tasks, the risks of mass job losses appear overstated. Further, it is not only the current allocation of tasks between capital and labour that is important, but the opportunities –

and incentives – to reconfigure the distribution of tasks or, indeed, to expand the range of tasks, that is important.

4. The UK: a problem of too few robots?

If economic, organisational, social, and institutional factors matter in guiding the future path of automation, what are the prospects for the UK? The UK's overall poor investment record is well documented and long-standing (see Kitson and Michie, 1996). This is a reflection of a wider set of deep-seated, institutional barriers to performance that have shaped the evolution of the UK's jobs structure (Nolan and Slater, 2010). Weaknesses rooted in ownership and management structures, the industrial relations system and macroeconomic policy were exacerbated under the (deliberate) economic chaos unleashed by the Thatcher governments and consolidated by New Labour, which failed to check the influence of the City, develop a coherent industrial strategy, or do more than install a low floor to employment regulation (Jessop, 2007). Hence, by the early twenty-first century, the UK's model of capitalism has become characterised by: the dominance of lightly regulated, international finance; a flexible labour market with limited and poorly enforced protections, growing contingent work and stagnant real wages; a shift towards low skill, low wage and low productivity service jobs; and an exposure to, and reliance on, foreign direct investment with a domestic tendency to favour property over productive investment (see Lavery et al., 2019). At the corporate governance level, UK

firms have focused on maximising short-term profitability, looking to appease financial stakeholders, above other groups (see Appelbaum et al., 2013). It is in this broader context that the incentives and scope for automation in the UK should be considered.

The deep-lying barriers to investment are clearly evident in the limited adoption of automation in UK manufacturing. On the latest data, South Korea is the leading robotised manufacturing nation with 631 installed industrialised robots per 10,000 manufacturing employees, whilst Germany is the leading economy in Europe, and third in the world, with 309 (IFR, 2018A). By contrast, the UK lags far behind, and below the global average, with a robot density of 71. Further, whilst annual installations are forecast to increase by 41 per cent between 2017 and 2021 in Europe as a whole, the corresponding projection for the UK is an increase of only 11 per cent (IRF, 2018B).

More broadly, in relation to economy-wide investment in software, IT and communications equipment, the UK fares better, matching the OECD average of 2.3 per cent of GDP in 2015 (OECD, 2017, figure 5.1), although lagging behind the US (3.1 per cent) and Sweden (3.4 per cent) and much of this investment will not be in leading edge technologies. Turning to employment in related technology areas, the UK position is better still: over 4.5 per cent of workers are found in information and communication technology (ICT), electro-technology engineering and telecommunication

technician occupations, one of the highest shares in the OECD (ibid., figure 4.22).

All this suggests a rather mixed picture in terms of the extent of current automation and computerisation of work and production. A relatively high share of ICT professionals is probably unsurprising for the UK economy, dominated as it is by services including ICT intensive sectors such as finance. Here a high share reflects existing investments in computer systems; it does not necessarily reflect the onward march of automation. Indeed, a relatively high share of existing investment in computer systems may be a further hurdle to future investment given the need for new developments to be compatible with legacy systems or due to the high cost of replacing entire systems. Given the rising significance of low skill service employment (see below), it is also likely concentrated in a limited range of sectors.

The above highlights a key economic consideration that is missing from much of the debate over automation risk: aside from all the other potential barriers and considerations, the cost of capital associated with the automation of work tasks (and associated adjustment costs) needs to fall sufficiently relative to labour to be viable. In recent years, real wages in the UK have stagnated for an unprecedented period and there is little sign of upward pressure in real wages despite low measured unemployment (Bell and Blanchflower, 2018). In this sense, there is no great incentive for firms

to automate production in many sectors: labour is often relatively cheap and available in sufficient supply. A stark example of the dynamics this situation creates is the rise in hand car washes, which have grown from virtually zero in 2004 to the dominant form of car wash with over 10,000 sites (Clark and Colling, 2017). This is a clear example of technological regress and it builds on some of the same factors that underlie relatively low investment across the UK economy including the availability of low cost labour in a lightly and weakly regulated labour market.

For some firms, then, the availability of new technology may have no effect on their current operations. The fact that these firms can make a profit without automating labour functions will mean that they will forgo investment in new technology. Here labour intensive methods may continue even though they could be automated simply because it suits the interests of firm managers and owners not to adopt new technologies. Needless to say, the continuation of work may not add to the welfare of workers – indeed, it may harm their welfare if it entails their performing tasks with low levels of pay, skill, and responsibility.

We can relate the arguments here to those made by Acemoglu and Restrepo (2019A). Like them, we take the view that automation should be seen at the level of tasks. We also agree with them that certain country-specific factors should be considered in understanding the nature and impacts of the automation process. The above two authors focus on the US. Here we can

extend their argument to the UK. It is clear that, in the UK, like in the US, a lack of support from government and from domestic firms has led to a weak reinstatement effect from automation. Tasks have been extinguished as opposed to extended – a fact that has weakened new jobs growth. At the same time, the lack of new task creation has held back productivity growth and with it, wage growth. It is evident that, in the UK, automation has not coincided with productivity gains – to the contrary, it has occurred in the context of a productivity slowdown. There are feedbacks to consider here, as lower wages have blunted the incentive for firms to automate and encouraged the move to low-cost, labour-intensive technologies. Further, there is the broader context of austerity and the move away from government intervention in creating conditions where firms can employ labour cheaply and automate only as a means to cut costs, rather than to raise productivity and grow wages. More generally, in common with Acemoglu and Restrepo, we would argue that automation does not guarantee either the demise of work or outcomes favourable to workers. Rather, it can be argued – as in the example of the UK – that automation can occur even while economies remain jobs-rich and circumstances change in ways that are detrimental to workers.

Indeed, there is as yet no clear evidence that automation is impacting in significant ways on the structure of jobs. As Table 1 shows, relatively routine work remains important with over half of jobs in the EU15

accounted for by clerical, sales, craft, operative and elementary roles (e.g. cleaners, labourers, food preparation, refuse collection).

TABLE 1 NEAR HERE

As jobs growth has returned, following the 2008 financial crisis, there has not been a trend away from these more routine jobs. To be sure, professional and technical roles have accounted for a greater share of jobs growth – reflecting shifting industrial structure as much as any trends within industries – but growth has remained positive in clerical, sales, operative and elementary jobs across the EU15.

The UK stands out both for its relatively low share and growth of associate professional roles and for its relatively high share and growth of elementary occupations. Further, as Table 2 indicates, the UK is a relatively low wage economy. Reflecting the arguments made above, even if it is technically possible to automate some or all of certain occupations, relatively low wages render it uneconomic. For the UK, this is particularly the case for clerical, service, sales and elementary occupations, where wages are low both in comparison to other EU states and, within the UK, in comparison to overall median earnings.

TABLE 2 NEAR HERE

A more detailed look at recent occupational change within the UK further highlights the continuing salience of routine, low skill and low paid work.

The ten occupations with the largest absolute growth over the period 2011-2018 includes IT professionals, but their growth is swamped by rising numbers of care, distribution, clerical and service occupations (see Table 3). Turning to shrinking occupations, although it may be the case that automation explains the decline of bank clerks to some extent, the largest absolute falls in national government and other public sector occupations reflects the shrinking of the state under the post-crisis policy of austerity. In short, structural, institutional and policy decisions seem to be able to explain more of the trends in occupational structure than the simple narrative around automation.

TABLE 3 NEAR HERE

All this is to focus on the evidence – or lack of it – for the substitution of labour. However, it is also important to consider the way that firms can invest in technology to extract more effort from workers rather than to displace jobs, an issue not directly addressed by Acemoglu and Restrepo. The desire of firm owners and managers to maximise profit, in this situation, may lead to jobs becoming more intensive and controlled – as a result, workers will face the prospect of technology eroding the quality of their jobs. Here we see how inequalities of power can affect the selection and implementation of new technologies. Green (2006, chapter 5) notes, for example, how in the UK there appears to be some evidence of an association between the introduction of advanced technology and a decline

in task discretion. This could be through more direct monitoring induced by advanced technology or reflect the standardisation and harmonisation of jobs to reconcile existing work activity with automated systems. Evidence of how new automated technologies are being used to monitor and intensify work in what are often referred to as 'routine' jobs has been found in UK care work (Hayes and Moore, 2017) and in supermarket supply chains (Newsome et al., 2013) reinforcing the notion of a 'low-road' approach in many parts of the UK service sector.

The weakness of workers' bargaining power in the UK, at a more general level, has created a climate that is not conducive to high investment. Indeed, it has underpinned low levels of investment and created an incentive for firms to maintain relatively low-skilled, labour-intensive production methods in many sectors (see also Coulter, 2016). In recent years, this has been exacerbated by falling real wages.

The argument here is that the UK economy has lacked the necessary social and institutional forces to upgrade production and service delivery (see also Lloyd and Payne, forthcoming). The relative cheapness of labour has not provided a spur to investment, including in new digital technologies. Faced with relatively expensive and risky new technologies, too often firms in the UK have opted for the cheaper and more reliable option of labour. Where new automated technologies have been adopted, there is evidence that these have often been focused on control or have further routinized activity rather

than be taken as an opportunity to reconfigure job tasks and to adopt new automated technology in a way that could enhance longer term productivity prospects. No wonder the UK has a 'productivity problem'

In the debates on technical change and employment, it is often argued that robots and new digital technologies complement high skill, professional and managerial roles and help to explain growth in these occupations. By the same token, outside of the underlying technologically deterministic argument that underpins many of the forecasts of future job risk, there is no reason why 'middle' and 'low' skill jobs could not be reconfigured to complement new technology (and indeed, the two designed in tandem). Indeed, it is important to consider the synergies between the design and implementation of new technologies in relation to human and organisational factors to ensure their successful introduction (Totterdill, 2017; see also Davenport and Ronanki, 2018 for examples). In the UK, however, the risk is that there are too few incentives to drive the positive embrace of automation in these ways. Indeed, the prospect is of technology being shaped by a system that perpetuates low skill and low paid work.

5. Policy responses

The issue of policy intervention remains to be discussed. Based on the foregoing discussion, it can be argued that, at present, the UK faces a future where automation is unlikely to deliver for the majority in society – indeed,

given the current policy and political arrangements in place (a weak industrial policy plus the continuing hegemony of finance and a private sector intent on cost reduction), the future is likely to bring about a form of automation that features unequal outcomes, adding to existing inequalities of income and opportunity. In this context, the uncertainties of Brexit are only likely to magnify the above problems. If Brexit leads to a lurch to the right in policy terms, it will make things much worse.

The question then is what is to done? How are we to harness automation differently and in ways that add to societal well-being? It can be stated that the conditions now limiting automation can be changed through policy shifts, though the shifts needed can be seen as profound and radical, at least in relation to current policy thinking.

Here we offer some general reflections on possible policy interventions. We are aware these interventions require further substantive work. Nonetheless, we see them as important inputs into a wider debate on how the UK (and other countries) might harness the potential of automation in positive ways.

At a broad level, there is a need to abandon the UK's current economic and employment model through new policies of investment and a renewed industrial and labour market strategy. What we would propose here is a decisive move away from austerity and the embrace of a programme of economic renewal. Such a programme would entail the state supporting high

levels of investment through its own spending and via the raising of minimum wages and labour standards. In relation to the latter, this would involve the state as employer embracing automation as a positive role model. By abandoning the current command and control models and focus on using technology to replace labour, it could instead embrace new technology as a way of raising job quality, retraining and up-skilling workers, and reconfiguring job design to increase autonomy, discretion and self-directed teamworking (Green et al., 2016). Through a blend of leadership, information, persuasion, regulation and procurement requirements, the state could then have a positive impact on job design in the private sector. In combination with higher wages, the 'low-road' to growth could be closed off, with a stimulating effect on business investment. A goal would be to raise productivity growth, in part through the creation of new tasks that are welfare-improving. With or without Brexit, the UK needs to develop a new model of capitalism if sagging productivity and living standards – and the social and economic pressures they bring – are to be addressed.

Equally importantly, there is a need to reform the ownership of capital. A neglected element in debates on automation is the barriers to reform that stem from unequal ownership in society. While capital owners can direct technology in their own interests, the outcomes for workers from automation are necessarily uncertain. It can be argued that for workers to

stand a better chance of gaining from automation – in the form of higher pay, shorter hours, and more interesting work – there is a need to alter ownership in favour of workers. Via the support of the state (e.g. tax incentives), encouragement should be given to worker ownership. The goal here is not just to democratise the workplace but also to create the necessary conditions for automation to evolve in ways that are socially and economically beneficial. Of course, the obstacles, economic as well as political, to the creation of worker-owned firms are formidable. But this should not deter us from seeking their creation. Indeed, overcoming these barriers should be a priority of a progressive economics and politics.

6. Conclusion

It is impossible to predict the effects of automation on the future of work. But, based on the arguments made in this paper, it can be contended that paid work will likely persist into the future. Work will not be lessened as such but rather will be consolidated, in ways that limit leisure time. Beyond its effects on the volume of work, future technologies may also erode wages and the quality of work. Far from being a liberating force, automation is likely to lead to more and worse quality work.

At the same time, there will be crucial limits to automation due to economic, social, legal and institutional factors. Many jobs will survive, despite the possibilities for automation, because it is cheaper for firms to retain labour.

Cleaning jobs, for example, will remain not because they are not automatable but because cheap human cleaners are readily available and easy to hire. Firms may resist technology because it erodes the power of its managers and owners, whereas they may embrace forms of technology that discipline workers, at the cost of lower wages and worse working conditions. The influence of politics on technology will skew the latter in regressive directions – ones, again, that entail work's persistence.

In the UK, as argued in this paper, the possibilities for automation appear limited. Ironically at a time when commentators are worrying about 'the rise of the robots', the UK features record employment levels and lagging productivity. The key problem in the UK remains centred on low investment in a context of few imperatives for improvement. The latter reflects and reinforces the associated problem of low real wages and in turn feeds the problem of low productivity. The failure of the UK to achieve high levels of investment will not be solved without a radical shift in policy. In particular, it will require a concerted effort by the state to reform labour market institutions, corporate governance structures, and wider ownership relations. Until policy changes, the UK will remain stuck with a form of automation that works for the few, not the many.

References

Acemoglu, D., and Restrepo, P. (2019A) Automation and new tasks: how technology displaces and reinstates labor, *Journal of Economic Perspectives*, 33: no. 2.

Acemoglu, D., and Restrepo, P. (2019B) The wrong kind of AI? Artificial intelligence and the future of labor demand, *NBER Working Paper Series*, working paper 25682.

Appelbaum, E., Batt, R. and Clark, I. (2013) Implications of financial capitalism, *British Journal of Industrial Relations*, 51: 498-518.

Arntz, M., Gregory, T. and Zierahn, U. (2016) The risk of automation for jobs in OECD countries: a comparative analysis, *OECD Social, Employment and Migration Working Papers*, no.189

Autor, D. (2015) Why are there still so many jobs? The history and future of workplace automation, *Journal of Economic Perspectives*, 29: no. 3.

Autor, D., Katz, L. and Kearney, M. (2006) The polarization of the U.S. labour market, *American Economic Review,* 96: no.2.

BBC (2014) Singularity: the robots are coming to steal our jobs, BBC News. Available online at: https://www.bbc.co.uk/news/technology-25000756 [Accessed 10 July 2019].

BBC (2015) *Will a Robot Take Your Job?* Available online at: https://www.bbc.co.uk/news/technology-34066941 [Accessed 30 November 2018].

Bell, D. and Blanchflower, D. (2018) The lack of wage growth and the falling NAIRU, *National Institute Economic Review,* 245: 40-55.

Berman, E., Bound, J. and Machin, S. (1998) Implications of skill-biased technological change: international evidence, *The Quarterly Journal of Economics*, 113: no.4.

Berriman, R. and Hawksworth, J. (2017) Will robots steal our jobs? The potential impact of automation on the UK and other major economies, *UK Economic Outlook,* London, PWC. Available online at: https://www.pwc.co.uk/services/economics-policy/insights/uk-economic-outlook/march-2017.html [Accessed 30 November 2018].

Brynjolfsson, E. and McAfee, A. (2014) *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*, New York, Norton.

Clark, I. and Colling, T. (2017) Work in Britain's informal economy: learning from road-side hand car washes, *British Journal of Industrial Relations,* 56: no.2.

Clarke, S., Corlett, A., Finch, D., Gardiner, L., Henehan, K., Tomlinson, D. and Whittaker, M. (2017) *Are We Nearly There Yet? Spring Budget 2017 and the 15 Year Squeeze on Family and Public Finances.* London, Resolution Foundation.

Coulter, S. (2016) The UK labour market and the 'great recession'. In M. Myant, S. Theodoropoulou and A. Piasna, (eds.) *Unemployment, Internal Devaluation and Labour Market Deregulation in Europe*. pp.197-227. Brussels, European Trade Union Institute..

Daily Mail (2019) Rise of the robots could wipe out 9 million jobs, *The Daily Mail,* 7 January.

Davenport, T. and Ronanki, R. (2018) Artificial intelligence for the real world, *Harvard Business Review,* 96: no.1.

Donnelly, L. (2018) 'Carebots' could take over from NHS medics to save £13bn a year, *The Telegraph,* 11 June. Available online at: https://www.telegraph.co.uk/news/2018/06/10/carebots-could-take-nhs-medics-save-13bn-year/ [Accessed 30 November 2018].

Elliott, L. (2018) Robots will take our jobs. We'd better plan now, before it's too late, *The Guardian,* 1st February. Available online at: https://www.theguardian.com/commentisfree/2018/feb/01/robots-take-our-jobs-amazon-go-seattle [Accessed 10 July 2019]

Felstead, A. and Green, F. (2017) Working longer and harder? A critical assessment of work effort in Britain in comparison to Europe.In D. Grimshaw, C. Fagan, G. Hebson and I. Tavora, *Making Work More Equal: A New Labour Market Segmentation Approach.* pp. 188-207. Manchester, Manchester University Press.

Ford, M. (2015) *The Rise of the Robots. Technology and the Threat of Mass Unemployment*, London, Oneworld.

Frey, C. and Osborne, M. (2017) How susceptible are jobs to computerisation? *Technological Forecasting & Social Change,* 114: 254-280.

Goos, M., and Manning, A. (2007) Lousy and lovely jobs: the rising polarization of work in Britain. *The Review of Economics and Statistics*, 89, no. 1.

Green, F. (2006) *Demanding Work. The Paradox of Job Quality in the Affluent Economy,* Princeton, Princeton University Press.

Green. F., Felstead, A., Gallie, D. and Henseke, G. (2016) Skills and work organisation in Britain: a quarter of a century of change, *Journal of Labour Market Research*, 49: 121-32.

Haldane, A. (2015) *Labour's Share*. Speech at the Trades Union Congress, London 12th November 2015. Available online at: http://www.bankofengland.co.uk/publications/Documents/speeches/2015/speech864.pdf [Accessed 30 November 2018].

Harris, L. and Ennis, J. (2016) Automation and the workforce. *POST Note,* no. 534, Parliamentary Office of Science and Technology, London. Available online at: https://researchbriefings.parliament.uk/ResearchBriefing/Summary/POST-PN-0534 [Accessed 30 November 2018].

Hayes, L. and Moore, S. (2017) Care in a time of austerity: the electronic monitoring of homecare workers' time, *Gender, Work and Organization*, 24, no.4.

IFR (2018A) Robot density rises globally, *IFR Press Releases*, 7th February 2018, Frankfurt, International Federation of Robotics. Available online at: https://ifr.org/ifr-press-releases/news/robot-density-rises-globally [Accessed 30 November 2018].

IFR (2018B) *World Robotics: Industrial Robots 2018,* Executive Summary, Frankfurt, International Federation of Robotics. Available online at: https://ifr.org/downloads/press2018/Executive_Summary_WR_2018_Industrial_Robots.pdf
[Accessed 30 November 2018].

Jessop, B. (2007) New Labour or the normalization of neo-liberalism? *British Politics.* 2: 282–288.

Kitson, M. and Michie, J. (1996) Britain's industrial performance since 1960: underinvestment and relative decline, *The Economic Journal*, 106: no.434.

Lavery, S., Quaglia, L. and Dannreuther, C. (2019) The political economy of Brexit and the future of British capitalism, *New Political Economy,* 24: no.2.

Lloyd, C. and Payne, J. (forthcoming) Rethinking country effects: robotics, AI and work futures in Norway and the UK, *New Technology, Work and Employment.*

Mokyr, J., Vickers, C. and Zierbarth, N. (2015) The history of technological anxiety and the future of economic growth: is this time different? *Journal of Economic Perspectives*, 29: no. 3.

Newsome, K., Thompson, P. and Commander, J. (2013). You monitor performance at every hour: labour and the management of performance in the supermarket supply chain, *New Technology, Work and Employment*, 28: no.1.

Nolan, P. and Slater, G. (2010) Visions of the future, the legacy of the past: demystifying the weightless economy, *Labor History,* 51: no.1.

OECD (2017) *Digital Economy Outlook 2017*, Paris, OECD.

ONS (2019A) *Labour Market Overview, UK: June 2019,* Office for National Statistics. Available online at: https://www.ons.gov.uk

ONS (2019B) The probability of automation in England: 2011 and 2017, Office for National Statistics. Available online at: https://www.ons.gov.uk

Schwab, K. (2016) *The Fourth Industrial Revolution,* World Economic Forum, Geneva.

Skidelsky, R. (2019) *How to Achieve Shorter Working Hours*, London, Progressive Economy Forum.

Slater, G. and Spencer, D. (2015) Workplace relations, unemployment and finance-dominated capitalism, *Review of Keynesian Economics*, 2: no.2.

Smithers, R. (2016) Pull a fast one: London bar installs world's first tap-and-pay beer pump, *The Guardian,* 16th December 2016. Available online at: https://www.theguardian.com/lifeandstyle/2016/dec/16/contactless-beer-pump-worlds-first-london-bar [Accessed 30 November 2018].

Spencer, D. (2018) Fear and hope in an age of mass automation: debating the future of work, *New Technology, Work and Employment*, 33: no. 1.

Srnicek, N. and Williams, A. (2015) *Inventing the Future. Postcapitalism and a World without Work*, London, Verso.

Susskind, R. and Susskind, D. (2015) *The Future of the Professions: How Technology Will Transform the Work of Human Experts,* Oxford, Oxford University Press.

Thompson, D. (2015) A world without work, *The Atlantic,* July/August.

Totterdill, P. (2017) The corporate response to the fourth industrial revolution, *European Journal of Workplace Innovation*, 3: no.2.

Turner, A. (2018) Capitalism in the age of robots: work, income and wealth in the 21st-century, Lecture at School of Advanced International Studies, Johns Hopkins University, April 10th 2018.

West, D. (2018) *The Future of Work: Robots, AI, and Automation,* Washington, Brookings Institution Press.