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Productivity Commission

SHIFTING THE DIAL



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SUPPORTING PAPER **NO. 8**

UPSKILLING AND RETRAINING

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The Productivity Commission

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Key points

- Technological advances will create new job opportunities but will also displace some jobs, including occupations previously considered ‘irreplaceable’. If the education system, and those in or entering the workforce, are not responsive to changing skill needs, there is a risk of higher unemployment, underemployment and lower earning prospects, which in turn are likely to reduce engagement in the labour market.
- Improving the employability of workers through upskilling and retraining is a necessary response to the combined effect of an ageing workforce and technological change. However, negative stereotypes and myths about older workers’ abilities and their willingness to learn new skills create barriers to training opportunities. These need to be addressed if the economy is to benefit from their skills and experience through greater participation in the labour market.
- There are no easy ways of ensuring that the current workforce has the relevant skills, particularly given the uncertainty about the effect of technology on the usefulness of existing skills and occupations. However, a number of the reforms canvassed in chapter 3 of the main report will reduce barriers and assist people to upskill and retrain, including:
 - ensuring the schooling system delivers strong foundations not only helps with jobs and income prospects of young people, but also provides a strong basis for education and training throughout life
 - establishing an independent system that enables recognition of, and trust in, new ways of acquiring knowledge and skills that may stimulate further upskilling and retraining. The lower costs and greater flexibility of these new approaches may be particularly relevant for people who have existing job and family commitments
 - introducing graded assessment may assist future learning pathways for students wanting to upgrade their VET qualification to a university degree.
- In addition, consolidation of the growing number of government websites to assist people considering particular occupations and looking to undertake training should make it easier to navigate for the end user. Some of these users may be workers who have not had much contact with the education and training system for a number of years.
- The investment approach to welfare reform used for young adults at greater risk of welfare dependency may also have lessons for the development of employment and skill initiatives focused on older cohorts at high risk of losing their jobs due to structural adjustment.
- There are a range of other initiatives used internationally, such as career advice, learning accounts and tax incentives, that may have merit. However, the rationale, objective, policy design, effectiveness and costs of such measure should be carefully examined prior to their introduction.

1 Risks and pressures in the labour market

1.1 Jobs, change and future living standards

Jobs matter.

For almost all of us, they are more than a source of income, extending to the provision of opportunities for social interaction; a source of self-esteem; or a feeling of contribution to a profession or community.

From an economy-wide viewpoint, growing employment rates and higher labour market participation are primary sources of improved living standards along with the increasing skills and capabilities of workers. Encouraging labour market participation, skills formation and supporting a well-functioning labour market are vital steps that governments can take to ensure that society can maintain or improve its standard of living, particularly in the context of an ageing population.

But labour markets do not stand still.

Occupations, skills and jobs come ... and they go. More than a century ago, lamplighters, icemen, and telegraph operators fell into decline. In the middle of the last century, dunny men and bread delivery vans started to disappear. Towards the end of the century, switchboard operators, typists and TV repairmen became rarer and rarer. Travel agents, bank tellers and supermarket cashiers still exist as occupations, but opportunities in these occupations are diminishing.

Some jobs and occupations may be disappearing, but technology and changing consumer preferences are driving demand for new skills and jobs.

- High-skilled jobs tend to be complementary to new technology — raising productivity and the demand for suitably skilled workers. The productivity savings result in lower prices for consumers, higher wages for employees or higher profits, leading to increased demand and more jobs.
- With lifestyle and demographic changes and rising incomes, consumers are increasingly seeking new products and services, particularly when it enhances convenience. The internet, for example, is driving this demand and creating new jobs and occupations, primarily in the services sector. Demographic change has also increased the demand for workers in the care sector, including aged care and childcare.

History has shown that over the long run, technology and other labour market changes have been a friend to many employees, removing jobs that are often unpleasant, physically

tiring, dangerous or tedious. Overall employment persistently grew despite these fundamental technology changes (PC 2016a).

Profound labour market change on the horizon or manageable risk?

While the speed and magnitude of future technological change is contested, even the most conservative estimates suggest that the nature of occupations and jobs are likely to change sufficiently quickly that some skills will become redundant, with workers vulnerable to unemployment, underemployment, poor skills utilisation and lower incomes. The potential acceleration of automation into occupations previously not considered feasible means that a wider group of people may be affected by structural change (chapter 2 below).

Outsourcing is also presenting risks for the nature of jobs. There is increased scope to offshore jobs in the services sector, including in areas previously expected to be safe from outsourcing (such as jobs in human resources). And firms — enabled by exchange platforms like Freelancer — are able to contract out short-term, discreet tasks. The prevalence of the gig economy is often grossly exaggerated. Nevertheless, it may grow in significance, with a greater proportion of workers thus relying on a portfolio of work rather than long-term employment with a limited number of employers (chapter 3 below).

People are also working longer and retiring later. This trend is likely to continue (appendix A below). As noted above, this is generally considered good, as jobs provide income, purpose and social connections, along with the broader economy-wide benefits. But the increased need and desire to maintain strong labour market attachment also brings risks of vulnerabilities, as it is not always possible for people to work longer.¹ Workers in jobs that have a highly physical component (such as labouring or nursing) or whose skills have become redundant, may not be able to continue in these roles to the age when they are eligible to access retirement benefits.² Instead, they may have a material period in which they need to work in alternative jobs, with some workers requiring upskilling or retraining to make this change. Recent tightening of eligibility of social security payments, such as the increase in pension age, has heightened income risks associated with redundancy for older workers.

Collectively, these risks threaten employment opportunities, along with participation rates and Australia's standard of living. Some view these changes in the labour market as a looming crisis, while others see them as a sign that there is a need for a transition process

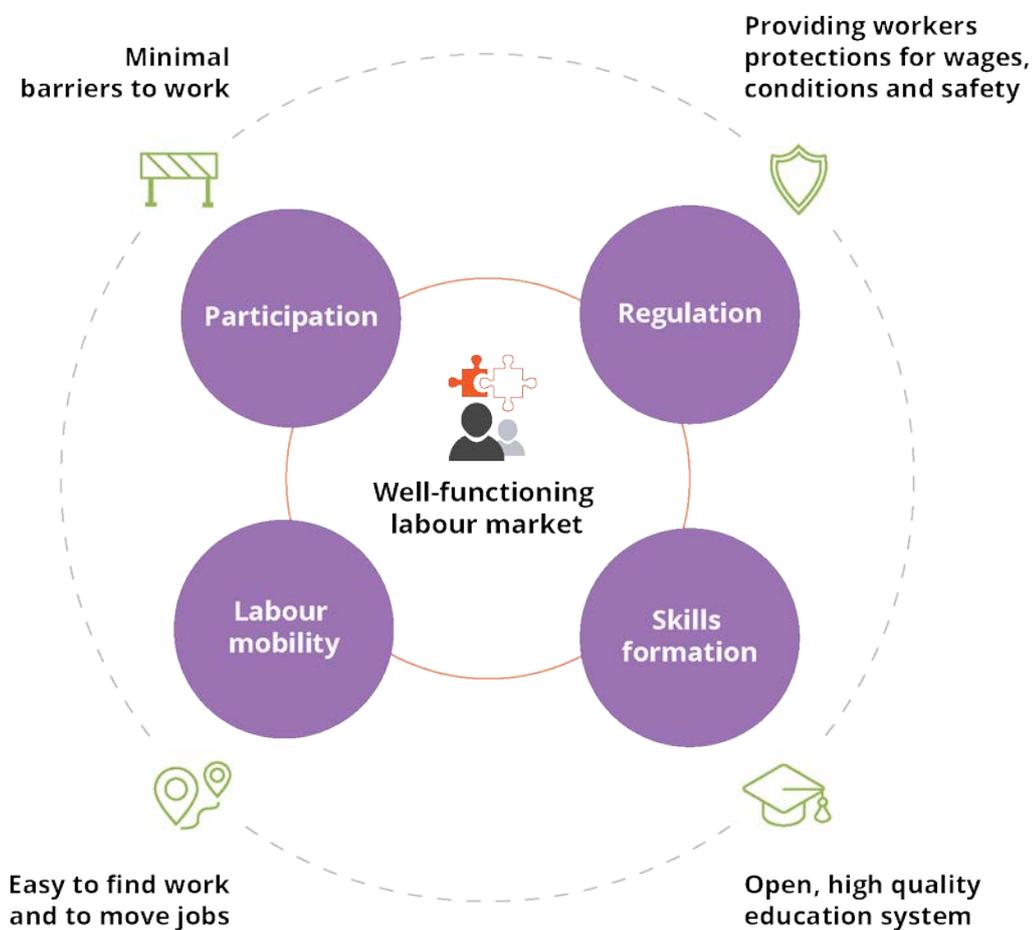
¹ A substantial share of retirements are involuntary, for example, due to retrenchment and subsequent difficulties in obtaining a job (Australian Centre for Financial Studies 2014). This increases financial insecurity in retirement or in the years leading up to retirement, particularly if workers have not received large redundancy payments.

² The average age of retirement among labourers is approximately 58 years old with 35 per cent retiring prior to 55 years old (ABS 2016c).

to deal with any potential obstacles and barriers (Dunlop 2016; Ferrier, Burke and Selby Smith 2008; PC 2013).

A comprehensive assessment of the ways to foster greater participation and employment, in light of these risks, would consider all aspects of a well-functioning labour market (participation, mobility, regulation and skills formation), as well as the interaction of government policies (such as superannuation and pension eligibility age) in achieving this aim (figure 1.1).

Figure 1.1 **A well-functioning labour market**



This paper examines one element of this wider issue: skills formation for working-age individuals. In particular, it investigates the role can governments play in creating an environment to cultivate and encourage retraining and upskilling of the population to foster an extended (retiring later and less involuntary retirement) and fuller working life (less periods of unemployment and less underemployment).

While the estimated effects on GDP of increased participation of older workers are significant (box 1.1), concerns over the effects of ageing on material living standards do

not per se justify policy initiatives to increase involvement by older people in work. People value retirement and the leisure it brings. Indeed, Figgis (2012) highlighted that many non-professional or low skilled workers viewed retirement as a ‘relief’ and that work was something that was ‘suffered’ (p. 10). However, the economic and social benefits of more enduring participation are genuine if people’s choices of retirement are involuntary and reflect avoidable obstacles, such as obsolescent skills.

Box 1.1 Greater participation will bring sizable economic effects

The economic effects of greater participation in the labour force can be high.

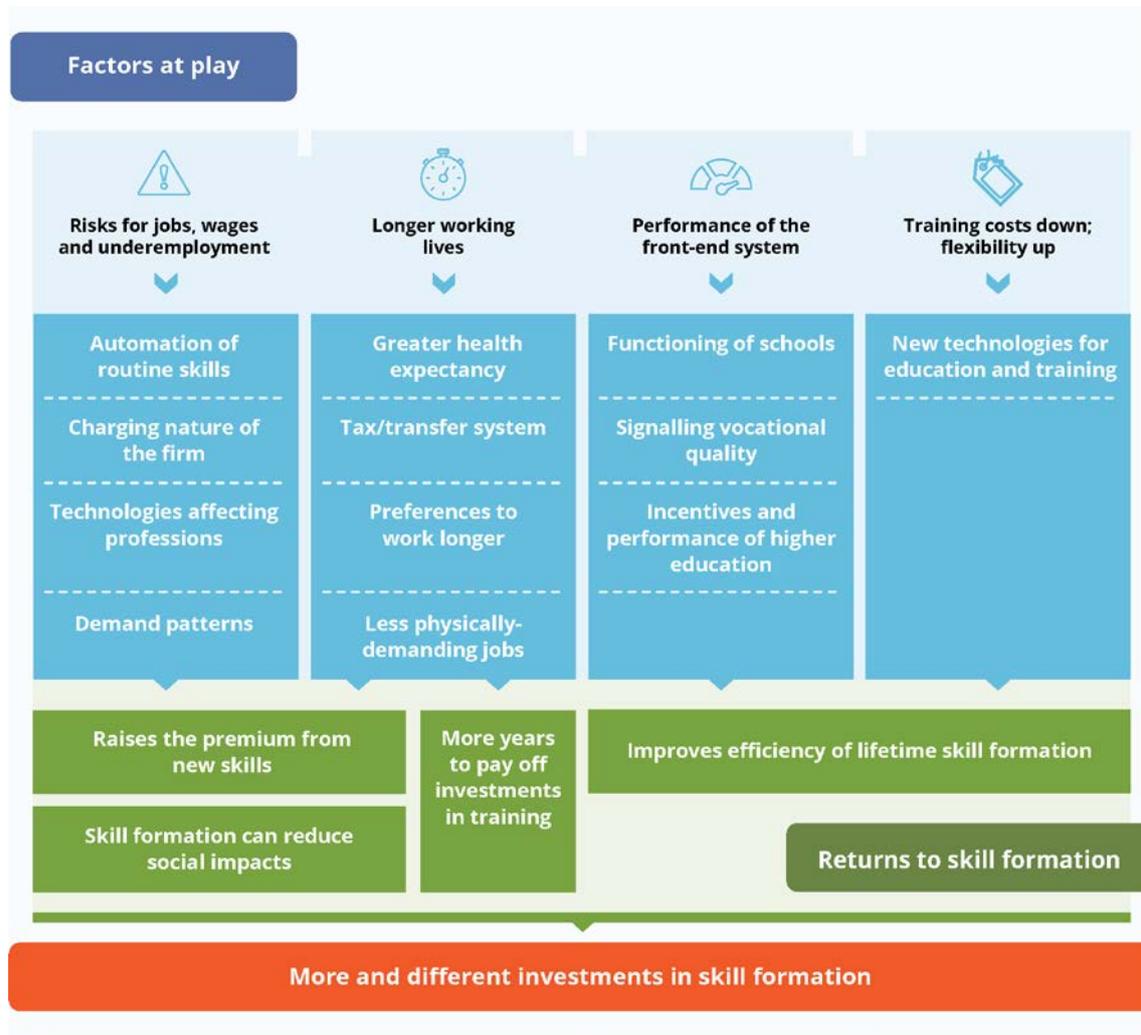
- PwC estimate that if Australia's employment rate for workers aged 55 years plus (52 per cent) was to increase to Swedish levels (74 per cent), the potential gains could be about \$69 billion or 4.7 per cent of GDP (PwC 2016).
- The Grattan Institute estimated that a seven per cent increase in the mature age labour force participation rate (to bring it to a rate that would still be less than New Zealand's) would raise GDP in 2022 by about \$25 billion or 1.4 per cent (Daley, McGannon and Ginnivan 2012).
- Deloitte Access Economics (2012) estimated that an extra three percentage point increase in participation among workers aged 55 and over would result in a \$33 billion boost to GDP – or 1.6 per cent of national income.

While these exercises highlight the potential economic effects of higher labour force participation or employment, they model quite large changes, but with limited evidence on how such changes would be achieved (with the exception of the Grattan Institute's analysis).

Workers reap personal benefits (financial and non-financial) from staying in the workforce longer. Generally, working provides an income that is above the pension allowance and is an avenue for contributing to superannuation balances, which provides for greater income in the future (AHRC 2012). Approximately three quarters of people in older low-income households received at least 90 per cent of their cash income from government payments, mainly the age pension (AHRC 2016). Working may also provide non-financial benefits, such as purpose and meaning to daily life, as well as social interaction, which can help boost people's confidence and self-esteem (Aylward 2015; Davenport and Kirby 2016).

The main premise of this paper is that, given the likelihood of continued structural change, it is worthwhile encouraging training and education of those in the labour force because it benefits both workers and the wider economy. This reflects the Commission's view that the threats and opportunities posed by new technologies and markets to existing occupations will be manageable and, combined with people working longer, will increase the payoff to upskilling and retraining of workers (figure 1.2). But workers, particularly older workers, face barriers to upskilling and retraining, potentially limiting the uptake of worthwhile skills formation. A more detailed understanding of the main pressures and barriers faced by workers is outlined in chapters 2 to 4 below.

Figure 1.2 **Skills formation for existing workers — drivers and implications**



Core competencies are changing, increasing the need for ongoing learning

For many future jobs, new skills and knowledge will be needed as part of the core competencies (CEDA 2017). Basic foundations in science, technology, engineering and maths have been highlighted as important, along with business acumen and entrepreneurial skills (PC 2016a). At a fundamental level, all workers will also need the skills to interact with digital technology — whether it is maintaining records in caring professions, taking orders in hospitality, or operating equipment in a processing plant. A range of ‘soft’ skills (such as communication, empathy, creativity and adaptability) complement other ‘harder’ skills, and are useful to navigate changes in job requirements (CEDA 2017; Vandeweyer 2016). In short, while an innovative economy requires the development and

use of skills in many disciplines and at a variety of levels, ‘there is no skills-related silver bullet’ (OECD 2015b, p. 50).

It is well accepted that education in the early years of life is vital. Consistent with this, there has been considerable policy focus on preparing younger cohorts for future labour markets (however, there are signs that Australia’s school system is not functioning well (appendix B below)). But a greater commitment needs to be given to ensuring ongoing education and training, including work-based training, so that workers are able to develop new core competencies and skills and be able to navigate the expected labour market changes.

To highlight the importance of ongoing skills formation consider the following situation. A person aged 55 years retiring in 2003 would not, for work purposes, need to understand and use smartphones, social media, the Cloud or modern internet search engines. In contrast, a person aged 65 years retiring 10 years later may have needed to understand these digital tools at work. Accordingly, decisions to change retirement dates affect the knowledge and skills that people need at work.

A matter of definition

The target group of this paper is working age individuals above the conventional age of completing a post-secondary school qualification (either a vocational qualification or a university degree) directly after high school (that is, approximately 25 years old and above). This contrasts with many labour market structural adjustment studies that focus on mature age or older workers — which are generally considered to be people (at least) above 45 years and older.

The broader group has been chosen because potential labour market vulnerabilities are not only a result of age. Some older workers fare quite well in the labour market, working into their 60s and sometimes their 70s, particularly those with a university education (ABS 2016b). By focusing on this broader population there is potential to reduce labour market vulnerability before these workers reach this ‘older’ category. Therefore, rather than focusing on age alone, it is more constructive to consider the factors that make employability difficult for certain types of workers, such as the relevance of skills for future workplaces (Billett 2011). However, much of the evidence and data, particularly on the barriers to education and training, relate to the mature age workers — those 45 years and older.

2 Automation and future work

Technological developments have been happening for centuries — changing the way people live and work. A key question is the technological prognosis over the next 30 to 40 years, and associated with that:

- the degree to which transitions between jobs can occur autonomously
- the extent to which government policies, from taxes on mobility (like stamp duty), inadequate transport planning and investment, and education and training, may be required.

To determine what policies may be necessary, in particular in the education and training sector, it requires an understanding of the nature of technological change and its timing. This chapter focuses on automation.

2.1 Some see high risks for many segments of the labour market

Some profess ‘little doubt’ about the increasing effect of technology in the early 21st century (Frey et al. 2016) or that the acceleration of technological achievement is ‘unprecedented’ (in an ILO paper by Chang and Huynh 2016). The diagnosis is that the associated changes in the nature and type of work will increase the rate of obsolescence of workers’ skills, making more jobs redundant than in the past, with workers changing occupations more frequently than ever (Bostrom 2014; Brynjolfsson and McAfee 2012).

These claims stem from expectations that technological developments will move into areas that were previously not considered feasible (non-routine manual and cognitive tasks) (PC 2016a). Not only are machines starting to undertake these tasks, in certain circumstances, they can make better decisions than people, as they are free from factors which often impair people’s decision making. For example, Rio Tinto runs two mine sites with driverless trucks that eliminate a ‘very high risk role, where employees are exposed to fatigue’ (Diss 2015, p. 1).

The concerns of widespread job losses have been underpinned and reinforced by a series of recent empirical studies. These are largely based on a common methodology developed by Frey and Osborne (2013), which rates the degree of vulnerability of hundreds of occupations. Depending on the occupational mix of any country, the studies estimate that somewhere between 30 to 60 per cent of *existing* jobs will disappear in a range of countries, including Australia (Chang and Huynh 2016; Deloitte 2014a; Durrant-Whyte et

al. 2015; Edmonds and Bradley 2015; Frey and Osborne 2013; PwC 2015). Many of these predicted job losses are a combination of the continued automation of jobs that has been occurring over recent decades, along with automation advancing into new areas.

Some offer unsettling predictions of mass job losses with no ‘higher ground’ for workers to move to (that is, more skilled jobs), as they have in the past. Essentially, they predict that there will not be enough jobs and hours of work (for example Brynjolfsson and McAfee 2012; Dunlop 2016). In that vein, some argue that government should end ‘miserable busy-work’ or ‘job pathway’ schemes as there will not be enough jobs to transition to (Dunlop 2016, p. 1). Instead, they suggest that governments need to investigate systems for distributing wealth, including a basic or universal income.

The *timing* of the possible structural adjustment associated with automation is less precise than the *extent* of adjustment, yet is equally important. Frey and Osborne refer vaguely to changes over the ‘next decades’, but Deloitte and the ILO studies refer to changes over the next 10 to 20 years. The implications for education and training policy are quite different if the pace of change is slower and anticipated.

2.2 But the actual effects will likely be less severe and more amenable to policy action

Fortunately, it is likely that the dire predictions of rapid change suggested by some commentators are misplaced. This increases the prospects for automatic market responses to technological change, as well as the potential for successful policy initiatives to assist in labour market transitions. As several economists observed:

From our perspective, the more extreme of modern anxieties about long-term, ineradicable technological unemployment or a widespread lack of meaning because of changes in work patterns seem highly unlikely to come to pass. As has been true now for more than two centuries, technological advance will continue to improve the standard of living in many dramatic and unforeseeable ways. However, fundamental economic principles will continue to operate. Scarcities will still be with us, most notably of time itself. The law of comparative advantage strongly suggests that most workers will still have useful tasks to perform even in an economy where the capacities of robots and automation have increased considerably. (Mokyr, Vickers and Ziebarth 2015, p. 47)

There are two main of methodological concerns that cast doubt over the scale of the predicted job losses occurring.³

One reason is that the dominant method for calculating vulnerability to automation ignores the substantial variation in the complexity and skills required for tasks within an

³ Atkinson and Wu (2017) are quite scathing of the Frey and Osborne methodology used to calculate job losses noting that they are ‘the products of faulty logic and erroneous empirical analysis, making them simply irrelevant to the current policy debate’ (p. 1).

occupation and that once this is considered, occupational vulnerabilities are much reduced. One estimate of job replacement based on analysis of the task content of individual jobs rather than occupations suggested that just 9 per cent of jobs on average, across 21 OECD countries were at high risk of automation (Arntz, Gregory and Zierahn 2016). (Nevertheless, they still found a further 20 to 35 per cent were at risk of having at least half the component tasks changed significantly because of automation.) If it is tasks (rather than entire occupations) that are replaced by technology, this would slow the process of making jobs or skills redundant.

Another reason is that the bleak projections relate to gross jobs, not net jobs. Historically, technological advances have also created new jobs. This is evidenced by the absence of any pronounced downward long-term trends in Australia's employment to population ratio or a sustained increase in unemployment rates (PC 2016a). The degree to which new jobs involve higher skills varies because there are several mechanisms that affect the skill composition of jobs:

- Technology is often complementary to high-skilled labour. This skilled labour, combined with technology, raises the productivity and the demand for skilled workers.
- Technology also creates jobs throughout the economy. Productivity gains arising from technological progress flow through to the economy — as lower prices, higher wages for the remaining employees, and/or higher profits — to create new demand and associated jobs (Autor 2015).

Multiple factors limiting a job destruction tsunami

Apart from the methodological difficulties of forecasting occupational vulnerability, there are multiple other factors that suggest that a job destruction 'tsunami' is not likely to hit soon.

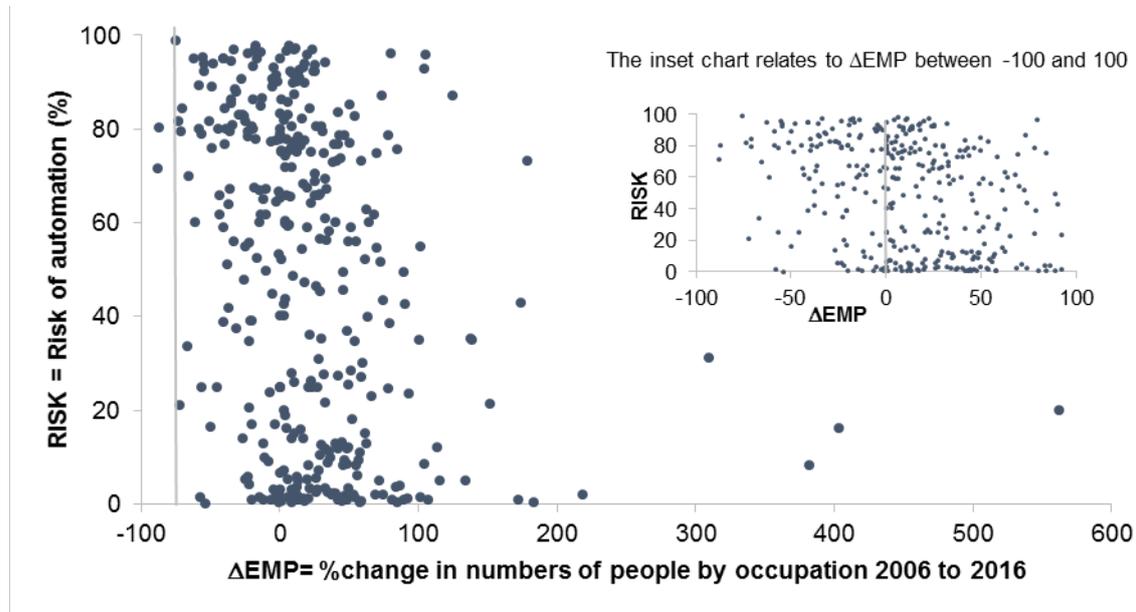
- The uptake of technology is highly dependent on consumer preferences, their ability to trust technology, relative costs of technology and the regulatory frameworks operating (PC 2016a). Consequently, for many technologies, diffusion is relatively slow. This is suggested by the divergence in apparent productivity levels in given industries between countries and by evidence on the varying productivity levels between businesses (Bloom et al. 2012; OECD 2015a).
- There is evidence that the current wave of technological development is similar to past transitions — jobs are being automated at a comparable pace to that of the last century (Miller and Atkinson 2013; Williamson et al. 2015). In this context, it is unlikely that across a whole economy, occupations would be displaced by automation at the rapid pace forecast by pessimists.
- The investment required for widespread automation would also be very large, and it would be hard to see investment of that magnitude across much of the economy over a short period. It would also entail the mass scrapping of existing capital. Investment

growth is currently low relative to past trends, even after accounting for falls in mining investment (Supporting Paper 1).

- Factors other than technology will also influence the nature of future jobs (such as increased demand for aged care services), which often require skills that are difficult to automate (Gahan 2016). It is hard in the foreseeable future to see machines — ‘intelligent’ or not — as fulfilling people’s need for authentic emotional connections that are required in many caring jobs. Machines might be able to simulate these crudely (like Pepper, an ‘empathetic’ robot developed in Japan by Softbank), but people know they are programmed not real.
- Occupational risks are moderated by the growth in the Australian labour force and total employment as the population rises. This provides the scope for the share of an occupation in total employment to fall, but for total employment in that occupation to rise (or not fall by much). To the extent that this holds, this provides scope for people to avoid the problems of vulnerable occupations by not entering them when they start their careers, or to develop new skills and move to other occupations while still holding down a job (the latter being the prominent policy issue for this paper).

The empirical evidence highlights the relative importance of factors other than automation to the growth of employment of particular occupations (figure 2.1). While certain jobs have been at risk of automation for some time, the growth and decline in occupations has not always followed predictions (based on their risk of automation). It appears that some apparently high-risk occupations have fared well (or at least grown) in the past decade, notwithstanding that the technologies that make their skills redundant are already in existence (checkout operators, laundry workers, transport and dispatch clerks, general clerks, payroll clerks and real estate agents for example). Moreover, some occupations with non-automatable skills, such as visual arts and crafts professionals, have contracted significantly.

Figure 2.1 **Occupations with high risks of automation have not always fared badly in the previous 10 years^a**
2006-2016



^a There were a limited number of occupational categories at the 4 digit levels that did not include an assigned automation risk from Edmond and Bradley (2015). Rather than exclude these from the analysis, subjective judgments were made about their risks – based on the job type and the risks for similar occupations.

Sources: Edmond and Bradley (2015); ABS 2016, *Labour Force, Australia, Detailed, Quarterly, Nov*, Cat. no. 6291.0.55.003; and PC calculations.

2.3 Claims may be overstated but still grounds for concern

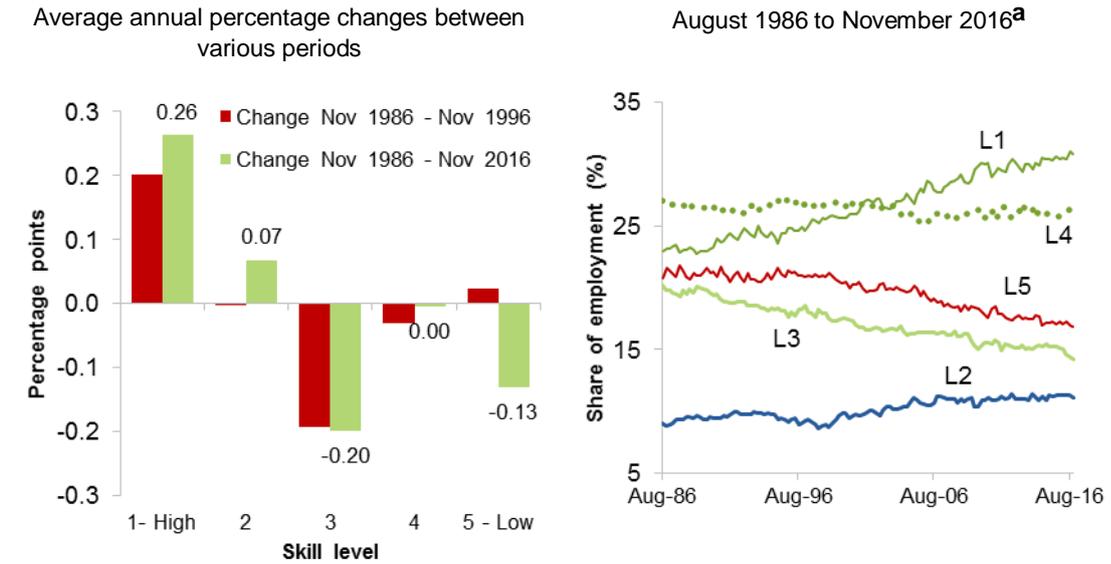
Although the effect of automation on net employment may be much less than claimed by some, there are reasonably grounded concerns about the impacts of automation on jobs, industries and occupations.

History tells us that structural change can be significant

The historical data — while suggesting less extreme outcomes than the predictions — support the contention that significant structural change can occur over several decades (figure 2.2). The impact of skill level on the composition of the labour market shows that high-skill occupations have increased in significance throughout the three decades from 1986, and that moderate (level 3), rather than lower-skill occupations, have experienced the biggest and continuous reduction in shares (Coelli and Borland 2015). In part, this may reflect that there has been a substantial expansion in low-paid, relatively low-skilled jobs in

community and personal services (for example, child, aged and disability care workers; educational aides; and fitness instructors). Routine manual jobs have declined since at least the mid-1980s, and routine cognitive jobs since the early 2000s (Heath 2016).

Figure 2.2 Which jobs are advancing and retreating?
1986 to 2016



^a L1 to L5 refer to skill levels

Source: ABS 2016, *Labour Force, Australia, Detailed, Quarterly, Nov*, Cat. no. 6291.0.55.003; and PC calculations.

The past record of technological disruption shows that some cohorts have been affected more than others, such as male mature-age workers those with limited English, lower educational qualifications, or in blue collar jobs (Murtough and Waite 2000).⁴ Case study evidence also suggests that job displacement outcomes vary considerably across different businesses, depending on the nature of the local labour market, the age of the worker (older people fare worse) and the scale of the displacement (Borland 1998). Longitudinal data show that the likelihood of still being in the labour force in 2011 for a person who was unemployed in 2006 is dependent on age and educational attainment. For example, the likelihood that an unemployed person aged 45-54 years with a postgraduate degree in 2006 was outside the labour market in 2011 was about 23 per cent. Different ages and educational levels produce significantly different outcomes:

⁴ A major reason for the uptake of the Disability Support Pension prior to the 2000s was the long-term unemployment of low-skill, older workers associated with structural changes in manufacturing. Once on the DSP, few ever left to get another job (death and eligibility for the Age Pension being the most common reason for exiting this payment).

-
- *Age effect:* For an otherwise similar person aged 35-44 years in 2006, the likelihood was about 9 per cent
 - *Education effect:* For an otherwise similar person with only school education in 2006, the likelihood was nearly 40 per cent.⁵

It is hard to argue that structural pressures will abate in the future. Therefore, even if there is no ‘average’ adverse outcome for employment and participation associated with automation, this would provide little solace for specific groups that are more likely to be affected.

Furthermore, even if participation and unemployment rates are not affected by new technologies, wages and hours worked may be affected. Many of the jobs requiring manual dexterity or personal skills that cannot readily be automated (domestic tasks; disability, aged and childcare) are at the lower end of the wage distribution and involve part-time work.

2.4 Other developments that affect occupations

Much of the current analysis of the risks for jobs and wages posed by technological progress assumes that automation of tasks is the predominant form of disruptive technology. That may be the case, but this could overlook some other important technological and economic drivers that affect future jobs, but are unrelated to the sophistication of the tasks involved in those jobs. Appendix C examines two case studies in the education and health sectors, and how occupations, which may be at low risk of automation, may face reduced demand as a result of technology (other than automation), changes in consumer preferences, task redesign and regulation.

⁵ Based on Productivity Commission calculations using the ABS Australian Census Longitudinal Dataset 2006-2011.

3 Digitalisation is changing the nature of firms

Technologies and markets have always shaped the nature of businesses and their labour markets. For example, electricity generation in Australia used to be a municipal function supported by local poles and wires. That changed with the advent of large relatively remote coal-fired generators and associated long-distance transmission networks. It then changed even more with the creation of the National Electricity Market. Just as that market is underpinned by sophisticated communication technologies, often so too are domestic and global supply chains.

While emerging technologies will have many effects on business structures, concern often centres on the growing significance of offshoring and the gig economy, and their implications for skill formation, labour markets and trade regulations.

3.1 Offshoring

Digital technologies have changed the extent and nature of links between geographically-separate businesses, or arms of them, either within Australia or offshore. This has permitted more offshoring of traditionally non-traded services involving skilled jobs like accountancy and IT services, and low-skill jobs such as call centres located in low-income countries using voice-over-IP systems (Deloitte 2014b; Smith 2014).

As offshoring is a global phenomenon, it cannot be assumed that it will lead to overall job losses in the affected high-skill occupations in Australia. Indeed, there is some (albeit dated) evidence that demand for Australian high-skill jobs has increased because of offshoring by other countries (Woods 2007).

Nevertheless, as occurred with competition from low-wage developing economies in basic manufacturing, it seems likely Australia will experience a relative decline in more routine service jobs that do not require face-to-face contact. As with trade liberalisation generally, this can be expected to shift people between jobs and occupations rather than affect aggregate employment. One of the reasons for this is that offshoring lowers production costs for domestic businesses, reduces prices, increasing consumer demand and inducing demand for the types of jobs still required in the home country (for example, non-routine abstract tasks, such as marketing and design).

But it could lead to the stranding of some people with skills that would formerly have been expected to be safe from structural change (such as human resources jobs). Retraining may

be an important resort for such people to maintain employment, and they may have a greater capacity to retrain given their existing skills.

An added ‘political economy’ argument for government investment in proactive retraining is that the effects of offshoring can fuel demands for regulatory measures to limit its use. Governments can reduce this risk by increasing the labour market prospects of those people who are adversely affected. Others have equally noted that improving skills, rather than regulating offshoring, is the key policy imperative:

Task upgrading occurs because the offshored tasks are less complex than the tasks that remain at home. Because offshoring can lead to productivity gains and task upgrading at home, what policymakers should prioritize is not curtailing offshoring but rather helping domestic workers seize the opportunities presented by task upgrading. Policymakers can do this by supporting domestic workers in building the types of communication and cognitive skills that domestic firms have a hard time finding abroad through forward-looking vocational education for future workers and focused retraining programs for current workers. (Ottaviano 2015, p. 9)

3.2 The gig economy

Businesses are platforms for organising labour and capital. In their traditional form, they typically involve interpersonal relationships — hierarchies, training, career development, monitoring — and can often adapt quickly to the needs of individual employees. The actions of employees are subject to clear managerial direction (one of the key criteria for the legal definition of an employee rather than a contractor).

The gig economy departs from this model. The platform is digital and more impersonal. The rise of platform websites (such as Uber, Upwork, Whizz, Freelancer, Airtasker and 99designs) extends the ability of businesses to break down jobs into components, buying in ‘tasks’ as needed (PC 2016a). These arrangements can help improve productivity by more accurately matching and scaling resources to the needs of businesses and customers. The worker may have greater independence in the way they undertake their work and the tools they use. This raises the possibility that contracting will rise in significance as a form of employment, though there is no evidence of such a trend in labour market data in Australia.⁶

While it seems likely that the gig economy will grow, contemporary evidence on its significance is patchy and inconsistent — a reflection of different definitions of this part of the labour market, varying survey methods and differences between prevalence rates measured at a point in time and over a period (Brinkley 2016; Taylor 2016). Definitions of

⁶ There is also emerging case law in the United States and the United Kingdom that challenges the preconception that people working under platform arrangements, such as Uber, are contractors. In 2016, the UK Employment Tribunal found that Uber drivers were employees and not contractors, as claimed by Uber (Macinnis 2016).

the gig economy that differentiate it from traditional contracting and informal work suggest that it is currently very small in Australia and most other countries (box 3.1).

Box 3.1 How big is the gig economy?

In its enumeration of the gig economy, the Australian Industry Group suggests that 4.1 million Australians or about 30 per cent of the workforce had ‘freelanced’ some time in 2014 (AI Group 2016, based on a 2014 survey by Edelman Berland). An updated 2015 survey found participation to be 32 per cent, an increase that may simply reflect statistical variation in a small sample survey (Edelman Berland 2015). The surveys use a definition of freelancers as ‘individuals who have engaged in supplemental, temporary, project- or contract-based work’. There is no requirement in this definition that the person is a non-employee (in the legal sense) or that ICTs have any role in facilitating freelancing. The former is a critical issue in the Australian context because the concerns about gig economy workers often assumes that they are not employees and therefore not covered by the protections of the Fair Work Act and the National Employment Standards. Moreover, a person only needs to have engaged in some freelance work over a year to be counted as a ‘freelancer’. Period prevalence rates of this kind do not capture normal routines of work for people or the economic significance of particular working arrangements.

There are similarly high estimates of the significance of freelancing for the United States (34 per cent in 2014) drawing on the same methodologies (an Edelman Berland survey commissioned by Freelancers Union and Elance-oDesk 2014). Surveys that pick up people sometimes selling used goods online and babysitting suggest informal ‘work’ had increased to about 50 per cent in the United States, but informal work and most accepted definitions of the gig economy are not the same (Bracha, Burke and Khachiyan 2015).

Other research focused on jobs that would more commonly be seen as part of the gig economy find their importance to be much smaller than the above figures suggest (summarised in Brinkley 2016). For example, a Brookings Institution paper estimated that the US gig economy involved between 600 000 to 1.9 million people or 0.4 to just over 1 per cent of total US employment. Using a different approach, McKinsey suggests a possible prevalence rate of 1 per cent. In Australia, using a tightly focused definition of the gig economy suggests that about 0.5 per cent of adult Australians work on peer-to-peer platforms (Minifie 2016).

If the gig economy was growing rapidly, it would be visible in official data on independent contracting. It is not. ABS data suggest that independent contracting increased from 8.5 to 8.7 per cent of employment from 2012 to 2015. The prevalence of independent contracting, however, was lower in 2015 than it was in 2009 (ABS 2014, 2016a). This is not consistent with any marked increase in the economic significance of gig economy employment in Australia, though it is possible that the gig economy is shifting already existing independent contractors from a conventional contracting arrangement to a gig platform.

Overall, the current evidence does not suggest that the gig economy — ‘the finding of discrete parcels of work by direct connection between individual providers and customers and clients through a digital platform’ (Brinkley 2016) — is anything other than a boutique component of labour markets. However, the prospect of growth seems strong.

While the correctly-defined ‘gig’ economy is in its infancy, a substantial rise in employment in the industry may lead to more workers having a portfolio of work — something commentators are predicting (Dishman 2017; Wailes 2016). This type of

employment arrangement may place greater emphasis on people taking more responsibility for continuous learning over their lifetime to ensure their ongoing employability.

4 The obstacles to lifelong education and training

A system that minimises unnecessary barriers to workers accessing and gaining skills and qualifications (such as refreshing existing qualifications or gaining new skills) may enable workers to continue working, utilising these skills, beyond the current average retirement age. But some workers currently face a range of barriers to accessing education and training. This chapter examines the nature of these barriers.

4.1 Time and financial cost barriers: will training bring sufficient labour market benefits to justify the costs?

The cost of training include course fees, any foregone income from reduced hours of work and time traveling to classes along with the direct cost of that travel. The financial cost of training, the opportunity cost of the time taken and the perceived return on additional education and training for the individual and their employer can all reduce upskilling and retraining, particularly later in life. In its submission to the Australian Human Rights Commission (AHRC) inquiry into age discrimination, National Seniors Australia summarised the dilemma of weighing up of the costs and benefits of further training:

It can be difficult for a mature-age person to justify the risk of taking time out of employment and taking on debt to invest in the development of skills when the returns of this investment are unknown and they have family responsibilities, existing financial commitments and shortened time frames for paying back loans. (National Seniors Australia 2015, p. 17)

Traditional methods of acquiring skills and qualifications are costly and time consuming. With the deregulation of fees in VET, annual average course costs for students studying diploma level and above qualifications were about \$14 000 in 2015 (Deloitte 2016). For the university sector, the *annual* student contribution for a university bachelor degree ranges from just over \$6000 to almost \$11 000 and taking about 3 to 4 years to complete. Income-contingent loans assist in deferring costs for some courses until a person's income reaches a certain level, but the lengthy nature of formal training remains.

Older workers cite a lack of time as a barrier to participating in education and training. Compared with people aged under 24 years, older workers tend to have more commitments competing for their time, including work (often full-time, necessitated by financial commitments of a mortgage and children's education) and family responsibilities. To

undertake training, workers need to find the time — either during working hours (for employer supported training) or outside of work hours. Often the tasks usually performed at these times would still need to be completed, in addition to any training. While not related to formal learning, ABS data on barriers to non-formal learning provide some insight into the relative importance of time as a barrier. For people who wanted to participate in non-formal learning but did not, or participated in non-formal learning but wanted to do more, approximately half indicated that lack of time or too much work was the main reason (ABS 2013b). Men (53 per cent) were more likely to report ‘too much work’ as the main barrier compared with women (45 per cent).

Some employers believe that training mature age workers is not a good investment as they may leave or retire in the short- to medium-term, reducing the length of time the employer has to recoup their investment in training and skills development (Ferrier, Burke and Selby Smith 2008). However, as outlined in appendix A, working lives are lengthening, providing a longer pay off period for any investment in education and training. Furthermore, older workers are less likely to change jobs than younger, more educated workers — providing more time for employers to reap the benefits of additional workplace training (Billett 2011).

4.2 Employee attitudes as a barrier to training

The attitudes of some older workers about their abilities to undertake education and training can reduce their participation in skills development (Billett 2011; Ferrier, Burke and Selby Smith 2008). Some older workers lack confidence in their learning abilities and can adopt the attitude that they are ‘too old to learn’. Lack of confidence can also make older workers unwilling to learn jointly with young people — with older workers fearing embarrassment and failure if younger adults learn faster (Ferrier, Burke and Selby Smith 2008; Keys Young 2000).

Workers’ willingness to retrain can also limit the uptake of training. Some workers are reluctant to undertake new training or training in a different field as they are unwilling to relinquish their previous skills and occupation (Keys Young 2000). People often attach personal value, worth and identity to their work, and the skills and capabilities embodied in the tasks they do. To accept that those skills (and jobs) may be obsolete (because of automation, for example) can reduce the value of a person’s lifetime of work — something that is often borne out when workers are made redundant (Wood 2014).

Some may be unwilling to move into new fields, viewing those occupations as inferior to previous work. For example, service sector jobs, historically done by women, are sometime considered inferior to manufacturing jobs (Potter and Durkin 2016). Wholesale change can be confronting, and the requirement to make such a change can be overwhelming for workers of any age (Billett 2011).

Upskilling and retraining opportunities may be limited by a lack of familiarity with the learning process and how to study. Workers are a diverse group, particularly in terms of

their past exposure to education and training and their own learning skills. Many older workers have not undertaken formal training since leaving school. (About 40 per cent of people over 45 years old have no post-school qualification (ABS 2016b). Others may have low levels of literacy and numeracy and computer skills, limiting their ability to actively participate in work-related skills development and potentially reinforcing a lack of confidence in their own ability to learn (ABS 2013a).

Furthermore, workers may not recognise the future benefits of retraining or upskilling because of status quo bias — in which current circumstances are seen as the reference point from which departures are perceived as a loss. This can be coupled with myopic optimism in which people are overly positive about the future relevance of their current skills. For example, employees may focus on the current positives (such as current job stability and wages) while discounting potential future periods of reduced income because of lower wages, underemployment or unemployment (arising from technological change, for example). Similarly, workers may choose not to undertake training believing they have limited time left in the workforce before retiring, without fully assessing their financial needs for retirement.

4.3 Employers' attitudes to older workers present barriers to training

Some employers believe older workers have a reduced capacity to learn from training compared with younger people (captured by the unfortunate phrase that one 'can't teach an old dog new tricks'). This concern is related to the decline in cognitive skills that accompany ageing. While cognitive abilities do decline with age, some cognitive abilities start to decline in young adulthood (such as speed, reasoning, spatial ability and short-term memory), but other cognitive abilities that rely on the use of pre-existing knowledge and long-term memory (such as language) are much more stable, declining only when people are in their late 70s (Picchio 2015). This is well after the age when an employer would be considering any significant investment in training. Research has found that older workers *can* learn new skills. However, as there are age-related declines in some aspects of cognitive skills, the learning process may need to differ from that offered to younger people to be effective in developing new skills (Billett 2011; Ferrier, Burke and Selby Smith 2008; Picchio 2015). These workers may need longer time or self-paced courses that use multiple instructional methods to aid learning. Moreover, older workers perform better in training that raises their existing skills than in new fields (Picchio 2015).

5 What options are available to government?

If the existing workforce is to have an extended and fuller working life, weathering the potential effects associated with demographic and technological change, it will require governments to give ongoing consideration to strategies that smooth the effects of structural change.

Education and training is one element.

Training and information are the keys to empowering workers to be able to make choices that benefit their living standards. Ultimately, training needs to build confidence, develop foundation skills such as numeracy, literacy and digital skills as well as teach technical and ‘soft’ skills that can be applied in the workplace.

5.1 Measures to reduce the barriers to upskilling and retraining

To cope with the likely risks and pressures in the labour market, it is necessary to examine both the demand and supply-side settings of the skills formation system, minimising the barriers to upskilling and retraining.

It is crucial for governments to create the right *supply-side* settings for the skills system. That means an efficient, high-quality and flexible education and training system that is driven by the needs of users (the people acquiring the skills and the businesses that need them) rather than the interests of suppliers or legacy models of provision and government funding. That system also needs to be able to respond to the inevitable transitions from job to job and occupation to occupation and the associated skills required that will occur over people’s lifetimes.

It is also essential to have policy settings that ensure that the *demand-side* for the right *skills* is not frustrated by poor incentives to train by employees and businesses, excessive costs of obtaining skills, poor information about the skills needed for future work, or weak foundational skills that make such investments virtually impossible.

Let's start with strong foundational skills

First and foremost, to have a workforce that is capable of ongoing learning, they need to have strong foundational skills. This starts with a good school system that ensures people have the key foundational skills like numeracy and literacy, analytical skills, and the capacity to easily acquire knowledge throughout their lives (appendix B). While addressing the current academic performance outcomes of school students will not help those currently in the labour market, it will set up future cohorts to be in a position to be receptive to further education and training (when needed), potentially making them more adaptable and resilient to ongoing labour market changes. The main report makes recommendations on priority reforms in the schooling sector.

The skills and knowledge of older workers appears to largely reflect investment decisions made early in their lives in an economy quite different from the current one (or in the case of immigrants, a country). Notably, in Australia:

- the former immigration policy allowed 457 visa holders to transition to permanent residency even if they had weak English proficiency (PC 2016b)
- older Australians have poorer literacy and numeracy than younger people, with this affecting their employment, wages and productivity (OECD 2016b).

While the Productivity Commission has not assessed the success of current policy initiatives to develop solid foundational skills of adults who did not acquire them when they were younger, it is generally preferable to avoid remedial strategies. In light of this, policy makers, in designing employment-targeted immigration policies, should be mindful that low levels of foundational skills among these cohorts leave such people vulnerable to future labour market changes.

Overcoming cost barriers: embracing flexible, affordable and easily-acquired skills

Traditional, formal methods of acquiring skills and qualifications are costly and time consuming, as discussed above. A modern education and training system needs to evolve to become flexible enough to teach new skills quickly and efficiently. This will probably mean that non-formal and informal education, including emerging forms of learning, will play a larger role in the future skills formation of workers. One of the key advantages of these emerging forms of learning (such as Massive Open Online Courses) is that they provide faster, cheaper and more flexible methods of acquiring knowledge and skills. But currently there is a gap between what is demanded in terms of the method of acquiring skills and what is accepted as a universal signal of skills and ability in the labour market (formal qualifications from traditional institutions, which can take years). A framework or system that enables recognition of and trust in new types of learning is a missing element.

As outlined in The New York Times:

Free online courses won't revolutionize education until there is a parallel system of free or low-fee credentials, not controlled by traditional colleges, that leads to jobs. (Carey 2015, p. 1)

If Australia's education system is to be adaptive to the forthcoming labour market challenges, it is necessary to have an education system that values these new models of learning, particularly as they tend to address the cost barriers of traditional forms of learning. A certification framework will go some way to doing this. The main report makes a recommendation regarding an independent assessment system to stimulate further upskilling and retraining.

Overcoming information barriers: easier access to information

Information barriers can be large for some workers. Governments have taken some steps to overcome the information barriers to skill development and employment. There are a burgeoning number of websites to assist people considering particular occupations and looking to undertake training, including:

- My Future — a national career information and exploration service
- My Skills — a directory of training opportunities in the VET sector
- Job Outlook — a careers and labour market research site
- Quality Indicators for Learning and Teaching (QILT) — information on higher education course and graduate employment outcomes.

The Australian Government is also developing a new website to provide a single point of entry for information about higher education admissions policies and processes (Australian Government 2016). There is evidence that improved availability of course outcome information helps people, including disadvantaged workers between the ages of 25 and 54, seek out courses with good expected labour market outcomes (Polidano, Van de Ven and Voitchovsky 2017).

One improvement could be to consolidate the information about training and education into one website. While the current websites are usually linked, they do not provide a single, comprehensive information source for either school leavers or those in the workforce to review their employment and study options. A single platform may make it easier to navigate for the end user — in this case, workers who may not have had much contact with the education and training system for a number of years. A single platform will also make it easier to market to the public providing greater awareness of information available. One advantage of online tools is that the costs are principally associated with development and upgrade, with the incremental costs of access to the tool being zero. Increasing awareness and use of a single platform represents a cost-effective method of promoting careers and training information. However, any such portal must be properly maintained to be useful, with a single agency accountable for its quality and usability.

There is also scope for improvement in the content of the existing tools. The Australian Human Rights Commission (2016, p. 93) found that ‘information and guidance available to older people considering formal skills training is inadequate and does not support people to overcome barriers’. It also found that there were gaps in the provision of information for VET courses on the My Skills website. And information is often lacking in granularity:

Currently, graduate occupation information is limited to ANZSCO major group level (for example, Technician and trades workers, Managers, Labourers), which provides no indication to prospective students on the likelihood of their finding work after graduating in the occupation for which the course is designed to prepare them. (Polidano, Van de Ven and Voitchovsky 2017, p. 10)

While the provision of information to help people make education and training choices for work is important, it also involves risks (Polidano, Van de Ven and Voitchovsky 2017). In particular, people may undertake training in response to information about the future demand for particular skills, but the response in aggregate may lead to oversupply. Publicly available information on year-on-year changes in course enrolments could help identify the risk of oversupply for would-be students (and could, in principle, inform any long-term skill projections). A recommendation regarding an improved single website are outlined in the main report.

Improving path ways for upskilling

In the VET system, competency-based assessments provide people with a qualification based on their ability to perform a task to a minimum standard. Chapter 3 of the main report makes a recommendation to introduce graded proficiency for VET qualifications. This is largely motivated by improved information in the labour market to enable more efficient recruitment and job matching and to provide greater incentives for attainment of excellence (which can be rewarded in the forms of better job prospects and higher wages).

In addition to these direct labour market benefits, graded proficiency could also provide extra information to educational institutions that would assist future learning pathways for students wanting to upgrade VET qualifications to a university degree (such as upskilling from an ‘enrolled’ to a ‘registered’ nurse). Although, such pathways would not be automatic with the introduction of graded assessment, as a number of barriers would still remain (Gillis, Clayton and Bateman 2008).

Overcoming employer attitudes to barriers to training

Despite age discrimination being unlawful for well over a decade, some older workers are excluded from employment and ongoing education and training because of discrimination. The AHRC (2016) found that:

... too many people are shut out of work because of underlying assumptions, stereotypes or myths associated with their age ... These beliefs lead to discriminatory behaviours during

recruitment, in the workplace and in decisions about training, promotion and retirement, voluntary and involuntary. The cost and impact of this is high, for individuals and for our economy. (p. 5)

With an ageing population and workforce, the cost of discrimination (both social and economic) will grow if left unaddressed. These issues are comprehensively outlined in the AHRC report (2016), along with a range of recommendations. In particular, the AHRC inquiry recommended a national community education and information campaign — developed and delivered in collaboration with business, unions and community organisations — to dispel myths and stereotypes about older people.

Other potential policy options to overcome barriers to training

There are a range of other initiatives used internationally, such as career advice, learning accounts and tax incentives, that may have merit. These measures also seek to overcome barriers to education and training. However, the rationale, objective, policy design, effectiveness and costs of such measure should be carefully examined prior to their introduction (appendix D).

5.2 Lacking a trigger to prompt some workers to retrain

Overcoming barriers associated with workers' willingness to upskill and retrain are somewhat more difficult. The problem facing vulnerable employees is one of creeping gradualism. The risks of job loss grows slowly, varying by place and skill, so that there is no obvious trigger for acquiring new skills before the risks are realised.

A well-functioning education and training system, adaptive to user's needs, may not be enough to induce demand for upskilling and retraining for some workers vulnerable to redundancy. For example, long distance truck drivers are at risk of displacement if automated vehicles are adopted for long haul freight distribution. But they do not know when. It might happen only for some trucks on some routes, or may occur for some companies ahead of others. Regulatory uncertainty about the safety of autonomous vehicles also make prediction difficult. And more importantly, how does a truck driver develop the necessary skills to make a career change when there is limited opportunity to reskill while working? (*The Economist* 2017).

Switching occupations not only involves a gamble in terms of forgone wages and conditions, but it removes people from the familiar setting of their job and their colleagues — workplaces are often valued as much for the relationships they create as their earnings, as noted above. Overcoming these barriers to upskilling and retraining is much more difficult, leaving some people more vulnerable to labour market changes.

Lessons from the investment approach and innovative funding methods

Given the costs associated with people leaving and not re-entering the workforce — in terms of forgone income, lost social connections and purpose, increased reliance on the social welfare system and potentially increasing inequality for society — there is an argument for more intensive, proactive investment to prevent this situation from occurring. Such assistance should not be universal, and instead be targeted at those people facing multiple sources of disadvantage.

The investment approach in the Australian Government’s ‘Try, Test and Learn’ (TTL) program may have lessons for the development of employment and skill initiatives focused on cohorts at high risk of losing their jobs due to structural adjustment. The TTL is an early intervention program that aims to improve the economic and social participation of young carers, young parents and young students at risk of long-term unemployment (DSS 2016). These groups were identified as promising targets for interventions since actuarial assessment suggested that the cost savings from avoiding prolonged welfare dependency were high. The TTL model is not prescriptive in nature, but harvests ideas for small-scale interventions gathered through submissions from the community sector, government, academics, business and individuals. The advantage of many of the ideas put forward under the TTL program is that they are low cost and readily able to be abandoned or scaled up. Many use online platforms and peer support (a ‘free’ input). Through this initiative, the Australian Government is seeking to develop a body of evidence of ‘what works’ and to discover how behaviours, pathways or systems can be changed to improve workforce participation (DSS 2016).

While the funding round for TTL is not complete and programs are yet to be implemented, a similar model could be used for workers who may also face protracted periods of welfare dependency after redundancy — particularly if they shift to a disability payment. The evaluation outcomes from the TTL program will provide lessons for the future development of a new program targeting that group.

A Factors contributing to the lengthening of working lives

While population ageing is set to decrease aggregate ratios of employment to population, employment rates by mature-age Australians have been rapidly rising, particularly for women (figure A.1). Increasing employment rates among these groups reflect a range of factors:

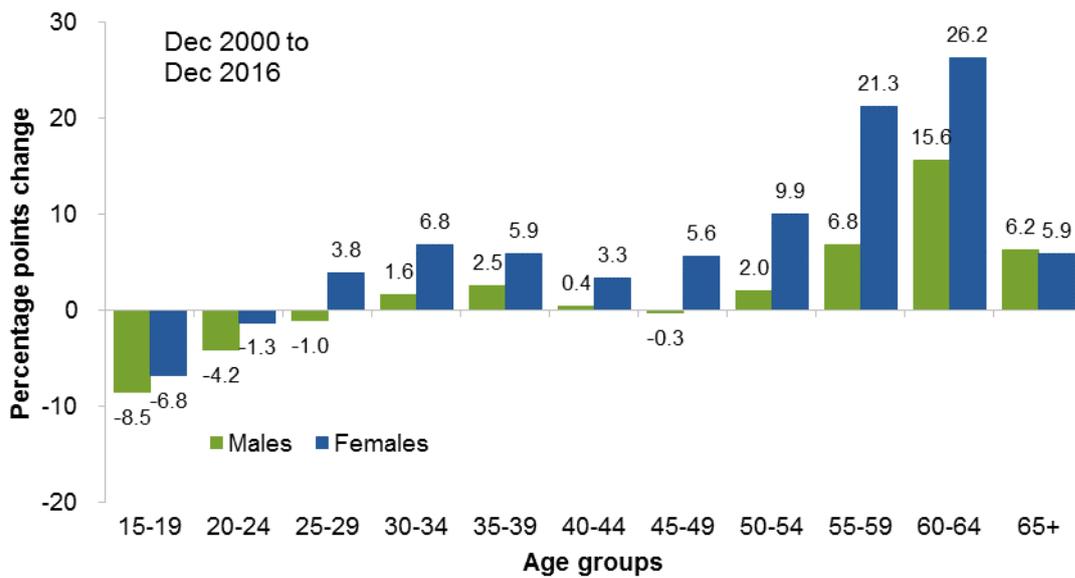
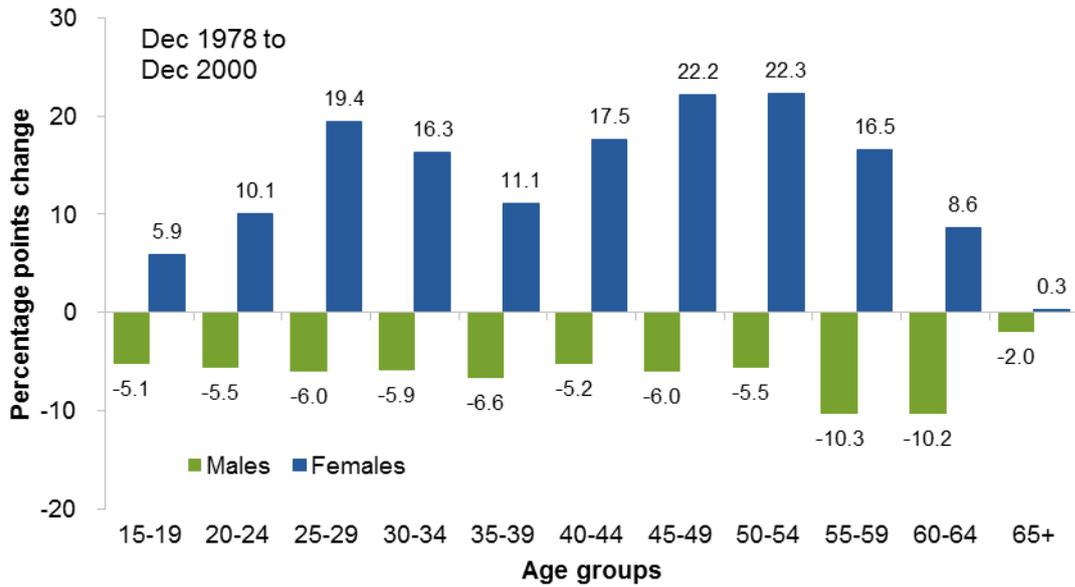
- *females entering the workforce*: the greater involvement of females in the labour force at all ages from 25 years and upwards. The higher involvement of women in work was evident for most of the age groups between 25-29 and 55-59 years old in the two decades preceding 2000, while it was more concentrated among older women in the period 2000–2016. Increased female employment rates in the child-bearing years is one contributing factor to rising rates at older ages. This is because once in employment at younger ages, people tend to stay in the workforce in subsequent years. (For men, the increase in employment rates only commenced two decades ago and primarily for older age groups.)
- *healthier people living longer*: rising life expectancy has been accompanied by improved health-adjusted life expectancy. People, therefore, have the scope to work longer without necessarily reducing the share of their lifetime spend in retirement (Kent 2014). This has been reinforced by the occupational shift away from physically-demanding manual jobs, which allows people to work longer with reduced risks of muscular-skeletal injuries
- *a more educated population*: the future ‘old’ will be better educated. So while 27 per cent of people aged 55-64 years had a university education in 2016, the comparable figure for 25-34 year olds was just under 40 per cent. Given some people acquire university education after age 34 years, it must be the case that by 2046, more than 40 per cent of 55-64 year olds will have such qualifications.⁷ People with higher educational attainment tend to participate in the workforce more than those with lower attainment and retire later
- *financial pressures* associated with changes to the pension system and to greater life expectancy (which creates longevity risk for those not on defined-benefit retirement income plans)
- changing *social norms* about when people should retire.

The implication is that people’s post-school working lives have been lengthening, particularly for women, with this trend likely to continue, albeit at a reduced pace (Australian Government 2015).

⁷ ABS 2016, *Education and Work, Australia, May 2016*, Cat. no. 6227.0, table 14.

Figure A.1 Employment rates have been rising for females

Change in employment rates (percentage points)^a



^a The employment rate is the ratio of employment to the civilian population in each age group.

Source: ABS 2017, *Labour Force, Australia, Detailed - Dec 2016*, Cat. no. 6291.0.55.001, 24 January.

B Performance of the schools sector is troubling

A good school system ensures that people have the key foundational skills like numeracy and literacy, analytical skills, and the capacity to learn about learning so that they can easily acquire knowledge throughout their lives (Ainley and Gebhardt 2013; Hattie 2016). Many are also calling for schools to teach ‘soft skills’, such as teamwork, collaboration, leadership and creativity, as it is believed that these skills will be essential to securing and maintaining employment now and in the future (Anderson 2017; Williamson et al. 2015).

In some critical areas, there are signs that Australia’s school system is not functioning well:

- National and international assessments of student achievement in Australia show little basic skill improvement over a sustained period; and in some areas standards of achievement have dropped (PC 2016c).
 - Australia’s performance in the OECD’s PISA tests showed absolute declines in performance in scientific, reading and mathematical literacy, a growing share of lower student performers, and a diminishing share of high performers in all three domains (Thomson, De Bortoli and Underwood 2016).
 - Results from the Trends in International Mathematics and Science Study, show little change in Australian students’ achievement since the study began in 1995 (Thomson 2016a).
 - NAPLAN measures of Australian students’ reading and numeracy achievement indicate little improvement between 2008 and 2015 (PC 2016c).
- The national participation rates in year 12 physics and advanced mathematics have fallen by more than 30 per cent from 1992 to 2012 (Masters 2016).
- Learner engagement — one of the most reliable predictors of gains in learning — is low for some students, with approximately 40 per cent of students involved in unproductive behaviours (being inattentive, noisy or anti-social) (Goss, Sonnemann and Griffiths 2017). School attendance is considerably lower for the most disadvantaged students (Ross 2014).

The Commission is not alone in drawing together observations like these (for example BCA 2017; Daley, McGannon and Ginnivan 2012; Thomson 2016a; Wilson, Dalton and Baumann 2015). These trends are cause for concern for a number of reasons.

First, the declining or stagnating results have occurred during a time of considerable policy focus on schooling, including significantly increased expenditure. These efforts have focused on preparing school students for future labour markets through changes to school funding, reviewing teaching methods and curriculums, attempting to raise year 11 and 12

retention rates, testing academic proficiency in schools and implementing strategies to increase the uptake of STEM subjects in schools.

Second, Australia's performance in international studies have either stagnated or decreased, while other countries (including some already high-performing countries) have recorded improvements in student achievement. Between 2009 and 2015, Australia experienced a *decline* in average reading literacy. Exacerbating this result, high performing countries (Singapore is an example close to home) continued to improve despite their already elevated standing (Thomson, De Bortoli and Underwood 2017).

Third, Australia's sustained decline in academic achievement (as reported by the PISA results) represents considerable lost opportunities for individuals in terms of their overall wellbeing and lost economic prosperity for society.

- While Australia's academic achievement is above the OECD average, declining performance over time means Australia's young people *may now be less capable* than previous cohorts. For example, in mathematical literacy, an Australian 15 year old in 2015 had a mathematical aptitude equivalent to a 14-year-old in 2000.
- An OECD projection suggests if all 15-year-old students in Australia attained at least the baseline level of performance in PISA by 2030, Australia's GDP in 2095 would be 10 per cent higher (OECD 2015c).⁸ Moreover, Australia's growing group of low performing students will be increasingly exposed to unemployment or low participation in the future world of work (OECD 2016a). As noted by Thomson (2016b), a prominent expert in this area, '[t]hese students do not have the level of knowledge that will allow them to participate as productive citizens in a modern society' (p. 5).
- The declining proportion of high performing students sits at odds with the skills requirements of an advanced economy, which will increasingly depend on the capability of that group to be employed in highly skilled jobs (OECD 2015b). Basic foundational skills in science and mathematics developed at school are likely to be fundamental to future work.

School workforce and teacher education

To improve skills outcomes, the policy consensus favours direct measures to address the effectiveness of the teaching occurring in schools, the quality of the school workforce and the quality of teacher education. And for good reason, as there are strong links between the ability and aptitude of individuals entering the teaching profession, the quality of their training and their eventual teaching effectiveness (Ingvarson et al. 2014).

⁸ However, poor academic performance is not generally the result of any single risk factor, but rather a combination of various barriers and disadvantages that affect students throughout their lives and consequently will require a range of policy interventions beyond education (OECD 2016a).

There is some evidence that literacy and numeracy levels of the pipeline of new school teachers have declined and, unlike high-performing countries, Australia is not selecting the next generation of teachers from high-performing school leavers (Ingvarson et al. 2014; Leigh and Ryan 2006). Countries with high academic outcomes have tended to pursue deliberate policies to attract the most able people into teaching, including offering salaries and working conditions that enable teaching to compete with other professions (Ingvarson et al. 2014).

A related concern is that many teachers are ‘teaching out of field’ (that is, they are barely, if at all, qualified in the disciplines they are teaching). For example, in information technology, about 30 per cent of year 7 to 10 teachers have neither studied the subject at second-year tertiary level or above, nor been trained in teaching methodology for that subject at the tertiary level (Weldon 2016). Teaching out of field not only affects students, but anecdotal evidence suggests that it also contributes to teacher attrition (Stroud 2017). Given the high levels of teaching out of field and its unacceptability, it requires special recruitment efforts and targeted high-quality professional development for existing teachers willing to acquire the knowledge and teaching skills in the relevant disciplines.

There are compelling grounds to fix these problems, because not only do they affect the job and income prospects of young people, but they create barriers to subsequent education and training in later life (the focus of this supporting paper). Chapter 3 of the main report outlines reforms needed to improve the performance of the school sector.

C Other developments that affect occupations

This appendix examines two case studies in the education and health sectors, and how occupations, which may be at low risk of automation, may face reduced demand as a result of technology (other than automation), changes in consumer preferences, task redesign and regulation.

C.1 Educators: low risk of automation but ... online provision may disrupt

Educators are regarded as among the least susceptible to automation and therefore largely immune to technologically-based displacement (Edmonds and Bradley 2015). It is certainly the case that (good) educators must keep up to date with developments in their field and modern pedagogic methods, and must cater for the differences in the aptitudes and interests of the people being instructed.

However, online provision of information to people by excellent and highly trained communicators has the potential to decrease the number of trainers required per student, lowering costs without reducing the quality of student learning. Massive Open Online Courses are an example, and are already being used by traditional universities to lower the cost of degrees by reducing direct tuition (chapter 3 of the main report). A meta-analysis of online learning found that on *average* students using online learning tools performed better than those receiving face-to-face instruction, though this may not apply to all students or courses (Means et al. 2009; Smith Jaggars and Bailey 2010).

There is also good evidence that technology can be used as a complement to traditional educational techniques (Tamim et al. 2011) with the prospect that this can allow larger class sizes per teacher. Meta-analysis of the evidence also suggests that learning through gamification, virtual worlds and simulation shows promise (Merchant et al. 2014), which may also reduce the required number of educators per group of students.

The key underpinning advantage of the online and computer environment is cost. Once the fixed costs of a high quality ‘course’ is developed, the incremental cost of providing it to millions of people is low, relative to incremental costs of traditional learning models.

C.2 Health care occupations: low risk of automation but ... technology and social developments may improve outcomes and lower demand

Technological changes and less regimented regulations may (*when compared with the counterfactual*) reduce the need for non-routine high-level cognitive occupations in health service provision.

- Various meta-analyses found internet-delivered cognitive behavioural therapy (usually with some, but little clinical backup) to be as successful as face-to-face clinical interventions for some conditions.⁹
- Effective communication between caregivers and patients has the prospect (in the United States at least) of reducing re-admission rates by about 5 per cent (Senot and Chandrasekaran 2015). Similarly, health and wellbeing programs aimed at better self-management of chronic conditions have been shown to reduce the frequency and duration of hospital admissions (Hamar et al. 2013).
- Drugs can sometimes substitute for the medical labour force, and allied health professionals can also sometimes substitute for the higher-cost clinicians without effecting the quality of care (to the extent that rules concerning the scope of practice do not preclude this).
- Pharmacists are perceived to have a very low risk of facing automation, but this presumes that they are able to use their expertise in the role they perform in the health system. Robotic dispensers are already in place in retail pharmacies and more complex ones in hospitals. So, despite their education and skills, among the health professions, the pharmacist occupation *is* subject to considerable technological risks, especially if the regulations that give rise to their privileged status to dispense is withdrawn (issues that are explored in chapter 2 of the main report).

Developments of these kinds are unlikely to reduce the absolute number of health professionals (pharmacists aside). This is because the substitution effects will probably be offset by the need for the health sector to grow (a reflection of population ageing and the tendency for richer societies to invest more in health).

Economic incentives reinforce the technological pressures on these occupations. While it may seem harder to replace them, their costs are much higher than other personnel, and so the incentives to reduce or change their role are also strong. This has implications for the required future professional workforce and skills formation of incumbents.

⁹ For example, depressive symptoms (Cuijpers et al. 2011); anxiety disorders and chronic pain (Vigerland et al. 2016); sleep disorders (Seyffert et al. 2016) and post-traumatic stress disorder (Sijbrandij, Kunovski and Cuijpers 2016).

D Other possible policy options to overcome barriers to upskilling and retraining

D.1 Career guidance: assessing skills and providing training advice

In addition to the options outlined in chapter 5 above, government-supported career guidance services could be used to overcome potential labour market disadvantages. The goal would be to assist people to objectively diagnose their current skill levels and aptitudes, assess the relevance of these to emerging market needs, and then provide advice on achieving realistic transitions to alternative jobs and how that may be achieved if further education and training is required. As with any policy, the issue is would it work, for whom, and at what cost?

In 2016, the Australian Government completed a career guidance service pilot — Skills Checkpoint — targeted at workers aged 45-54 years. It provided workers with an assessment of their skills and career interests in relation to their current role or future employment opportunities. The service also provided participants with guidance on transitioning into new roles within their current industry or on pathways to a new career, including any relevant education and training options. An evaluation based on feedback from participants and service providers was broadly supportive of the pilot, but the Commission is not aware of plans to continue the service or roll it out more widely or for more rigorous evaluation (DET 2017).

While such a policy may have value, there are major challenges in adopting taxpayer-funded career guidance services, including:

- *additionality*: to avoid providing careers advice to people who would have, on their own account, paid for such a service. Some obvious measures to address additionality are that subsidised services should not be provided to people who have reasonable income, are highly educated or do not have substantial labour market vulnerabilities
- *ability to benefit*: providing services to those people most likely to benefit from the service. This is a less manageable issue. The traits of a person that are likely to lead to high or low value are probably hard to observe prior to providing the service
- *cost-effective*: the recent problems in the VET sector have shown that poor quality, high-cost supply can survive even in a supervised market

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- *accuracy of advice*: it would be necessary to have oversight to ensure the advice given was accurate (an issue also reflecting the risk of fraud and the entry by poor quality providers)
 - *net benefit*: it would be necessary to confirm that a career guidance service produces better outcomes than the counterfactual. Identifying impacts requires ex post evaluation, and the subsequent adaptation of program eligibility and design.

In this context, and given the absence of strong evidence about the performance of the Skills Checkpoint program, it would be premature to roll out an Australia-wide counselling program. A less risky and lower-cost option would be to continue developing an online tool for assessing people's capabilities and occupational preferences — as described above.

D.2 Lifelong learning accounts

Lifelong learning accounts are like a bank account, but the balance can be used to finance a worker's education and training. They are usually targeted at those that have finished their front-ended education. Funding for these accounts can come from government, an employer or the worker, or a combination of any of these parties. By providing financial incentives, the aim is to motivate workers to participate in skills development by reducing the direct cost of further education, as well as trying to change the mindset of people that education is for the young.

The idea of individual lifelong learning accounts is not a new one. A number of countries, including the United Kingdom, Canada and Singapore, have tried such approaches over recent decades. In 2016, for example, Singapore introduced an initial credit of SGD 500 (about \$485 in Australian dollars) to be used for approved education and training courses. These credits do not expire and will be topped up over time — allowing people to either use the credits or save them for future use (Shanmugaratnam 2015).

While the basic idea has some appeal, there are a number of major issues that would need to be overcome before implementation.

- Such a scheme could be costly. Providing untargeted allowance to all Australians over a particular age (in Singapore, it is above the age of 25) would place undue pressure on government budgets.
- Like career advice, ensuring additionality would be an issue. Targeting could reduce costs and decrease assistance going to people who would have undertaken training anyway.
- Internationally, fraudulent behaviour has been an issue. The system in England was closed after only a short period of operation due to fraud, although not before losses of millions of pounds. Even the relatively new system in Singapore has been subject to fraudulent claims, although they appear to have been detected quickly and their system adjusted accordingly (Chia 2017; Min 2017).

Even if these policy design challenges could be overcome sufficiently, the bigger issue is that any additional entitlement would cut across Australia's relatively open education system, muddying existing funding sources of education and training.

This is not to suggest that government subsidies for post-secondary school education and training could not be improved. Rather, it would be preferable to comprehensively consider funding arrangements for the university and VET sectors, and any interaction, than to tack-on another entitlement.

D.3 Tax incentives for businesses investing in training and development

While the Australian tax system allows some deductions for education and training expenditure (for both businesses and individuals) as expenses against income earned, the use of the tax system to increase education and training is limited compared with direct funding.

European countries, on the other hand, use various tax incentives to foster national education and training activities (ECDVT 2009). These incentives take many forms (rebates, allowances, exemptions) and are directed at individuals and/or businesses to encourage investment in education and training.

One common tax incentive used in Europe are tax credits or rebates to reduce company taxes for businesses that contribute funding to their employees' education and training (ECDVT 2009). A recent proposal by two academics from the Brookings Institution also advocated for the introduction of business tax credits in the United States (Bradford and Burkhardt 2017).

Like a number of other initiatives discussed above, before introducing tax incentives for businesses, policy makers should consider:

- the reasons for any apparent business underinvestment in skills. Regulatory settings or prior inadequate investment in skills formation¹⁰ may sometimes explain business behaviour, and to the extent that this is true, would best be addressed directly, rather than through changes to the tax system
- the type of education and training that would qualify for favourable tax treatment. Arguably, any incentives should be directed at portable skills that can be used across an industry, rather than at highly firm-specific skills, where businesses already have strong incentives to train
- the evidence that the foregone revenue from the tax incentives has induced additional worthwhile investment in training

¹⁰ Businesses may not invest in people with inadequate initial skills.

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- the administrative and compliance costs associated with any incentives, especially in validating genuine claims for training
 - the effect on allocative efficiency. Even if there is a net benefit from any tax incentive for education and training, policy makers need to be satisfied that the foregone revenue could not have been used to achieve other policy objectives with a greater benefit.

Evidence from Europe indicates (ECDVT 2009) that:

- actual performance information and public evaluation of the effectiveness of tax incentives on education and training is ‘practically non-existent’ (p. 100)
- the main criticism of tax incentives is that there is little additionality — the individuals and enterprises would have been involved in these training activities regardless of the tax incentive
- tax incentives for business tend to favour individuals that already have considerable access to education and training (that is, those that are employed and that have previously undertaken post-school qualifications)
- tax incentives on their own are insufficient, and direct funding of particular parts of education and training will remain necessary.

Overall, the available evidence suggests caution in using tax credits to increase business skill formation. If governments do adopt them, their design should focus on maximising additionality and eliminating fraudulent behaviour. Any widespread adoption should also be preceded by a carefully designed randomised control trial to examine the degree to which they crowd out privately-funded investment and to assess unintended effects.

References

- ABS (Australian Bureau of Statistics) 2013a, *Programme for the International Assessment of Adult Competencies, Australia, 2011-12*, Cat. no 6227.0.
- 2013b, *Work Related Training and Adult learning, April 2013*, Cat. no. 4234.0.
- 2014, *Forms of Employment, Australia, November 2013*, Cat. no. 6359.0.
- 2016a, *Characteristics of Employment, Australia, August 2015*, Cat. no. 6333.0.
- 2016b, *Labour Force, Australia, Detailed, Quarterly, Aug 2016*, Cat. no. 6291.0.55.003.
- 2016c, *Retirement and Retirement Intentions, Australia, July 2014 to June 2015*, Cat. no. 6238.0.
- AHRC (Australian Human Rights Commission) 2012, *Working Past our 60s — Reforming Laws and Policies for the Older Workers*, June.
- 2016, *Willing to Work: National Inquiry into Employment Discrimination Against Older Australians and Australians with a Disability*, 2 May.
- Ai Group 2016, *The Emergence of the Gig Economy*, Thought Leader Paper, Education and Training Policy Team, August.
- Ainley, J. and Gebhardt, E. 2013, *Measure for measure : A Review of Outcomes of School Education in Australia*, Australian Council for Educational Research.
- Anderson, M. 2017, 'Forget the 3Rs: Modern Schools Need to Embrace the 4Cs', *The Sydney Morning Herald*, 7 March.
- Arntz, M., Gregory, T. and Zierahn, U. 2016, 'The Risk of Automation for Jobs in OECD Countries' OECD Social, Employment and Migration Working Papers, No. 189, OECD Publishing, Paris.
- Atkinson, R. and Wu, J. 2017, *False Alarmism: Technological Disruption and the US Labour Market, 1850-2015*, May, Information Technology and Innovation Foundation.
- Australian Centre for Financial Studies 2014, *Involuntary Retirement: Characteristics and Implications*, 28 March.
- Australian Government 2015, *2015 Intergenerational Report: Australia in 2055*, March.
- 2016, *Improving the Transparency of Higher Education Admissions: Australian Government response to the report of the Higher Education Standards Panel*, December.
- Autor, D. 2015, 'Why Are There Still So Many Jobs? The History and Future of Workplace Automation', *The Journal of Economic Perspectives*, vol. 29, no. 3, pp. 3–30.

-
- Aylward, M. 2015, 'Overcoming Barrier to Recovery and Return to Work: Towards Behavioural and Cultural Change', in Schultz, I. and Gatchel, R. (eds), *Handbook of Return to Work: From Research to Practice*.
- BCA (Business Council of Australia) 2017, *Better Services, Better Value: 2017-18 Budget Submission*, March.
- Billett, S. 2011, 'Older workers, employability and tertiary education and training', *Older Workers: Research Readings*, National Centre for Vocational Education Research.
- Bloom, N., Genakos, C., Sadun, R. and Reenen, J.V. 2012, 'Management Practices Across Firms and Countries', *The Academy of Management Perspectives*, vol. 26, no. 1, pp. 12–33.
- Borland, J. 1998, 'Microeconomic reform and displaced workers — an introduction', presented at the Microeconomic Reform and Productivity Growth, pp. 365–399.
- Bostrom, N. 2014, *Superintelligence: Paths, Dangers, Strategies*, 1st edn, Oxford University Press.
- Bracha, A., Burke, M.A. and Khachiyan, A. 2015, *Changing Patterns in Informal Work Participation in the United States 2013–2015*, Current Policy Perspectives, Federal Reserve Bank of Boston.
- Bradford, C.I. and Burkhardt, R. 2017, Proposal to accelerate social mobility: Incentivizing greater private investment in the skill development of 21st century workers, Brookings Institute, 20 March, www.brookings.edu/research/proposal-to-accelerate-social-mobility-incentivizing-greater-private-investment-in-the-skill-development-of-21st-century-workers/ (accessed 22 May 2017).
- Brinkley, I. 2016, *In search of the Gig Economy*, August, The Work Foundation - Lancaster University.
- Brynjolfsson, E. and McAfee, A. 2012, 'Race Against The Machine: How The Digital Revolution Is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy', *Research Brief*, The MIT Center for Digital Business.
- Carey, K. 2015, 'Here's what will truly change higher education: Online degrees that are seen as official', *The New York Times*, 5 March.
- CEDA (Spies, Taylor and Zimmerman) 2017, 'Education and training enabling productivity in services industries', in *Improving Service Sector Productivity: The Economic Imperative*, June.
- Chang, J. and Huynh, P. 2016, ASEAN in Transformation: The Future of Jobs at Risk of Automation, Working Paper 9, July, Bureau of Employers' Activities, International Labour Office, Geneva.
- Chia, A. 2017, Changes made to SkillsFuture Credit claims processes, www.gov.sg/news/content/changes-made-to-skillsfuture-credit-claims-processes (accessed 25 May 2017).

-
- Coelli, M. and Borland, J. 2015, Job Polarisation and Earnings Inequality in Australia, 24 February, University of Melbourne.
- Cuijpers, P., Donker, T., Johansson, R., Mohr, D.C., van Straten, A. and Andersson, G. 2011, 'Self-Guided Psychological Treatment for Depressive Symptoms: A Meta-Analysis', *PLoS ONE*, vol. 6, no. 6.
- Daley, J., McGannon, C. and Ginnivan, L. 2012, *Game-changers: Economic Reform Priorities for Australia*, June, Grattan Institute.
- Davenport, T. and Kirby, J. 2016, *Only Humans Need Apply: Winners and Losers in the Age of Smart Machines*, HarperCollins.
- Deloitte 2014a, *Agiletown: the relentless march of technology and London's response*, Insights, November
- 2014b, Deloitte's 2014 *Global Outsourcing and Insourcing Survey: 2014 and beyond*, December.
- 2016, *Vocational education: Unintended consequences and bad apples*, Deloitte, www2.deloitte.com/au/en/pages/finance/articles/vocational-education.html (accessed 17 February 2017).
- Deloitte Access Economics 2012, *Increasing Participation Among Older Workers: The Grey Army Advances*, Report prepared for the Australian Human Rights Commission, 25 July.
- DET (Department of Education and Training) 2017, Skills Checkpoint Pilot, www.education.gov.au/skillscheckpointpilot (accessed 17 May 2017).
- Dishman, L. 2017, How The Gig Economy Will Change In 2017, Fast Company, www.fastcompany.com/3066905/how-the-gig-economy-will-change-in-2017 (accessed 7 June 2017).
- Diss, K. 2015, 'Driverless trucks move iron ore at automated Rio Tinto mines', *ABC News*, 18 October, www.abc.net.au/news/2015-10-18/rio-tinto-opens-worlds-first-automated-mine/6863814 (accessed 2 May 2016).
- DSS (Department of Social Services) 2016, Australian Priority Investment Approach to Welfare, www.dss.gov.au/review-of-australias-welfare-system/australian-priority-investment-approach-to-welfare (accessed 26 April 2017).
- Dunlop, T. 2016, 'Why do we keep inventing programs for jobs that just aren't there?', *ABC News*, 5 May.
- Durrant-Whyte, H., McCalman, L., O'Callaghan, S., Reid, A. and Steinberg, D. 2015, *The impact of computerisation and automation on future employment, Australia's future workforce?*, CEDA.
- ECDVT (European Centre for the Development of Vocational Training) 2009, *Using Tax Incentives Education to Promote Education and Training*, Greece.
- Edelman Berland 2015, Freelancing in Australia: 2015, 27 October, Slideshare.

-
- Edmonds, D. and Bradley, T. 2015, *Mechanical boon: will automation advance Australia?*, Research Paper, October, 7/2015, Department of Industry, Innovation and Science.
- Ferrier, F., Burke, G. and Selby Smith, C. 2008, *Skills Development for a Diverse Older Workforce*, 30 May, NCVET.
- Figgis, J. 2012, *Reskilling for Encore Careers for (What Were Once) Retirement Years*, National Centre for Vocational Education Research (NCVER).
- Freelancers Union and Elance-oDesk 2014, *Freelancing in America: A National Survey of the New Workforce*.
- Frey, C. and Osborne, M. 2013, 'The Future of Employment: How Susceptible are Jobs to Computerisation?', Oxford Martin Programme on Technology and Employment.
- , ——, Holmes, E., Rahbari, R., Garlick, G., Friedlander, G., McDonald, G., Curmi, E., Chalif, P. and Wilkie, M. 2016, *Technology at Work v2. 0: The future is not what it used to be*, January, CityGroup and University of Oxford.
- Gahan, P. 2016, Will a robot take your job?, <https://pursuit.unimelb.edu.au/articles/will-a-robot-take-your-job> (accessed 21 April 2016).
- Goss, P., Sonnemann, J. and Griffiths, K. 2017, *Engaging students: creating classrooms that improve learning*, Grattan Institute.
- Hamar, G.B., Rula, E.Y., Wells, A., Coberley, C., Pope, J.E. and Larkin, S. 2013, 'Impact of a chronic disease management program on hospital admissions and readmissions in an Australian population with heart disease or diabetes', *Population Health Management*, vol. 16, no. 2.
- Hattie, J. 2016, Shifting away from distractions to improve Australia's schools: Time for a Reboot, October, 54, Monograph Series, ACEL.
- Heath, A. 2016, 'Speech: The Changing Nature of the Australian Workforce', <https://www.rba.gov.au/speeches/2016/sp-so-2016-09-21.html> (accessed 11 May 2017).
- Ingvarson, L., Reid, K., Buckley, S., Kleinhenz, E., Masters, G. and Rowley, G. 2014, Best Practice Teacher Education Programs and Australia's Own Programs, Australian Council for Educational Research.
- Kent, C. 2014, Ageing and Australia's Economic Outlook, Address by Christopher Kent to the LASA National Congress.
- Keys Young 2000, *Older Workers and Education and Training*, Report commissioned by NSW Board of Vocational Education and Training, September.
- Leigh, A. and Ryan, C. 2006, *How and Why has Teacher Quality Changed in Australia?*, ANU Research Publications, Australian National University.
- Macinnis, A. 2016, Contractor or employee? One landmark case reveals the hidden dangers, HRM online, www.hrmonline.com.au/section/featured/results-landmark-uber-case-impact-hiring/ (accessed 4 June 2017).

-
- Masters, G. 2016, 'Five Challenges in Australian School Education', *Policy Insights*, May, 5, Australian Council for Educational Research.
- Means, B., Toyama, Y., Murphy, R., Bakia, M. and Jones, K. 2009, *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies*, US Department of Education.
- Merchant, Z., Goetz, E.T., Cifuentes, L., Keeney-Kennicutt, W. and Davis, T.J. 2014, 'Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis', *Computers & Education*, vol. 70, pp. 29–40.
- Miller, B. and Atkinson, R. 2013, *Are Robots Taking Our Jobs, or Making Them?*, The Information Technology and Innovation Foundation.
- Min, C.H. 2017, '4,400 caught in January submitting false SkillsFuture claims amounting to \$2.2m', *The Straits Times*, www.straitstimes.com/singapore/jump-in-false-claims-for-skillsfuture-credits-4400-caught-in-january (accessed 25 May 2017).
- Minifie, J. 2016, *Peer-to-peer pressure policy for the sharing economy*, Grattan Institute.
- Mokyr, J., Vickers, C. and Ziebarth, N.L. 2015, 'The History of Technological Anxiety and the Future of Economic Growth: Is This Time Different?', *Journal of Economic Perspectives*, vol. 29, no. 3, pp. 31–50.
- Murtough, G. and Waite, M. 2000, *Unemployment and Re-employment of Displaced Workers*, Staff Research Paper, Productivity Commission.
- National Seniors Australia 2015, *Submission to the Willing to Work Inquiry*, no. 266.
- OECD (Organisation for Economic Co-operation and Development) 2015a, *The Future of Productivity*, July, Joint Economics Department and the Directorate for Science, Technology and Innovation Policy Note, Paris.
- 2015b, *The Innovation Imperative: Contributing to Productivity, Growth and Well-Being*, Paris.
- 2015c, *Universal Basic Skills*, Paris.
- 2016a, *Low-Performing Students: Why They Fall behind and How to Help Them Succeed*, Country note: Australia, Paris.
- 2016b, *Skills Matter: Further Results from the Survey of Adult Skills*, OECD Skills Studies, Paris.
- Ottaviano, G. 2015, *Offshoring and the migration of jobs*, July, IZA - Institute of Labor Economics.
- PC (Productivity Commission) 2013, *An Ageing Australia: Preparing for the Future*, Research Paper.
- 2016a, *Digital Disruption: What do governments need to do?*, Research Paper.
- 2016b, *Migrant Intake into Australia*, Inquiry Report.

-
- 2016c, *National Education Evidence Base*, Inquiry Report.
- Picchio, M. 2015, Is training effective for older workers?, January, *IZA World of Labor*.
- Polidano, C., Van de Ven, J. and Voitchovsky, S. 2017, *Making ‘Good’ Choices: The Impact of Entitlement Models on Up-skilling Later in Life*, 13 February, NCVET.
- Potter, B. and Durkin, P. 2016, ‘Attention angry white men: a service job isn’t “sheila”’s work’, *Australian Financial Review*, 29 November, www.afr.com/business/manufacturing/attention-angry-white-men-a-service-job-isnt-sheilas-work-20161128-gsz1th (accessed 30 November 2016).
- PwC (PricewaterhouseCoopers) 2015, *A Smart Move: Future-proofing Australia’s workforce by growing skills in science, technology, engineering and maths*, April.
- 2016, *PwC Golden Age Index: How well are OECD economies harnessing the power of an older workforce?*, Australian Edition.
- Ross, M. 2014, *New approaches to persistent problems*, Background paper, 01/2014, Mitchell Institute.
- Senot, C. and Chandrasekaran, A. 2015, ‘What Has the Biggest Impact on Hospital Readmission Rates’, *Harvard Business Review*, hbr.org/2015-09/what-has-the-biggest-impact-on-hospital-readmission-rates (accessed 19 January 2017).
- Seyffert, M., Lagisetty, P., Landgraf, J., Chopra, V., Pfeiffer, P.N., Conte, M.L. and Rogers, M.A.M. 2016, ‘Internet-Delivered Cognitive Behavioral Therapy to Treat Insomnia: A Systematic Review and Meta-Analysis’, *PloS One*, vol. 11, no. 2, p. e0149139.
- Shanmugaratnam, T. 2015, SkillsFuture, SkillsFuture, www.skillsfuture.sg/ (accessed 25 May 2017).
- Sijbrandij, M., Kunovski, I. and Cuijpers, P. 2016, ‘Effectiveness of Internet-Delivered Cognitive Behavioral Therapy for Posttraumatic Stress Disorder: A Systematic Review and Meta-Analysis’, *Depression and Anxiety*, vol. 33, no. 9, pp. 783–791.
- Smith, M. 2014, Can Australian Accounting Graduates Survive Offshoring?, people2people blog, people2people.com.au/blog/can-australian-accounting-graduates-survive-offshoring/ (accessed 17 January 2017).
- Smith Jaggars, S. and Bailey, T. 2010, *Effectiveness of Fully Online Courses for College Students: Response to a Department of Education Meta-Analysis*, July, Community College Research Center, Columbia University.
- Stroud, G. 2017, ‘Why do teachers leave?’, *ABC News*, 6 February.
- Tamim, R., Bernard, R., Borokhovski, P., Schmid, A. and Schmid, R. 2011, ‘What Forty Years of Research Says About the Impact of Technology on Learning: A Second-Order Meta-Analysis and Validation Study’, *Review of Educational Research*, vol. 81, no. 1, pp. 4–28.

-
- Taylor, T. 2016, How Many in the Gig Economy?, *Conversable Economist*, conversableeconomist.blogspot.com.au/2016/02/how-many-in-gig-economy.html (accessed 18 January 2017).
- The Economist* 2017, 'The Elephant in the truck: Retraining low-skilled workers', 14 January.
- Thomson, S. 2016a, 'Australian schools continue to fall behind other countries in maths and science', *The Conversation*, 29 November.
- 2016b, 'Ideas for Australia: Why is Australia falling behind in maths, science and literacy – and what can be done about it?', *The Conversation*, April.
- , De Bortoli, L. and Underwood, C. 2016, PISA 2015: A first look at Australian student's performance, December, Australian Council for Educational Research.
- , ——— and ——— 2017, PISA 2015: Reporting Australia's results, March, Australian Council for Educational Research.
- Vandeweyer, M. 2016, Soft skills for the future, *OECD Skills and Work*, oecdskillsandwork.wordpress.com/2016/06/17/soft-skills-for-the-future/ (accessed 8 June 2017).
- Vigerland, S., Lenhard, F., Bonnert, M., Lalouni, M., Hedman, E., Ahlen, J., Olén, O., Serlachius, E. and Ljótsson, B. 2016, 'Internet-delivered cognitive behavior therapy for children and adolescents: A systematic review and meta-analysis', *Clinical Psychology Review*, vol. 50, pp. 1–10.
- Wailles, N. 2016, The gig economy: Are workers on demand the future face of employment?, *Business Think*, www.businessthink.unsw.edu.au:443/Pages/The-gig-economy-Are-workers-on-demand-the-future-face-of-employment.aspx (accessed 7 June 2017).
- Weldon, P. 2016, Out-of-field Teaching in Australian Secondary Schools, *Policy Insights*, June, 6, Australian Council for Educational Research.
- Williamson, R.C., Nec Raghnaill, M., Douglas, K. and Sanchez, D. 2015, Technology and Australia's Future: New Technologies and Their Role in Australia's Security, Cultural, Democratic, Social and Economic Systems, September, Australian Council of Learned Academies.
- Wilson, R., Dalton, B. and Baumann, C. 2015, 'Six ways Australia's education system is failing our kids', *The Conversation*, 16 March, <http://theconversation.com/six-ways-australias-education-system-is-failing-our-kids-32958> (accessed 29 March 2017).
- Wood, S. 2014, 'Redundancy: when losing your job means losing yourself', *Sydney Morning Herald*, 20 July, www.smh.com.au/nsw/redundancy-when-losing-your-job-means-losing-your-self-20140521-zrjya.html (accessed 17 November 2016).
- Woods, G. 2007, The statistical evidence for offshore outsourcing and its impact on the Australian labour force, *Research Paper*, 3 2007-08.