

# THE FUTURE OF WORK

What are the implications of technological change for the labour market as we know it? asks **David Gruen**<sup>1</sup>

The displacement of jobs by technology—often technology from overseas—is one of the developments that is leading to a sense of unease among many in the community. This unease might be about the possibility that the jobs people are currently doing might be replaced by machines or, on a longer timescale, that there will be insufficient meaningful jobs for our children.

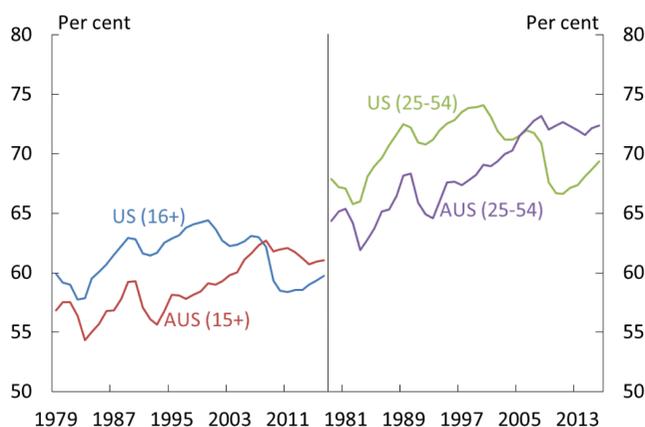
Fear that technological advances will render many jobs obsolete is an idea with a long pedigree. Probably the best-known historical example is the early 19th century Luddite movement, named after Ned Ludd, when English textile workers destroyed weaving machines because, having invested time and effort learning the skills of their craft, they feared that it would all go to waste as machines replaced their jobs.

Of course, the observation that the Luddites were on the wrong side of history does not automatically imply that a similar argument might not have merit in the modern world. After all, the technological advances we see all around us are far more widespread and sophisticated than those contemplated by Ned Ludd, and are capable of displacing a vastly wider array of human tasks than was possible in earlier waves of technological innovation.

Nevertheless, despite the technological disruption we see around us, the Australian labour market has performed well over recent years.

Figure 1 shows one measure of this performance. It shows a comparison of employment-to-population ratios for Australia and the United States since the late 1970s, for both the adult population (15+ in Australia and 16+ in the US), and for those of prime working age (aged 25 to 54).<sup>2</sup>

**Figure 1: Employment to population ratios**



Source: ABS 6202.0, BLS

On both measures, the US employed a larger proportion of its population than did Australia over several decades before the global financial crisis. Since about 2007, however, the opposite has been true, with employment ratios higher for Australia.

Both employment ratios continue to be higher in Australia in the most recent data, even though the US unemployment rate is currently more than one percentage point below the Australian unemployment rate.

The key lesson I draw from this comparison is that the avoidance of deep recessions improves outcomes



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in the labour market enormously over extended periods of time.

There is little doubt that significant structural and technological change has occurred in both the Australian and US economies over the past decade. In addition, Australia has experienced the largest sustained rise and then fall in our terms of trade in our history.

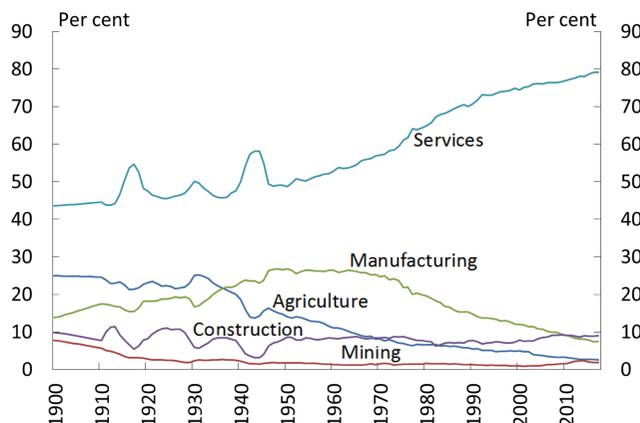
In the United States, many of those displaced from their jobs during this time—due to either recession, technology or trade—were unable to find alternative employment—at least over any reasonable period. And this inability to find alternative employment for displaced workers occurred despite the obvious flexibility of the labour market in the United States.

By contrast, in Australia, where there was no economic collapse because of the global financial crisis, and where the macro-economy continued to grow at a reasonable pace in its aftermath, it was possible for those people displaced from their jobs to find alternative employment. While clearly this was not true for everyone displaced from a job, it was true on average and in aggregate.

Jobs across the economy are not equally susceptible to being displaced by technology and automation.

Of course, technological change has affected organised labour markets for as long as organised labour markets have existed. Figure 2 acts as a reminder that technological change (along with changing patterns of demand) drives large changes in the sectoral pattern of employment over time. But our experience is that, provided the pace of technological change is not too rapid, it leads to changes in the demand for labour between sectors of the economy at a sufficiently gradual pace that the labour market can absorb them without too much aggregate disruption. At the beginning of the 20th century, around a quarter of the Australian workforce worked in agriculture, compared with less than 3% today. This significant transition has not been associated with any secular rise in the rate of structural unemployment because of the pace at which it occurred.

Figure 2: Shares of employment by sector



Source: ABS; RBA; Withers, Endres and Perry (1985)

### Is this time different?

Let me turn now to the current pace of technological change. Perhaps surprisingly, at the aggregate level, there has been no sign in recent years of a quickening in the rate of change of employment shares across occupational categories.<sup>3</sup> Further, it is hard to find evidence of rapid economy-wide productivity growth. Across the developed world, both labour and multi-factor productivity have been growing particularly sluggishly for some time.

Arguably, this lack of productivity growth could be a measurement problem. Productivity could be rising fast but our capacity to measure it could have become increasingly degraded. While this is a theoretical possibility, it is as well to recognise that measures of productivity have been subject to measurement issues for as long as they have been generated. Most scholars who have examined the issue carefully argue that measurement issues can explain some of the productivity slowdown, but only a minority of it.

An alternative possibility is that the disruptive technological changes we are observing will lead to strong enhancements to productivity but that these enhancements will take time to manifest themselves. A suggestive analogy is the invention of the electric dynamo, which had minimal impact on economy-wide productivity until factory owners figured out how to re-organise completely their factories to make the most of electric power rather than steam engines.<sup>4</sup>

It will take some time to assess the relative merits of these arguments.

But what has been clear for some time is that jobs across the economy are not equally susceptible to being displaced by technology and automation. Routine or predictable tasks are more susceptible to displacement than non-routine tasks. This observation applies to both manual and cognitive tasks—whether manual or cognitive, routine tasks are easier to automate than non-routine ones.

We can use occupational data from the Labour Force Survey to characterise jobs across two dimensions: whether they are manual or cognitive, and whether they are routine or non-routine, which leads to four distinct categories of jobs. Examining how the proportion of jobs in these four categories changes over time yields Figure 3.

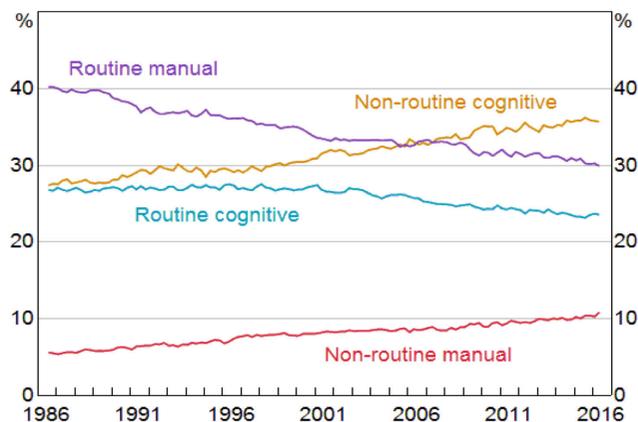
Over the thirty years since the mid-1980s, there has been a gradual, though noticeable, decline in the share of routine jobs, both manual and cognitive, and a corresponding rise in non-routine jobs of both kinds. With continued technological change and automation, we should expect these trends to continue.

How does the advance of technology affect the overall number of jobs in the economy? An insightful way to understand this is as a race between two technological forces: automation on the one hand, and the creation of new useful complex (non-routine) tasks on the other.<sup>5</sup> These are both ongoing, dynamic processes. All else being equal, automation tends to take jobs away while, acting in the opposite direction, the invention of new complex tasks creates new jobs.

In the history of technological advance, at least in the two centuries since Ned Ludd, the second process has broadly kept pace with the first. That is, there have been sufficient useful new complex tasks invented for people to do that there has been no secular rise in technological unemployment over that time. And importantly, with rising levels of education, people have risen to the challenge of mastering these new complex tasks.

One of the ways automation and the invention of new complex tasks interact is that tasks that are not eliminated by automation are often complemented by it. Thus, for example, the introduction of word processing eliminated the

**Figure 3: Employment shares by job type**



Source: ABS, RBA

typing pool but, at the same time, facilitated the transformation of the roles of executive assistants towards more complex tasks that were both more valuable for the organisations for which they worked, and could not be automated. Importantly, these tasks were also more fulfilling for the people doing them than the alternative of being stuck in a typing pool.

Let me digress briefly to discuss a further way in which technological advances have had an indirect impact on the labour market. That is the impact of technological advances on leisure activities, rather than directly on jobs. In a recent paper Joel Mokyr, Chris Vickers and Nicolas Ziebarth argue that the increased ‘quality’ of leisure is one of the underappreciated aspects of technological progress over the past century.<sup>6</sup>

Tasks that are not eliminated by automation are often complemented by it.

At one time, members of an elite leisure class spent much of their time engaged in activities like golf, hunting or formal dances. Mokyr et al argue that what makes today different is that there is so much high-quality leisure that now can be accessed at low cost by virtually anyone. The sorts of leisure activities they have in mind are watching drama or sport on a high-definition flat screen TV, attending virtual rock concerts or operas with high-quality sound, networking with friends via social media or, indeed, playing video games.

A fall in the cost of leisure and a rise in its quality is surely a positive development in general, since it provides direct benefits to individuals. Of course, standard economics leads us to expect these changes in the cost and quality of leisure to generate some substitution from work to leisure in response.

One group for which there is good evidence of such substitution is young men. Time use data for the US show that young men have substituted video gaming and other recreational computer activities for other forms of leisure. Furthermore, US men in their 20s experienced a larger decline in work hours over the past 15 years than either older men or women. (A similar pattern is evident for Australian men in their 20s, who have also experienced a larger decline in work hours over the past 15 years than either older men or women.)

It is worth noting the long history of leading thinkers who have overestimated the potential of new technologies to substitute for human labour and underestimated their potential to complement labour.

Academic research suggests that these two developments are related, and that a significant part of the decline in work hours by US men in their 20s is a direct result of the lure of video games for these young men.<sup>7</sup>

While young men may be enjoying ‘higher quality’ leisure by playing video games, the rest of us might worry about what this use of their time in early adulthood might mean for their prospects for fulfilling employment later in life.

Having gotten the topic of video games off my chest, let me return to the likely future impact of technology on jobs. A critical issue, but one on which there is no agreement, is whether the increasing sophistication of machines will eventually overwhelm the invention of new complex tasks, and thereby see machines substitute for all human tasks.

On this point, it is worth noting the long history of leading thinkers who have overestimated the potential of new technologies to substitute for human labour and underestimated their potential to complement labour.

To give two prominent examples, Maynard Keynes warned in 1930 that: ‘We are being afflicted with a new disease of which some readers may not have heard the name, but of which they will hear a great deal in the years to come—namely, technological unemployment.’<sup>8</sup>

Twenty-two years later, Nobel Prize winning economist Wassily Leontief speculated that: ‘labour will become less and less important. . . . More and more workers will be replaced by machines. I do not see that new industries can employ everybody who wants a job.’<sup>9</sup>

It is always easier to identify jobs that are at risk of being eliminated by technology and automation than to identify the new job opportunities that will emerge. Before they came into being, it was hard to anticipate that there would be roles in the 21st century for ‘big data’ scientists, cybersecurity experts, and online-reputation managers, to name just a few examples.

David Autor<sup>10</sup> provides a nice characterisation of those tasks that are particularly hard to automate. These are tasks ‘that people understand tacitly and accomplish effortlessly but for which neither computer programmers nor anyone else can enunciate the explicit “rules” or procedures. . . . tasks that have proved most vexing to automate are those demanding flexibility, judgment, and common sense—skills that we understand only tacitly.’<sup>11</sup>

Autor might well have added to this list tasks that rely heavily on interpersonal skills.

It is also worth noting that these attributes that make automation difficult—flexibility, judgement, interpersonal skills—are attributes that most clearly distinguish humans from other species.

### Some public policy responses

While the predictions of widespread technological unemployment have turned out to be wrong, at least thus far, there have been distributional consequences of the automation of routine tasks. Many advanced countries, including Australia, have seen significant ‘job polarisation’—the simultaneous growth of high-education, high-wage and low-education, low-wage jobs at the expense of middle-education, middle-wage jobs. Advanced countries have also seen a fall in share of national income accruing to labour, as opposed to capital.

Part of the growth of low-education, low-wage jobs results from rising demand for labour-intensive services that seem a long way from being automated, like health, aged and disability care, personal trainers and house cleaners. Some of the increased demand for these services is driven by rising living standards, whose ultimate source is the technological advances we have been discussing.

It is impossible to know whether continued technological advance will see a continuation of these trends, or their reversal. But anything that leads to changes in the distribution of income across groups in society, especially long-lived changes, is likely to generate a wider societal response to those changes.

Further, we should not ignore the costs borne by those displaced by technological change.

In contrast to earlier eras of job displacement by technological change, such as the original industrial revolution, in the modern world public policy has a role to play in helping people adjust and spreading the benefits of new technology more widely across the community.

In a recent speech motivated by the election of President Trump and the general *laissez-faire* approach of US public policy, the former Chairman of the Federal Reserve, Ben Bernanke, had this to say:

It's clear in retrospect that a great deal more could have been done, for example, to expand job training and re-training opportunities, especially for the less educated; to provide transition assistance for displaced workers, including support for internal migration; to mitigate residential and educational segregation and increase the access of those left behind to employment and educational opportunities; to promote community redevelopment through grants, infrastructure construction, and other means; and to address serious social ills through additional programs, criminal justice reform, and the like. Greater efforts along these lines could not have reversed the adverse trends [described earlier in the speech] . . . but they would have helped.<sup>12</sup>

Bernanke's list is motivated by the US experience. Nevertheless, it provides a helpful guide to those public policy interventions that can help support people at risk of being left behind by technological advance, as well as helping to spread the benefits of technological advance more widely across the community.

Public policy in Australia takes a much more active role across the dimensions identified by Bernanke than it does in the US. Since space does not permit an exhaustive list of Australian policy responses, I will limit myself to mentioning three of the more important ones.

First, the needs-based funding of schools combined with the Gonski review to achieve academic excellence in Australian schools. This holds out the promise of major improvements in school teaching of the skills and capabilities that will be needed by the next generation to adapt successfully to the further disruptive technological changes likely to occur throughout their working lives.

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Second, the range of programs designed to keep people attached to the labour market. These programs include Jobactive, for the unemployed; the Youth Jobs PaTH program, to provide assistance and new skills, including tailored industry-specific training, for young people seeking work; and ParentsNext, for disadvantaged parents, to provide support and training to develop their skills and prepare for employment in a way that recognises their role as parents. Most of these programs are targeted at people from disadvantaged backgrounds and groups with lower rates of workforce participation.

Third, the range of programs designed to help retrenched workers in disadvantaged regions to connect them with training, job opportunities and other forms of existing support. These are often complemented by substantial financial support

from government for regions hit hard when firms that previously employed a sizeable share of the region's population are forced to close down. We have had particular success in regional cities like Geelong, Newcastle and Wollongong, from which we continue to draw lessons. In many cases, corporations also have a role to play providing support for workers they are planning to retrench.

Nevertheless, helping retrenched, disadvantaged and older workers transition to new careers remains a difficult challenge. As policymakers, there is always a role for proper evaluation of programs and adjusting them when they are not working.

Public policy interventions like those I have listed improve the prospects that future technological changes will generate economic benefits spread more broadly across the community, and help to maintain broad community support for embracing such technological changes, rather than the ultimately futile attempt to resist them.

There have been recurring fears that technological advances would eliminate so many jobs that insufficient meaningful jobs would be left for people to do. That fear has turned out to be unfounded, at least thus far.

## Conclusion

Technological advances over the past 200 years have been the major driving force behind improved standards of living across the globe. Notwithstanding that, there have been recurring fears that technological advances would eliminate so many jobs that insufficient meaningful jobs would be left for people to do. That fear has turned out to be unfounded, at least thus far.

But we shouldn't be complacent. The latest wave of technological change is leading to some significant distributional consequences. Further, we should not ignore the costs borne by those left behind by technological advance. Public policy has an important role to play in helping these people adjust, as well as helping to spread technology's benefits more widely across the community. Among other things, this helps bolster

community support for continuing to embrace such technological advances, rather than turning inwards and attempting to resist them. Recent political events across the developed world reinforce the importance of this endeavour.

## Endnotes

- 1 I am grateful to Louise Rawlings and Dan Smith for enthusiastic assistance, Kerry Collins, Simon Duggan, Angelia Grant, Malcolm Greening, Linda Laker, Renée Leon, Nigel Ray, Jenny Wilkinson and Luke Yeaman for helpful comments on an earlier draft, and to Jason McDonald for comments and many illuminating discussions on the topic.
- 2 The employment-population ratios for the adult population in both the US and Australia have tended to fall in recent years because of ageing.
- 3 Jeff Borland, 'Are Our Jobs Being Taken by Robots?', *Labour Market Snapshot #31* (University of Melbourne, Department of Economics, 2016).
- 4 Paul A. David, 'The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox', *The American Economic Review* 80:2 (1990), 355-361.
- 5 Daron Acemoglu and Pascual Restrepo, 'The Race Between Machines and Humans: Implications for Growth, Factor Shares and Jobs', *VOX, CEPR's Policy Portal* (2016).
- 6 Joel Mokyr, Chris Vickers and Nicolas L. Ziebarth, 'The History of Technological Anxiety and the Future of Economic Growth: Is This Time Different?', *Journal of Economic Perspectives* 27:3 (Summer 2015), 31-50.
- 7 Mark Aguiar, Mark Bilal, Kerwin Charles and Erik Hurst, 'Leisure Luxuries and the Labor Supply of Young Men', *NBER Working Paper No. 23552* (National Bureau of Economic Research, June 2017).
- 8 John Maynard Keynes, 'Economic Possibilities for Our Grandchildren', in *Essays in Persuasion* (New York: Norton & Co., 1930).
- 9 Wassily Leontief, 'Machines and Man', *Scientific American* 187 (1952).
- 10 David H. Autor, 'Polanyi's Paradox and the Shape of Employment Growth', *NBER Working Paper No. 20485* (National Bureau of Economic Research, 2014).
- 11 There is, however, a new challenge to the notion that machines can't replicate tasks that require the tacit knowledge of humans, with machine learning making strides in that direction.
- 12 Ben S. Bernanke, 'When Growth is Not Enough', remarks at the European Central Bank Forum on Central Banking (Sintra, Portugal: June 2017).