

The Impact of AI on the Future of Work: Technology and Jobs in the Digital Era

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New technology is the foundation on which economies can grow. Short episodes of growth could take place for other reasons but long-term sustainable growth requires new technology. New technology raises productivity which enables higher wages, higher standards of living and better social services, such as health, education and environmental protection. Yet, in most cases the introduction of new technologies can be “disruptive”. New technology rarely, if ever, benefits all sectors of the economy and all workers to the same degree. There are winners and losers and although the winners far outweigh the losers in both number and financial gain some workers are hurt, by losing their jobs or by dropping behind in wage relativities. Sustainable growth requires “inclusiveness,” with all workers benefiting from it, which removes the incentives for disruptive behaviour by the losers.

Economic revolutions are events that disrupt established modes of economic organization and replace them with new ones. Inevitably, market participants who were playing key roles in the old regime lose their influence and in order to prosper they have to abandon doing the things that brought them large benefits in the past and engage in new types of activities. The role of government is to help them in this transition, not disrupt the development of new methods of production in order to “protect” them. In an open economy foreign markets can be a source of further growth if a country adopts the new technology fast enough but delays can cause loss of competitiveness and slower growth, even with the new technology. So with globalization of the kind that we have had since the 1980s it is not only adoption of the new technology that is important, speed of adoption is also important.

The agrarian revolution that was the first underpinning for the formation of communes and cities dates back 10,000 years. But agricultural employment absorbed the vast majority of the working population until much more recently, and in many countries it still does. The first industrial revolution started in England in the mid-18th century and spread to the rest of Europe and to North America over the following 100 years; it relied on land improvements that freed labour from agriculture, a good transportation system that was built on waterways and the railways, and steam power, which mechanized both transport and production. It led to the destruction of artisan jobs – ones that were performed by skilled craftsmen who took care of all stages of production of a good – and the obsolescence of the cottage industry, most

prominently of women weaving textiles at home. Machines at that time replaced skilled workers but were more efficient because they could produce the same things faster.

The second industrial revolution came with further improvements in factory production built on electric power and the internal combustion engine and led to the mass production of transport equipment, including at a later stage motor vehicles, domestic appliances and all kinds of consumer goods. This took place after about 1880, mainly in Britain, Germany and North America. New technology at this time replaced unskilled labour; the workers working in factories on mechanical and repetitive jobs were replaced by the assembly line.

The second industrial revolution and the development of consumer durables – cars, refrigerators, washing machines, and eventually bigger things like aeroplanes – brought the golden age of industrial employment, as every home in the industrialized world was becoming equipped with all kinds of appliances. The main industrial countries were employing as much as 40% of their labour force in the factories that housed the assembly lines.

The 1960s saw the introduction of digital technologies and computers. By the 1970s in industrial countries consumer demand for electric goods was slowing down to replacement demand and industrial jobs started disappearing. The Digital Revolution brought the computer to the workplace and the home, replaced even more unskilled or routine jobs than the second industrial revolution and led to the shrinking of industrial development, as services delivered at urban locations became the dominant force for job creation.

Computerization and new developments in digital technologies brought the internet and – nearly half a century after the introduction of digital technologies to the workplace – artificial intelligence, robotics, the internet of things and 3D printing; machines now have the potential to replace brain power to an extent unthinkable only half a generation ago. The disruption to the traditional economic models of production that is likely to be brought by the new technologies is still unknown. Countries that respond to the new technology by obstructing its adoption, be it driverless cars or cross-border internet transactions, will fall behind and lose large potential gains. Worse still, once restrictions are put into place to protect vulnerable groups they are very difficult to remove. Instead, they usually bring other restrictions to enhance the effectiveness of the earlier ones or to compensate those who suffer from the first set of restrictions. Eventually this vicious circle can lead to protectionism and bad politics of trade restrictions, industrial policies that subsidize obsolete jobs and populism in politics that lead to bad outcomes for the majority of a country's citizens.

Despite the above claims, however, one thing that is certain is that higher education attainment will always be associated with more job security. The reason is not necessarily the fact that lower skill jobs are more likely to be destroyed by machines, but also the fact that more highly educated people are more adaptable in the face of new technology and will be more likely to learn new techniques and find alternative employment if their jobs are made obsolete. In addition, digital technologies open up new opportunities for research that can lead to start-up companies with large potential. The smartphone is only ten years old yet today there are billions in use in the world! Such discoveries require a lot of human capital input and countries that succeed in getting in first will benefit. But although human capital

acquisition is essential for new research and productivity growth, it will not provide the jobs for the large numbers of people that can potentially be displaced by the new technology. Frey and Osborne (2013) examine tasks that can be replaced by automation based on digital technology and find that as many as 47% of US tasks can be destroyed by machines in the next two decades (and somewhat less in European countries). This number is too large if translated one-for-one for jobs at risk, because there is not a one-to-one correspondence between tasks and jobs, but even if maximum multi-tasking is taken into account, the estimated job destruction is not less than about 10% (OECD, 2019).

In parallel to the impact of the new technology on the number of jobs, there is also an impact on wages. The new technology increases the productivity of labour so overall rewards from production increase. But with computerization these rewards are not likely to be evenly spread across the working population. The reason is that highly skilled workers who remain in employment can enhance their productivity more than the average by making use of computers whereas workers in labour intensive sectors that cannot benefit directly from computerization do not enjoy the same productivity gains. As a result, the wages of skilled workers increase by more than the wages of the unskilled, increasing the gap between the two. In addition, because digitalization replaces many mid-level jobs, wages in these types of jobs stagnate, in the face of falling demand for labour. This shifts the wage distribution even more in favour of skilled workers.

Within the skilled worker group, the main beneficiaries are the very top income earners, occupying the managerial positions. Again the reason is the new digital technology in combination to globalization, which enables the successful companies to expand quickly and globally. The returns to capital, very often closely associated with the payoffs to top management, benefit from global expansion as the company's value increases to reflect the large market access. The big successes of recent years, Apple, Google, Facebook, Alibaba, Tencent, Spotify and many others are all based on new digital technologies that enabled them to access huge markets.

The rise in wage inequality started in mainly free-market Anglo-Saxon economies in the early 1980s with the first large scale introduction of computers in industry and the office. It continued into the 1990s but it is now checked, except for the very top managerial level, which still enjoys wage rises above the rest. But if the process of job substitution between humans and machines is the main reason for the increase in wage inequality, and given that it is still ongoing, we should expect further increases in inequality. Inclusive growth requires a more even distribution of the rewards from new technology than has been observed in recent years in the United States and in some other countries. China has been more successful in spreading the rewards from growth to larger numbers of workers so far but large-scale digitalization has not yet taken place. When the agenda of *Made in China 2025* begins to have a bigger impact on industry the distributional pressures that have been experienced in the United States will become stronger.

It follows from this discussion that the fourth industrial revolution can have harmful effects on large groups of workers both because of job losses and because of increases in wage inequality. If growth is to be inclusive and sustainable governments need to act to help the

displaced workers and check the rise in inequality. What can be done? I begin by addressing the job displacement issue.

John Maynard Keynes writing in 1933 claimed that as new technology takes over jobs there will not be enough work left for humans to do, so within the timeframe of “our grandchildren” we could all be fully employed by working fifteen hours a week. Although we are now in the generation that Keynes was talking about it is certainly not the case that 15 hours a week from a fully-employed labour force could account for all the work done in modern labour markets. But he was right about the trends. Hours of work do fall as technology advances. Germany and the Netherlands, two of the more technologically advanced countries in the OECD, have the smallest annual hours of work per worker in the Organisation, at about 1,400 hours. Greece and Mexico, two of the least technologically-advanced countries, have the highest, at about 2,080 hours. There is a fairly good correlation between productivity per worker and hours of work per worker, according to which countries with higher labour productivity work fewer hours. Noting that the productivity range is 15 to 65 (in 2005 constant prices and PPP US dollars), a 5 dollar increase in productivity (about 13% at the mid-point) is associated with a reduction of one hour per week. This is a substantial impact but not as much as could be expected if we just focused on industrial sectors that are more affected by new technology, like manufacturing.

The reason that jobs will not vanish and we should not expect a fall of weekly hours to as low a number as 15 is that new jobs are created in service sectors that cannot be automated. As societies become wealthier from the technological advances that destroy the jobs, they create new demands for services that cannot be replaced by new technology. These jobs vary from time to time and with artificial intelligence the impact of the new technology on jobs is less predictable; but it is fairly clear which sectors will attract the new jobs. William Baumol (1967) got the idea more or less right when he wrote that as technology advances labour shifts to sectors that experience less productivity growth, with the arts being an obvious destination that will never be automated. But the cost of those services will be going up and up with productivity rising elsewhere because workers need to be attracted by high wages away from the jobs that benefit from the productivity rise. This is known as Baumol’s “cost disease” and we certainly see it taking place.

But jobs in arts will not be the only ones remaining, even in the very distant future. Many other jobs cannot be automated. Health and care is a sector that will create many jobs, partly because, even with some tasks taken on by robots, people will still need care that can only be provided by human hands. Demand from this sector will increase more than average partly because of ageing populations and partly because as societies become wealthier they have more requests for good quality medical and nursing care. In less wealthy societies a lot of care is done in the home. Younger members of the family might look after ageing members at home and people suffering from minor ailments might stay at home until they recover. These practices become less common as educational standards for women rise and they leave the home for work in the market and as families become better off and buy more specialized medical services to speed up recovery than rely on self-help.

Another sector that will create jobs is the hospitality and leisure industry. Baumol’s arts fall into this category. More generally, as societies become wealthier and hours of work fall, there

is more travel, more restaurant meals, more nights in hotels, and so the demand for workers in this industry rises at all levels of skills. The demand for workers by households and companies for services traditionally regarded as “chores” will also increase as societies become wealthier. The history of the domestic worker is interesting in this respect. Up to the advent of large scale electrical household appliances housework was done by domestic assistants who would specialize in different areas: cleaning, cooking, sewing etc. When domestic appliances became widespread in the 20th century these jobs disappeared as householders, especially women, found it easier to do them themselves with the aid of the electrical appliances. But with rising living standards and more women acquiring higher education and entering the labour force, the jobs are coming back, only this time they are better paid and performed with the aid of the latest technological household gadgets.

Similar developments are taking place in office maintenance, real estate management, household accounts, shopping and home deliveries and even dog walking, all of which are services that are labour intensive and are now getting “marketized”; they are services that traditionally were done in the home by family members, mainly women, but as the technology of market services improves and their relative costs fall, they move to the market and are done by paid employees (Ngai and Pissarides, 2008).

Finally, the education sector is also creating jobs. Despite some automation, namely teaching with the aid of the internet and the availability of large teaching resources through freely-available internet sites, the demand for teachers for direct teacher-to-student instruction is increasing. This is partly because of smaller classes in schools and increasing demand for post-school education and training, including lifelong learning.

So jobs will be created and although this entails continuous structural change, such change has always been taking place since societies moved away from dependence on agriculture. Many of these services will be provided by individuals working on their own account but others will be provided by companies. The big companies of the future will be active in creating jobs of this kind – for example, companies like Apple and Amazon create jobs for delivery people and demonstrators in addition to the ones for the more specialized IT operators. But most of the new jobs in the service sector will be created by SMEs, the start-ups and specialized service providers. SMEs need support, especially in initial finance but also subsequently in the form of tax breaks and administrative simplicity. For this reason a policy that encourages industrial automation needs to be accompanied by supporting policies for the SMEs that will create the new jobs that will absorb the workers that lose their jobs in the technology sectors. A modern industrial society will have a small dynamic industrial sector that will drive productivity growth and most of the country’s exports, and a much larger service sector that will provide the jobs for its workers.

As with the earlier industrial revolutions, it is clear that more education and training in traditional STEM skills and the use of computers will move a person up the wage distribution. Education, especially one that takes into account the new technology requirements in both the industrial workplace and the office, makes growth more inclusive. At its most successful technical education in combination with the right market environment can lead to successful technology start-ups that yield large rewards to the workers and move the country forward, as experienced in the emergence of several technology hubs in the world. Technical

education, however, is not the only type needed in the environment of the fourth industrial revolution. Modern theories of the firm emphasize the importance of the broader concept of “intellectual capital”, which includes the traditional technical skills but also includes organizational concepts, managerial capital and social skills as important determinants of a successful firm (Stiles and Kulvisaechana, OECD, 1999, Wright, Dunford, Snell, 2001). The ability of the manager to combine the resources of the firm in a productive way, by giving strong incentives to the employees to direct their efforts to productivity-enhancing activities, and the ability of both manager and other workers to engage in social interaction and network building both inside the firm and with its customer base, are important determinants of success. Schooling and other forms of education and training traditionally pay less attention to such skills yet they are ones that can potentially yield high rewards in the digital era.

As most jobs will involve personal contact (health and care, household services, hospitality), especially the ones lower down in the skills distribution, education needs to provide it. Early school leavers will need training in person-to-person service provision. Current education systems do not provide such training but it is needed. A reform of the school curriculum on the basis of new labour market requirements will facilitate the entry of school leavers into the labour force and their speedy transition to a job.

The best form of sustainable inclusive growth is the one that rewards all workers sufficiently well to make them feel that their livelihoods are improving because of the introduction of new technology and the destruction of inefficient jobs. But very often the free market does not reward sufficiently all workers and in such cases social policies are needed to avoid poverty in working life – due to low-wage employment, unemployment, or disability. Social policies include pensions, provision of subsidized health care, childcare centres and other social services provided by the state. In most countries there are also direct transfers to people on lower incomes.

Such policies will inevitably require redistribution through taxation. Redistribution is not popular in most societies but it is inevitable if societies want to see a reduction in inequality caused by the free market in a post-industrialization world. The experience of the Scandinavian countries has shown that redistribution through the provision of public services such as childcare and health care is more easily acceptable in modern societies than direct redistribution that makes use of tax revenue to transfer money to unemployed or low-income households.

But as important in making growth more inclusive is the social perception of jobs. Many of the new service jobs that I have described do not have high social standing in the minds of most people. This has to change, for example through the educational system, so as to make them more respectable and more attractive to young people as career jobs. A good example is how the job of a chef has become socially more highly regarded, to the extent that the best performers have become media celebrities. Personal trainers are another example, now regarded as highly skilled qualified professional with high rewards. Sportsmen and women are in a similar situation. The reason that these jobs have moved up the social scale is that wealthy societies enjoy good quality product from these jobs and pay large rewards to the best performers. Such changes in social perceptions make growth more inclusive and sustainable.

In conclusion, we should reiterate that the automation of industry will raise productivity, make society wealthier but destroy jobs – especially routine mid-level jobs. There is still a lot of uncertainty exactly how the fourth industrial revolution will change the labour market but it is likely that the best social response will be fewer hours of work for everyone, more education for everyone, more jobs in labour-intensive service industries and a combination of high wages and social provision to ensure that growth benefits everyone in society.

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