

## Understanding the UK's productivity problems

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# **Understanding the UK's productivity problems: New technological solutions or a case for the renewal of old institutions?**

## **Abstract**

### **Purpose**

In this paper, we examine the nature, causes and consequences of the UK's productivity problems and whether these may be addressed through the new technologies of artificial intelligence (AI).

### **Design/methodology/approach**

This paper reviews the literature on productivity to explain how it relates to earnings within different theoretical frameworks, advocating a 'power over rents' framework as most realistic. It explains the UK's twin productivity problems and reviews their potential causes, critically assessing the capacity for new AI technologies to address them. It highlights the enduring importance of distribution and the design of work to improving the UK's productivity.

### **Findings**

We find that the UK's productivity problems will not be solved by AI technologies due to technical and socio-technical challenges which will require the significant re-design of work. We highlight the importance of aggregate demand, which has been inhibited by the shifting distribution of income towards capital and rising inequality of earnings. These issues suggest an important role for trade unions and a renewal of the institutions of employment regulation and collective bargaining. While reversing recent trends raises considerable challenges, we observe renewed interest in trade unions from previously hostile thinktanks and international institutions including the IMF and OECD.

### **Originality/value**

This paper advocates adopting a 'power over rents' theoretical framework to understanding productivity and the distribution of gains. This provides a clear rationale for the role of trade-unions, employment regulation and collective bargaining in improving distributional outcomes, raising firm-level productivity and achieving real productivity growth at an aggregate level.

## **1. Introduction**

Developed economies and the UK in particular have experienced what has been labelled a productivity problem since the financial crisis of 2008. That is, real productivity growth has been historically low with consequent effects for economic growth, real wage growth and tax revenues. The UK faces a further problem that its recent nominal productivity, measured in current price terms, is one of the lowest of the industrialised countries (ONS 2018; 2016).

It has become a focus of government, academics and the media to diagnose and suggest initiatives to address these problems. A range of diagnoses have been put forward for the widespread low productivity growth, which are broadly pessimistic for the future (e.g. Summers, 2013;2016; Gordon, 2016). Counterposed with this is huge anticipation that AI technologies are poised to revolutionise work and in doing so dramatically increase productivity (Brynjolfsson and McAfee, 2014; Frey and Osborne, 2013). The hope is that, if implemented effectively, these new technologies could also

improve the nominal productivity of UK sectors and firms, hence the focus of UK research councils on the intersection of innovation, productivity and management.<sup>1</sup>

We argue in this paper, however, that the focus on solving the UK's productivity problems through technology is likely to disappoint and will not automatically lead to the widespread sharing of benefits for workers. The other major political economy concern of recent times, high and growing inequality, suggests that as well as the generation of economic product, we also need to pay attention to its distribution. In fact, addressing inequality could be a key component in solving the productivity problems. In this regard, trade unions more than ever have an important role to play through the mechanism of collective bargaining and the involvement of workers in the organisation of work.

This paper proceeds as follows. Section 2 outlines the different measures of productivity and how they relate to income growth. Section 3 adopts a 'power over rents' framework to explain the falling labour share of national income and rising inequality which inhibit aggregate demand. Section 4 presents the empirical evidence for the UK's twin productivity problems and examines the different mainstream diagnoses of low productivity growth. Section 5 critically examines the arguments for Artificial Intelligence (AI) revolutionising work and productivity, highlighting the technical and socio-technical challenges. Section 6 draws the previous sections together in order to argue that addressing the UK's productivity problems requires first addressing the distribution of economic surplus and worker involvement in the design of work, which in turn requires the institutional strengthening of labour in the employment relationship.

## **2. Productivity and its relationship to income growth**

Workers, consumers and politicians all have an interest in productivity growth as it increases real incomes with attendant benefits for consumption and taxation. As Paul Krugman put it, 'Productivity isn't everything, but, in the long run, it is almost everything' (1994:8).

It has also been a longstanding concern of industrial relations scholarship and practice, where the relationship between the real output of workers, the nature of wage agreements and the consequence for product prices and real incomes ran through discussions of, and experiments with, collective bargaining and incomes policy from the late 1940s until the end of the 1970s (Flanders 1963; Burchill, 1970; Clegg, 1971; Brown and Nolan, 1988; Ahlstrand, 1990; Brown and Edwards, 2009).

In order to understand how productivity relates to incomes requires an outline understanding of the measure and the mechanisms through which companies and workers benefit.

At its simplest, productivity is a measure of output over input. The measure of output commonly used is gross value-added (GVA) which measures the value-added created in the production of a good or service by taking the value of the products sold (quantity times price) and subtracting the

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<sup>1</sup> The UK Government's Industrial Strategy Challenge Fund, delivered by UK Research and Innovation is intended to 'raise productivity and earning power in the UK' through investing in the UK's 'world-leading research base and highly-innovative businesses to address the biggest industrial and societal challenges today'. The challenge areas focus on the application of new technologies to provide productivity and competitiveness benefits to UK industries. [https://www.ukri.org/innovation/industrial-strategy-challenge-fund/?utm\\_source=innovateuk&utm\\_medium=website](https://www.ukri.org/innovation/industrial-strategy-challenge-fund/?utm_source=innovateuk&utm_medium=website)

value of all intermediate goods or services used up in their production. A commonly reported input measure is the number of workers or worker-hours that have gone into producing the particular good or service. Labour productivity is therefore the GVA produced per worker or worker-hour for a given sector or group of sectors in a specified geography. Hence, labour productivity for the UK provides an average view of GVA per worker-hour across all of the economic activities performed there.<sup>2</sup>

When considering productivity growth, economists and statisticians are interested in the *increase* of labour productivity independently of price changes. This is because price inflation is not an indication that we are producing more goods or services per worker than we were before. Hence productivity increases are usually reported as a volume or *real* measure of productivity and are calculated by holding prices constant for a period of time, and measuring the additional volume of goods or services produced per worker-hour (see Lewis and Peng, 2018 for further details of productivity measures).

To the extent that competition forces firms to pass on productivity increases as price savings, increasing real productivity, i.e. producing more with the same worker input, also increases the *real consumption wage* of everyone, including workers. That is, even if there is no increase in nominal or money wages, what those wages can purchase will have increased, improving the standard of living of every worker. This is why real productivity growth is the most important component of economic growth. Per capita economic growth is the product of growth in output per hour worked (labour productivity) and hours worked per capita of the total population (Gordon, 2014). Hence economic growth increases if productivity rises and/or more of the population work and for longer.

While productivity growth is important for all consumers and therefore workers in the economy, it is more ambiguous how it relates to profits and wages in the sectors where it occurs. In the economics of perfect competition, which is the equilibrium strived for in neoclassical economics, there is very little effect on individual companies because they are unable to translate productivity gains into higher profits. Similarly, money wages should vary little from economy-wide labour markets. There is clearly historical evidence for the argument that productivity increases result in falling prices in those sectors and rising real standards of living. Agriculture and manufacturing are examples of this over the twentieth century, with both ultimately requiring fewer workers and those workers moving into lower productivity increasing services (Baumol, 1967; Appelbaum and Schettkat, 1995; Broadberry, 2006). However, such effects are insufficient to support modelling economies as being perfectly competitive.

An alternative, and we suggest more realistic, way to think about the generation of economic product centres on the firm and ‘power over rents’ (Lewis et al, 2018). Firm’s *raison d’être* is to generate economic surplus and, as such, they employ a number of strategies to differentiate themselves, establish barriers to competition and achieve rents<sup>3</sup> (Bain, 1956; Kaplinsky, 1998; Kaplinsky and Morris, 2001). Firms, therefore, are not focused on increasing real productivity per se, although this can be a response to competition, what matters is increasing economic surplus. This is achieved by raising *nominal* or current price productivity, a combination of real productivity increases and pricing power over margins. Hence, it is not only sectors that have a high capacity for real productivity increases which generate high levels of nominal productivity in an economy. Finance and Business Services, for example, were found to have low real productivity growth, but

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<sup>2</sup> Measuring GVA raises challenge for non-market sectors where certain assumptions have to be made (See Lewis and Peng, 2018 for a more detailed discussion of measures of productivity)

<sup>3</sup> Rent in this sense is conceptualised as returns above an average benchmark .

have high levels of nominal productivity (Jorgensen and Timmer, 2011) and hence to generate significant economic rents.

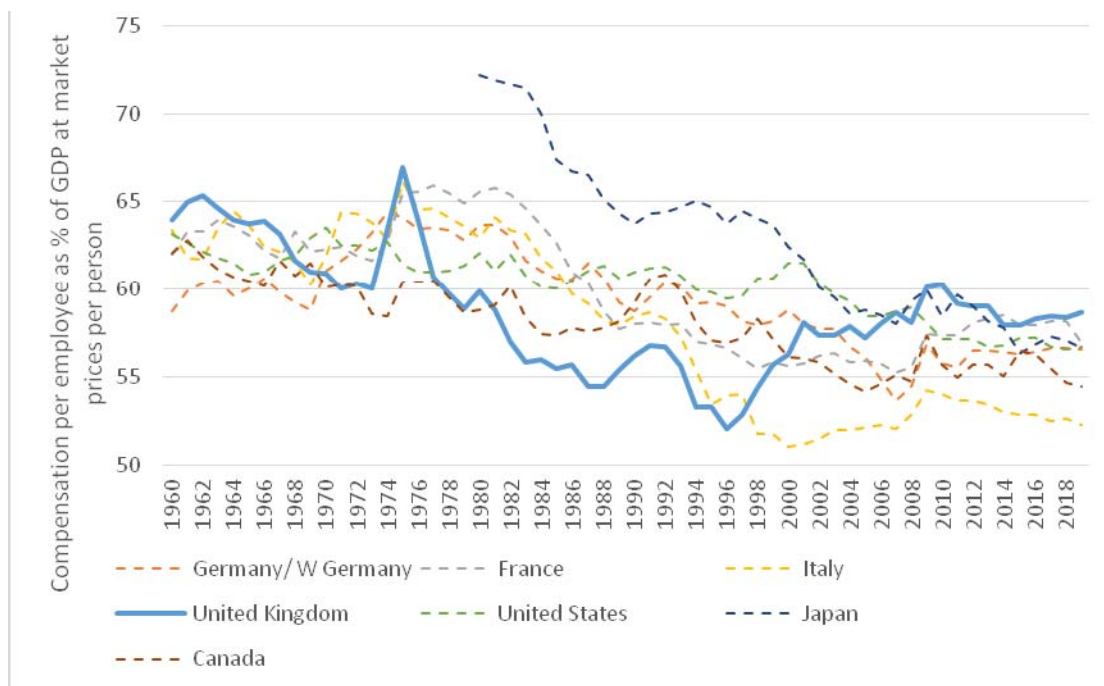
### 3. From productivity growth to the distribution of rents

Following the 'power over rents' framework outlined in the previous section, rents are subsequently laid claim to by stakeholders, including workers, shareholders and government in the form of taxes. From the perspective of workers, collectively and sectionally as groups with particular skills or occupations, their capacity to share in the economic surplus generated determines their nominal wages, while the extent to which real productivity growth across the economy is passed on as falling prices increases the purchasing power of those wages. Similarly, the capacity for governments to generate tax revenues from sectors generating surplus will influence the degree of re-distribution that can occur. This is the framework adopted by Brown et al. (2009) when discussing the extent to which increased competition has removed the economic basis for collective bargaining. In contrast to that interpretation of events, a number of recent commentators have expressed concern over a corporate and financial governance system that prioritises rent seeking over real productivity growth. For example, Stiglitz (2012), Pierson and Hacker (2016) and Schwartz (2016) are concerned by the consequences of rent-seeking by corporations, their senior management and financial investors, upon inequality, economic growth and political stability.

Lewis et al. (2018) have demonstrated that between 1970 and 2007, across a range of OECD countries, that increases in wages within a sector are associated with increases in the nominal productivity generated by that sector. They have also demonstrated that sectoral pricing power is more important in this than real productivity increases. While suggesting that this may indicate something of an automatic transfer of sectoral productivity increases to workers and hence an alignment of interests with shareholders; the terms of distribution between labour, capital and government will necessarily depend upon the relative power of each party.

There is evidence that that the functional distribution of income between labour and capital has been shifting in favour of capital since the late 1970s across developed countries (Kristal, 2010; Piketty, 2014; Stockhammer, 2017). This is a consequence of real wages rising more slowly than labour productivity (Glyn, 2009; OECD, 2018a) (see figure 1)

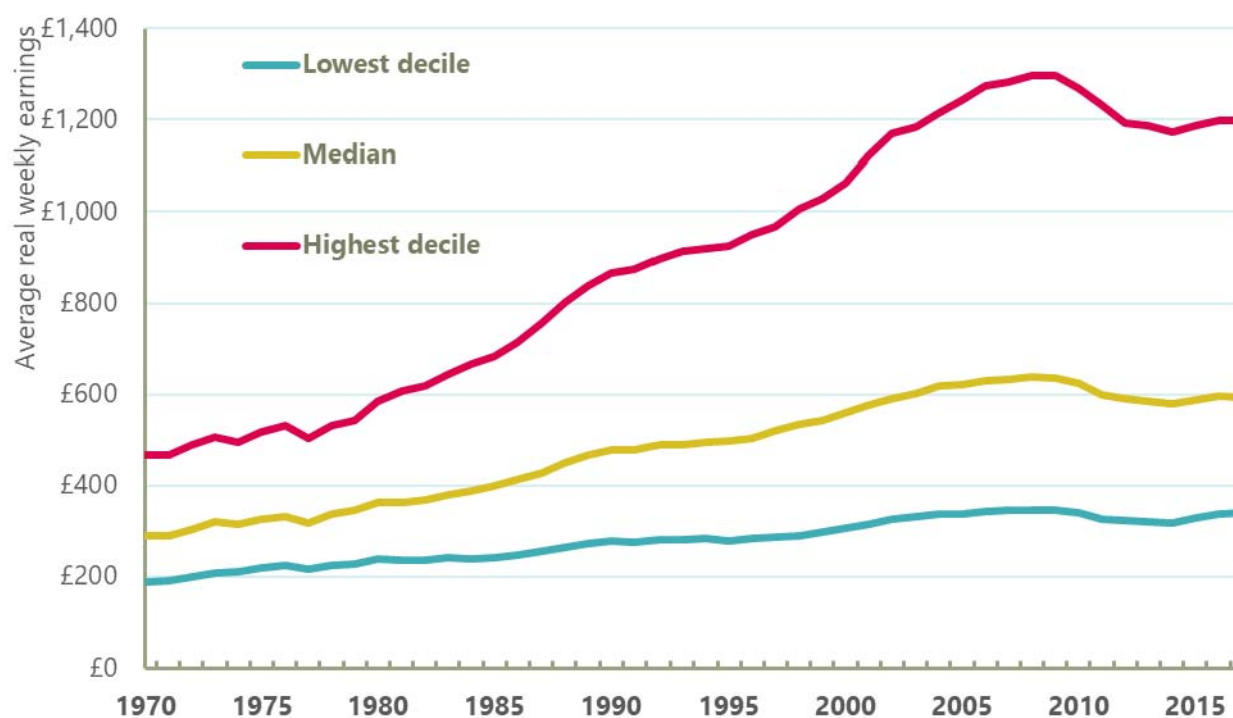
**Figure 1 – Adjusted wage share, as percentage of GDP at current prices, selected developed countries**



Source: AMECO and TUC analysis; Reproduced from TUC, 2018a

Recent research by the OECD estimates that had real wages perfectly tracked productivity growth between 1995 and 2014 then median wages would have been 13% higher. Both a falling labour share and rising wage inequality contributed to the relative reduction (OECD, 2018). While not experienced evenly across industries or workers, the highly skilled and highly paid have experienced a growing share of national income, this has been the net effect in 26 of 30 advanced economies between 1990 and 2009 (ILO 2014; ILO/OECD, 2015). Increasing wage inequality has been particularly pronounced in the UK, as illustrated for male full-time workers in figure 2:

**Figure 2 – Distribution of male full-time worker's real weekly earnings since 1970**



Source: ONS/ASHE/NES/TUC analysis; Reproduced from TUC, 2018a

The dominant explanation for this rising inequality, which came from mainstream economics, was that it was due to technological change, particularly the increasing use of computers. This technological change was said to be skill-biased, making low-skilled workers redundant and requiring highly skilled workers to operate and maintain the new systems (Autor et al., 2003; Machin, 2001; Nickell and Bell, 1995). The theory was later amended to 'routine biased technological change', recognising that job expansion has continued at both the top and bottom of the labour market, with technology increasingly replacing workers performing routine activities in the middle of the skill distribution (Autor et al., 2006; Goos et al., 2009, 2014; Spitz-Oener, 2006; see also Nolan and Slater, 2010). However, for wages at the top of the distribution to dramatically pull away from the rest also requires that increasing demand for highly skilled workers has outstripped their supply. Given the expansion of education during the same period and the extent to which 'credentialism' has been observed, that is the qualifications of workers in roles has increased while the skill requirements have not (Goos and Manning, 2007; ONS, 2013; Lewis and Heyes, 2017), this seems a doubtful proposition. A more likely explanation is that the bargaining power of workers, below those at the senior levels of organisations, to share in the increasing economic product of their organisations has reduced (Onaren and Guschanski, 2018).

Trends in work and employment over the last fifty years, particularly in the UK, are consistent with the weakening of the majority of workers' position in the employment relationship. Rubery (2015) identifies four contributory trends, the four Fs: feminisation, flexibilisation, fragmentation and financialisation, which she suggests result from broad global trends interacting with political choices. These trends include the increasing importance of the service sector and the development of new technologies which support transnational networks of production. They interact with national and transnational political choices and institutions<sup>4</sup>, meaning that while there has been a common neoliberal direction of travel, this has been refracted and responded to differently in different countries, ensuring some enduring differences in national business systems or varieties of capitalism, and in the extent to which Rubery's four 'Fs' have been experienced (see also Hay, 2000). The UK is widely recognised to have actively liberalised its economy since the 1980s, including de-regulation, de-collectivisation and de-politicisation of the employment relationship (Rubery, 2015; see also Pyper, 2017), placing it in the vanguard of countries embracing and promoting the four Fs.

However, these changes have not produced the productivity benefits which they were intended relative to other developed economies (Brookes et al., 2018), and they clearly have consequences for how the economic growth which has been achieved is distributed. As will be discussed in subsequent sections inequality may actually be acting to inhibit productivity growth. The next section examines the recent history of low productivity growth across developed economies and the UK's particular problem with its nominal productivity as compared with other developed economies. Different diagnoses, predictions and solutions are examined from a macroeconomic perspective, although while recognising the issue of distribution, they do not address this.

#### **4. The UK's twin productivity problems**

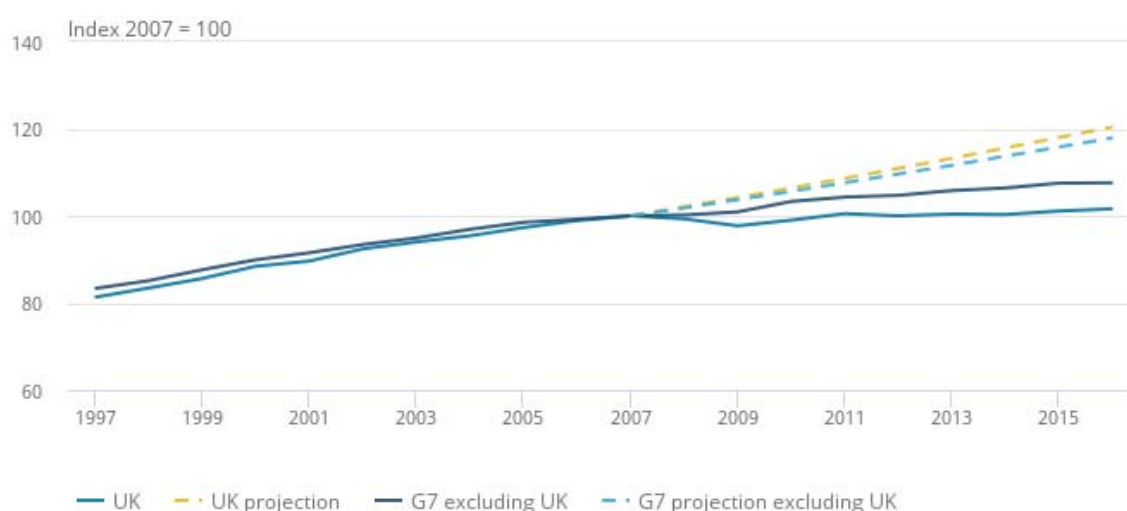
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<sup>4</sup> For example, the governance of product and financial markets at both national and transnational levels impact the employment relationship in addition to the national institutions of industrial relations (Thompson, 2003).

Developed economies and the UK in particular have had a problem with productivity growth since the financial crisis of 2008-9, with real productivity growth historically low. This means that the volume of goods and services produced per worker or worker-hour has not increased significantly for the last decade (see figure 3) As discussed, this is important because it underpins economic growth, which broadly raises living standards across economies and also increases tax revenues.

The UK also has a second problem, that its current price labour productivity, also referred to as nominal labour productivity, which is the current value in monetary terms produced per worker-hour, is lower than most of the G-7 economies (ONS, 2018). This could be due to the UK's balance of economic activities, there may not be the same concentration of high value-added activities in areas of the UK as in other developed economies, and/or that UK based companies are less internationally competitive within the same sectors. Recent analysis has tended towards the latter, suggesting that the UK has a long-tail of low productivity firms *within* each sector, which also displays regional variation (ONS, 2017a; 2017b; Haldane, 2017:11-15).

**Figure 3 Constant price gross domestic product per hour worked, actual and projections, UK and G7 countries, 1997 to 2016**



Source: OECD, Eurostat and ONS Calculations; Reproduced from ONS, 2018a

Various explanations have been put forward by macroeconomists for the last decade of low growth, with different degrees of pessimism for the future. The majority relate to inadequate aggregate demand as a consequence of a higher propensity of households and businesses to save and a lower propensity to invest. This in turn has been associated with a range of factors including: rising inequality, demographic change, the pressures of financialization to downsize and distribute, the debt overhang from the last financial crisis, cheaper capital goods from China, and new technology requiring less investment in capital (Reinhart, Reinhart and Rogoff, 2012; Bernanke, 2015; Summers, 2016). Proposed solutions include deficit based fiscal spending and increased spending from surplus producing countries, but such macro solutions do not address the underlying distributional issue.



Although agreeing with the pessimistic diagnosis for the future, Gordon (2014) has provided supply-side rather than demand-side reasons why productivity and economic growth will continue to be weaker than that experienced between 1891 and 1972. His arguments focus upon the US but have relevance to other developed countries. Gordon argues that a number of ‘headwinds’ will reduce per capita economic growth by reducing labour productivity, hours worked per capita of the population, or the majority of people’s share in the benefits of growth. They include an ageing population, educational stagnation, growing inequality, and a need for rising taxes and reduced transfer payments to balance budgets.

Independent of these growth reducing headwinds, Gordon is also sceptical of the capacity of the latest wave of technological innovation to produce a step-change in productivity growth. He argues that the third industrial revolution associated with computerisation has achieved a much shorter and shallower boost to productivity than the second industrial revolution of the turn of the twentieth century which included electricity, the internal combustion engine and wireless data transmission.

These broadly pessimistic predictions of growth, whether emphasising demand or supply-led reasons contrast with the views of the ‘techno optimists’ who predict accelerating innovation with huge productivity potential from automation related to AI technologies. Within this, two groups of commentators may be identified: those highlighting the skills, income and demand challenges arising from mass automation (Brynjolfsson and McAfee, 2014; Ford, 2015) and those looking forward to a post-work, post-capitalist world (Mason, 2015; Srnicek and Williams, 2015) While mass automation cannot be observed in the recent productivity and economic growth data, perhaps it could be seen in the future. As mentioned, harnessing technological innovation is also hoped by policymakers responsible for the UK’s industrial strategy to begin to address the UK’s nominal productivity deficit. We consider this potential and its likely impact upon workers in section 5.

## **5. New Technology as the solution to the UK’s productivity problems?**

Largescale, sustained productivity increases require the industrialisation of sectors of the economy, mass producing goods and services at low enough cost that a large number of the population are able to consume them (Broadberry, 2006). This has depended upon the standardisation and codification of activities and the division of labour supported by automation (Braverman, 1998). Following the previous waves of industrial revolution based upon steam and water power in the 19<sup>th</sup> century and electrification in the 20<sup>th</sup>, the application of computerisation since the 1980s has allowed the gradual automation of ‘cognitive routine’ tasks, whilst robots have allowed some ‘manual routine’ tasks to be automated, such as repetitive assembly, sorting and picking in controlled environments (Autor et al. 2003). Software packages, notably Enterprise Resource Planning (ERP), Supply Chain Management (SCM) and Customer Relationship Management (CRM) systems that standardise the background processes which organisations undertake and the way they interact with suppliers and customers have now been around for decades, moving downstream from implementation in large companies to SMEs, through the provision of lower cost services through the ‘cloud’. Such software allows companies to reduce the number of workers required to perform processes, outsourcing some to lower labour cost locations, and more tightly controlling and performance managing those workers who remain (for an assessment of their impact upon work in the retail sector see Evans and Kitchin, 2018) . One consequence of this has been a ‘hollowing out’ of work, while inequality of earnings have also dramatically increased (see section 2).

The promise of AI is that it will extend this process of automation into new domains, increasingly being able to perform activities currently considered to be too non-routine to be automated via the previous wave of computerisation. However, a brief assessment of the new technology puts some of these claims into question.

While there is no agreed definition of AI, one which gets at many of its key features is, ‘the name given to a collection of programming and computing techniques that attempt to simulate, and in many cases exceed, aspects of human-level perception, learning and analysis’ (Policy@Manchester, 2018). The techniques alluded to in this definition include: sensory related processing such as speech to text conversion, which underpins voice controlled digital assistants; image recognition and categorisation, used in medical diagnosis and autonomous vehicles; and natural language processing, identifying patterns in language necessary for document analysis and predictive text applications. Each of these has improved dramatically in recent years because they utilise techniques which can automatically learn from large datasets without having to be programmed for every possibility at the outset. The overarching name given to this is Machine Learning within which is the subfield of Deep Learning, which attempts to mimic features of the human brain in learning through artificial neural networks (see Alpaydin, 2016). Machine learning can also be applied to robots in an attempt to achieve self-learning in production lines or picking and sorting.

However, despite some impressive recent advances which are visible in everyday technology, including smartphones, AI technologies are not close to displaying the flexibility, adaptability and range of skills of human beings. In the language of computer science, they do not possess ‘general intelligence’ (Newell and Simon, 1976) but rather are ‘narrow’ or ‘domain specific’ (Kurzweil, 2005). The things which humans are good at and have evolved to do naturally such as rapidly making sense of new environments and making decisions from relatively limited sensory data is very difficult for machines (Waters, 2018). AI is good at finding patterns in very large, clean, well-structured datasets and then using that to solve well-defined tasks or problems, such as games but it does not have conceptual abstraction or understanding from this in the way that humans do (Al Khalili 2018). In most of the models attempting to estimate the impact of AI upon work, it is accepted that AI is not able to handle tasks that involve complex perception and physical manipulation, for example cleaning non-standard environments such as houses; creative intelligence, such as forming and testing hypotheses; and social intelligence, the ability to empathise with others, form relationships and hence to persuade or care for people (Frey and Osborne, 2013).<sup>5</sup> Given the way that machine learning occurs, it seems unlikely that these skills are going to be technologically feasible for machines in the foreseeable future. Drawing upon Bloom et al. (2017), Upchurch also highlights the tendency for largescale research projects to stagnate over time with diminishing productivity returns as new ideas become harder to find (Upchurch, 2018: 214).

This poses challenges for those who argue that AI will revolutionise work with associated productivity benefits. The theme that has catapulted AI into mainstream media attention are the predictions that it will result in largescale job losses, with machines replacing human workers on a vast scale. Frey and Osborne (2013) famously modelled that 47% of US jobs were at risk. However, more recent studies have dramatically downgraded this estimate to around 10% (Arntz et al. 2016; Nedelkoska and Quintini, 2018). The downward revisions are due not to a reassessment of the limitations of the technology but rather due to the increasing recognition that jobs, even many of

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<sup>5</sup> These were considered to be engineering ‘bottlenecks’ by computer scientists asked to identify the limitations of AI

those considered to be low-skilled, involve a bundle of tasks including activities that AI is simply not very good at.

Where AI has been deployed effectively to date, sometimes disruptively to an industry, has been in areas where the type of task could be easily separated from other uniquely human tasks that people perform. These include document discovery and analysis in legal services (Lohr, 2017) and medical diagnosis (Kohn et al., 2014). Even in activities well suited to AI, companies have faced difficulties. For example, interviews with practitioners involved in the implementation of AI in UK law firms have highlighted that they face challenges in cleaning and standardising data and training lawyers to be able to train the systems before they can be useful (Galiffi, 2018).

It is still very early stage in the application of the technology, but it is becoming clear that AI is more likely to augment workers performing re-defined roles than it is to wholesale replace them (Spencer, 2018). As discussed, there are many instances where people are still far more flexible and adaptable than AI and, depending upon labour market conditions, will continue to be much more cost effective (Manyika et al., 2017). Deploying AI will require the 'unbundling' of tasks, allocating them between people and machines to play to the strengths of both. This will raise challenges for organisations and professions, for example law and accountancy, in some cases requiring a new understanding of the most important human skills involved and re-defining the nature of training and progression. However, in many ways this should be viewed as an extension of the wave of computerised automation which has been occurring since the 1980s, rather than a radical step-change (Wyatt, 2018).

Given the technical limitations, socio-technical challenges and historical evidence of previous waves of technological innovations, we are sceptical that this new wave of technology will provide sustained growth in real productivity. As Upchurch details, new technologies tend to exhibit congestion effects, whereby after rapid, widespread adoption there are diminishing marginal returns and hence only a temporary boost to productivity (2018:214). This is consistent with Gordon's (2014) analysis that the productivity gains of the so-called ICT boom can only be observed between 1996 and 2004. It is also doubtful that new technologies will improve the UK's comparative nominal productivity in anything other than the short-run. As Porter has commented with regard the first wave of internet technology but could apply to any of the waves of enterprise computer systems, 'as all companies come to embrace internet technology, the internet itself will be neutralised as a source of advantage' (2001:62 cited in Upchurch, 2018:214). While AI may remove certain roles, the extent of predicted job-losses is being dramatically revised downward, this is before considering the new jobs that will be required. Even if AI does produce significant real and nominal productivity gains, this will not automatically address their distribution. In fact, as most of the macro-economic accounts in section 3 have recognised, unequal distribution is a factor in reducing demand, investment and resultant productivity and economic growth. As Spencer reminds us, technology is not an exogenous, inexorable force. There are choices regarding how it is designed and the impact that it has on work and workers. It could be designed so that productivity gains reduce average working time, spreading work more evenly across the available population and improving its qualitative content (2018:9). However, both he and Upchurch (2018:215) are sceptical of the likelihood of this under capitalism, as from a Marxist standpoint surplus value extraction from the remaining workforce needs to intensify in order to achieve a return on constant or fixed capital. However, enhancing the voice and power of workers could be a mechanism to ensure that society more broadly may harness the potential productivity benefits of new technology (Spencer 2018:10). With this in mind, we turn to the interconnected question of distribution and productivity in the final section.

## **6. Discussion and Conclusions - Beginning to address the UK's productivity problems**

We have highlighted in this paper the twin productivity problems which the UK faces: low real productivity growth and lower nominal productivity than comparable countries. We have argued that the reasons for these issues are multiple, and cannot be resolved by recourse to a single exogenous solution such as technological innovation. Real productivity growth involves the complex interplay of aggregate supply and demand. Nominal productivity levels are determined by the choices and strategies of individual firms compared to overseas competitors. The two are ineluctably linked. Macro-economic conditions are both a consequence of, and influence upon, the behaviours of individual firms. Firms face choices over their business models including investment in capital equipment, the management and training of staff and the distribution of rewards. The strategies available are influenced by supranational and national institutional systems (Hall and Soskice, 2001) which in turn provide the context in which labour and capital interact. Beginning to try and address the UK's twin productivity problems requires recognising the interconnected issues involved at different levels of analysis, which we outline further below.

Innovation in the organisation of production, and investment in the tools available, influences the supply side of the economy. However, as we have argued in the previous section, AI technologies pose as many challenges to the organisation of work as the benefits suggested by techno-optimists. Rather than treated as exogenous, something done to organisations, there are many choices as to how technology is to be designed and implemented and how workers and machines will interact and be managed. Involving workers in this process is central to ensuring that productivity gains can be realised and shared. New technology has the potential to reduce working time and free workers for more rewarding, higher value-adding activities (TUC, 2018b) but this has been promised by previous waves of technological innovation and yet rarely realised (Spencer, 2018).

New investment in capital equipment and redesigning how work is done on the supply side will not occur unless companies are confident that there is sufficient demand for their products and services to generate a return on investment and that other less risky business models are not available. As explained in section 3, aggregate demand is inhibited by a falling labour share of output and growing inequality between workers. The falling labour share indicates an inability of labour collectively to maintain its share of output as productivity increased. This is associated with a reduction in the coverage of collective bargaining (Hayter, 2015), from over 70 per cent of UK workplaces in 1984 (Brown et al., 2009) to around 26 per cent in 2016 (TUC, 2018). Growing within labour inequality has been a consequence of the top of the earnings distribution pulling away from the middle and bottom (Figure 2). This is also associated with reduced collective bargaining (Hayter, 2015), while recent IMF research links it to de-unionization and the erosion of minimum wages (Jaumotte and Osorio, 2015; see also Dickens et al., 1993). The causes of these trends are complex, but Rubery's four 'Fs' intensified by the UK's political choices towards the de-regulation, de-collectivisation and de-politicisation of the employment relationship (2015), coupled with trade unions' difficulties to organise in new establishments (Machin, 2000), indicates the multi-layered interplay of structure and agency involved.

As mentioned in section 4, the UK's poor real and nominal productivity performance is associated with a comparatively long-tail of poorly performing firms. This in turn is correlated with poor management processes and practice (Bloom and Van Reenen, 2007; ONS, 2017a; 2017b). As

discussed in section 2, firms are primarily focused upon their nominal productivity, as this is closely associated with the economic surplus which they can generate. If this can be achieved without increasing real productivity, then firms have the option to choose a low investment, lower risk path. Such 'low-road' business models are more easily pursued where there is a readily available pool of cheap and flexible labour, particularly in sectors where international competition may be limited. Again, this is associated with the de-regulation of the employment relationship, specifically employment protection legislation, which in itself tends to lower real productivity (Brookes et al., 2018) and establishes a vicious circle whereby an increasing number of people on low and precarious incomes reduces aggregate demand.

While we agree with the diagnosis of poor management in the long tail of UK firms, the management processes considered in this primarily economic literature are ill-defined, focusing upon the existence of targets and monitoring, primarily because this could be measured from ONS surveys. Qualitatively, practices and processes are likely to differ considerably between firms reporting that they employ them and the research councils have begun to recognise that further research is required in this area (ESRC, 2018). Furthermore, management processes of command and control are inconsistent with the claims being made of AI technologies to free workers for more creative and empathetic activities. Following this understanding of new technology, outlined in section 5, a more enlightened approach to management will be necessary, one in which the voice of workers needs to play an important part if potential productivity gains are to be realised (TUC, 2018a)

So where does this leave us in terms of potential solutions to the UK's twin productivity problems? From a theoretical perspective, if we apply the 'power over rents' framework to the generation and distribution of economic output outlined in sections 2 and 3 (Lewis et al., 2018), then strengthening the position of labour, particularly in terms of the regulation of the employment relationship and collective bargaining over economic surplus, would begin to address issues of distribution between labour and capital, could begin to address inequality of distribution within labour, and would provide workers with an important voice in the design of work as new technology is incorporated. Each of these outcomes, we have argued, would have a positive effect upon real productivity growth.

We realise, of course, that reversing the trends of the last forty years, raises considerable, some might say insurmountable, challenges. Grady and Simms, for example, have argued that financialization erodes the solidarities required for union renewal and makes it very unlikely that there will be the political will to re-establish the institutions necessary for effective, widespread collective bargaining (2018:8). This may well be true, however, it begs the question of why and how an international trend, financialisation, has been more completely incorporated into a regime of accumulation in the UK compared to other, admittedly Western European countries, where collective bargaining remains a deeply embedded element of production regimes. As Grady and Simms suggest, the neoliberal political and economic philosophy in the UK has informed policy making which facilitated financialisation (Ibid.:4). Therefore, in addition to the solidaristic challenges of union renewal, these political-economic ideas must be effectively challenged if there is to be any hope of institutional renewal.

One faint ray of light here is that as concern over rising inequality has risen, some previously hostile think-tanks and international institutions, including the OECD and IMF, have begun to rediscover the potential benefits of trade unions and collective bargaining. The faith placed in labour market flexibility (OCED, 1994) may be waning. In preparation for the 2018 Jobs Strategy (OECD, 2018b), the OECD has conducted in-depth research examining the role of different models of collective bargaining for pay inequality, labour market inclusion, and the workplace environment. They find

clear effects that co-ordinated systems of bargaining – for example at sectoral level - are particularly effective at tackling wage inequality. A key route for this is by reducing the links between wages and productivity, or rather, ensuring that the gains from productivity increases are distributed more effectively across the economy (See also Author A et al., 2018 for a discussion of the successfulness of this in the Scandinavian context). In contrast to earlier suggestions that trade unions achieved wage increases for their ‘insider’ members at the expense of ‘outsiders’ to the labour market, they also find that co-ordinated systems of bargaining deliver higher employment rates for groups subject to below average labour market outcomes, including women and young people (OECD, 2018b).

To be clear, we do not see collective bargaining as a panacea, there have been many issues and unintended consequences with how it has been historically implemented in the UK (Brown and Nolan, 1988; Ahlstrand, 1990). However, despite challenges over its design and execution, we do view it as one potential channel through which to address the distribution of economic product, and by extension improve real and nominal productivity. In this regard it is necessary to deal with a more directly economic argument against collective bargaining, that it cannot function in a highly competitive product market environment where there are no rents to share (Brown et al., 2009). In such an environment, raising wages can only raise costs, potentially driving less productive companies out of business. While we agree with the understanding of collective bargaining as determining the distribution of economic surplus, we disagree with the argument on two levels. First, contrary to causing economic harm, national and sectoral-level wage setting was an effective strategy adopted by Scandinavian countries to raise productivity and transfer resources to higher nominal productivity sectors under the Rehn-Meidner and FOS models. This deliberately drove less productive companies out of business and redistributed economic surplus through the taxation system (Lundberg & Henriksson, 1994; Lewis et al., 2018). Second, the claim that we are in a period of near perfect competition with minimal economic rents is inconsistent with the current era of financialization, where multinational corporations sit on huge retained earnings and achieve financial performance through share buy-backs rather than investment in their operations (Lazonick, 2014). This behaviour is entirely consistent with the low demand, low productivity, low growth environment in which the UK and other developed economies find themselves.

In summary, trade unions have long asserted that the decline of the collective institutions of the employment relationship has reduced workers’ fundamental rights at work, their ability to have a say in the decisions that influence their day-to-day lives and their ability to gain a fair share of productivity increases at a workplace, sector or economy level (TUC, 2018a). We would add that it has allowed poor management practices and a long-tail of low productivity firms to survive, damaging the UK’s comparative nominal productivity and lowering its real productivity growth. New technology is not the solution, what is needed is a rebalancing of the power of labour in the employment relationship.

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