DRIVERS OF CHANGE

for the Australian labour market to 2030

EDITED BY KATHERINE BARNES AND PETER SPEARRITT

ACADEMY OF
THE SOCIAL SCIENCES
IN AUSTRALIA

DRIVERS OF CHANGE FOR THE AUSTRALIAN LABOUR MARKET TO 2030

DRIVERS OF CHANGE

for the Australian labour market to 2030

EDITED BY KATHERINE BARNES AND PETER SPEARRITT

PROCEEDINGS OF AN
EXPERT SCENARIO FORUM

ISBN (Online PDF) – 978-0-9925829-0-6

ISBN (Print) – 978-0-9925829-1-3

Enquiries should be addressed to:
Academy of the Social Sciences in Australia
GPO Box 1956
Canberra ACT 2601
Australia
Email: secretariat@assa.edu.au
Website: www.assa.edu.au

This publication covers the proceedings of an expert scenario forum held by the Australian Workforce and Productivity Agency and the Academy of the Social Sciences in Australia.

Copy editing: Ms Freya Job
Layout: Ms Sunita Kumar
Cover design: Ms Anne Wakefield

Printer: Print on Demand Centre, UQP

Contents

Introduction

Glenn Withers

Understanding current patterns of work and changes in the nature of work is central to comprehending our present situation. Trying to assess likely changes in the demand for and supply of workers, and the products and services they create, is critical to understanding how the nation may develop over the next decade. Such tasks require a close appreciation of the role of education and technological change. These topics draw on a variety of disciplines in the sciences and the social sciences, as can be seen in the contributions to this book.

Acknowledging this, the then Australian Workforce and Productivity Agency (AWPA) and the Academy of the Social Sciences in Australia (ASSA) convened a forum in Sydney in February 2014 at the University of New South Wales city campus. This provided an occasion to examine in depth and through expert eyes, the employment outlook and future skills needs for the Australian workforce.

Workforce commitments and skill formation can be very long-term. Work arrangements help determine locational choices, family formation and more, with huge implications for life arrangements. Education, specialised training and skill formation can occupy many years of life and be highly influential in life choices. The importance of these matters, their links to wider social and economic life and the significant gestation periods involved in the processes led AWPA and ASSA to look to analysing their evolution and change in Australia. Such a perspective provides a considered context for informing discussions about policy settings that influence Australia's workforce needs.

Background

An initial forum convened and co-hosted by AWPA and ASSA in 2008 had concluded that a useful way to consider a long-term perspective appropriate to much workforce strategy would be to consider scenarios for Australia's future.

Scenarios are intended as coherent narratives about the future. Depending upon events and their flow-on and related developments, alternative scenarios are possible. Indeed instead of seeking to forecast the most likely future or define the most desired future, with alternative scenarios uncertainty about the future can be acknowledged and reflected. The capacity for a nation to position itself for various such possibilities then becomes natural, while still recognising the immediate need to forecast and to seek the best. Scenarios can help add resilience and flexibility to the armoury of policy instruments and achievement of policy objectives.

For its first National Workforce Development Strategy (*Australian workforce futures*, 2010), AWPA used three scenarios developed by Royal Dutch Shell. For the second strategy, AWPA conducted a scenario forum in 2011, resulting in four bespoke scenarios which were then modelled for their implications for skills demand and supply for Australia to 2025. The outcomes and recommendations that emerged from the consideration of this analysis and approach formed the basis for the 2013 National Workforce Development Strategy, *Future Focus*.

Such strategy however should never be fixed in stone. It needs review and revision. To consider updated strategy for the period to 2030, the 2014 forum was put in place. It was seen as commencing the process for a revised Workforce Development Strategy for 2016.

The forum would help in refreshing advice to government on national workforce development in the light of further analysis and of changes since the previous systematic stocktake that was commenced with the 2011 forum.

A central scenario approach

This time however a variant on the preceding approach was considered, which adapted the methodology to allow for fresh thinking. The new approach determined to focus initially on a single central or base scenario and conduct a review of the drivers of that scenario to determine what might challenge or confirm its elements.

AWPA itself reviewed the following drivers of long-term change for its scenario construction: social, demographic and cultural trends and consumer preferences; technology, science, innovation and sustainability; economic and financial trends and globalisation; labour force, industrial and workplace trends; and, public policy and governance.

The central scenario was based loosely on the *Future Focus* smart recovery scenario. It was intended as a discussion starter rather than as a forecast or a preferred path. Over the period to 2030 the scenario outcomes for economic growth and the size of the labour force overall were based on projections for population, workforce participation and labour productivity (PPP). For the first few years of the projection period some further assumptions were made about demand as the economy adjusted to a forthcoming decline in mining investment. The scenario assumed a global environment in which growth of output picks up only slowly in the major advanced economies. Material on the projected change in industry and workforce composition over the period, drawing on earlier AWPA work, was also included.

The result was a hypothetical scenario based on the PPP assumptions and the intention was for the assumptions and their implications and indeed for the projection methodology too, to be reviewed by experts at the 2014 Forum so that the central scenario was explicitly and implicitly tested for its plausibility and for the effect of variations in those assumptions on outcomes that would in turn influence workforce issues.

Such methods of testing for alternatives and sensitivity in assumptions and their implications have the distinct advantage of checking analysis for both robustness and consistency. Things must add up for the economy, and the consequences of changes and alternatives can be examined within this approach.

Scenarios combined with projections and modelling provide a nice cross-disciplinary set of analytic methods and constitute a base for evidence-based policy and not merely policy-based evidence or even simple intuition, instinct and ideology, which all too often are the only basis even for long-term policy settings. The Central Scenario projections are provided as Attachment A to this chapter.

Also provided for the forum from prior AWPA staff work was an additional discussion paper on Industry Transformation. This paper examined the way four particular macro-drivers were transforming the industry landscape in Australia. The drivers were technology, globalisation, consumer trends and the mining boom. How emerging trends for these drivers were influencing employment and skills was examined across the economy and then in greater depth for key industry sectors. In this way some ‘meso’ level insights or foundations were provided to complement the more ‘macro’ or economy-wide analysis, especially as embodied in the central scenario even where some industry, occupation or skill categorisations were offered as part of the projections. However a ‘deeper dive’ was felt to be helpful in testing and elaborating the projections.

Through such industry transformation analysis the good sense of the more aggregate approach can be tested by review of more sector-specific knowledge, and its plausibility and coherence in that narrower and deeper frame, including by those with more sector-specific knowledge or experience. The sectors examined in detail were retail industry, manufacturing, resources, health services, education and food and beverages.

The industry transformation discussion paper authored by Kirsten Woyzbun, Susan Beitz and Katherine Barnes, and included in this volume, was duly dissected at the forum and the role of technology as destroyer and creator, as Schumpeter had it, was seen as its distinctive theme. Technology in turn was defined broadly in this paper as the 'sum total of knowledge, information and processes used to turn inputs into outputs of goods and services. Technology thus encompasses scientific knowledge, technical efficiency of production, improvements in organisation and the use of resources, and other forms of product innovation'.

This focus on technology was complemented at the forum by like discussion in many other places but especially in further direct examination of the likely evolution of technologies themselves and in looking at their implications for management functions and skills. Further, in all cases of industry transformation, it was reiterated that the finding of the *Future Focus* report remained robust: enhanced skills were a key to facilitating change, no matter what the source of change—but especially so for technology!

At the forum invited experts examined the drivers of change embodied in the central scenario analysis and in the analysis of industry transformation. This was to test the adequacy of the assumptions and analysis being conducted and enhance and improve it, with further rigorous review of the issues and approach.

The experts and their area of analysis are:

- Peter McDonald—Social, demographic and cultural trends and consumer preferences.
- David Gruen—The implications of economic and financial trends and globalisation for demand and supply for skills.
- Roger Wilkins and Mark Wooden—Labour force, industrial and workplace trends.
- John Wanna—Governance and public policy.
- Michelle Nic Raghnaill and Robert Williamson—Technology and work.

The papers for these contributions are included in this collection, revised in the light of forum discussion. Indeed a presentation by Jeff Borland on labour force matters has morphed here into a chapter by Jeff's Melbourne University colleagues Roger Wilkins and Mark Wooden. An additional paper by Tom Karmel was commissioned to cover the area of education and training.

The forum included both plenary discussion at the time of presentation to all participants and discussion in break-out groups devoted to each of the drivers of change. The participants who contributed their time, interest and expertise in this way—and in plenary discussion following syndicate review—are listed and acknowledged in Attachment B. Their willingness to attend and participate is part of the largely unsung process of better informing policy that is so important to good decision-making in this country.

Industry transformation and drivers of change

The Industry Transformation paper provided to inform discussion focused on how industry arrangements adapt in response to a range of internal and external drivers. It emphasised how the requirement to adjust affects all of industry but that in the end it is agriculture and manufacturing that have seen the most disproportionate employment effects with ongoing declines in their workforces only a little offset by mining employment advance, despite a major mineral production boom. That said, national employment growth has been strong through service industry expansion and also, importantly, this has been concentrated at the high end of the skills spectrum. Indeed across the whole economy there is a substantial decline in the share of middle- and lower-skilled roles. The chapter also concludes that within skills there has been a move away from lower-level

vocational qualifications especially in the more generic areas, and more toward higher-end skills and university qualifications.

Some of the adjustment is driven by globalisation and global resource demand but also by technology, especially digitisation, and consumer preference changes. The precise pattern varies across sectors, and will of course change in the future. What seems common to all sectors is how the influence of various technologies is pervasive and how a skilled workforce seems a key to successful adjustment. The technology changes are often particularly disruptive, offering challenges to existing ways and opportunities for new ways, but raising the question of management capacity to handle such change.

Nevertheless basic forces such as social, demographic and cultural trends and consumer preferences have their own ongoing, fundamental impacts. Peter McDonald's chapter makes this very clear. In labour supply the poor skill match to changing jobs for those outside of current employment is a major issue, as is the reduced share of new younger labour market entrants due to population ageing. These two domestic supply trends will help sustain Australia's long-term reliance on immigration to supplement its workforce growth and skills (e.g., more entrepreneurship), and this in turn will be an influence on culture given its likely ethnicity.

On the demand-side changes in demographic structure influencing housing preferences, family spending on children (more per child) and on retirees (more on retirement consumption and health support) will feature. These changes are less gradual and less disruptive in the short-term than some other drivers of change, but they too are pervasive and almost inexorable and so will be steadily influential.

The McDonald chapter raises important issues of workplace flexibility in the face of changing demography, training and education adjustment to changing skill needs of an ageing population, cultural adaptability with ongoing migration from changing areas of origin and from changing employment patterns within Australia, e.g., declining agricultural work.

David Gruen's chapter also emphasises the importance of labour supply and sees the outcome ahead for labour participation as a contestation of rising participation through education and migration factors with reduced participation from population ageing and education participation itself, and some discouragement effects with youth unemployment. On balance Gruen's view is that participation may rise a little less and decline faster than in the central scenario provided for the forum.

The Gruen chapter also emphasises the ongoing significance of Asian growth for Australian economic prospects, with flow-on effects for the industry structure and skills characteristics of the workforce. A middle class of up to three billion people on Australia's doorstep by 2030 cannot be ignored in pursuing comparative advantage in our industry and employment scene.

Gruen stresses that, in the immediate future, a difficult adjustment task will still face those parts of the traded sector not linked to mining and energy, until exchange rate rebalancing occurs following a peaking of the terms of trade. Nevertheless longer-term projection of future employment shares by industry accepts a strong payoff from growing Asian demand that, along with domestic demand, will sustain enhanced Australian service employment, while keeping agriculture steady with manufacturing declining. The precise nuances of this relative to other projections such as that for the central scenario are debatable, but the broad pattern is similar.

How far the risks and uncertainties in projections should influence skill planning is a theme that the Gruen paper gives rise to. Also how much and how far should skill flexibility be pursued? And how is this to be accomplished and for which groups?

So the focus is firmly back on the labour force—a theme pursued by Jeff Borland at the forum and by Roger Wilkins and Mark Wooden in the corresponding chapter for this publication. The analysis of

aggregate labour supply reinforces the importance of the balance of ageing and education and the role of migration, including a particular emphasis on the fact of growth of temporary migrant entry more than permanent migrant entry. It also makes clear that the sustained high rates of employment growth and earnings growth into the 21st century have been distinctive and strong.

Wilkins and Wooden also delve inside the workplace and look at the nature of work, reinforcing the shift to service work and high skilled work. Indeed even growth likely in some so-called 'low skill' occupations needs to be re-examined through this lens as it is likely to be often in care professions involving skill upgrading over time. They also point to the variegation of work arrangements as regards employment status, e.g., casualisation, self-employment, and as regards work hours, e.g., under-employment and job security, and as regards remuneration patterns, though some trends here are less clear than sometimes thought, e.g., overskilling, female wages, working from home. What does seem clear, though, is a rising inequality even when all wages have grown. Skill-based wages have simply been growing faster.

The need for a close scrutiny of the metrics in interpreting the complexity of employment and earnings experience seems a key lesson from the picture revealed in this labour market discussion.

Complementing the labour force paper is closer examination of education and training by Tom Karmel. The labour market imperatives for education and training and consideration of education and training as an industry are the themes chosen here. Karmel shows how expansion of higher level education and training over the past several decades in Australia, as elsewhere, has been substantial and has increased workforce shares significantly for workers with such qualifications yet average returns to qualifications have not decreased.

That said, Karmel finds some potential limits to such outcomes still possible, with ongoing absorption being challenged overseas and some growing signs of credentialist outcomes rather than productivity gain from the further education and training in Australia itself. Likewise, both the universities and, especially, the vocational training providers are experiencing a wide range of further challenges such as marketisation, technology change (e.g., MOOCS), regulatory problems and cross-sectoral competition. If well managed these can be sources of continuous improvement but where mishandled adverse change can happen quickly, as with international student reputational risks, or gradually, as with regulatory zeal that inhibits innovation just as much as it addresses low quality.

Such 'straws in the wind' deserve closer scrutiny if the nation is to reap best returns on investment and to be best prepared for the times ahead. Still, higher education and vocational training have long pedigrees and have displayed a worthy resilience that should assist in underpinning skill needs and building comparative advantage.

Whether government itself is a source of comparative advantage and how far the evolution of government will itself influence employment and skills as employer and as policy maker are themes in John Wanna's contribution. The chapter emphasises how governments world-wide, and including Australia, seem to be frenetically seeking to 'address' all sorts of problems and putting laws and policies in place for this purpose, but ultimately demonstrating that they are not necessarily effective in achieving the intent of these laws and policies. There is an 'announce, move on and forget' mentality evident all too often. This can be overlaid with problems from the structure of politics itself such as short-termism, adversarialism, marginalisation of minorities and public issues of scepticism and trust. Perhaps relative to many others, Australian public decision-making has been a source of comparative advantage. But whether this will continue to be the case needs close discussion—and the settings ensured to sustain and enhance this.

In the area of workforce development and future provision itself, a succession of lost planning opportunities well illustrates the problem. Possible approaches suggested by John Wanna include the 'new experimentalism' in public administration and program design informed by the new

behavioural economics, both of which mean innovation in policy implementation can be thoroughly attested.

A final chapter by Michelle Nic Raghnaill and Bob Williamson returns to the technology theme. It emphasises that boundaries here are fluid and that prediction is complex and fraught for technology invention, innovation and even adoption, but that evolutionary models of impact on the workforce could be more successful and that perhaps a constructive response is to prepare a workforce for such change however unpredictable. One conclusion that qualifies an otherwise strong focus on managers as the key to ensuring that new technology is quickly and efficiently encouraged and deployed, is the Nic Raghnaill and Williamson emphasis on also understanding the importance of the wider 'eco-system' of stakeholders involved in the innovative process. Since this means interdependence is salient and the quality of all participants relevant, prediction is more problematic as are clear policy solutions. 'Magic bullets' remain elusive, but understanding complexity can allow better prescription.

Nic Raghnaill and Williamson also conclude that while technology is a change agent of a high order for the workforce, it is not the aggregate net job destroyer that has long been feared. The very productivity benefits that result from adoption of much successful technological innovation are also the sources of increased real incomes and hence capacity to make demands for new consumption and so generate more employment in a 'virtuous circle'.

The implications of the analysis

The analysis from the forum provided material for future development of workforce policies. In doing so it also provided a guide to key questions that any such initiative needs to take into account.

One set of questions relates to setting the agenda in this field. Can it cover quality of skills as well as quantity? Can it extend into the nature of work? How can it examine flexibility in skills and skilling as well as seek to help meet specific specialised needs? How much skilling is enough and who pays? How are vested interests to be distinguished from the public interest? Who is to communicate and champion the needs and requirements in this field?

A second set of questions relates to closely linked polices in education and training. Can education and training better reflect work-integrated training? How can education and training cover both generic skills, such as leadership, teamwork and change management, and specialised training requirements? Whose responsibility is retraining and does this need a different approach? Can education and training be properly culturally sensitive, locationally diverse and granular?

A third set of questions links to the conduct of analysis for workforce policy development. Can analysis go beyond head counts to quality of skills and culture of participants? Can it link and analyse welfare overlaps such as with unemployment support and disability support? Where does integration with migration planning occur—both for internal migration and international migration? How do risk and uncertainty get reflected in both analysis and policy?

The forum provided a range of answers to many of these questions. It also raised many new questions. Either way the policy salience of pinning down these answers is made very clear in the chapters that follow. Equally clear is the importance of supporting and conducting continued research and analysis in this field. Australia has had a chequered history in this respect.

Glenn Withers

Australian National University.

Attachment A: Central Scenario Assumptions

Summary

Slow growth in the Australian economy through 2014, changing patterns of global demand, and a decrease in the size of Australia's working age population (proportional to older age groups) pose challenges for Australia. High levels of sovereign debt and weak demand in major advanced economies continue to drag on global output growth. Global growth resumes slowly from 2015, coinciding with recovering GDP growth for Australia, which reaches a high of 3.0 per cent in 2018. Our companies and government are challenged to improve productivity. Knowledge based industries are increasingly important in contributing to productivity growth. By 2030, GDP growth falls to 2.8 per cent as population growth slows and the participation rate falls due to population ageing pressures.

Social, demographic and cultural trends and consumer preferences

Confidence is lower in the early part of the scenario, affecting consumer behaviour, patterns of spending and saving, and levels of investment.

A better balance between work and family, health and wellbeing is achieved for both women and men, bringing about a modest downward adjustment in the average number of hours worked.

The trade-off between work and leisure influences consumer behaviour at the higher end of the spectrum, while economic constraints (including living costs and levels of disposable income) prove a greater influence at lower income levels.

The saving behaviour of older people is influenced by wealth effects and the desire to achieve a certain standard of living in retirement. These factors also influence older people's decisions about when to retire and/or whether to continue to work part-time.

While the cost of housing remains high, the cost of technology continues to remain accessible to both low and high earners due to the low cost of globalised production. Mobile and wireless technologies and high-tech, home-based entertainments are consumer trends even for those on low incomes.

Improved internet connectivity gives regional areas access to the online world of social and economic activity, increasing opportunities to work from home. This, and the quest for low-cost housing, brings more people into smaller cities and regional areas, revitalising these regions in the process.

Economic and financial trends and globalisation

Growth in China and India to 2016–17 is steady, moderated by inflationary pressures in China and India's limited capacity to pursue regulatory reform, which constrains the latter's growth potential. European economies retain high levels of debt and the US is in no position to provide the engine of world growth in the short-term. This means that only modest rates of economic growth are seen until 2015.

Chinese demand continues to impact the Australian economy strongly to 2030, even with lower overall economic growth in China compared to a decade ago. This is due to the expansion of the

Chinese population, the much greater absolute size of the Chinese market and rising domestic demand for goods and services, particularly among China's expanding middle class.

In early 2014, there is a decline in mining investment and Australian business investment overall continues to slow. Declining investment in skills due to rising unemployment helps constrain labour productivity growth to 1.4 per cent. But tough conditions also challenge Australian companies and governments to put in place measures to improve productivity and develop successful strategies to make Australian business internationally competitive. An important element is business attention to harnessing the power of technology and associated improvements in the supply and use of skills.

In the years to 2016–17, global exchange rates are adjusted to better reflect countries' purchasing power parity, ratios of governments' debt to GDP are reduced, and confidence in the global system returns.

By mid-2014, labour productivity recovers to historical levels, with a focus on human capital development for the knowledge-based economy. As a result of this investment, labour productivity growth returns to its long-run average of 1.6 per cent.

Labour force, industrial and workplace trends

In 2014, jobs are lost as firms fold, slow or move activity elsewhere in the world. After that, employment growth picks up to 1.4 per cent in 2017, until it falls to around 1.2 per cent from 2026 due primarily to declining population growth.

Migration is maintained during the downturn at levels consistent with the employment growth specified. Companies that have invested in people during the early part of the scenario are the first to benefit from the opportunities that return as the economic situation improves. Knowledge work, requiring increased investment in education and training, is recognised as the most significant contributor to productivity gains and new job creation. Highly-skilled people are at a premium.

The overseas education sector is competitive, leading Australia to strive to attract international students and retain them as skilled workers after graduation.

The participation of women of childbearing age plateaus by the middle of the scenario due to family commitments and an undersupply of childcare places. There is a cohort effect on participation, with the increasing proportion of highly educated women leading to an increase in average female participation in the workforce as they age.

The overall participation rate is further affected by a decline in the proportion of the population traditionally considered to be of working age (15–64 years). Conversely, by 2030, the proportion of the adult population aged 64 years and older has increased by over five percentage points. However, despite the effects of ageing, the participation rate increases to 2017 when participation peaks at 66.2 per cent. From 2020 the participation rate begins to fall and is 64.8 per cent in 2030.

Older Australians would like to work to provide for their retirement, but in the early part of the scenario there are few jobs and many find themselves retiring early. In the latter part of the scenario, older people are more readily able to find employment, although those who maintain familiarity with technology fare best in the job market.

Science, technology, innovation and sustainability

The adoption of smart technology proves to be a key factor in moving Australia out of the low growth economy. The years from 2016 to 2030 see an increase in the rate of technological innovation and adoption by industry.

Breakthrough innovations and creative strategic thought are imperatives for competing in the global economy and proficiency in using new technologies is a necessary criterion for most jobs. At the same time, technology reduces the need for people in workplaces through increased mechanisation, use of smart technologies and redesign of work practices.

Improved internet connectivity and mobile and wireless technologies are narrowing the gap between households and businesses in metropolitan and regional areas.

Environmental impacts, rising energy costs and demand for finite natural resources call for new approaches to systems of production. Australia improves its research efforts on food and water security. Smart grids and smart homes and buildings increase connectivity while mitigating energy costs.

Governance and public policy

In the early part of the scenario, government struggles to meet the electorate's expectations with a reduced revenue base. The ageing population increases pressure on health and aged care services and government expenditure.

Central to the Australian recovery beyond 2018 is improved fiscal capacity as industry profits pick up, employment increases more rapidly and consumer demand improves.

In an increasingly multi-polar world, the ability of governments to provide a framework that enhances stability and enterprise is challenged by issues of security, defence and international economic relations, such as trade rules and protectionism, agreement on how to handle climate change and protection of taxation revenues.

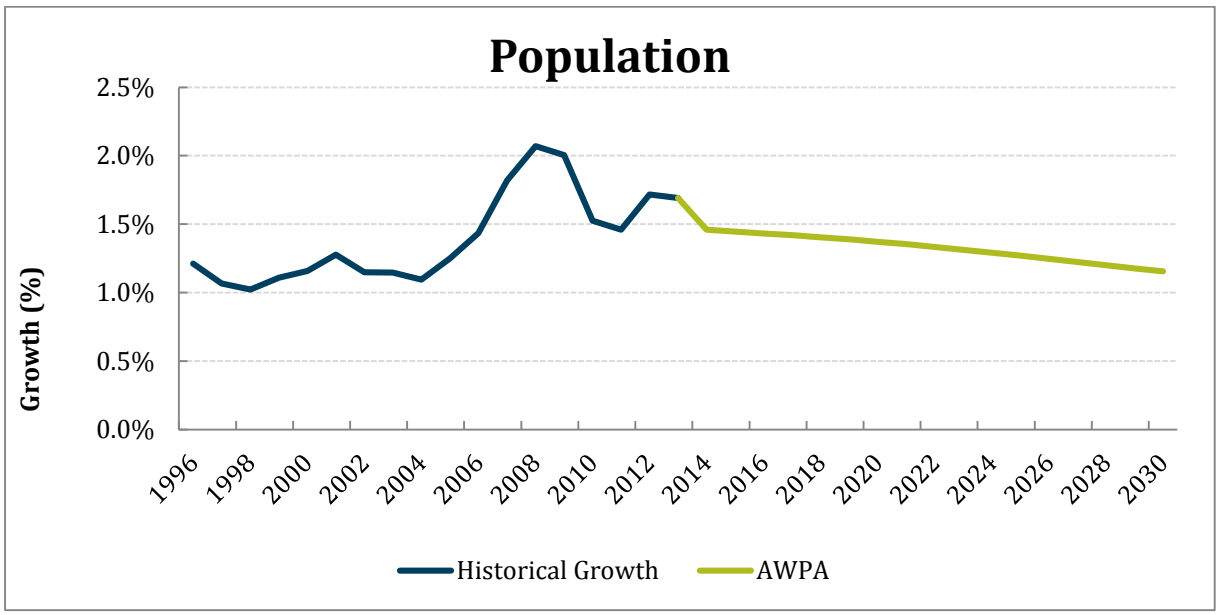
Modelling

Note: The modelling outlined in this section does not aim to project actual future values of variables. Rather, the projections reflect (i) underlying trends that reflect the average value a variable might be expected to return to over time and (ii) features of the scenario being modelled that reflect the possible future outlined in the preceding section. The modelling is not meant to be a definite or accurate prediction of the future but simply a discussion starter.

Population

- **Figure 1** shows projected population growth.
- Population projections are taken from the Productivity Commission's (PC) latest 2013 figures, estimated for their *An Ageing Australia* report.
- Under these population projections, population growth is 1.7 per cent in 2013, before falling over the projection period to 1.2 per cent growth in 2030.

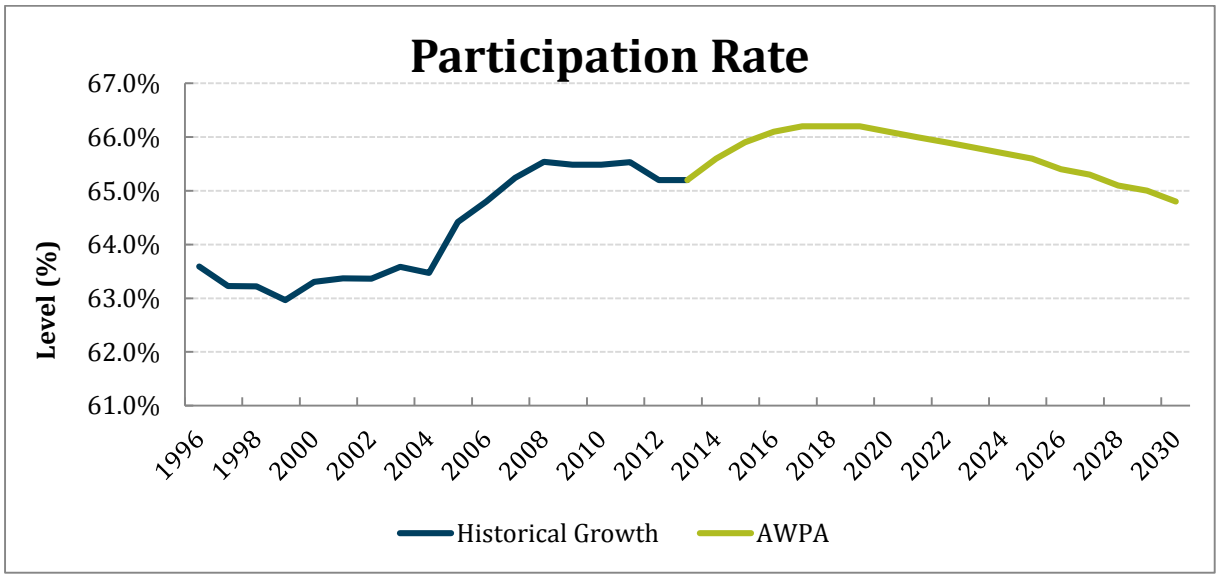
Figure 1: Population growth projections



Participation

- **Figure 2** shows the projected participation rate to 2030. The projection takes into account changes in demography (based on the above mentioned population projections) and current trends in participation rates (based on PC modelling for its 2013 report into ageing), adjusted to take fuller account of the effects that increased qualifications holdings by the future old (relative to previous generations of older workers) will have on participation. The PC report foreshadowed the possible need to make such an adjustment.
- Overall, the participation rate is projected to increase from 65.2 per cent in 2013 to a high of around 66.2 per cent from 2019, before falling to 64.8 per cent in 2030.

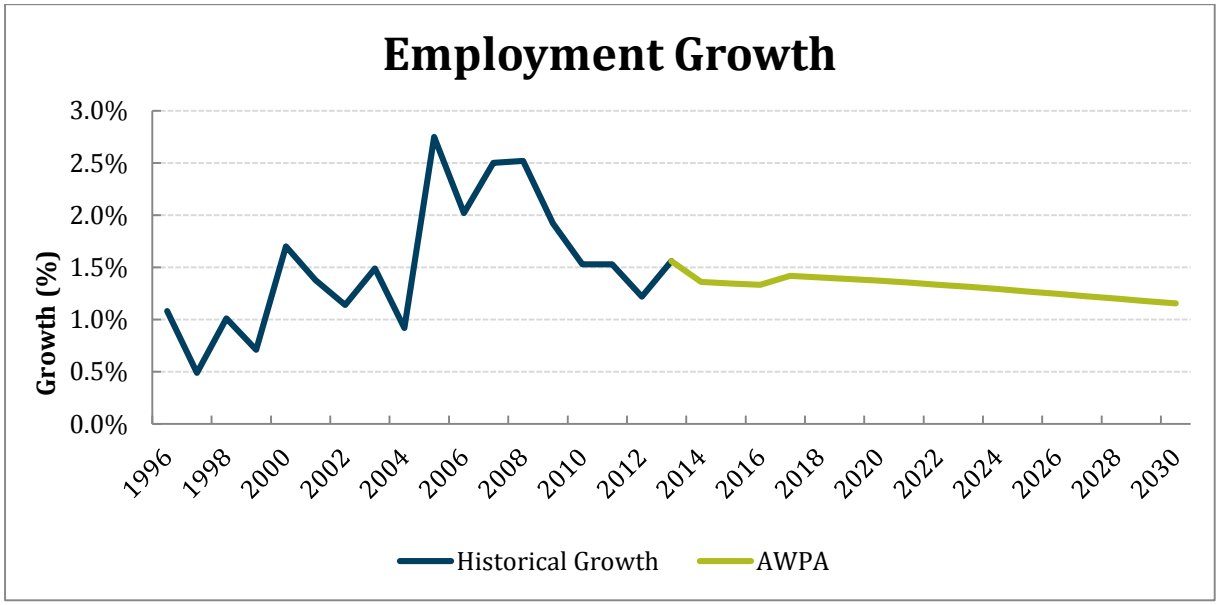
Figure 2: Projected participation rate level



Employment growth

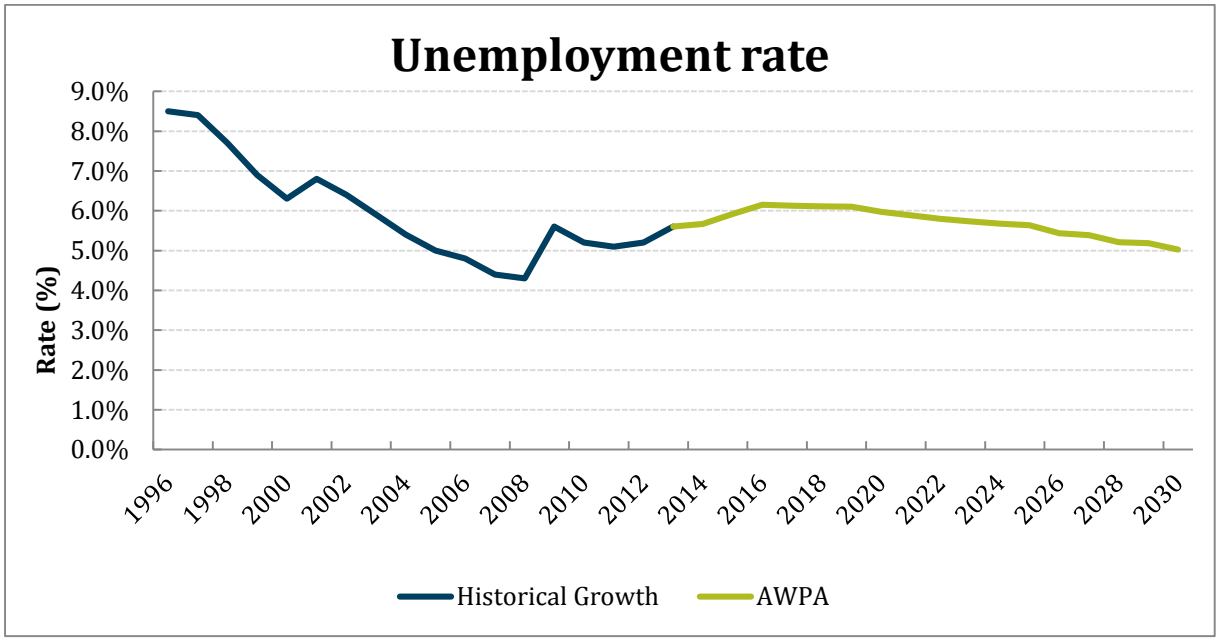
- **Figures 3 and 4** show projections for employment growth and the unemployment rate, respectively.
- Employment growth is facilitated by growth in labour force participation and population growth. 2014 sees a fall in employment growth being driven by scenario parameters, but then an increase in employment growth to a high of 1.4 per cent in 2017. From this high, employment growth slowly falls to around 1.2 per cent in 2030.

Figure 3: Employment growth projections



- The unemployment rate peaks at around 6.2 per cent in 2016 before falling to 5.0 per cent in 2030. The unemployment rate averages 5.7 per cent over the projection period to 2030.

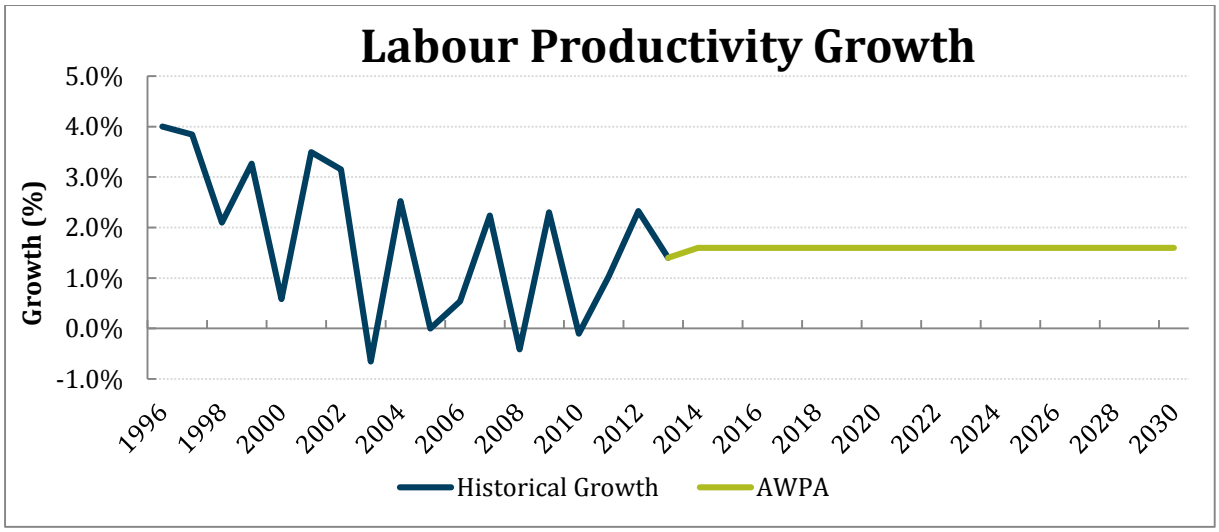
Figure 4: Projected unemployment rate



Productivity

- **Figure 5** shows projected labour productivity growth. Labour productivity is projected to grow from 1.4 per cent in 2013 to reach its historical average of 1.6 per cent per annum in 2014, and then remain steady throughout the rest of the hypothetical scenario.

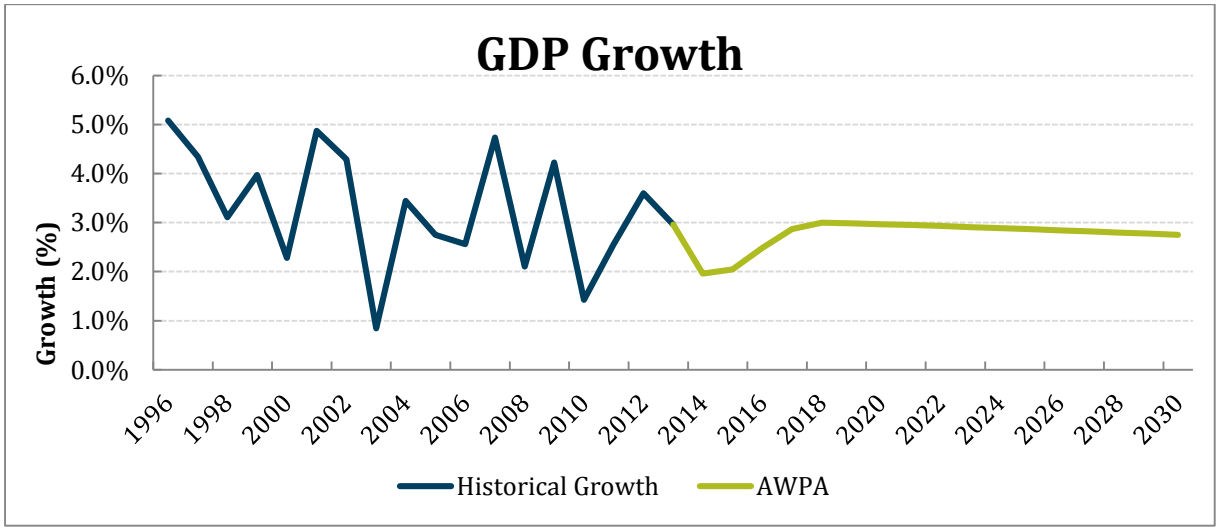
Figure 5: Productivity growth projections



Output growth

- **Figure 6** shows projections for output growth.
- Output growth is driven by changes in the 3Ps that drive long-term economic growth—Productivity, Participation and Population. However, during the scenario output growth is also affected by demand factors outside the 3Ps, particularly during the early years of the scenario.
- The fall in output growth during the early part of the scenario is driven primarily by slowing demand. From 2015, the economy begins to recover as demand begins to return to earlier levels. Slowing population growth primarily drives the gradual decline in output growth after 2020. In 2030 output growth is projected to be around 2.8 per cent per annum.

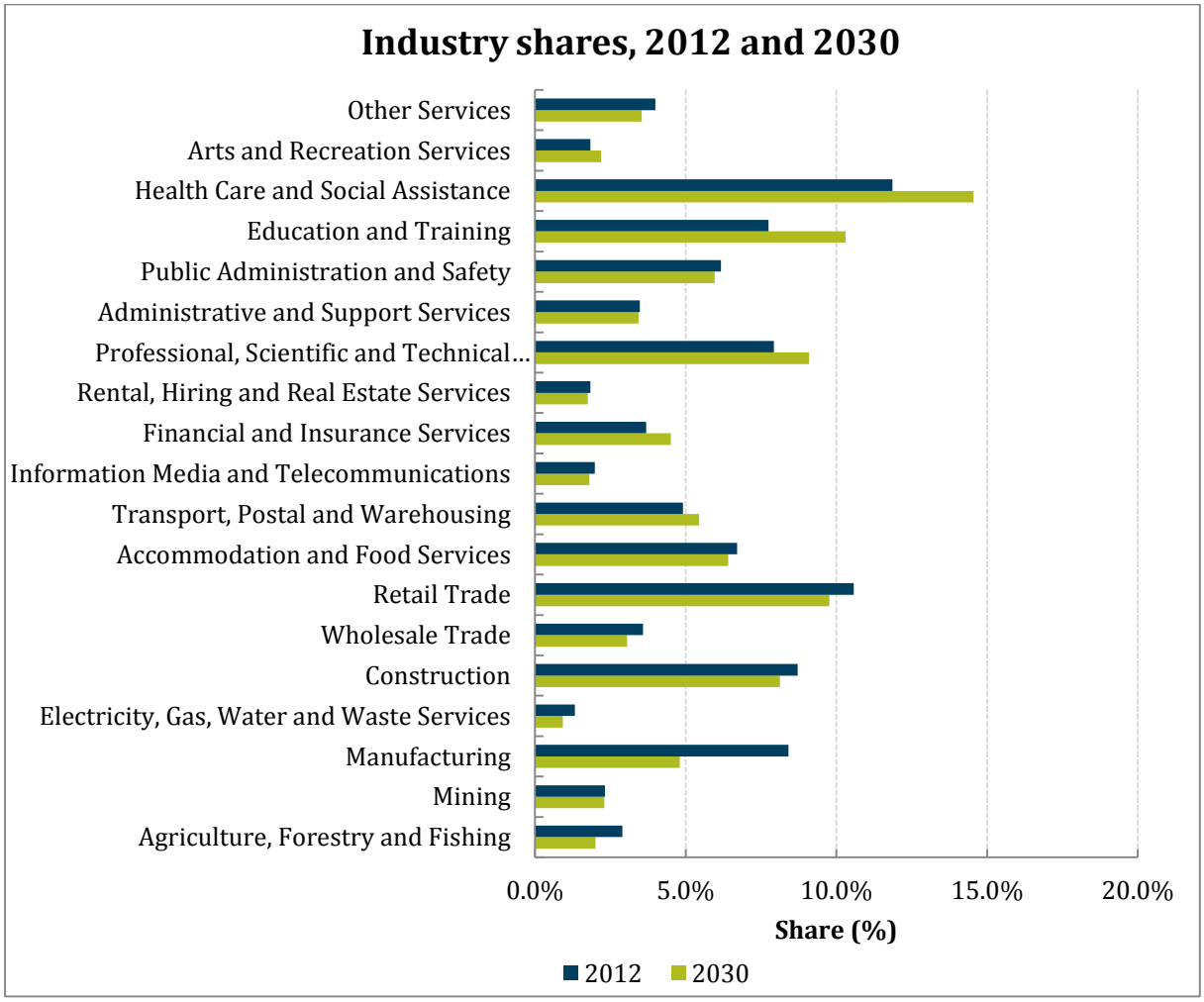
Figure 6: Projected output growth



Industry projections (ANZSIC 1 digit level)

- **Figures 7** and **8** show the projected share of employment by industry (2012 and 2030) and the projected change in the share of employment of each industry (2012 and 2030), respectively. For the industry share data, the ABS' Labour Force Survey (6291.0.55.003) was used for 2012 and DAE Smart Recovery forecasts to 2025 were used to produce projections to 2030 based on trend growth rates for individual industries.
- Health Care and Social Assistance is projected to remain the largest employing industry in 2030, while growth within Education and Training between 2012 and 2030 sees it become the second highest employing industry, overtaking Retail Trade, which experiences a small drop in employment during this period. Employment in Professional, Scientific and Technical Services is also projected to increase, with the sector becoming Australia's fourth largest employer by 2030, after Retail.

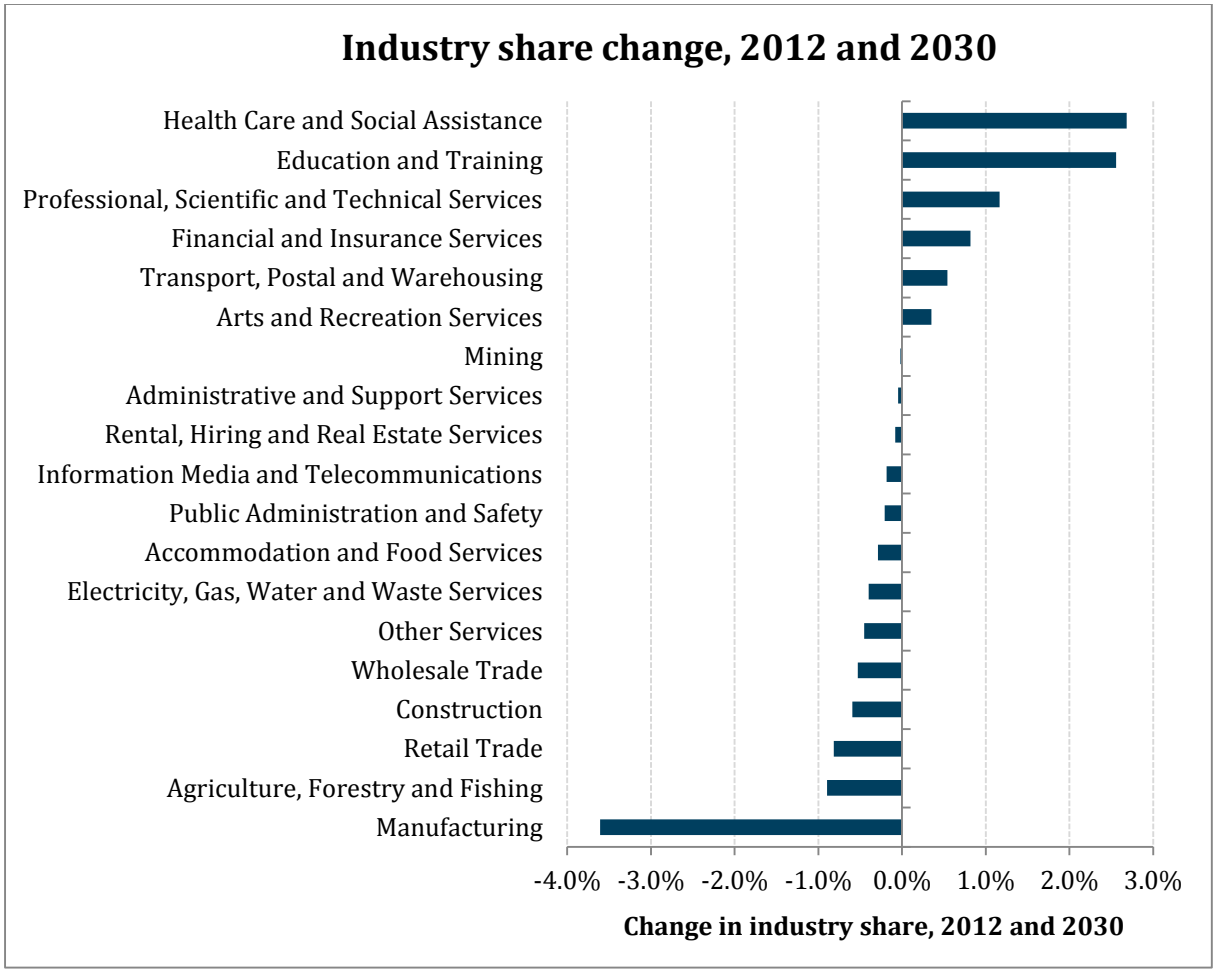
Figure 7: Industry shares, 2012 and 2030



- The largest increases in employment are projected to be in the Health Care and Social Assistance, Education and Training, and Professional, Scientific and Technical Services sectors. Manufacturing is expected to experience the largest relative decease in employment to 2030, followed by Agriculture, Forestry and Fishing; Retail Trade; Construction; Wholesale Trade; and Other Services.

Employment in Mining is forecast to remain relatively stable, with only a very modest decrease to 2030 due to increased efficiencies and technological change within the industry.

Figure 8: Industry share change, 2012 and 2030



Chapter 1

Industry Transformation

Kirsten Woyzbun, Susan Beitz and Katherine Barnes

Industry transformation is the ongoing process by which industry, organisations and labour market arrangements adapt in response to a range of internal and external drivers[1].

In an increasingly diffused global economy, the manner in which industry responds to opportunities and threats can bring about a fundamental transformation in technological uptake and business strategy. This impetus allows organisations to compete, maintain capabilities and increase market potential: driving innovation and new ways of working.

The impacts of industry transformation can affect the whole economy, influencing measures of productivity, levels of business confidence and investment potential. How we respond to these changes through policy and business practices will shape our future prospects and prosperity.

There are a number of drivers for industry transformation in Australia, all of which are interconnected and mutually reinforcing. The Productivity Commission identifies six: technological change, consumer behaviour, demography, global shocks and transformations, natural resources discoveries and government policy.[2] For the purposes of this chapter we are concentrating on three: technology, changing consumer preferences and globalisation.

Advances in technology have transformed existing economic activities and led to the emergence of entirely new industry sectors. Technological innovations have changed the way people work while allowing enterprises to outsource services that were previously conducted in-house, such as IT, accounting and customer support. These innovations will continue to change the manner in which people consume, learn and communicate.

The movement of jobs and high value-added activities offshore is shifting wealth to developing countries, even as those countries struggle to address long-term structural challenges. Growing populations and incomes in these countries are expected to account for shifts in consumer spending in the medium-term.[3] The development and use of innovative products and processes in developing countries is matched by their accumulation of capital and labour.[4] The flow of skilled workers is increasingly moving in multiple directions, with emerging economies such as China, India, Brazil and South Africa beginning to compete strongly for talent.

While globalisation has brought about countless opportunities as a result of the movement of capital and trade across borders, developing economies are expected to start competing on value as well as volume.[5] This will require industries in advanced economies to undertake further change and adaptation if they are to compete effectively in a global marketplace.

Competition will be further fuelled by changing customer preferences. Spending on services (such as financial services and 'experiences') has been steadily growing across the developed world in line with rising incomes. Discretionary spending combined with competitive pricing from overseas/online companies heightens the onus for Australian enterprises to continually innovate, customise and market their products and services from a variety of platforms.

---

[1] We are grateful to Michael Keating for feedback on earlier drafts of this paper.

[2] Productivity Commission, 2012, 'Structural adjustment in a "multi-speed" economy', *Annual report 2011–12*, Australian Government, Canberra; Stevens, G, 2012, 'The glass half full', address to the American Chamber of Commerce (SA) Internode Business Lunch, June.

[3] Hepburn, D et al, 2013, *The world's industrial transformation*, A Chatham House Report, http://www.chathamhouse.org/sites/default/files/public/Research/International%20Economics/0713r_industrialtransformation.pdf.

[4] OECD, 2013, *Perspectives on Global Development 2013: Industrial policies in a changing world*, OECD and European Development Finance Institutions, http://www.oecd.org/dev/pgd/COMPLETE-%20Pocket%20EditionPGD2013.pdf; Hepburn, D 2011, *Mapping the world's changing industrial landscape*, International Economics, Chatham House, July, http://www.chathamhouse.org/sites/default/files/0711bp_hepburn.pdf.

[5] WEC, 2012, *The shifting geography of global value chains: Implications for developing countries and trade policy*, Geneva: World Economic Forum.

The first part of this paper focuses on macro drivers of industry transformation: technology, changing consumer preferences and globalisation, while the second part examines the implications for employment and the workforce.

Key drivers of industry transformation

The drivers of industrial transformation are those factors which cause industry transformation to occur and provide the momentum for it to continue. These drivers are many and varied, taking in a range of demographic, political, environmental and macroeconomic influences. Importantly, these are interconnected and mutually reinforcing. For example, demographics and changing social and individual values intersect with changing technologies to produce changes in consumer preferences, expectations and buying behaviour. Technology is an overriding driver of industry transformation, particularly as it is disseminated around the world and creates new industries, changes older ones, and influences the very ways in which people work.

The drivers of industry transformation have been facilitated over the past 25 years by 'international trade rounds, the development of international capital markets, the spread of multinationals and the flow of ideas around the world'.[6] Other influences, such as economic and product regulation and multi-level governance, also clearly play a role. However, for the purposes of this project three key drivers have been identified as crucially important for industry transformation in Australia, particularly as concerns the future of employment and skills. These are: technology, changing consumer preferences and globalisation.

Technology

Technology has long played an important role in transforming industries and economies, reducing the costs of doing business and changing the way people work. The digital revolution—including the rise of the personal computer in the early 1990s; the growth and commercialisation of the internet; the ubiquity of mobile devices; and continued adaptation to advances in ICT in the workplace—have brought about exponential transformations in commerce, communications and the world of work.

In addition to the microeconomic reforms of the 1980s and '90s, the productivity gains achieved in Australia during the mid-to-late 1990s are frequently attributed to technological advances which allowed for existing resources to be utilised more efficiently. This period saw unprecedented innovation in ICT, leading to technological and procedural improvements across a range of industries.[7] General purpose information and communication technologies are therefore arguably at least as important to innovation as are more customised or sector-specific technologies, such as robotics.[8]

McKinsey has identified the following technologies as having the potential to affect billions of consumers, hundreds of millions of workers, and trillions of dollars across economies in the years to 2025:

- Mobile internet
- Automation of knowledge work including artificial intelligence (AI)
- Cisco's 'Internet of Things' (machine-to-machine connectivity)
- Cloud technology

[6] Hepburn, D 2011, Mapping the world's changing industrial landscape, International Economics, Chatham House, July, http://www.chathamhouse.org/sites/default/files/0711bp_hepburn.pdf, p.2.

[7] Gretton, P, Gali, J and Parham, D 2003, The effect of ICTs and complementary innovations on Australian productivity growth, Productivity Commission, Canberra.

[8] Jovanovic, B and Rousseau, P 2005, 'General purpose technologies' in Aghion, P and Durlauf, S (eds), Handbook of economic growth, Volume 1, Chapter 18, New York: Elsevier: 1181–1224.

- Advanced robotics
- Autonomous and near-autonomous vehicles
- Next-generation genomics
- Energy storage
- 3D printing
- Advanced materials engineering
- Advanced oil and gas exploration and recovery
- Renewable energy.[9]

Further benefit can be expected from the interplay between rapidly advancing technologies. For example, advances in renewable energy and energy storage mean that electric vehicles are becoming increasingly cost-competitive with conventional vehicles. In developing countries, improved energy storage can extend electricity to remote locations. Technological improvements in energy exploration, recovery and storage have also resulted in decreasing costs using means that were previously economically unviable.[10]

Technology is also being used to create new processes and ways of working. Deloitte Access Economics argue that technological developments in the mobile sector 'will result in a productivity benefit to the Australian economy of $11.8 billion over the period to 2025… and benefits are expected to grow over time [given the] many ways mobile technologies contribute to productivity for an individual business—for labour or capital'.[11]

While bringing considerable benefits, technology also has significant capacity to disrupt the economy, particularly in the case of technologies which experience rapid breakthroughs, leaving industry scrambling to adapt.[12]

In particular, technology can represent a threat to existing jobs. Where technological improvements bring the promise of higher productivity, it can be the most vulnerable workers who bear the brunt of this change.

Job shedding and business closures affect many individuals, families and communities. The adjustment pressures created by such events can be felt more heavily by segments of society that are relatively less adaptable—for a range of reasons such as age, language background [and] skills.[13]

Policies aimed at mitigating negative impacts on individual workers are therefore particularly important, whether by providing support for retraining or enabling access to job expos.

Yet history shows that the savings generated by productivity-enhancing technologies have tended to actually create demand via higher incomes and lower prices, which in turn generate new jobs economy-wide.[14] Employment in some industries declines but employment in others grows with an overall net benefit to the economy.

---

[9] Manyika, J et al, 2013, *Disruptive technologies: Advances that will transform life, business, and the global economy*, McKinsey Global Institute.

[10] Ibid.

[11] Deloitte Access Economics, 2013, *Mobile nation: The economic and social impacts of mobile technology*, Report commissioned by the Australian Mobile Telecommunications Association, Deloitte Access Economics, February, http://www.deloitte.com/assets/DcomAustralia/Local%20Assets/Documents/Services/Corporate%20Finance/Access%20Economics/Deloitte_Mobile_nation_7Feb2013.pdf.

[12] Manyika, J et al, 2013, *Disruptive technologies: Advances that will transform life, business, and the global economy*, McKinsey Global Institute.

[13] Productivity Commission, 2012, *Annual Report 2011–12*, Canberra.

[14] Miller, B and Atkinson, R 2013, 'Are robots taking our jobs or making them?', The Information Technology and Innovation Foundation.

Digitisation and emerging technologies

The ability to digitise a diverse array of information into electronic formats and to store, share and analyse unprecedentedly large and complex data sets has the potential to transform industry and the way we work. In particular, recent advances in the collection and analysis of large data sets—'Big Data'—have implications for innovation. The applications of big data across subject areas range from analysis of marketing and business trends, to heath and epidemiology, legal research, crime prevention applications and logistics management.

The use of large data sets in industry is not new. Global telecommunications companies collect billions of call records each day, while stock exchanges process millions of transactions per minute.[15] However big data offers new and unique opportunities. Firstly, the penetration of the internet means personal and professional activities are increasingly conducted online and therefore produce real-time data on just about every sphere of human activity. Secondly, advanced analytic technology allows more sophisticated information to be extracted with greater accuracy and at greater speed. As the OECD explains,

Data forms a key pillar in 21st century sources of growth. The confluence of several trends, including the increasing migration of socioeconomic activities to the Internet and the decline in the cost of data collection, storage and processing, are leading to the generation and use of huge volumes of data—commonly referred to as 'big data'. These large data sets are becoming a core asset in the economy, fostering new industries, processes and products and creating significant competitive advantages.[16]

IBM characterises big data by the 'four Vs', namely: high volume, accelerating velocity, variety, and veracity.[17] In its Big Data @ Work survey, IBM found that businesses valued big data's ability to discern patterns in consumer preferences and behaviour. However big data also has the potential to create value and enhance productivity across industry sectors other than retail and marketing. It has already contributed to innovations in areas such as health care and medical research, utilities, transport and logistics, and professional, scientific and technical services.[18]

Big data has driven growth in new companies and new business areas within organisations that specialise in information-driven business models. These businesses play an enabling role by providing advanced analytical services to other organisations. As data and information becomes increasingly valued as assets, other businesses have started generating value out of 'exhaust data' by selling data they have collected to augment business and economic forecasts.[19]

The emergence of big data is expected to result in increased demand for expertise in computer science, data analysis, and data storage and security, among other disciplines. In addition, McKinsey suggests that management and senior executives also have a critical role to play. Looking back at earlier waves of transformational technology, it is evident that productivity surges not only because companies adopt new technologies but also because they can adapt their management practices and change their organisations to maximise the potential these technologies offer.[20]

---

[15] IBM, 2012, *Analytics: The real-world use of big data*, http://www-935.ibm.com/services/us/gbs/thoughtleadership/ibv-big-data-at-work.html.

[16] OECD, 2013, *Internet economy: The role of data in promoting growth and well-being*, Paris: OECD, http://www.oecd.org/sti/ieconomy/data-driven-innovation.htm.

[17] IBM, 2012, *Analytics: The real-world use of big data*, http://www-935.ibm.com/services/us/gbs/thoughtleadership/ibv-big-data-at-work.html.

[18] Ibid.

[19] Manyika, J et al, 2013, *Disruptive technologies: Advances that will transform life, business, and the global economy*, McKinsey Global Institute.

[20] Ibid.

Emerging industries, the knowledge-based economy and implications for skills

As more economies invest in technology, there will be associated growth in high technology industries and increasing demand for highly-skilled workers. The shift to a higher-skilled workforce is also expected to result in increased productivity gains. Emerging industries, in particular, tend to be knowledge and technology intensive and driven by innovation and entrepreneurs. The OECD reports that knowledge-intensive and high-technology economies tend to be 'the most dynamic in terms of output and employment growth'.[21]

Modelling of the Australian workforce based on four scenarios for Australia to 2025 shows an increasing demand for highly-skilled workers, with an average annual increase in post-school qualifications projected at between 1.7 per cent (for the lowest growth scenario) to 3.9 per cent for the most positive scenario. However, industry's need for higher-level qualifications (Certificate III and above) will grow faster than for lower level qualifications in the years to 2025.[22]

Emerging industries have an important role to play in Australia's transition to a knowledge-intensive, service driven economy. Globally, economies are undergoing profound transformations and cultivating emerging industries is a strategic way of responding to the new goods, processes and services which will likely characterise the next decade and beyond.[23] As economies become increasingly interlinked, applying innovation and industry collaboration in key emerging areas such as nanotechnology, biotechnology and advanced manufacturing systems offer opportunities for growth and competitive advantage.

Emerging industries can cause structural changes as they create new suppliers, customer bases, business models, products and services.[24] In this way, new and emerging industries have been described as 'disruptive' as their ideas can impact upon value chains, market demand and social acceptance and can trigger reallocation of resources from existing to new activities and enterprises.[25]

There is strong potential for Australian knowledge-based industries (KBIs) in both global and regional contexts. Countries such as China and India are focusing on KBIs to drive their economic growth and prosperity. However, many Australian sectors in this grouping have not yet recovered after the global financial crisis and are still in cost-containment mode. Small-to-medium enterprises, which constitute a significant component of the KBI sector, are suffering from low confidence levels and capital expenditure growth in this group has fallen to the lowest levels in 19 years.[26] Offshoring can be a particular risk for this grouping, with occupations such as ICT managers, support technicians, business and systems analysts, security specialists and computer network professionals faced with the possibility of seeing their positions offshored.[27] However, the movement of skills goes both ways, as Australia also

---

[21] OECD, 1996, 'The knowledge based economy', Paris: OECD.

[22] Australian Workforce and Productivity Agency, 2013, *Future focus: A national workforce development strategy*, Australian Government, Canberra.

[23] Kocker, Z et al, 2012, 'Clusters in emerging industries', Working paper of the Institute for Innovation and Technology, *iit-Perspektive*, no. 9, June.

[24] Bruskova, P 2011, 'Emerging sectors and industries as important element of regional innovation policy', Know-Hub, www.know-hub.eu/knowledge-base/encyclopaedia/emerging-sectors-and-industries-as-important-element-of-regional-innovation-policy.html; TACTICS Reflection Group, 2011, *Task force on using excellent clusters to address emerging industries (and services),* European Commission, Input paper for task force workshop, Warsaw, 12–13 May; Lin, M et al, 2013, 'Regional strategies for developing emerging industries of strategic importance in China,' *Journal of Science and Technology Policy in China*, vol. 4, no 1: 20–35.

[25] Bruskova, P 2011, 'Emerging sectors and industries as important element of regional innovation policy', Know-Hub, www.know-hub.eu/knowledge-base/encyclopaedia/emerging-sectors-and-industries-as-important-element-of-regional-innovation-policy.html; Manyika, J et al, (2013) *Disruptive technologies: Advances that will transform life, business, and the global economy,* McKinsey Global Institute, May.

[26] 'Middle Focus: the sector that is wedged between our two speed economy', *Business and Population Monitor 2012*, PKF Chartered Accountants and Business Advisers, p 12, accessed at http://www.pkf.com.au/publications/Research/BusinessPopulationMonitor2012.pdf on 24 October 2012.

[27] National Institute of Economic and Industry Research, 2012, 'Off-shore and off work: The future of Australia's service industries in a global economy', *A report for the Australian Services Union and the Finance Sector Union,* September.

'imports' considerable numbers of workers in ICT occupations via skill stream and employer-sponsored migration.[28]

In a world where traditional based models (of 'land, labour, and capital') are rapidly changing, 'managing intellect—knowledge-based assets and knowledge workers—has become the centrepiece of profitability in virtually all companies'.[29] The importance of developing knowledge-based capital therefore cannot be overestimated.

Challenges to uptake of new technology

The capacity of management to foster innovation is a key enabling factor in the uptake of opportunities arising from new technology.[30] Businesses that are 'innovative, productive and networked' tend to have better educated and better quality management.[31] Alignment of innovation strategy, business model and culture is important if a business is to achieve maximum productivity and profitability.[32]

However the Australian Institute of Management has found that the areas of organisation capability and innovation are where Australian managers feel themselves least capable.[33] While Australia has some high-performing companies, this has tended to conceal the fact that innovation is far from being entrenched. A recent survey of Australian company boards found that:

[There is] the view that lack of innovation may be cultural… Many Chairs and CEOs felt that while Australian companies are good at adapting and may be incremental innovators, they have not generally been breakthrough innovators.[34]

Other commentators do not see the 'incremental' approach as a problem for Australian organisations, given that some of the most innovative organisations across the OECD do not engage in research and development.[35] Instead, they rely on adopting and implementing complementary innovations. Policy frameworks (including education and training policies) and organisational structures are all key factors in how effectively knowledge-based capital is transformed into innovation.[36]

Changing consumer preferences

Changing consumer preferences do not occur in a vacuum. Social, demographic and cultural trends coalesce with changing individual and group identities, changing standards of living, economic factors (such as household spending, levels of disposable income and the affordability of goods) and the emergence of new technologies to change people's buying behaviour. Other factors (such as a focus on

[28] Department of Immigration, 2011, Continuous Survey of Australia's Migrants (CSAM), employment by occupation, unpublished data.

[29] Quinn, J 1994, 'Forward' in CD Winslow and WL Bramer, *FutureWork: Putting knowledge to work in the knowledge economy*, New York: Free Press.

[30] Hall, R, Agarwal, R, and Green, R 2012, *The Future of Management Education,* scoping paper for the Australian Business Deans Council 'Future of Management Education project'; Karpin, D 1995, *Enterprising Nation,* Report of the Industry Taskforce on Leadership and Management Skills; Innovation and Business Skills Australia, 2012, *Karpin Report Revisited: Leadership and Management Challenges in Australia,* East Melbourne.

[31] Gray, C 2006, Absorptive capacity, knowledge management and innovation in entrepreneurial small firms. *International Journal of Entrepreneurial Behaviour and Research* 12: 345–360; Green, R 2009, *Management Matters in Australia: Just how productive are we?,* report commissioned by the Department of Innovation, Industry, Science and Research, November. Quoted in Ron Johnston, *Capacity of Australian companies to address/uptake new technologies*, Australian Centre for Innovation, Sydney.

[32] Jaruzelski, B, Loehr, J and Holman, R 2011, *Why Culture is Key: The Global Innovation 1000.* Booz and Co. Issue 65, Winter.

[33] Australian Institute of Management, 2012, *2012 Australian Management Capability Index*, http://www.aim.com.au/resources/AIM-AMCI.pdf, last accessed 30 August 2012.

[34] Grenot, K, and Johnston, R 2013, Australian Centre for Innovation, The Structural Basis for Science, Technology and Innovation-dependent decision-making by Australian Company Boards, report to the Office of the Chief Scientist.

[35] See for example Arundel, A, 'Science, technology and innovation', paper presented to Skills Australia/Academy for the Social Sciences in Australia expert scenario forum February 2011.

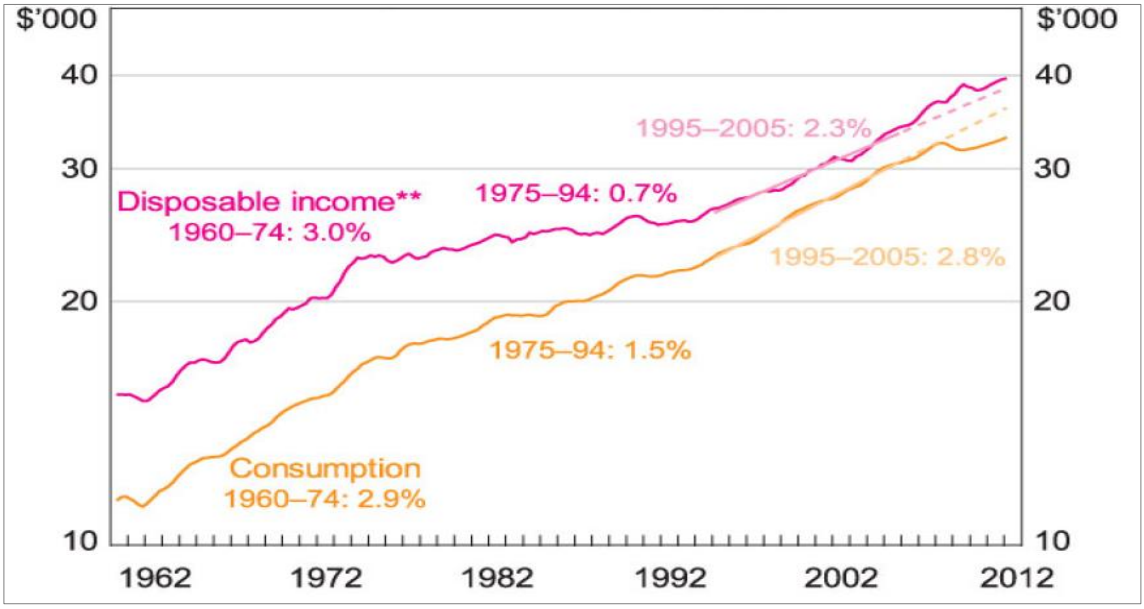
[36] OECD, 2010, *The OECD Innovation Strategy: Key Findings*, Paris, OECD, May.

sustainability) can also exert an influence on consumption, including transport and household choices and the use of water and energy. More recently, macroeconomic 'shocks' such as the global financial crisis have also been shown to help determine consumer preferences, including levels of debt and the extent to which people choose to spend or save their earnings. Meanwhile, as covered in the discussion on technology, the rise of mobile technologies which are readily and easily replaceable (if not outright disposable) is a key consumer trend of the past decade.

Household spending patterns

Household patterns of spending and saving have undergone a reverse since about 2005. As **Figure 1** shows, the rate of saving from current income was declining for quite a long period up to that point.[37] Figure 1 shows the change in household economic circumstances over the past 50 years.

Figure 1: Real household income and consumption* (per capital annual rolling sum, log scale)



Notes: * In 2009/10 dollars; deflated using the household final consumption expenditure implicit price deflator;
** Disposable income is after tax and net interest payments.
Sources: ABS; RBA.

With the beginnings of the global financial crisis in 2007–08, Australian households began to change their patterns of spending and saving at this time or a little earlier, with the rate of saving from current income reversing its decline around 2003–04 and increasing from 2005–06, with a more rapid increase in 2008–09. Real consumption spending per head grew from 2008–09, but at a slower annual rate than previously observed, about 1.5 per cent.

As the Productivity Commission points out, 'consumption and saving decisions by households are capable of influencing the fortunes of whole industries and occupations'. The retail industry has been strongly affected by the turnaround, while impacted sectors are banking, mortgage brokering and real estate services—all of which had benefited from previously strong gains in household spending. There is some debate as to whether this change in the pattern of household spending is likely to be permanent.[38]

[37] Unless otherwise stated, the primary source for this section is Stevens, G 2012, 'The glass half full', address to the American Chamber of Commerce (SA) Internode Business Lunch, June.

[38] Productivity Commission, 2012, 'Structural adjustment in a "multi-speed" economy', *Annual report 2011–12*, Australian Government, Canberra; Stevens, G 2012, 'The glass half full', address to the American Chamber of Commerce (SA) Internode Business Lunch, June.

The shift to services

A rise in incomes in developed countries has coincided with rising proportion of income devoted to services as opposed to goods.[39] This can include rapid expansion in demand for health and care services; financial services; and recreation, reflecting the shift to purchasing 'experiences'.[40]

The rise in the relative contribution of services to Gross Domestic Product began in earnest at the start of the 1980s. At the end of 1974, goods-producing industries (that is, agriculture, forestry and fishing; mining; manufacturing and construction) contributed around 33 per cent to GDP, with non-goods-producing service industries contributing 47 per cent.[41] By mid-2013, the contribution of goods-producing industries to GDP had declined to 27 per cent, with service industries rising to 57 per cent.[42]

This shift in industry outputs and economic composition is not unique to Australia. As the Productivity Commission acknowledges, 'some structural trends, such as the relative decline in manufacturing and growth of services, are of long standing, and are common to all developed countries'.[43] Indeed, the rate of decline in manufacturing's share of GDP has been remarkably steady over the last two decades and probably longer (see Figure 2).

[39] Lowe, P 2012, 'The changing structure of the Australian economy and monetary policy', Address to the Australian Industry Group 12th Annual Economic Forum, Sydney, 7 March.

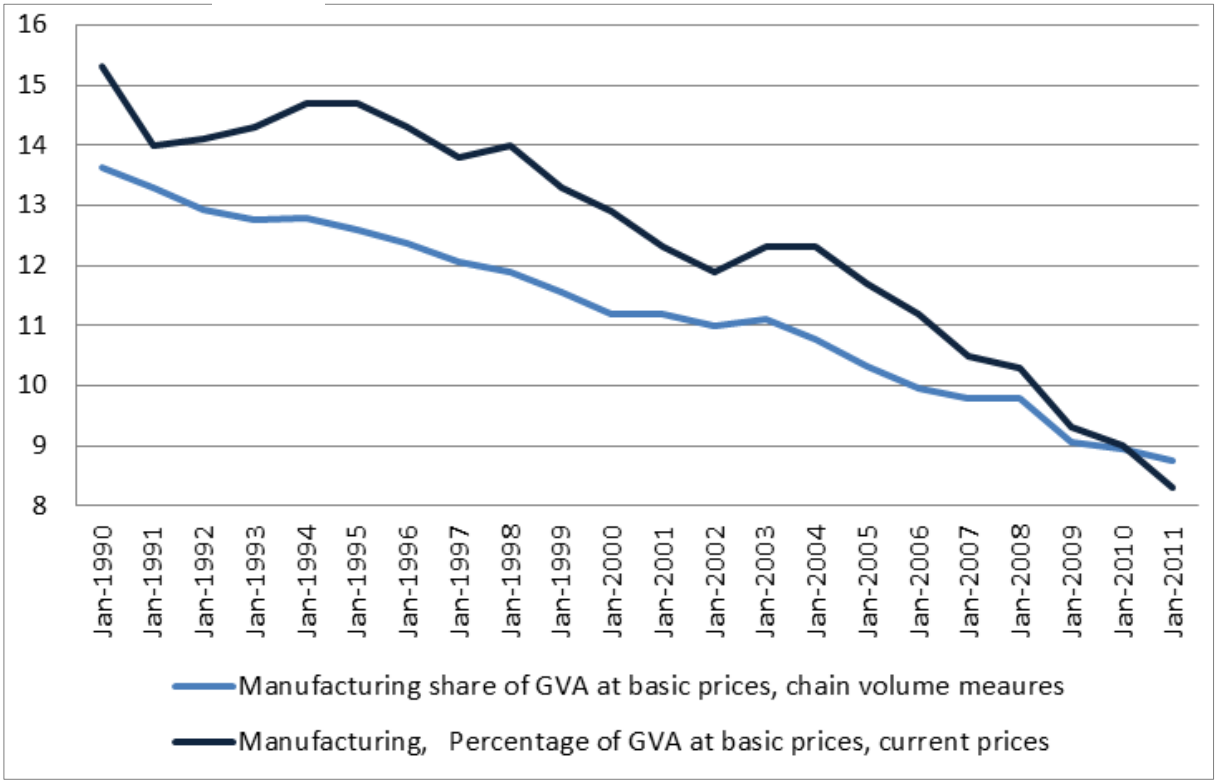
[40] Productivity Commission, 2012, 'Structural adjustment in a "multi-speed" economy', *Annual report 2011–12*, Australian Government, Canberra; Stevens, G, 2012, 'The glass half full', address to the American Chamber of Commerce (SA) Internode Business Lunch, June;

[41] Non-goods-producing service industries include all other major divisions under the ANZSIC classification except for Electricity, gas, water and waste services (D), which has not been included in this analysis as it can be considered as both a goods-producing and services-producing industry. Total for GDP also includes ownership of dwellings and taxes less subsidies on products.

[42] ABS, 2013, *Australian National Accounts: National Income, Expenditure and Product*, Cat. no. 5206.0, June 2013. Table 6 Gross Value Added by Industry, Chain volume measures.

[43] Productivity Commission, 2012, *Annual Report 2011–12*, Canberra: Productivity Commission http://www.pc.gov.au/__data/assets/pdf_file/0013/120262/02-annual-report-2011-12-chapter1.pdf.

Figure 2: Manufacturing as a share of Gross Value Added (GVA) by chain volume and value measures



Source: ABS (2010) Australian System of National Accounts, cat 5204.0, Table 5 Gross Value Added (GVA) by industry.

The rise of 'non-market sector' services is one of the common developments of the past half century across the developed world, with the decline in male-dominated 'blue collar' jobs mirrored by a parallel rise in female-dominated industries such as health care and social assistance; education and training; accommodation and food services; retail; and financial and insurance services.

Despite a 'mini' resources boom in the early 1980s, the '80s and '90s saw an ongoing decline in the relative contribution of goods-producing industries to GDP and a progressive rise in employment in services. To date, employment in services industries as a proportion of the Australian total outstrips even the rise in their contribution to GDP. Employment in goods-producing industries currently comprises only around 22 per cent of the Australian total, while employment in non-goods-producing industries accounts for more than three-quarters of the Australian workforce.[44]

Globalisation

Globalisation refers not only to the economic development of previously 'underdeveloped' countries but the emergence of new markets (for both production and consumption) and new patterns of trade. It also refers to the changing distribution of wealth and opportunity across the globe; the opening up of markets to international competition; and the increasing integration of the international economy via advances in technology, including changes in telecommunications infrastructure and transportation. In the context of industry transformation, international capital flows and the international flow of information are two of the most important aspects of globalisation. Immediate access to information around the world has affected governmental and inter-governmental relations, as well as the rate of diffusion of technology and innovation.

[44] Note: electricity, gas, water and waste services is not included in either industry cluster due to the issue of overlap in this sector between the provision of goods and services. ABS, 2013, Labour Force, Australia, Detailed, Quarterly, Cat no. 6291.0.55.003, May 2013. Total number of employed persons ('000), four quarter averages to May 1997 and 2013.

Global value chains

Global value chains (GVCs) have become a dominant feature of the world economy with important policy implications if Australia wishes to benefit from greater involvement in these sorts of international production networks.

Value chains refer to high-level supply and production chains, whereby raw materials are received as inputs; value is added through various processes; and the goods are supplied to the market and to the eventual end consumer. Globalisation and the internationalisation of technology and labour markets witnessed the emergence of *global* value chains in the late 1990s, which have both 'fragmented production processes across countries and continents and boosted network trade'.[45]

Over the past 50 years, 'Australia's trade intensity (the ratio of exports and imports to GDP) has nearly doubled', increasing from around one-quarter of GDP in 1975 to over 45 per cent by 2010.

In contrast to older industrial models in which products were largely conceived and produced in-house and only raw materials were sourced from outside the enterprise, global value chains have seen the diffusion of each stage of production across borders and around the globe, involving countries at all levels of development, from the poorest to the most economically advanced.

The production of goods and services is increasingly carried out wherever the necessary skills and materials are available at competitive cost and quality. The result is that the 'research, development, design, assembly, production of parts, marketing and branding' stages of goods can each take place in a different part of the world, and under different regulatory conditions.[46]

This fragmentation of production across borders is largely driven by changes in the business environment, by the systematic liberalisation of trade and investment, and by new technologies which have reduced transport and co-ordination costs and shifted corporate thinking.

Global value chains are often coordinated by multinational companies and a significant share of the trade in goods and services takes place within these networks. But GVCs can also encompass independent buyers and suppliers, and involve domestic small and medium firms in production.

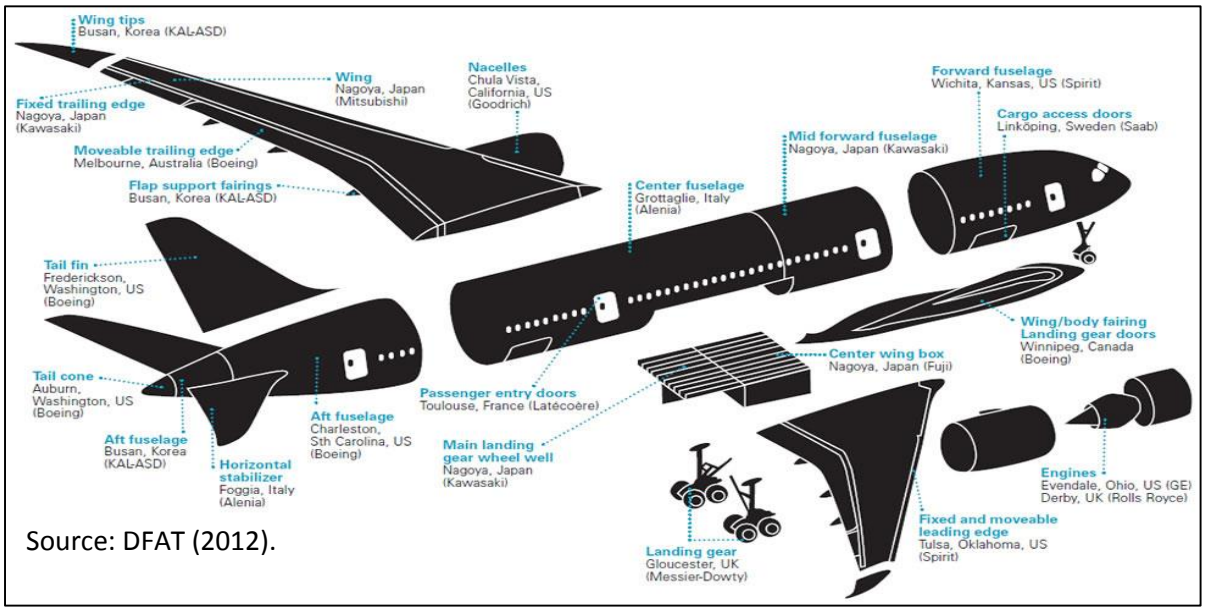
The new Boeing 787 Dreamliner is an example of a value chain in the aerospace sector, where various components of the aircraft are constructed at different sites across the globe. The moveable trailing edges of the wings are designed and manufactured in Melbourne, a contract which is worth approximately $4 billion over 20 years.[47]

[45] Banga, R, 2013, 'Measuring value in global value chains', Background Paper No. RVC-8, Unit of Economic Cooperation and Integration among Developing Countries (ECIDC), United Nations Conference on Trade and Development (UNCTAD), May, http://www.unctad.org/en/PublicationsLibrary/ecidc2013misc1_bp8.pdf.

[46] Gurría, A 2012, 'The emergence of global value chains: What do they mean for business?', G20 Trade and Investment Promotion Summit, Mexico City: OECD, 5 November.

[47] Department of Foreign Affairs, 2012, Trade at a Glance 2012, Commonwealth of Australia.

Figure 3: Example of a GVC: Manufacture and assembly of a Boeing 787 Dreamliner



Source: DFAT (2012).

Offshoring and global competition

New forms of foreign direct investment and the rise of multinational enterprises are blurring the lines in the global marketplace, with growing international transfers of capital, skills, technology, and products.[48] As part of this trend, the flow of skilled human capital is increasingly moving in multiple directions, with emerging economies such as China, India, Brazil and South Africa beginning to compete strongly for talent as innovation and technical progress gathers speed.

In the same way that the reduction of trade barriers and improvements in transport opened up manufacturing jobs to international competition, developments in information and communications technology (ICT) have exposed service-based jobs to the same competitive forces.

While, to date, globalisation has been an enabler of freer trade and the movement of capital, developing economies are expected to start competing on value as well as volume.[49] This will require further change and adaptation on behalf of industries in advanced economies if they are to compete effectively in a global market without recourse to protectionist measures and barriers to trade.

Trade agreements have to cope with the new reality of business and will need to reflect the fact that goods and services are now from 'everywhere', rather than, as they are defined today, from 'somewhere'.[50]

Offshoring will require policies that support adjustment in particular industries, regions and occupations and the ability of individuals to adapt to new employment opportunities.

Research on the link between globalisation and employment shows in general that globalisation does not have a negative effect on aggregate employment. Indeed in the services sector, research has found that offshoring has an overall positive effect on employment due to increased productivity.[51] From an

[48] OECD, 2010, *Measuring Globalisation: OECD Economic Globalisation Indicators 2010*, http://www.oecd.org/sti/ind/45954526.pdf.

[49] WEC, 2012, *The shifting geography of global value chains: Implications for developing countries and trade policy*, Geneva: World Economic Forum.

[50] OECD, 2013, 'Industry and globalisation: 21st century production', Paris: OECD http://www.oecd.org/sti/ind/21st-century-production.htm.

[51] Amiti, M and Wei, S 2005, 'Service Offshoring, Productivity, and Employment: Evidence from the United States', IMF working paper, vol. 5, no. 238, International Monetary Fund.

economic perspective, the labour market can play an important role in realising productivity gains by shifting resources and jobs from declining industries and occupations to expanding ones.

However the adjustment process does not always go smoothly and the impacts of offshoring can be more pronounced in certain industries, locations and occupations. Individual workers can face significant adjustment difficulties, particularly if they lack the skills or qualifications needed to take up new opportunities, or if the opportunities presented are located in different geographical regions.

In future, the critical labour market distinction may not be between the highly-skilled and the less skilled but between those types of jobs which are vulnerable to being substituted for work located elsewhere and those which are not.[52]

International development

The same advances in technology and communications that precipitate the flow of labour to developing countries is paving the way for a newly emergent and internationalised middle class to access services offered by developed economies, such as health, education and tourism.

Exporting product knowledge is another way that developed countries have been able to tap into the markets of emerging economies—such as Australian expertise in viticulture contributing to the development of China's domestic wine industry.[53]

Rapid innovation is the force that 'may help the developed world to move up the value chain even as its pre-eminence is being challenged'.[54] Industrial transformation is influencing the size and capability of businesses in a transformed economy, with more enterprises working in supply chains, in networks, working remotely and internationally, and taking advantage of innovations such as 'big data' to develop new processes and products. Australia's comparative advantage in this new global economy is shifting to higher technology and knowledge intensive sectors.[55] Advances in technology have led to entirely new industry sectors but also contribute to the 'renewal, transformation or intersection of existing economic activities'.[56]

Industry transformation: Impacts on productivity, employment and skill levels

So how have these various drivers actually affected the Australian economy, and what has this meant for employment and demand for skills?

Changes to the Australian economy in the 1970s and '80s are well documented, characterised by shifts in output shares between industries and a decline in the relative sizes of the manufacturing and agricultural workforces. This trend was echoed across most developed countries. While this has been attributed to a 'volatile and increasingly uncertain' global economy, spiralling oil prices and increasing

[52] National Institute of Economic and Industry Research, 2008, 'Off-shore and off-work—the future of Australian Service Industries in a global economy—a call to action', Services Union of Australia.

[53] Oliver, J 2010, 'Australian viticulture expertise in China', *Australia China Connections*, November/December.

[54] Hepburn, D 2011, *Mapping the world's changing industrial landscape*, International Economics, Chatham House, July, http://www.chathamhouse.org/sites/default/files/0711bp_hepburn.pdf.

[55] Downes, P and Stoeckel, A 2006, *Drivers of structural change in the Australian Economy*, Canberra and Sydney: Centre for International Economics, http://thecie.com.au/content/publications/MASTER%20DITR%2026%20Feb.pdf.

[56] TACTICS Reflection Group, 2011, *Task force on using excellent clusters to address emerging industries (and services),* European Commission, Input paper for task force workshop, Warsaw, 12–13 May.

competition from overseas manufacturers,[57] others have observed that the impact of technology and changing consumption patterns also contributed to the steady decline in manufacturing over four decades.[58]

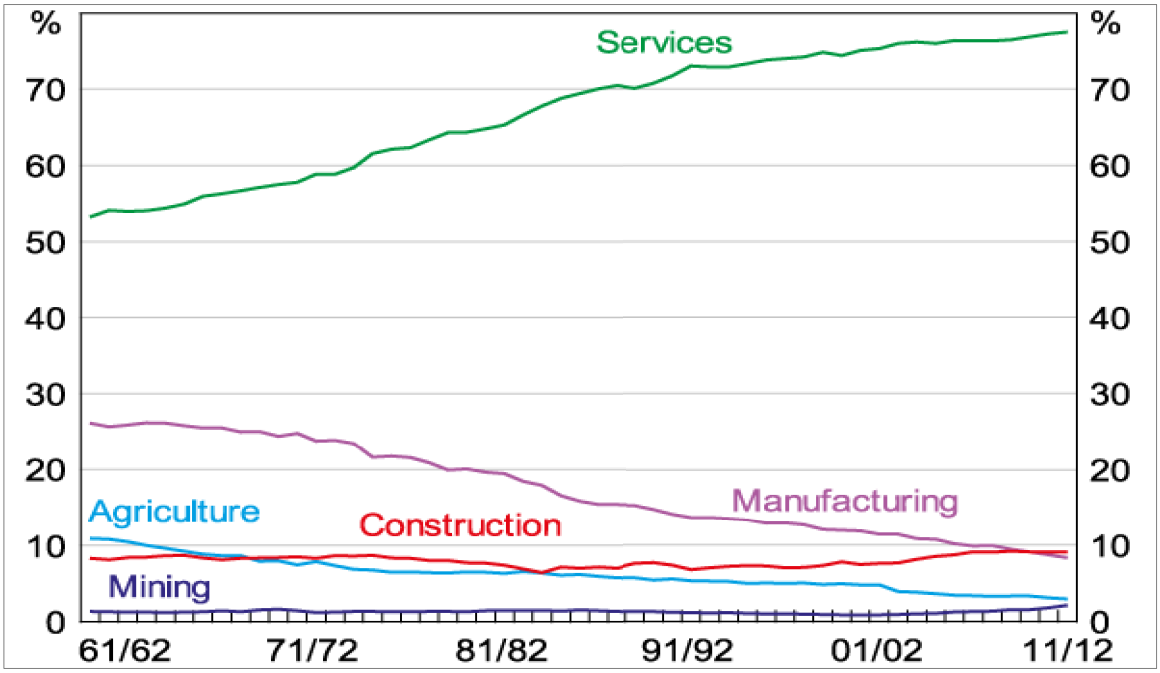
Jobs based on performing routine tasks (including routine cognitive tasks) have been those most affected by technological change. This had implications for production sectors, but also for 'white collar' work. Clerical occupations were among those most affected by the rise of personal computers in offices in the 1990s.

At the same time, technology has also led to an increase in non-routine analytic and non-routine interactive work, leading to more non-routine work being undertaken within each occupational level, and a consequent demand for upskilling. This has contributed to the relative increase in demand for highly skilled labour within the Australian economy.

Shifts in industry share of employment

Figure 4 shows how employment by industry has changed over time in Australia, from the early 1960s to the present.

Figure 4: Employment in Australia by industry, share of total, 1961–62 to 2011–12



Note: Totals for 2011–12 are estimated.
Sources: ABS; RBA; Withers, Endres and Perry (1985) in Lowe (2012).

As Figure 4 confirms, the greatest falls in employment are indicated for manufacturing and agriculture, but both sectors continue to be larger employers than mining, despite the resources boom. Today, agriculture employs approximately 321,000 people and manufacturing 954,000, accounting for around three per cent and eight per cent of total employment, respectively. In comparison, mining employs

[57] Krugman, P, 1988, 'External shocks and domestic policy responses' in R Dornbusch and FLCH Helmers (eds), *The open economy: Tools for policy makers in developing economies*, EDI Series in Economic Development, New York: Oxford University Press; Clark, C, Geer, T and Underhill, B, 1996, 'The changing of Australian manufacturing', Staff Information Paper, Industry Commission, Canberra.

[58] Thompson, G, Murray, T and Jomini, P 2012, 'Trade, employment and structural change: The Australian experience in Policy Priorities for International Trade and Jobs', Chapter 3, Australian Productivity Commission, http://www.oecd.org/site/tadicite/50287285.pdf; Kosturjak, A and Wilson-Smith, J 2004, 'The Relative

Decline of Manufacturing Employment in South Australia', *Economic Issues* no. 12, South Australian Centre for Economic Studies, University of Adelaide, July.

266,000 workers, or two per cent of total employment.[59] As Figure 5 indicates, this level of employment within the mining sector has been largely consistent over the past 50 years despite increases in output volume due to productivity improvements, among other factors.[60]

A more detailed overview of how employment has changed between industry sectors and occupational clusters can be seen in Table 1, which shows changes in employment mix over the past decade and a half.

As the table shows, the agricultural and manufacturing sectors continue to be disproportionately affected by ongoing changes to Australian industry. Of the 126,000 jobs lost within manufacturing over the past 15 years, most occurred within low- and middle-skilled occupations.

Job loss in the Agriculture, Forestry and Fishing sector (98,000), however, primarily occurred at the higher end of the skills equation. This reflects the trend towards larger rural holdings and a reduction in the number of small farms run by owner-operators.[61]

The gains in employment made over the past 15 years in other sectors have more than offset the losses experienced in manufacturing and agriculture. Employment growth during this time has been overwhelmingly concentrated at the high end of the skills spectrum within services industries, including:

- Professionals in Professional, Scientific and Technical Services (267,000)
- Professionals (249,000) and Community Service Workers (224,000) in Health Care and Social Assistance
- Professionals in Education and Training (181,000).

In addition, there is considerable growth in employment among sales workers in Retail Trade (210,000) and technicians and trades workers in the Construction industry (210,000).

Across the economy more broadly, there is a progressive movement towards higher-skilled jobs, with a decline in the proportion of people employed in middle- and lower-skilled roles. In the years between 1993 and 2003 there emerged 'a widening dispersion of earnings and changes in labour force status… principally due to changes in the structure of demand in favour of more skilled jobs'.[62] This pattern has continued over the past decade.

[59] Australian Bureau of Statistics, 2013, Labour Force, Australia, Detailed, Quarterly, Cat no. 6291.0.55.003, May 2013. Total number of employed persons ('000), four quarter averages to May 1997 and 2013.

[60] Lowe, P 2012, 'The changing structure of the Australian economy and monetary policy', Address to the Australian Industry Group 12th Annual Economic Forum, Sydney, 7 March, http://www.rba.gov.au/speeches/2012/sp-dg-070312.html.

[61] AWPA, 2013, *Food and beverage workforce study*, Australian Workforce and Productivity Agency, September.

[62] Keating, M 2003, 'The labour market and inequality', *The Australian Economic Review*, vol. 36, no. 4: 374.

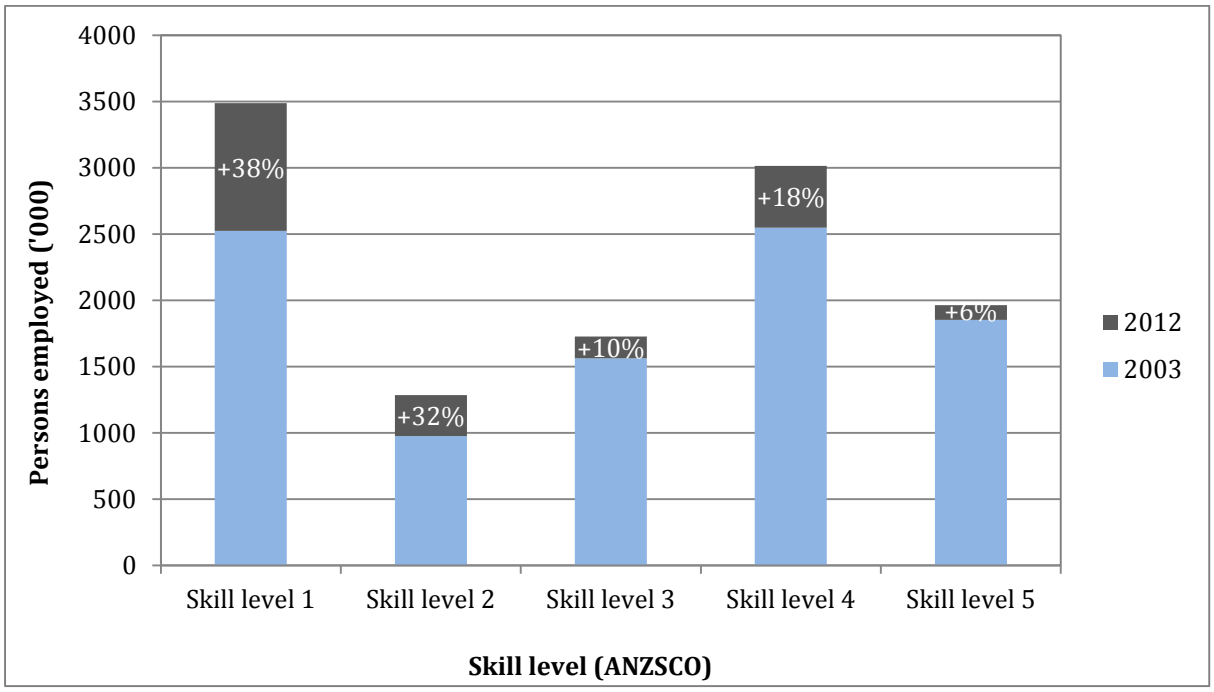
Table 1: Change in the number of employed persons by industry and occupation, 1997–2013 ('000)

Industry (ANZSIC Division)	Occupation (ANZSCO Major Group)									
	Managers	Professionals	Technicians and Trades Workers	Community and Personal Service Workers	Clerical and Administrative Workers	Sales Workers	Machinery Operators and Drivers	Labourers	Total	% change in industry's proportion of total employment
Agriculture, Forestry and Fishing	-72	0	-2	-2	8	-1	8	-37	-98	-2%
Mining	18	35	46	2	15	-1	55	9	180	1%
Manufacturing	48	11	-48	-1	-13	0	-61	-64	-126	-5%
Electricity, Gas, Water and Waste Services	14	17	9	-9	15	4	13	4	66	0%
Construction	41	21	210	-1	28	1	40	80	421	2%
Wholesale Trade	24	22	-13	-1	0	-15	19	-14	23	-1%
Retail Trade	66	22	-19	-14	14	210	-5	22	297	-1%
Accommodation and Food Services	41	2	29	88	-2	13	3	62	234	0%
Transport, Postal and Warehousing	25	18	-1	-6	28	4	86	0	154	0%
Information Media and Telecommunications	19	29	-17	-1	-13	8	-1	-3	20	-1%
Financial and Insurance Services	19	85	3	0	-7	2	-	-2	100	0%
Rental, Hiring and Real Estate Services	13	16	3	1	12	27	2	4	76	0%
Professional, Scientific and Technical Services	68	267	38	-3	34	-1	0	-4	400	2%
Administrative and Support Services	28	17	10	-5	15	0	0	85	150	0%
Public Administration and Safety	33	97	-1	78	55	-2	-12	-9	241	1%
Education and Training	31	181	2	78	29	-3	-1	-7	309	1%
Health Care and Social Assistance	43	249	19	224	82	3	5	1	624	3%
Arts and Recreation Services	15	14	12	33	6	0	0	7	87	0%
Other Services	3	-10	81	28	-2	-28	-7	-13	51	-1%
Total	475	1096	358	490	302	223	143	121	3209	
% change in occupation's proportion of total employment	1%	5%	-1%	2%	-2%	-1%	-1%	-2%		

Source: ABS (2013) Labour Force, Australia, Detailed, Quarterly, Cat no. 6291.0.55.003, May 2013. Total number of employed persons ('000), four quarter averages to May 1997 and 2013.

As Figure 5 shows, the proportion of persons employed in roles requiring higher-level skills (i.e., those at skill level 1 or 2, equating to a Bachelor degree or Advanced Diploma/Diploma, respectively) has grown at a much higher rate than those in lower skill levels (i.e., those at skill levels 3 or below) over the past decade.

Figure 5: Change in persons employed by skill level, 2003–2012



Source: ABS (2013) *Labour Force, Australia*, Detailed, Quarterly, cat. no. 6291.0.55.003, four quarter average to November.
* Skill levels provide an indication of the level and specialisation of skills required to competently perform tasks within a given occupation. Skill levels are generally associated with the skills gained through formal education and training but may also encompass previous experience and on-the-job training. In summary, skill level 1 generally requires Bachelor level or above qualifications (or equivalent); skill level 2, Adv Dip/Diploma level; skill level 3, Certificate III/IV level; skill level 4, Certificate II/III level; and skill level 5, Certificate level I qualifications. See ABS, ANZSCO, cat. no. 1220.0 for further details.

This supports the idea that structural changes within the economy are reducing the number of jobs that require lower-level qualifications, while growth in employment within managerial and professional occupations are reflecting a growing demand for higher-level qualifications. At the same time, the adoption of computer-based technologies has seen an historical decline in some middle-skill employment occupation categories which specialise in routine-manual tasks. This is particularly true of production and operation occupations in sectors such as manufacturing.[1]

[1] Acemoglu, D and Autor, D, 2010, 'Skills, tasks and technologies: Implications for employment and earnings', Working Paper 16082, Cambridge, Massachusetts: National Bureau of Economic Research.

As this brief discussion shows, industry continues to change and there is an increasing sense of urgency to 'get ahead of the game' in anticipating the impacts that industry transformation will have on Australia's future economy, workforce and demand for skills.

Determining what industry transformation and these structural changes means for jobs and skills is a complex undertaking, but analysis reveals that:

- Employment growth is expected to be greater in jobs requiring higher-level skills than lower-level skills.
- Changing technologies have continued to drive growth in knowledge-based work.
- Non-routine tasks are more likely to be insulated from technological change and productivity gains than routine tasks.
- Whether a job is vulnerable to offshoring is not just a matter of how skilled the role is, but how 'transportable' it is.
- The growth of the services sector is expected to continue in both domestic and international markets.

The extent to which enterprises innovate (incrementally or otherwise); invest in knowledge-based capital; participate in international partnerships and value chains; and successfully shift to higher technology and knowledge-intensive sectors will help determine if Australia benefits from industry transformation over the long term.

Australia, along with other advanced economies, will need to undertake further change and adaptation if it is to compete effectively in a global marketplace.

Kirsten Woyzbun, Susan Beitz and Katherine Barnes

Australian Workforce and Productivity Agency.

Chapter 2

Social, Demographic and Cultural Trends and Consumer Preferences

Peter McDonald

Social, demographic and cultural trends exert a clear influence on Australia's longer-term economy, with changing consumer preferences also among the broad drivers of change in the coming decades. The ageing of the workforce and falling participation among people of prime working age are issues that will affect labour supply and demand, but so too are the expectations of workers, developments in housing and infrastructure, the raising of families, and the manner in which individuals choose to spend their leisure time and discretionary income.

The continuing expansion of post-secondary education sees many young people seeking part-time work, while at the other end of the spectrum, some people over 65, from choice or necessity, still remain in full-time employment. The result is a longer working life, but one in which younger people may experience difficulties in finding their way into permanent, full-time employment. Similarly, while some older people may wish to extend their careers post-retirement age, others may not be in a position to do so.

Migration (both temporary and permanent) is needed to meet increases in labour demand, but long-term planning is also required to direct the training of Australians towards needed occupations. To understand the demand for and potential supply of labour we need to take into account the overall ageing of our workforce, the rise of part-time employment, the location of new jobs and the preparedness of both overseas migrants and the Australian-born to move to those jobs, either within or beyond the cities.

Changes in the age-structure and remuneration of the workforce will have a direct impact on what we consume and how we consume it. For example, rising labour force participation among parents will lead to greater demand for childcare, but also a growing need for out-of-school activities for children. Changes in population, families and household composition will likewise influence demand for housing and infrastructure and this will help fuel construction into the future, notwithstanding supply-side constraints that may slow down the realisation of this demand.

Labour supply

There are two labour supply issues in Australia. First, people of working age who are out of the labour force or are long-term unemployed may lack the skills (employment and personal) that Australian employers are seeking. In 2000, about nine per cent of prime age males were not in the labour force. Today, after considerable effort and funding directed to welfare to work programs, the percentage is much the same. Solving this problem is not simple.

Second, historically in Australia and other countries, labour supply has continued to rise because of increasing numbers of young people entering the labour market. This is no longer the case. In Australia in June 2013, the population aged 20–29 was 506,000 (or 18 per cent) larger than the population aged 10–19. Labour supply growth is also constrained by the fact that the population numbers in each age group from 20–24 to 50–54 are roughly the same. It is only at the older ages that population change supports future growth of the labour force. The age group 45–54 has 444,000 more members than the population aged 55–64. A precise calculation can be made by factoring in labour force participation rates. If labour force participation rates are assumed to remain constant between 2013 and 2018 and there is zero net migration, the fall in the labour force in ages 15–29 in the five-year period would be slightly more than the rise in the labour force in ages 55–69. In broad terms, this equation of constant labour supply (with constant participation and zero migration) remains the case throughout the coming 20 years.

For males aged 15–24, participation rates have been falling (see Table 1 below). The fall in participation has not been as great for females aged 15–24 (Table 2) but there is certainly no prospect of an upturn. About 41 per cent of employed 15–24 year-old males work part-time as do

60 per cent of females of the same age, the vast majority combining work with study. As more continue in education, participation is likely to fall further and the part-time component is likely to rise.

Table 1. Labour force participation rates, males by age group, Australia 2000–2013

	15–19	20–24	25–34	35–44	45–54	55–59	60–64	65+
2000	58.0	86.3	92.0	91.4	87.0	72.5	46.6	9.9
2001	59.7	85.4	91.4	91.3	87.5	71.7	46.7	9.9
2002	58.3	85.6	91.5	91.1	87.8	72.5	48.4	10.2
2003	57.9	85.2	91.2	90.5	87.7	73.8	49.8	10.1
2004	58.3	84.1	91.3	90.7	87.4	74.2	51.9	10.3
2005	58.8	85.1	91.3	91.4	88.1	75.3	54.2	11.3
2006	58.4	85.4	91.6	91.1	88.3	76.2	56.0	12.2
2007	58.0	85.2	92.2	91.5	88.6	77.1	56.5	13.4
2008	58.6	84.8	92.4	91.7	88.7	76.4	57.8	14.1
2009	55.7	84.1	91.1	91.3	88.6	78.3	59.4	15.3
2010	54.6	83.4	91.3	91.4	88.8	80.2	61.5	15.4
2011	53.5	82.8	91.8	91.4	88.4	80.7	61.8	16.1
2012	52.9	82.3	91.0	91.4	88.0	80.0	62.6	16.9
2013	51.7	81.6	91.1	91.0	88.2	80.8	62.5	16.9

Source: Australian Bureau of Statistics. Labour Force, Detailed-Electronic Delivery. Cat. No. 6291.0.55.001; Annual average.

Table 2. Labour force participation rates, females by age group, Australia 2000–2013

	15–19	20–24	25–34	35–44	45–54	55–59	60–64	65+
2000	59.5	77.6	69.6	71.2	70.5	46.9	21.5	3.0
2001	60.3	78.1	70.9	71.7	70.6	49.1	22.4	3.2
2002	59.6	77.0	70.6	71.6	72.6	50.3	24.7	3.4
2003	60.6	77.5	71.1	72.6	73.9	51.4	26.8	3.3
2004	61.2	76.8	70.6	71.3	73.8	52.1	29.6	3.5
2005	61.2	77.7	72.6	73.0	75.5	54.5	31.2	4.2
2006	60.7	77.9	72.7	74.0	76.0	58.1	33.3	4.3
2007	60.7	78.2	72.9	74.4	77.0	59.3	35.7	5.0
2008	59.9	78.6	74.1	74.8	77.3	60.7	37.9	5.4
2009	58.2	76.5	73.3	75.3	78.0	63.4	41.1	6.0
2010	57.6	75.9	72.9	74.3	78.3	64.5	42.7	6.8
2011	57.3	76.6	73.8	75.2	78.0	65.2	43.8	6.9
2012	56.7	75.8	73.9	75.5	77.4	65.7	44.4	7.8
2013	55.9	75.4	74.3	75.2	77.9	65.3	45.1	8.0

Source: Australian Bureau of Statistics. Labour Force, Detailed-Electronic Delivery. Cat. No. 6291.0.55.001; Annual average.

In general terms, the labour force will be ageing over the next 20 years and the implications need to be considered. The age distributions of workers in different occupations differ considerably and projection work is highly desirable to identify potential supply-side shortages well in advance.

While jobs sometimes move to where the workers are, labour demand in most jobs is localised and there is an issue of the match between demand and supply at the local level. This is primarily an issue for employment located outside the major cities. At the state level, jobs are more likely to be filled by migrants from overseas than by migrants from another state of Australia. Fly-in, Fly-out (FIFO) and Drive-in, Drive-out (DIDO) have emerged as strategies to deal with localised labour shortages in industries that can afford this approach. Working holiday-makers (see below) make a major contribution in seasonal agricultural work. Within states, there is a massive movement of people under age 25 to the metropolitan area but a smaller net movement in the opposite direction of young families. A study of the Victorian public service showed enormous turnover in jobs outside of Melbourne as career advancement was contingent upon working in Melbourne headquarters. This may also be true of other sectors such as retail and banking. This is an area deserving of further research.

Labour force participation

Over the 20 years, any increase in labour demand can be met only through increases in labour force participation rates or through migration. As mentioned above, labour force participation rates for prime age males (25–54 years) remained constant between 2000 and 2013 and there seems to be little prospect of change. Those who reported themselves being unemployed have much more prospect of work but the unemployment rate is relatively low. For females aged 25–54, there was some rise in participation from 2000 to 2010 but it seems to have stopped after 2010. My expectation, given rising levels of education and policies that are supportive of work and family (paid maternity leave, child care review) is that participation rates will rise slowly for women in the prime working ages over the next 20 years and the proportion working part-time will fall gradually as well. Here, there is some prospect of increasing labour supply.

At older ages, 55+, participation rose solidly, especially for females between 2000 and 2010. However, this trend slowed considerably from 2010 to 2013, although participation above age 65 continued to rise. Participation rates for older Australians are broadly similar to those in the United Kingdom, the United States and Canada but much lower than those in New Zealand. The slowing of increases in participation at older ages probably reflects softer labour demand in the past few years. However, with a gradual increase in the pension age and tax advantages to retiring beyond age 60, it might be expected that increases in participation will continue at these older ages in Australia over the next 20 years. Furthermore, changes in the composition of the older population by education, occupation, English capacity and housing tenure will tend to support upward movement along with a number of social changes (higher living standard aspirations, better health, one partner continuing to work means both do, lives that are more work-oriented, continued flow of cash to children).

Labour demand and migration

Strong demand in the first decade of the 21st century drove the substantial increases in net overseas migration in these years. In relation to the labour market, there are effectively three groups: skilled migrants both permanent and temporary; New Zealand citizens and partners in the skilled and family programs; and students and working holiday-makers.

Skilled migrants both permanent and temporary

These migrants are concentrated heavily in the professional and managerial categories, although about a quarter are in the trades. The temporary migration of skilled migrants from overseas is highly sensitive to labour demand in Australia. However, today, a majority of temporary skilled visa grants are made to people who are already living and working in Australia. Furthermore, a solid majority of new permanent skilled migrants are already living and working in Australia. There is a large backlog of applicants for permanent skilled migration already living and working in Australia and they are likely to receive priority in future grants. Only about 50 per cent of grants of skilled migration visas are made to primary applicants. The other 50 per cent are made to their family members (discussed below). The Commonwealth government controls the annual number of grants of skilled permanent visas and this is subject to politics. The temporary skilled visa movement remains uncapped although it is subject to labour market testing and market wage rates. There is also a relatively high minimum wage that prevents the nomination of workers in some occupations, such as commencing para-professionals in social service industries where there is growing demand.

Australia has developed a funnelling system by which temporary entrants (of various types) establish themselves in the labour force and move gradually towards permanent residence. Government policies have facilitated this process. Thus, while the number of new permanent skilled visas is determined annually, the fact that most grants and most applicants are already living and working in Australia means that there is less flexibility in reducing the target number in the short term. Nevertheless, in the longer term, it is the permanent skilled intake that determines overall net migration. If the annual skilled intake were to be cut dramatically, this would feed through to fewer temporary skilled migrants and fewer students and working holiday-makers at the larger end of the funnel. There is little evidence that governments are trying to make the large end of the funnel smaller but softer labour demand could have that result in the longer term.

New Zealand citizens and partners in the skilled and family programs

These groups enter Australia as a matter of rights provided through legal arrangements. Their numbers are large and they are spread across the occupation categories with some upward bias. New Zealanders would not stay if they did not have a job and they would not come if the New Zealand labour demand were strong. In other words, this movement is highly sensitive to relative labour market conditions in Australia and New Zealand. The flow has reduced recently due to the softer market in Australia and the improvement in the New Zealand economy.

Partners in the skilled stream and the family stream do relatively well in the Australian labour market being a little more likely to be employed than other Australians, controlling for age, family and human capital characteristics. The number of partners in the family stream is increasing over time and there is a considerable backlog of applicants.

Students and working holiday-makers

Students and working holiday-makers generally work below their skill levels in the service and retail sectors and, in the case of working holiday-makers, in agriculture. They are generally willing to work the number of hours, the days of the week and the times of the day wanted by employers. In other words, they are highly flexible and therefore favoured by employers. With the exception of Australian students who are very similar in many ways, Australians in general would not be able or willing to work with the same degree of flexibility. Employment of Australians on a full-time basis in these occupations would require enormous restructuring of the nature of these jobs, meaning that it would be difficult to change the present entrenched situation. Australian education providers also have a considerable vested interest in the continuation of student entry. The numbers of both working holiday-makers and international students are on a rising trajectory at present. The industries in which they work (service and retail) are also on the rise. Eventually, however, continued residence in Australia of these groups of temporary migrants is contingent upon them being able to move to more regular full-time jobs. If demand for these jobs is soft, students and working holiday-makers will leave.

Migration can only be assessed against demand in the Australian labour market on a disaggregated basis by industry and occupation. Historically, planning at this detailed level has been very limited in Australia. Demand for migrant labour is likely to remain strong in some higher-level professional occupations and in the jobs done by working holiday-makers and students. Migrant partners of Australian citizens and residents will continue, in relatively large numbers, to seek work in cities across a wide range of occupations and levels. Migration will be sensitive to labour demand in areas such as the trades and para-professionals but this may only be in the long term because it takes years to clear the backlog of temporary migrants already working in Australia.[1] The movement from New Zealand is likely to be highly sensitive to labour demand in both countries. The basic conclusions are that migration will be required to meet increases in labour demand and that the system can gear up relatively rapidly to meet increased labour demand. On the other hand, reducing the flow of migrants in a downturn and in a soft labour market is less easy to implement, especially in the short term. The logical approach, as far as possible, is to take a long-term approach to future demand for labour by occupation and industry and direct the training of Australians towards those occupations, with migration being used to fill the gaps.

Social changes and health, consumer preferences

Housing and infrastructure

As the population ages, there will be a gradual shift in household types. In the period, 2011–26, projections indicate that lone person households will grow by 51 per cent and households consisting of couples with no children by 28 per cent, while households consisting of couples with children will grow by about 20 per cent. These differences in the growth of household types are more pronounced in country areas than in the cities. However, these changes do not affect the relative demand for dwelling types, with demand for all three (separate houses, medium density and high density) set to increase by 30 per cent in the 15-year period. Total housing demand is projected to be 2.66 million new dwellings between 2011 and 2026, or 177,000 per annum. Among the cities, demand for new dwellings is highest in Perth (511,000) followed by Melbourne

[1] The large-scale movement in 2007–08 of Indian students into short-term courses with a view to permanent migration has taken until now to be cleared.

(506,000), Sydney (452,000) and Southeast Queensland (427,000). These four locations account for 71 per cent of the future new housing demand.

For the labour force, these housing trends imply a demand for housing construction workers. There are supply-side constraints such as land supply and planning regulations that tend to slow down this demand but, overall, we can expect demand for housing construction workers to remain strong. There is also a backlog in most other forms of physical infrastructure such as roads, public transport, freight transport, ports, energy supply, and airports. Restructuring of Australian industry from one form of manufacturing to another (or out of manufacturing into other industries) will also involve construction and the demand for commercial space will grow with the population. While construction in the mining sector has tapered off somewhat, potentially there is still quite a lot of steam in this engine. The demand for the construction of new infrastructure is strong but the capability to meet the demand has been weak because of a lack of agreement between governments at all levels, financial institutions, construction companies and unions. If this nut were to be cracked, the demand for construction workers would be considerable.

Family

A gradual shift towards more full-time employment among parents will lead to greater demand for children's services provided by the market, including childcare most obviously, but also out-of-school activities for children. Ageing of the population is often portrayed as involving a shift away from child-centred markets but the birth rate has been relatively high for the past decade and can be expected to remain high. Migrants, being young on arrival, also contribute substantially to growth in the numbers of children.[2] There is also growing attention by parents on the production of 'superior' children who are skilled in the arts and sports, the electronic age, and just about everything else. Organised family holidays have never been more prominent. Grandparents, often cashed up, also see their grandchildren as worth investing in with time and money. In other words, I see a very child-centred market in coming years, not the opposite. Examination of the child-related expenditures of families with children from the Household Expenditure Survey would provide a good basis for projecting where the future demand for products and services will be. Some possibilities include child-friendly restaurants and cafes, quality takeaway, child entertainments (at home and away), affordable family holidays, electronic equipment and any form of child-friendly consumer environment.

Working empty-nesters will be looking for ways to have quality holiday experiences between intensive work activities. Retired empty-nesters will be looking for appropriate activities to fill the time available to them. Movies, live entertainment, exhibitions and holidays stand out. Grand-parent with grand-child activities will also be in demand. With the retirement of the baby-boom generation, the coming two decades will be an era of the 'young and healthy' aged population. They will be interested in preventative health measures including fitness regimes. And, fashion for the person who is a little older.

For young singles and couples pre-child, predictably there will be more of the same late night entertainment, eating out, travel and parties. Also there will be demand for electronic forms of just about everything, especially instant provision of any form of knowledge or information. This has exploded in the past five years or so and can only get more detailed and intricate. There will be lots of jobs for young people in the design of apps.

Of course, at the older end of the older age bracket, the demand for health services will mushroom as technology leads to the availability of more and more procedures and pharmaceuticals. The long-term trend of supporting older persons to remain in their own homes

[2] Just because of migrant numbers not because of higher migrant fertility. In Australia, migrant fertility is a little lower than that of the Australian-born.

will remain the case but the demand for services to diversify has potential to expand. Transport services for older and disabled persons are a growing area of demand. Demand for mental health services is expanding rapidly and will continue to rise.

Ethnicity

Another important future trend is the emerging ethnic mix of Australia. The large number of Chinese and Indian immigrants in Sydney and Melbourne has already changed markets and will continue to do so in the future. But these ethnicities will be 'Australianised'. What will emerge will be an amalgam of Australian (already somewhat Southern Europeanised), Chinese and Indian cultures. Canadian cities such as Toronto and Vancouver are at a more advanced stage in a similar process and we can perhaps learn from their experience. This is likely to improve the level of entrepreneurship in Australia and to be yet another challenge for unionism.

In broad terms, improvement in living standards will shift demand to affordable but quality products as distinct from cheap products.

Peter McDonald

Professor of Demography, Crawford School of Public Policy, Australian National University.

Chapter 3

The Implications of Economic and Financial Trends and Globalisation for the Demand for and Supply of Skills

David Gruen

* I am grateful to Lucy Lu, John O'Leary and Daniel Silva Withmory for much help with this chapter

This chapter should be read in conjunction with an earlier paper (Gruen, 2011) I wrote for the Scenario Development Forum run by Skills Australia (the precursor to AWPA) and ASSA in 2011.[3]

The earlier paper discussed the re-emergence of China and India into the global economy. It observed that continued rapid growth by these Asian giants—together accounting for about a third of the people on the planet—was changing Australia's comparative advantage in significant ways, with flow-on effects for the industry structure and skills in the Australian labour market. In particular, the continued increased demand for Australia's mining exports was having significant impacts on the real exchange rate, exacerbating existing trends in the make-up of the labour force with employment moving from trade-exposed manufacturing sector jobs (such as the automotive industry) to the domestic service sector (such as health care and social assistance).

Although the detailed outline of economic events over the past three years was not foreseen when the earlier paper was written, the broad outlines of these events was anticipated. As a result, the messages in that paper remain apposite.

In this chapter, I do three things. First, I update some of the data presented in the 2011 paper for developments over the past three years. In doing so, I take the opportunity to comment on some of the questions posed by the organisers of the current forum.

Second, I comment on an aspect of the scenario presented in preparation for the forum that I think deserves further attention—what I see as the overly optimistic projection for the labour force participation rate.

Third, I provide a brief summary of some recent modelling undertaken by the Australian Treasury which provides projections of employment shares by industry out to 2030. These projections are, in broad outline, similar to those in the scenario presented for this forum.

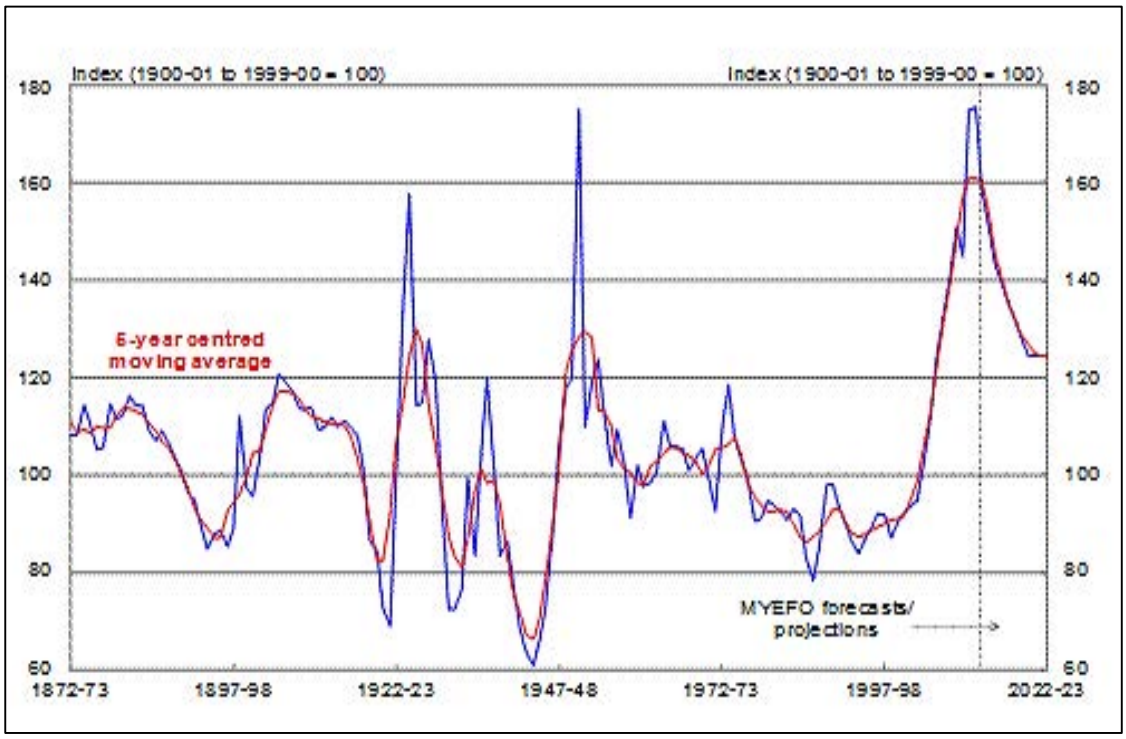
Implications of the rise of Asia

As discussed in my earlier paper, the most striking domestic manifestation of sustained rapid growth in China, India, and much of the rest of Asia, has been the behaviour of the Australian terms of trade over the past several years. (Another striking manifestation is, of course, the recent and related travails of the Australian car industry.)

Australia is in the midst of the largest sustained boost to the terms of trade in our history, with the five-year centred moving average of the terms of trade currently much higher than at any time in the past 140 years (Figure 1).

[3] Note that the figure showing projected participation levels is an early (December) draft of AWPA's participation projections. AWPA subsequently revised these projections and they are published in the introduction to this book.

Figure 1: Terms of trade



Source: ABS. Cat. No. 5204.0 and Treasury.

The terms of trade peaked in 2011-12, and have been declining since then. Most analysts expect this decline to continue, as the global supply of bulk commodities continues to rise rapidly.[4]

An interesting and important question is how far the terms of trade are likely to fall. In seeking to answer that question, Treasury has undertaken some detailed modelling that takes into account the three phases of the mining boom. These phases are the initial demand phase when there was a rapid rise in prices and a modest increase in supply; the current supply phase during which the capacity built over the demand phase is progressively employed, leading to a rapid increase in supply and falling prices; and an expected balanced growth (or long-run) phase where demand and supply are expected to move broadly together, with the terms of trade displaying no secular trend.

The new modelling approach was used for the first time as the basis of the terms of trade projections for the December 2013 Mid-Year Economic and Fiscal Outlook.[5]

The new approach uses a variety of techniques to model the main elements of the terms of trade (that is, for major export categories, volumes and export prices relative to the price of aggregate imports). These techniques include extensions of existing short-run econometric forecasting models, but the main part of the exercise involves detailed modelling of the evolving global

[4] The most important bulk commodities for Australia (with 2012–13 value shares of total exports of goods and services in parentheses) are iron ore (19 per cent), other mineral fuels—predominantly LNG and oil (nine per cent), metallurgical coal (seven per cent), thermal coal (five per cent), and gold (five per cent).

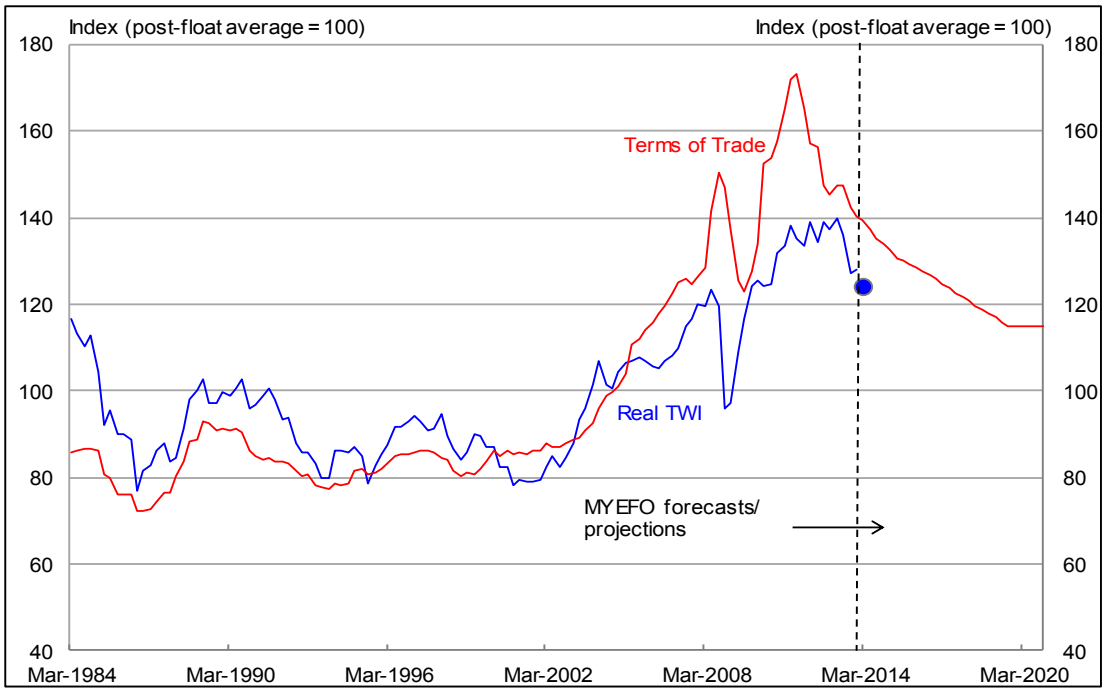
[5] The previous approach, used in Budget documents since the 2010–11 Budget, made the assumption that beyond the near-term forecast horizon, the terms of trade would fall by 20 per cent over the subsequent 15 years. That approach was clearly silent on when the expected decline would end and the level at which the terms of trade would eventually settle.

demand/supply balance for each of the three (individual) bulk commodities of most importance for Australia (iron ore, metallurgical coal and thermal coal).[6]

The high level of the terms of trade has had a powerful effect on the Australian real exchange rate, which for several years has remained well above its average since the dollar was floated in December 1983. This in turn continues to have a profound impact on the structure of the traded sector of the Australian economy. Those parts of the traded sector not linked in some way to the boom in the production of mining and energy commodities continue to face severe and sustained pressure from foreign competitors.

Despite the recent depreciation of the nominal exchange rate, the real value of the Australian dollar remains more than 20 per cent above its post-float average (Figure 2). Given the outlook over the next several years for significant falls in both the terms of trade and investment in the mining and energy sectors, it seems likely that the necessary rebalancing of the Australian economy towards non-mining sources of growth will require a further decline in the real value of the Australian dollar.[7]

Figure 2: Australian real exchange rate and terms of trade



Note: The blue dot shows an estimate for the real TWI in the March quarter, 2014.

Source: RBA and Treasury.

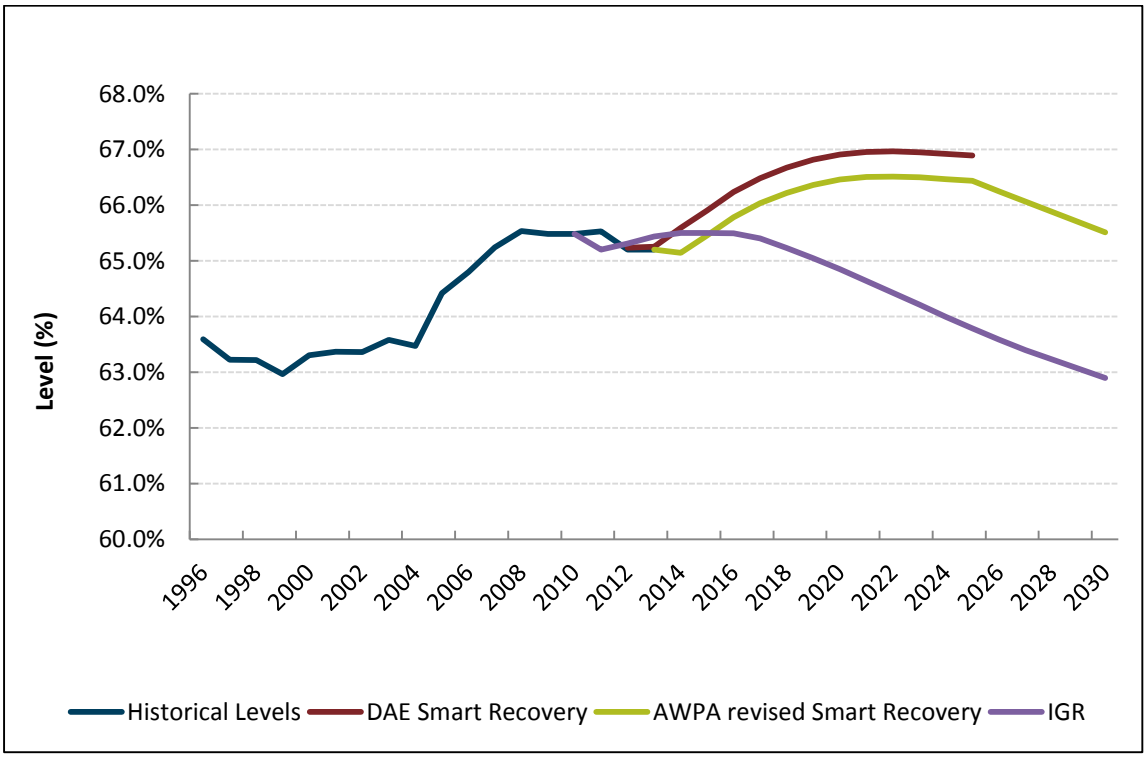
[6] The new modelling approach suggests the supply phase will end around 2017–18 with the long-run terms of trade settling around their 2006–07 level. To be prudent, the projections used for the 2013 MYEFO (shown in Figure 1) assume a slightly lower long-run level for the terms of trade; namely, the level last observed in 2005–06, assumed to be reached in 2019–20.

[7] Beyond the short-term forecasting horizon, the economic analysis underpinning the MYEFO projections assumes the real exchange rate moves proportionately with the terms of trade, in line with historical experience. The terms of trade projections shown in Figure 2 imply a fall in the real TWI of about eight per cent over the projection period.

Participation

In preparation for the forum, authors were asked to comment on aspects of the scenario presented in Appendix A of the briefing paper for speakers. In my judgement, most aspects seem plausible, with the possible exception of the projected labour force participation rate, reproduced as Figure 3 below. The preferred projection, 'AWPA revised Smart Recovery', has the 15+ participation rate rising from its current level to around 66.5 per cent by early next decade, and then declining gradually thereafter.[8] By contrast, the 2010 Intergenerational Report (IGR) has the 15+ participation rate at around 65 per cent by early next decade, and declining more rapidly thereafter.

Figure 3: 15+ Participation rate

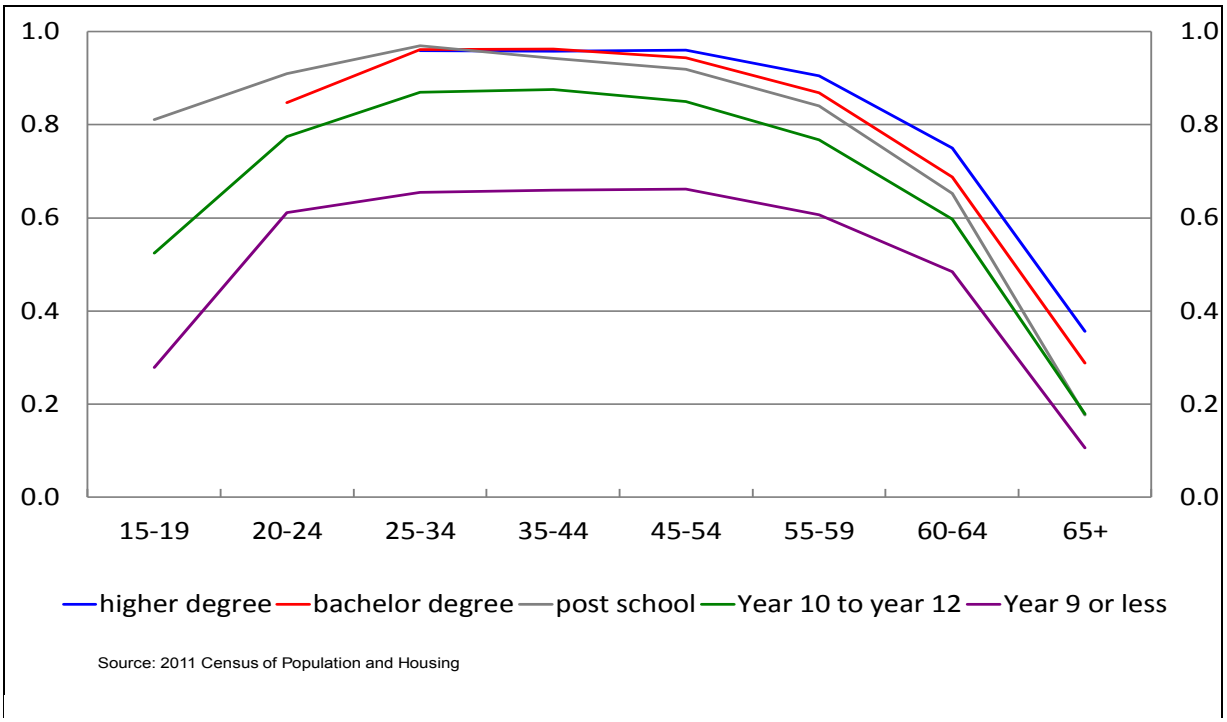


Source: AWPA draft projection December 2013

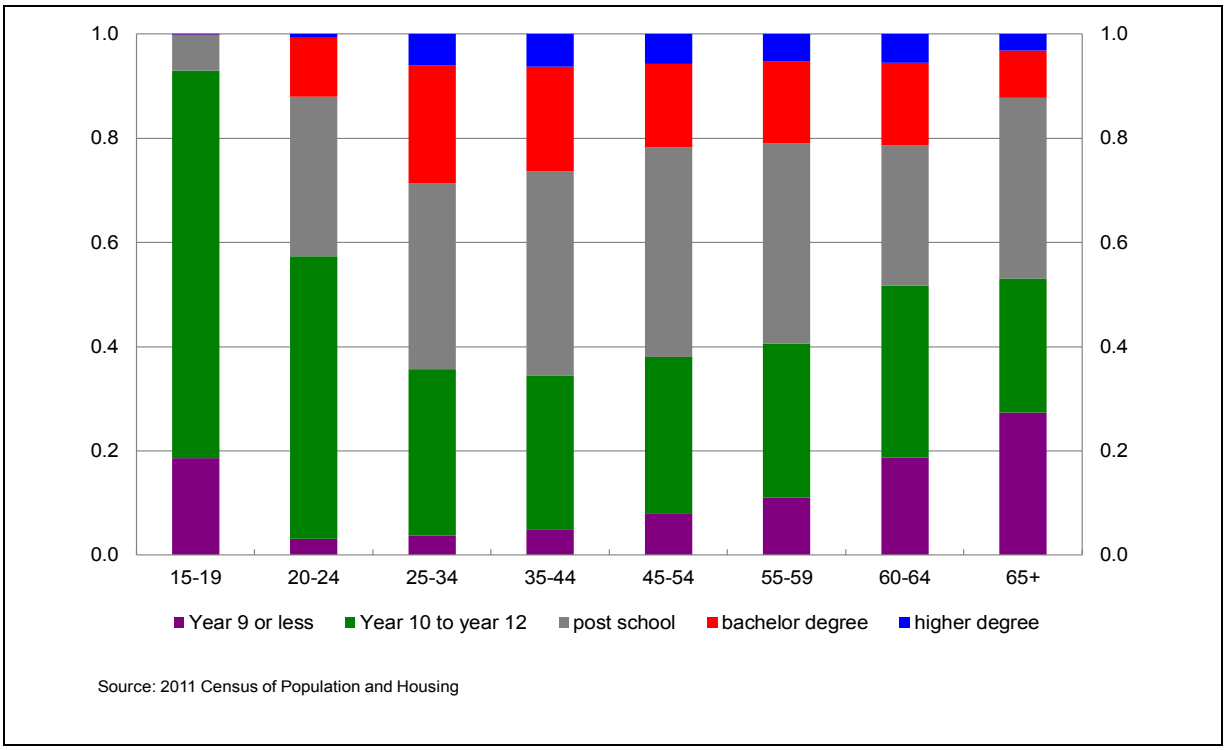
In analysing labour force participation, it is important to recognise the strong correlation between educational attainment and participation.

Figures 4 and 5 show participation rates and shares of the population, by level of education, for men of different ages from the 2011 Census. Figures 6 and 7 show the same data for women. As the charts show, people with higher levels of educational attainment have strikingly higher rates of labour force participation right across their lifecycles.

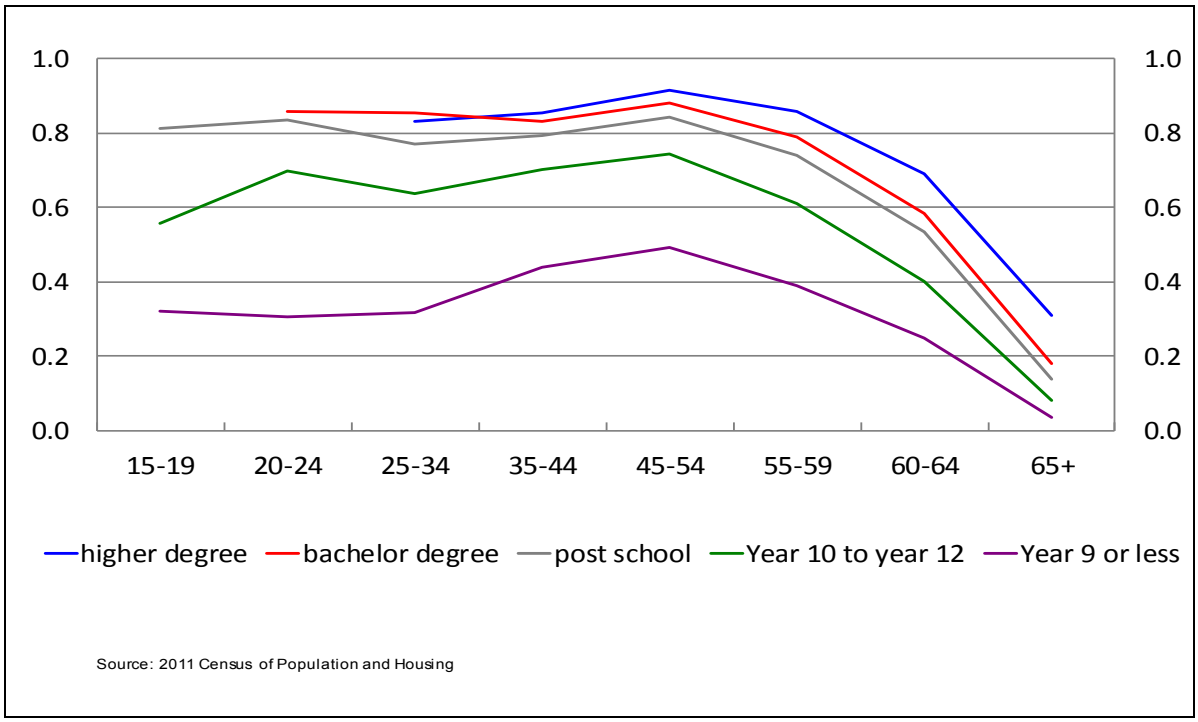
8 The projections shown in Figure 3 were sent to speakers in late December. An updated central scenario, sent out the week before the 28 February 2014 forum, has a lower participation rate projection than the preferred projection shown in Figure 3, although it continues to show a sizeable recovery in the participation rate to above 66 later this decade, which still seems too optimistic to me. The latest data, for February 2014, has the 15+ participation rate at 64.8 per cent, although this outcome is likely below its trend rate because of discouraged worker effects in a labour market with an unemployment rate of six per cent.



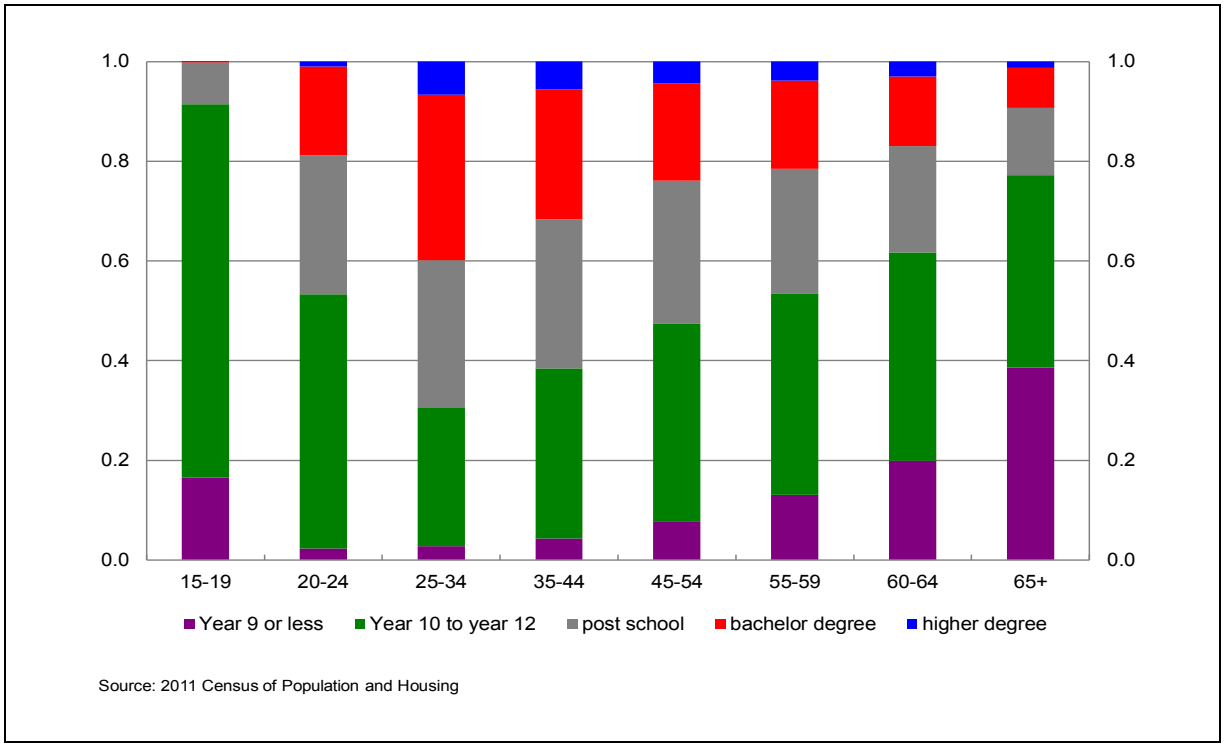
Source: 2011 Census of Population and Housing



Source: 2011 Census of Population and Housing



Source: 2011 Census of Population and Housing



Source: 2011 Census of Population and Housing

Over time, the average level of education in the workforce is rising as older cohorts—with lower average levels of educational attainment—retire, and younger cohorts take their place. Given the correlation between education and participation, rising levels of education should lead to higher levels of labour force participation over time, other things being equal.

As ever, other things are not equal. Of most relevance for future projections, the ageing of the population—with the first of the baby boomers having turned 65 in 2011—is reducing the aggregate 15+ participation rate over time.

An attempt some time ago to quantify the participation effects of the rising level of education concluded that, while it should lead to a noticeable rise in the participation rate relative to what would otherwise occur, the rise would fall well short of that needed to generate a 15+ participation rate of 66.5 per cent by early next decade (Gruen and Garbutt, 2003).[9]

In this context, it is also of interest to report on participation rate developments over the four years since the publication of the 2010 IGR.

For both men and women of prime age (25 to 54 years of age), participation rates over these four years have been quite close to those projected in the 2010 IGR.

For both men and women aged 55 and over, participation rates over the past four years have been more favourable than projected in the 2010 IGR; particularly for those aged 65 and over.

By contrast, for both men and women aged less than 25, participation rates have been noticeably lower than projected in the 2010 IGR, with the difference most marked for men (boys actually) aged 15 to 19.

Of relevance to the longer-term profile for the participation rate is the question of how much of the recent weakness in youth participation rates is cyclical and how much structural.

Undoubtedly, some of the recent weakness is a discouraged worker effect in a labour market with an unemployment rate that drifted up to six per cent in February 2014. That may be particularly important for these age groups given the disproportionate weakness in construction and retail trade employment, both industries with a concentration of young workers.[10]

But there may be also some structural factors behind the recent fall. In that category, better access to higher education may be playing a role, with the relaxation of government caps on university enrolment since 2010.

Taking into account these developments in participation rates for both the young and mature-aged over the past four years, as well as allowing for a somewhat higher net immigration intake than the 180,000 per annum assumed in the 2010 IGR, leads to a projection for the 15+ participation rate a little lower over the remainder of this decade than the 2010 IGR projection, crossing over to be a little higher than the 2010 IGR projection over the 2020s.

In my view, then, the 15+ participation rate probably already reached its peak in late 2010 at just below 66 per cent, and is unlikely to return to those levels over the next couple of decades.

---

[9] Gruen and Garbutt report 15+ participation rates of about 66.5 by 2020 assuming Australian age-and-gender-specific participation rates reach the (then) 80th percentile of OECD experience by that date. They also show (their Figure 12) that rising education levels should raise participation for all ages and both genders, but that the resulting participation rates remain much lower than those at the (then) 80th percentile of the OECD. Gruen and Garbutt based their work on the 2001 Census and the 2002–03 IGR, and outcomes for participation have been more favourable than anticipated at that time. Nevertheless, based on their work, rising education levels do not appear to have a sufficiently powerful effect on participation to explain the large differences between the participation rates projected in the 'AWPA revised Smart Recovery' scenario and the 2010 IGR shown in Figure 3.

[10] There is also some cross-country evidence suggesting that discouraged worker effects are larger for the young, and particularly for men aged 15 to 19 (Filatriau and Reynès, 2012). However, the falls in participation rates for young people in Australia over the past four years have been significantly larger than can be explained by this international evidence.

Projections of future employment shares by industry

Australian Treasury recently updated its modelling of the projected industrial structure of the Australian economy over the next several decades.[11] It is of interest to compare the results of this exercise with those presented in the scenario for this forum.

In broad outline, the results from the two modelling exercises are quite similar. Australia's comparative advantage is expected to continue to evolve in response to a range of economic developments and, as a result, so is the pattern of employment across the Australian economy. The economic developments of particular note are continuing strong growth in Asia (in turn generating rapidly rising numbers of Asians in the middle class with rising disposable incomes), developments in the terms of trade (largely a consequence of the evolving supply/demand balance in major resource commodities, discussed earlier), population ageing, and differential labour productivity growth across industries.

Australia's services sectors, which currently account for more than three-quarters of total employment, are projected to continue to expand to meet growth in both domestic and international demand. The international dimension represents predominantly the rapidly increasing membership of the Asian middle class with their rising demand for a broad range of services, including tourism, education, health and aged care, entertainment, financial and professional services. Employment in the (Australian) services sectors is projected to grow by around 30 per cent to 2030.

While mining accounts for a small share of employment, mining output is expected to grow strongly over the remainder of the decade as the enormous levels of investment in the sector progressively come on stream.[12] Gas extraction, for liquefaction and export, is expected to expand particularly rapidly. As the terms of trade fall from current high levels, employment growth in mining is projected to moderate from 2020 to 2030.

The level of employment in the manufacturing sector as a whole is projected to remain fairly unchanged over the period to 2020, with continued growth in areas like food manufacturing offsetting declines in heavy manufacturing. Manufacturing employment returns to growth in the following decade, albeit at a slower pace than the economy as a whole. This increase in employment is driven by increases in the food and high-value manufacturing sectors, brought about by the steady growth of the Asian middle class (Parkinson, 2014).

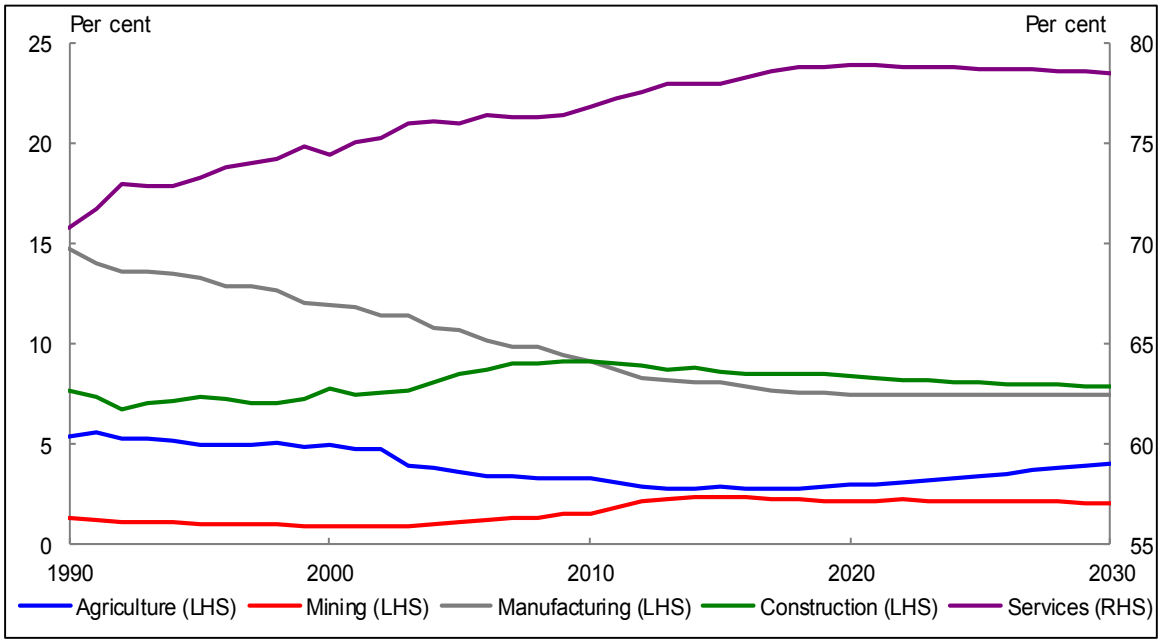
As with manufacturing, the level of agricultural production and exports has been adversely affected by the high exchange rate over recent years and the near-term outlook is for moderate growth. After 2020, rising international demand, particularly from Asia, and improved competitiveness from a declining real exchange rate, expands production across all major agricultural commodities.

Construction output continues to grow, but at a slower pace than in recent years as the peak in mining investment passes. The construction share of employment in the economy declines over time from its recent high level.

[11] The modelling used the MMRF computable general equilibrium model, and was conducted jointly by Treasury and the former Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education. The results shown here use the 'no carbon price' scenario published in Climate Change Mitigation Scenarios: modelling report provided to the Climate Change Authority in support of its Caps and Target review (2013).

[12] By 2014–15, the capital stock in the mining and energy sector is expected to be nearly four times its pre-boom level.

Figure 8: Industry shares of employment



Source: Treasury and DIICCSRTE (2013). 'No Carbon Price' Climate Change Mitigation Scenario.

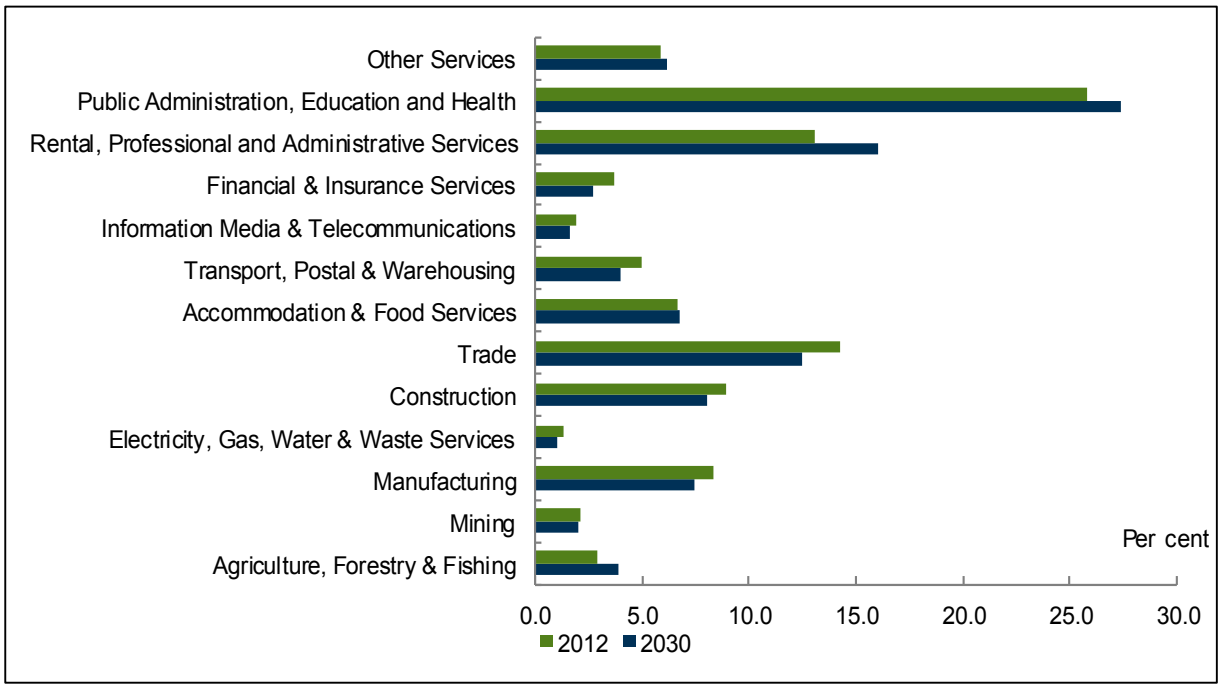
Figures 9 and 10 below show the employment shares by industry and the change in these shares from 2012 to 2030, aggregated to be as comparable as possible to Figures 7 and 8 in AWPA's briefing paper for speakers.[13] Comparing the results of the Treasury modelling with Figure 8 of the AWPA document, the change in shares is similar for both mining and construction. However, there are differences in agriculture, manufacturing and services. The AWPA modelling finds:

- A larger increase in the services industry employment share (4.2 percentage points compared to 1.0 percentage points in the Treasury modelling);
- A larger decrease in manufacturing industry employment share (3.6 percentage points compared to 0.9 percentage points in the Treasury modelling); and
- A fall in the agriculture industry employment share of about 0.9 percentage points compared to a rise of 1.0 percentage point from the Treasury modelling.[14]

[13] Strict comparability is thwarted by different industry classifications, with the Treasury modelling using ANZSIC 1993, while the AWPA modelling uses ANZSIC 2006.

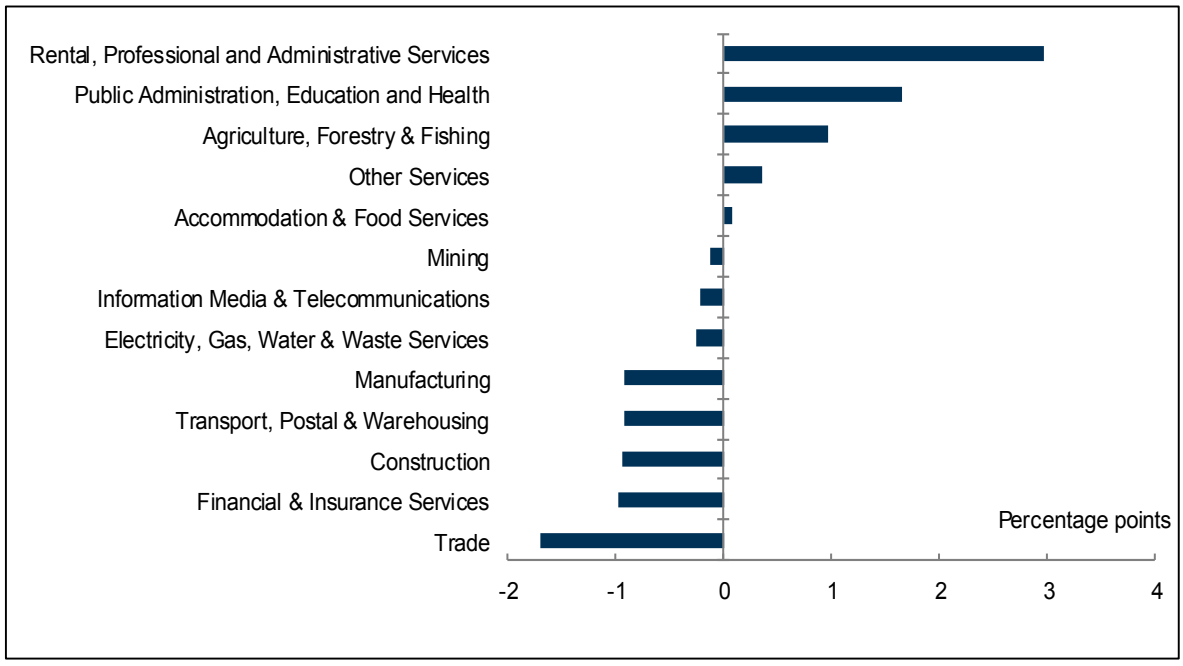
[14] Note that the relatively fast growth in the agriculture sector in the Treasury modelling is not a standard result. For example, ABARES long-term food production projections are weaker (Linehan et al, 2013). Projections for agriculture depend, of course, on assumptions about demand growth in Asia, access to land and productivity growth in different regions.

Figure 9: Employment shares by industry, 2012 and 2030



Source: Treasury and DIICCSRTE (2013). Unpublished data.

Figure 10: Change in employment shares by industry from 2012 to 2030



Source: Treasury and DIICCSRTE (2013). Unpublished data.

David Gruen

Executive Director, Macroeconomic Group, Australian Treasury.

References

Climate Change Mitigation Scenarios: modelling report provided to the Climate Change Authority in support of its Caps and Target review 2013, available at: http://climatechangeauthority.gov.au/Node/101.

Filatriau, O and Reynès, F 2012, 'A New Estimate of Discouraged and Additional Worker Effects on Labor Participation by Sex and Age in OECD Countries', Working Paper 2012-09, French Economic Observatory, available at: http://www.ofce.sciences-po.fr/pdf/dtravail/WP2012-09.pdf.

Gruen, D 2011, 'Economic and financial trends and globalisation over the next 15 years and how they will influence the supply and demand for skills', available at: http://www.treasury.gov.au/PublicationsAndMedia/Speeches/2011/Economic-and-financial-trends.

Gruen, D and Garbutt, M 2003, 'The Output Implications of Higher Labour Force Participation', Treasury Working Paper 2003-02, available at: http://archive.treasury.gov.au/contentitem.asp?NavId=&ContentID=702.

Linehan, V et al 2013, 'Global food production and prices to 2050: scenario analysis under policy assumptions', ABARES conference paper 13.6, Canberra, March 2013' available at: http://data.daff.gov.au/data/warehouse/9aat/2013/gfp5d9abt_001201303/globeFoodProd2050_v1.0.1.pdf.

Parkinson, M 2014, 'Fiscal sustainability and living standards—the decade ahead', Speech to the Sydney Institute, 2 April 2014 available at: http://www.treasury.gov.au/PublicationsAndMedia/Speeches/2014/Fiscal_sustainability.

Chapter 4

The Changing Australian Labour Market at the Start of the 21st Century

Roger Wilkins and Mark Wooden

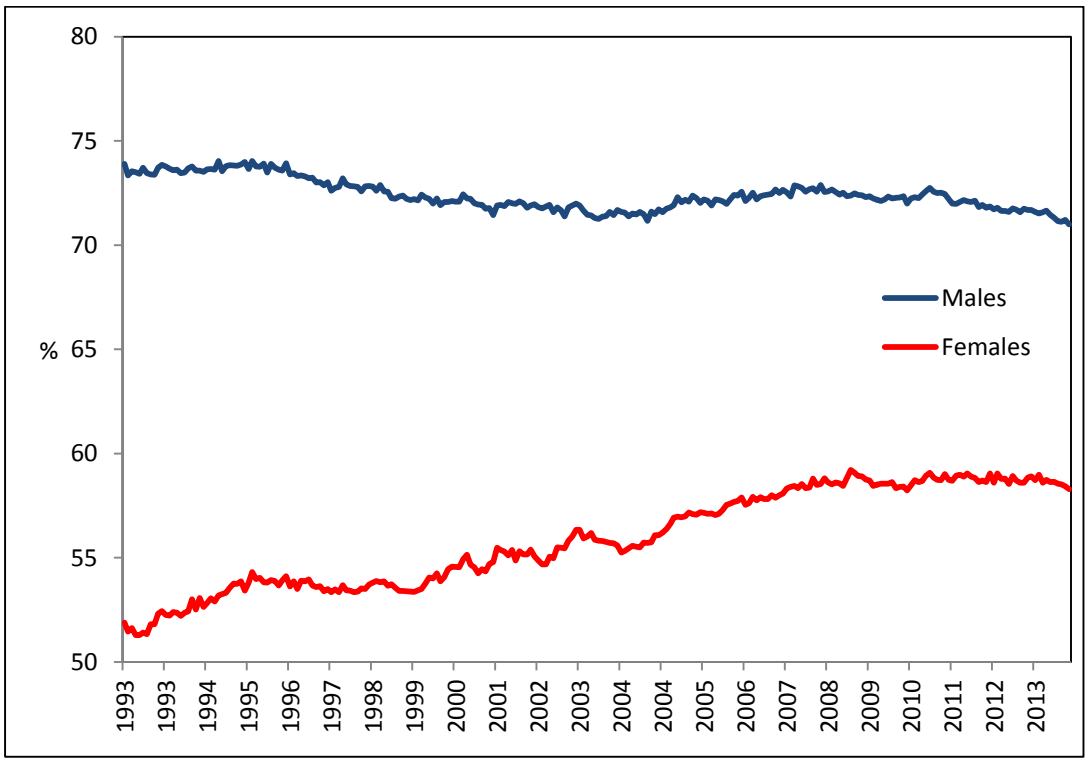
In the mid-1990s the Economic Planning Advisory Commission published a review of the changing Australian labour market (Norris and Wooden, 1995). A key theme of that report was that the quarter century beginning around 1970 was one of profound change in both the structure and operation of labour markets in Australia. In this report we revisit some of the issues covered in that report, but focusing on the last two decades (that is, the period between 1993 and 2013). In particular, we examine changes in: (i) the nature of labour supply and labour force participation; (ii) the extent of labour utilisation; (iii) differences across states in employment growth; (iv) the characteristics of jobs; and (v) patterns of earnings growth.

Changing supply of labour

Participation

The last two decades have seen reasonably strong growth recorded in rates of aggregate labour force participation, at least until the impact of the global financial crisis (GFC) began to be felt in late 2008. However, as shown in Figure 1, all of this growth has been due to continued rises in participation rates among women. Among men the long-term downward trend in participation rates has continued, though the rate of decline has slowed. Indeed, male participation rates rose during the five years prior to the GFC. But since the peak of 2008, male participation rates have fallen by almost two percentage points.

Figure 1: Labour force participation rates by sex, 1993–2013 (seasonally adjusted)



Source: ABS, *Labour Force, Australia, Apr 2014* (cat. no. 6202.0), Time series spreadsheets, Table 02: Labour force status by sex—Seasonally adjusted.

As highlighted in the various Intergenerational Reports produced by the Australian Treasury, a significant factor constraining further growth in participation is population ageing. Indeed, if the age structure of the population in 2013 were the same as in 1993 the aggregate labour force participation rate would have been 2.2 percentage points higher. The growth in the labour force participation rates observed over this period must therefore reflect increases in age-specific participation rates. Such rates are reported in Table 1, which reveals marked increases in participation rates among prime-age (25 to 54 year old) females and among mature-age persons of both sexes. As noted by Borland (2011), some of this growth, especially among women, will be due to cohort effects. Compared with previous generations, mature-age women today are likely to be much better qualified and to have spent much more of their life in paid employment, and thus are much more likely to extend their working careers until traditional retirement ages. More generally, increased life expectancy, improved health and changes in the occupational composition of employment are all likely to have contributed to increases in mature-age participation rates.

Table 1: Labour force participation rates (%) by sex and age group, 1993–2013

Sex / age group	1993	1998	2003	2008	2013
Males					
15–19	54.5	56.9	57.9	58.6	51.7
20–24	87.4	87.1	85.2	84.8	81.6
25–34	93.4	92.7	91.2	92.4	91.1
35–44	93.6	92.2	90.5	91.7	91.0
45–54	89.0	87.1	87.7	88.7	88.2
55–59	71.5	73.0	73.8	76.4	80.8
60–64	48.3	45.5	49.8	57.8	62.5
65+	8.1	9.7	10.1	14.1	16.9
TOTAL	73.5	72.7	71.5	72.6	71.4
Females					
15–19	54.1	57.7	60.6	59.9	55.9
20–24	76.1	77.1	77.5	78.6	75.4
25–34	65.5	68.9	71.1	74.1	74.3
35–44	70.2	69.9	72.6	74.8	75.6
45–54	65.4	69.1	73.9	77.3	77.9
55–59	36.8	43.3	51.4	60.7	65.3
60–64	15.2	19.4	26.8	37.9	45.1
65+	2.2	3.0	3.3	5.4	8.0
TOTAL	**51.7**	**53.6**	**55.9**	**58.5**	**58.6**

Note: Figures are annual averages.

Source: ABS, Labour Force, Australia, Detailed–Electronic Delivery, Apr 2014 (cat. no. 6291.0.55.001), Time series spreadsheets, Table 01: Labour force status by social marital status, age and sex.

Going forward, considerable scope for further increases in labour force participation within mature-age cohorts exists. For example, the rate of labour force participation within the 55 to 59 and 60 to 64 year age groups is much higher in New Zealand than in Australia—80.2 per cent and 67.9 per cent, respectively in 2013, compared with only 73 per cent and 53.7 per cent in Australia.[15] Nevertheless, it seems unlikely that increases within the older age cohorts will be enough to offset the effects of population ageing in the decades ahead. Thus while rates of participation within the working-age population will increase, the overall rate of labour force participation can be expected to decline.

Educational attainment

Critical to output is not just how many people are willing to work, but how skilled those workers are. Skills development is in turn largely a function of education and training, and over the last two decades we have seen continued growth in the proportion of the labour force with post-school qualifications. Most importantly, we have seen a marked rise in the proportion of the labour force that has completed a university degree. As reported in Table 2, in 1993 only about 12 per cent of the labour force reported having a university degree. Over the next two decades that proportion more than doubled to reach almost 28 per cent.

Table 2: Educational attainment of the labour force (%), 1993–2013 (May)

Education level	1993	1998	Education level	2003	2008	2013
Degree or higher	12.4	17.1	*Degree or higher*	20.8	24.4	27.9
Undergrad. / Assoc. diploma	10.3	9.0	*Advanced Diploma / Diploma*	8.1	9.4	10.4
Skilled vocational qual.	16.3	13.3	*Certificate III/IV*	17.6	18.3	20.5
Basic vocational qual.	6.7	9.0	*Certificate I/II (or n.f.d.)*	7.7	5.9	3.8
Any of the above qualifications	45.7	48.4	*Any of the above qualifications*	54.0	58.0	62.6

Source: ABS, *Education and Work, Australia* (cat. no. 6227.0), various issues.

Temporary migrants

Immigrants have long been an important source of labour supply in Australia, and today account for over 20 per cent of the labour force. Throughout the 20th century, most immigrants were granted permanent visas and temporary skilled migration was relatively unimportant. Gregory (2014) argues that the 2000s has seen a marked change in policy, with an increasing share of immigrants, and in particular skilled immigrants, arriving on temporary visas. In March 2014, there were 883,000 people on temporary visas with work rights, including 202,000 on temporary skilled (457) visas and 367,000 on student (580) visas. If all these people were labour market participants, they would amount to over seven per cent of the labour force. In addition, there were 644,000 on New Zealand (444) visas, some proportion of whom will be temporary residents (Department of Immigration and Border Protection, 2014). Notable has been growth in 457 visas, annual grants

[15] The data for New Zealand come from Statistics New Zealand, Household Labour Force Survey: December 2013 quarter—Excel tables, available for download from: http://www.stats.govt.nz.

rising from approximately 40,000 in the early 2000s to 126,000 in 2012-13. Annual grants of student visas have also risen by approximately 100,000 over the period from 2000 to 2013. By way of comparison, the skilled (permanent) migration stream is currently 128,000 per annum (and indeed, increasingly these visas are issued to existing temporary visa-holders).

The shift towards temporary migration has potentially had significant impacts on the character of the Australian labour market. In particular, the availability of a flexible, skilled immigrant work force that can respond to changes in labour demand relatively quickly is likely to have improved the operation of the labour market, especially from an employer perspective. Employment and wages of substitute Australian workers is, however, potentially adversely impacted by this alternative source of labour supply.

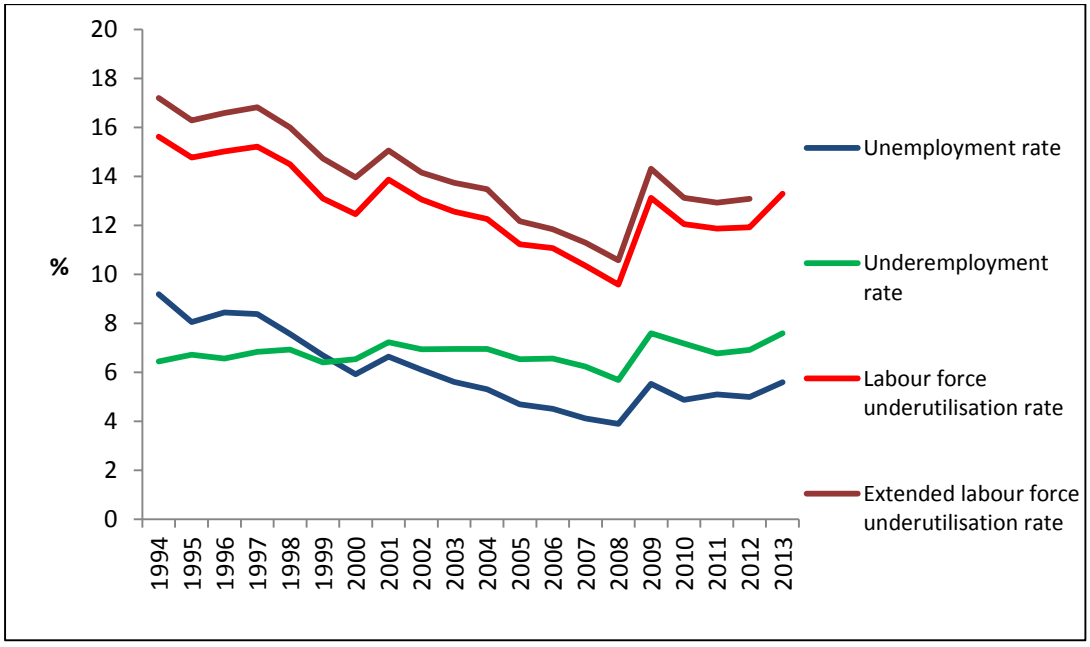
That said, as with permanent immigration, the net effect of temporary migration on economy-wide wage and employment levels could well be positive if it helps raise aggregate economic activity sufficiently (Muysken and Ziesemer, 2013).

Labour underutilisation

Labour's contribution to output depends not just on the amount of available labour input but also on how well that labour is utilised. The primary measure of labour underutilisation, the unemployment rate, is presented in Figure 2 for August of each year back to 1994. As can be seen, apart from a small rise in 2001, the unemployment rate fell continuously from 1996 until 2008. In the wake of the GFC the unemployment rate jumped upwards from its pre-GFC low of 3.9 per cent to around 5.5 per cent, and has remained at or around that level ever since (although the monthly data show it has been edging up closer to six per cent since the middle of 2013).

Figure 2 also presents three other less commonly used measures of underutilisation produced by the Australian Bureau of Statistics (ABS): the underemployment rate (the proportion of the labour force that is employed but working fewer hours than desired); the labour force underutilisation rate (the sum of the unemployment and underemployment rates); and the extended labour force underutilisation rate (which adds discouraged job seekers—people who want to work and are available to start work but were not actively looking for work because of the perceived absence of employment opportunities).

Figure 2: Measures of labour underutilisation, 1994–2013 (August)



Sources: ABS, *Australian Labour Market Statistics, July 2013* (cat. no. 6105.0), Data cube: Extended labour force underutilisation rate. ABS, *Labour Force, Australia, Apr 2014* (cat. no. 6202.0), Time series spreadsheets, Table 22: Labour underutilisation by age and sex—trend, seasonally adjusted and original.

The underemployment rate does not exhibit the same trend decline during the 1990s and 2000s as there was for the unemployment rate, and since 2000 has been higher than the unemployment rate. As a consequence, the labour force underutilisation rate has been more than double the official unemployment rate since 2000. The addition of discouraged jobseekers turns out to have only a modest effect on the total underutilisation rate, raising it by between 0.7 and 1.7 percentage points.

As measures of total labour underutilisation, however, all are imperfect because they are based on counts of heads, and take no account of hours worked. But using additional data on the number of hours of work sought by unemployed persons and on the number of hours part-time workers would prefer to work, the ABS has also constructed superior volume-based measures of unemployment and underemployment. The most recent figures are for August 2012 and give a labour force underutilisation rate of just 7.1 per cent, considerably less than the rate of 11.9 per cent provided by the headcount-based measure, but still higher than the unemployment rate.[16]

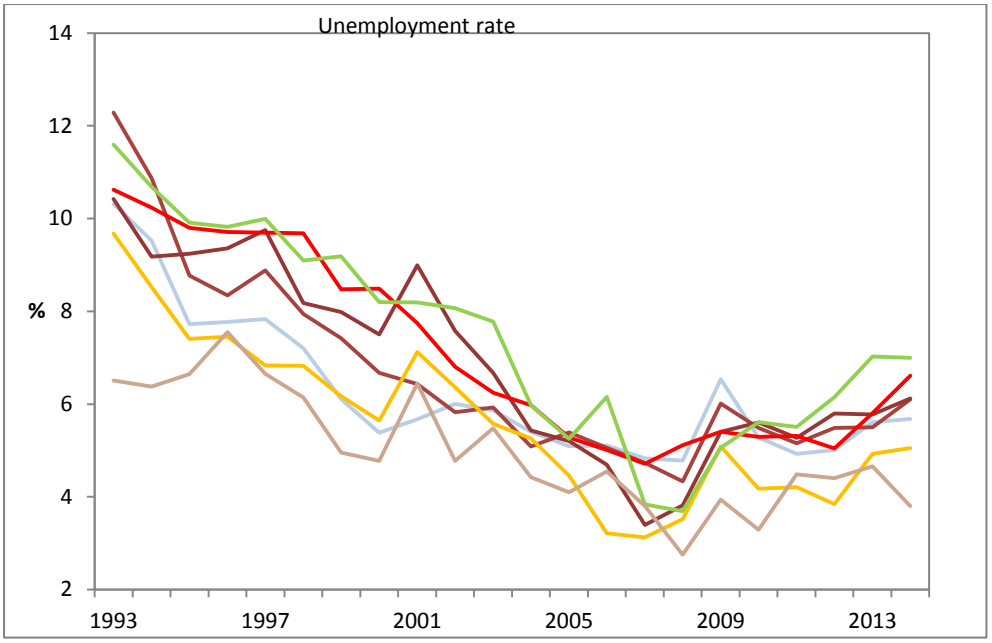
Finally, time is not the only dimension on which labour can be underutilised. Most importantly, workers may not make use of all their skills in their paid employment. Quantifying this form of underemployment, however, is extremely difficult, though recent attempts have been made using subjective data collected from workers participating in the HILDA Survey. Mavromaras et al (2010), for example, derive a measure which suggests that around 14 per cent of Australian workers during the period 2001 to 2006 were severely overskilled (i.e., made very little use of their skills and abilities in their current job) while another 30 per cent were moderately overskilled. Further, our own analysis of these same data suggests that there is no obvious trend in this measure over the last decade.

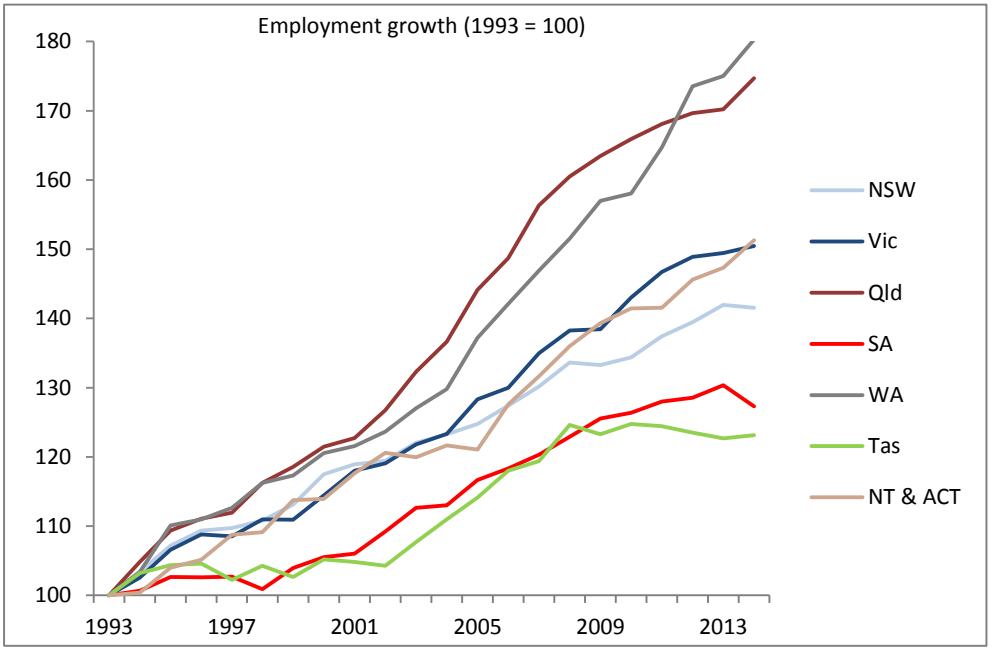
State differences in unemployment and employment growth

The onset of the mining boom in the mid-2000s gave rise to suggestions that Australia had a 'two-speed' economy split between fast-growing mining states and slower-growing non-mining states. The split has been perhaps more perceived than real, in part because most of the states have reasonably diversified industrial structures, including at least some mining activity in all states. Consistent with this, Figure 3 shows that unemployment rates tended to converge between 1993 and 2008, and thereafter diverged only slightly.

Figure 3: State unemployment and employment, 1993–2014 (May)

[16] Estimates of volume-based measures of labour underutilisation are provided in ABS, Australian Labour Market Statistics, July 2013 (cat. no. 6105.0), Data cube: Volume measures of labour underutilisation.





Source: ABS, *Labour Force, Australia, Apr 2014* (cat. no. 6202.0), Time series spreadsheets, Table 12: Labour force status by sex—states and territories.

However, rates of employment growth show marked differences between the states. Figure 3 also presents the growth in the number employed in each jurisdiction relative to the levels in 1993. Three broad groupings are evident: the fast-growing states of Western Australia and Queensland; the medium-growth states of Victoria and New South Wales, along with the two territories; and the low-growth states of South Australia and Tasmania. The differences in employment growth will reflect a multitude of factors, but differences in the strength of labour demand are likely to be an important source. The mining boom is therefore likely to be a factor in the high employment growth in Western Australia and Queensland, although the higher rate of growth is also evident prior to the onset of the boom.

The changing nature of work and employment

Changing industrial composition of employment

The latter part of the 20th century saw a marked change in the composition of economic activity in Western economies. Perhaps most important has been the decline in the relative importance of goods-producing industries and the rise in the relative importance of person- and knowledge-based service industries (e.g., Sheehan and Tikhomirova, 1998; Powell and Snellman, 2004). In Australia this has been most obviously reflected in the decline of manufacturing. As observed by Norris and Wooden (1995, p. 6), in 1970 the manufacturing sector accounted for around one-quarter of total employment, and by the early 1990s this share had shrunk to less than 15 per cent. Table 3 shows that the manufacturing sector has continued to shrink over the last two decades, and now only accounts for about eight per cent of all employed persons in Australia. Furthermore, all indications are that this sector will continue to shrink further in the years ahead, especially given the impending closures in the automotive manufacturing industry.

Table 3: Employment by industry, 1993–2014 (% of total employment)

Industry division (ANZSCIC)	1993	1998	2003	2008	2013
Agriculture	5.1	4.8	4.6	3.2	2.6
Mining	1.1	1.0	1.0	1.5	2.3
Manufacturing	13.6	12.3	12.3	9.8	8.1
Electricity, gas and water	1.4	0.9	1.1	1.1	1.3
Construction	7.2	7.3	7.5	9.2	8.8
Wholesale trade	5.5	4.9	4.8	3.8	3.7
Retail trade	11.2	11.2	11.4	11.3	10.7
Transport, postal and warehousing	5.1	5.1	5.1	5.3	5.2
Accommodation and food	6.1	6.7	6.6	6.6	6.8
Information media and telecommunications	2.1	2.2	2.2	2.1	1.8
Financial and insurance services	4.1	3.8	3.8	3.8	3.6
Rental, hiring and real estate services	1.5	1.5	1.6	1.9	1.7
Professional, scientific and technical services	4.8	6.5	6.0	7.4	7.9
Administrative and support services	2.4	3.4	3.2	3.2	3.4
Public administration and safety	6.1	5.3	5.9	6.0	6.5
Education and training	7.4	7.2	7.3	7.5	7.8
Health care and social assistance	9.0	9.4	9.4	10.3	12.0
Arts and recreation services	1.3	1.5	1.5	1.7	1.8
Other services	4.8	4.8	4.7	4.2	4.0
TOTAL	100.0	100.0	100.0	100.0	100.0

Note: Figures are annual averages derived from surveys conducted in February, May, August and November.

Source: ABS, *Labour Force, Australia, Detailed, Quarterly, Feb 2014* (cat. no. 6291.0.55.003), Time series spreadsheets, Table 04: Employed persons by industry—trend, seasonally adjusted, original.

Service industries have correspondingly become relatively more important. Growth within services, however, has been very uneven. The relative importance of employment in both financial and insurance services and information and telecommunications, for example, has shrunk, while the rise in the employment share of education and training has been modest. Instead, the rising importance of services over the last two decades in Australia has been dominated by just two sectors—professional, scientific and technical services, and health care and social assistance. Growth within the latter has been especially marked over the last decade. With the baby-boom cohort having only just reached retirement age, demand pressures will almost certainly mean that labour demand within this sector will grow well ahead of most other industries in the decades ahead.

Changing occupational composition of employment

Recent decades have also seen major changes in the techniques, technologies and skills employed at work. Of some contention is whether these changes have favoured more skilled work at the expense of both less skilled and more routinised forms of work, and thus been associated with a general upskilling of the workforce. The US-centric review of Acemoglu (2002) concluded that technical change throughout most of the 20th century had been skills biased, and that there was acceleration in this bias during the last two to three decades of that century. More recently, however, the consensus has shifted, with evidence from recent periods, and for both the US and Europe, indicating that employment changes are U-shaped in skill level (e.g., Goos, Manning and Salomons, 2009; Autor and Dorn, 2013). In other words, employment growth has been most pronounced in occupations requiring either very high levels of skills or relatively few skills. That said, the explanation for this that has gained most ascendancy suggests this pattern has less to do with the cognitive demands of jobs and more to do with the extent to which work is routinized and thus able to be replaced by new technologies, and especially information technology.

In Australia, most research has tended to find little evidence of polarisation (e.g., Wooden, 2000; Esposto, 2011). More recently, Borland (2011) has reported changes in employment at the occupation sub-group level over the 2000 to 2010 period and shown that when occupations are ordered by the mean hourly wage (an objective indicator of the mean skill level of an occupation) there is no marked U-shaped pattern. However, he still concludes that the patterns of employment growth are consistent with the thesis that adoption of new IT technology has favoured jobs involving non-routine work.

Our own assessment of the evidence, however, is that such claims are difficult to justify, and that clear links with the adoption of new technology are not obvious. Consider the evidence presented in Table 4. Here we report the change in the employment shares of the 43 occupations defined at the sub-major group level in ANZSCO (version 1.2) sorted into five groups based on skill level. Results are presented for two alternative approaches to sorting occupations. The first, following Goos et al (2009), sorts on the basis of average hourly earnings (in 2001), while the second approach sorts on the predominant skill level of each occupation (as determined by the ABS) based on the amount of formal education and training, previous experience and on-the-job training typically required for competent performance. The grouping by wage level assigns between seven and ten occupation sub-major groups to each group, resulting in approximately 20 per cent of total employment at the start of our observation period (1993). The ABS skill-level approach results in a less even distribution of employment across the five groups in 1993, mainly because the second skill level accounted for only 8.9 per cent of total employment in that year.

Table 4: Changes in occupation shares of employment, 1993–2013 (% of total employment)

	Ordered by mean occupation hourly wage, 2001		*Ordered by ABS skill level*	
	Per cent employment share in 1993	*Percentage point change, 1993–2013*	*Per cent employment share in 1993*	*Percentage point change, 1993–2013*
Top level	19.7	6.59	24.6	5.54
2nd level	20.1	-1.37	8.9	0.69
3rd level	20.8	-3.58	20.2	-3.83
4th level	19.5	0.53	23.7	0.26
Bottom level	20.0	-2.90	22.5	-3.39

Sources: Employment—ABS, *Labour Force, Australia, Detailed, Quarterly, Feb 2014* (cat. no. 6291.0.55.003), Data cube E07: Employed persons by occupation (ANZSCO sub-major group), age, status in employment and sex, August 1991 onwards.

Mean occupation wage—Confidentialised unit record from HILDA Survey (data release 12.0).

Skill level—ABS, ANZSCO: Australian and New Zealand Standard Classification of Occupations, Version 1.2 (cat. no. 1220.0), Table 2.

Despite the differences, both approaches lead to the same conclusions. Over the two decades to 2013, the combined employment share of the occupations in the highest skill-level group increased substantially, rising by 6.6 percentage points when sorted on the basis of wages and by 5.5 percentage points when sorted on the basis of ABS skill level. This is consistent with the hypothesis that economic change has favoured jobs in the most skill-intensive occupations.

Over the same period, the cumulative employment share of the lowest-skill occupations fell by 2.9 percentage points when sorted on the basis of wages and by 3.4 percentage points when sorted on the basis of ABS skill level. In contrast to what has been reported for both Europe and the US, there has been no relatively strong employment growth in Australia at the bottom of the skills distribution. Indeed, relative to the 'top quintile' of jobs, employment growth has tended to be weak along the entire skills distribution. The only exception is the fourth quintile, where the employment share rose by half a point. This has largely been driven by growth in employment among carers and aides. Borland (2011) highlights this occupation group as an example of a growth occupation dominated by non-cognitive, non-routine work tasks. But a problem with the claim that relatively lowly skilled, non-routine jobs have been favoured by economic change in Australia is that it is hard to come up with many other examples. Instead we suggest that the strong employment growth among carers and aides reflects growing demand stemming from demographic change (the ageing of the population), rising incomes, and continued growth in female labour force participation (driving increased demand for childcare).

So what then explains the differences between results for Australia presented here and that reported for other countries? Our only explanation lies in differences in the regulation of wages of low-paid workers. Minimum wage regulation applies to many more workers in Australia than is typical in other countries, with around 16 per cent of Australian employees dependent solely on award regulation.[17] That, combined with relatively high wage minima[18], may mean that employment growth within relatively low-paid occupations has been less than it would have been

[17] See ABS, Employee Earnings and Hours, Australia, May 2012 (cat. no. 6306.0), Data cube: ALL EMPLOYEES, Average weekly total cash earnings.

[18] According to the OECD database (at http://stats.oecd.org) only two other OECD nations (on a list of 26)—Luxembourg and France—had a higher real hourly minimum wage in 2013, measured in purchasing power terms, than Australia.

under different institutional settings, such as those that prevail in the US or most Western European countries.

The changing distribution of working time

The 1980s and 1990s saw a marked change in the distribution of working time in Australia, with the share of employed persons working either part-time hours or very long hours each week rising (see Wooden and Drago, 2009). In the 2000s, while the part-time employment share has continued to rise (albeit modestly), the proportion of the employed working long work weeks (50 hours or more) has actually fallen. This can be seen in Table 5, which reports the distribution of employment by usual weekly hours of work, disaggregated by sex, for the years 2003, 2008 and 2013.[19]

Table 5: Distribution of employed persons by usual weekly hours worked by sex: 2003–2013 (%)

	Usual weekly hours of work				
	0–34	35–40	41–49	50+	Total
Males					
2003	15.5	43.6	14.8	26.1	100.0
2008	15.9	45.8	14.0	24.3	100.0
2013	17.6	46.8	13.4	22.2	100.0
Females					
2003	47.7	36.9	7.5	8.0	100.0
2008	46.4	38.8	7.0	7.7	100.0
2013	47.7	38.6	6.5	7.2	100.0

Note: Figures are annual averages.

Source: ABS, *Labour Force, Australia, Detailed—Electronic Delivery, Apr 2014* (cat. no. 6291.0.55.001), Time series spreadsheets, Table 10: Employed persons and usual hours worked by sex.

Among men, the part-time employment share (represented here by the proportion of employed persons reporting usual weekly hours of work of less than 35) rose by around two percentage points over the decade to 2013, with most of that growth concentrated in the second half of that decade. In contrast, the share of male workers reporting usually working 50 hours or more per week has fallen by almost four percentage points—from 26.1 per cent in 2003 to 22.2 per cent in 2013. This decline is especially remarkable given the changing occupational distribution of employment discussed earlier has favoured managerial and professional occupations where the incidence of long hours working is relatively common.

Among women, the hours distribution has changed very little over the last decade. The part-time employment share remains at the same very high level (47.7 per cent) while the incidence of long hours working remains relatively low, though it has declined slightly (from 8.0 per cent to 7.2 per cent).

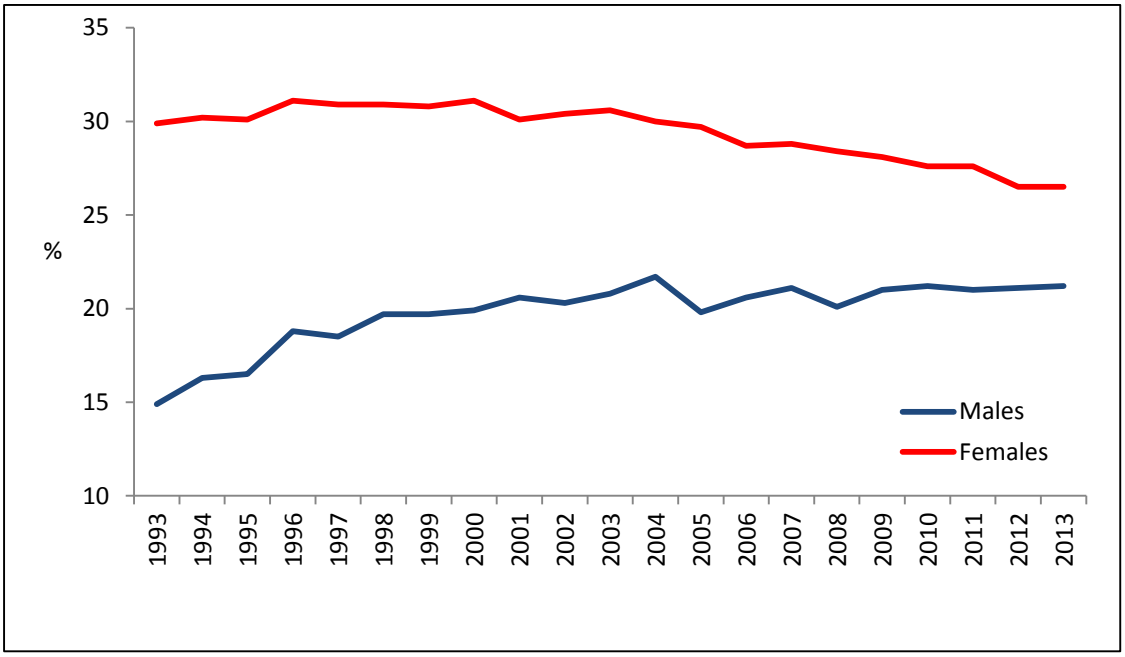
[19] The ABS only started collecting data on usual hours of work as part of the Labour Force Survey in April 2001. Prior to that date, weekly hours worked data related to the hours actually worked during the survey reference week, and as a result many workers on leave that week were recorded as working zero hours.

Job insecurity and non-standard employment

An often-expressed view is that jobs are more insecure today than at any other time in Australia's post-World War II history. Growth in non-standard forms of employment, such as casual work, fixed-term contracts and labour hire, are often identified as the major culprit for this rise in insecurity (e.g., ACTU, 2011). In fact, there is little evidence to suggest that these forms of employment have been rising over the last decade or so.

Figure 4, for example, charts ABS data on trends in the casual employee share, where casual employment is proxied by the absence of paid annual leave and sick leave entitlements. Casual employment clearly remains a pervasive feature of Australian labour markets, but it is just as clear that its importance is no longer growing. Among male employees the casual share has remained relatively steady since the late 1990s, fluctuating at around 20–21 per cent, while among females the share has fallen, from around 31 per cent to 26–27 per cent.

Figure 4: Casual employee share (percentage of employees), 1993–2013 (August)



Note: Excludes owner managers of incorporated enterprises. Casual employment defined by the absence of entitlements to both paid annual leave and paid sick leave.

Source: ABS, Employee Earnings, Benefits and Trade Union Membership, Australia (cat. no. 6310.0), various issues.

Similarly, there is little evidence that other forms of non-standard employment have been growing relative to more traditional forms of employment in recent years. Data collected each year since 2001 as part of the HILDA Survey, sort employees into one of three main groups based on their employment contract in their main job: fixed-term contract, casual, or permanent/ongoing. Population-weighted estimates from the most recent survey wave suggest that 67.5 per cent of employees in 2012 were in permanent or ongoing employment, slightly higher than the proportion in 2001 (66 per cent) when the survey commenced. The same survey also asks respondents whether they are employed through a labour-hire firm or temporary employment agency, and the evidence suggests that the share of labour-hire jobs is actually falling—from 3.7 per cent of employees in 2001 to 2.7 per cent in 2012.

And nor is there any evidence that there has been a substitution away from employees towards the greater use of the self-employed. Indeed, labour force survey data show that the self-

employment share has been steadily declining over the past two decades, falling from just over 14 per cent of total employment in the early 1990s to just 10 per cent in 2013.[20]

It has also been well established that even in earlier periods, when the casual employment share was growing, jobs had not become any less stable as measured by average job duration and rates of job mobility (Wooden, 1998). This is no less true today. As at February 2013, just 18.2 per cent of employed persons had been in their jobs for less than a year, which compares with 22.4 per cent almost two decades earlier (1994). At the other end of the distribution, just over one in four workers had been in their jobs for at least 10 years, which compares with 23.6 per cent in 1994.

Job duration, however, is a function of both dismissal and quits, which can be expected to move in opposite directions in response to any underlying change in job insecurity. As shown in Table 6, rates of involuntary job loss, while varying with the business cycle, have tended to decline over time, suggestive of rising job security. This is most obvious with respect to job loss caused by retrenchment and dismissal. Rates of voluntary job loss (i.e., quits), on the other hand, tend to move pro-cyclically, but have exhibited little obvious long-term trend.

Table 6: Job mobility by reason for ceasing last job (% of all persons who had a job at some time during the 12-month reference period [a]), 1994–2013

12 months ended:	Involuntary job loss			Voluntary job loss
	Retrenched[b]	Job temporary or seasonal[c]	All reasons	
Feb 1994	5.4	2.6	8.8	9.9
Feb 1996	4.6	2.7	8.0	11.5
Feb 1998	4.4	2.4	7.6	10.5
Feb 2000	4.0	2.4	7.2	11.7
Feb 2002	3.9	3.3	8.1	10.1
Feb 2004	2.7	2.9	6.5	11.4
Feb 2006	2.2	3.0	6.0	12.6
Feb 2008	1.8	2.8	5.4	12.7
Feb 2010	3.7	3.0	7.5	10.6
Feb 2012	3.1	3.3	7.4	12.4
Feb 2013	2.8	2.6	6.2	9.9

Notes: a. For the years 1990 to 2004 the scope of the Labour Mobility survey was restricted to persons aged less than 70 years. In 2006 the scope of the survey was expanded to include all people aged 15 years or older. Persons who changed locality but not their employer are not treated as having changed their job.
b. Comprises persons who lost their job because they were retrenched, the business in which they were employed closed down, or they had been dismissed.
c. Figures reported in this column for the years 2000 and earlier are not strictly comparable with those for later years. For the earlier years the additional requirement that the employee must have not returned to studies was also imposed.

Source: ABS, *Labour Mobility, Australia* (cat. no. 6209.0), various issues.

[20] These figures are the annual average share of employers and own account workers in total employment, and come from ABS, Labour Force, Australia, Detailed—Electronic Delivery, April 2014 (cat. no. 6291.0.55.001), Time series spreadsheets, Table 08: Employed persons by status in employment and sex.

Working from home

Yet another often heard claim is that, facilitated by changes and advances in information and communication technology, work is increasingly being undertaken away from conventional workplaces, and more specifically in the homes of workers. However, the available survey evidence provides little support for such claims. Analysis of data from the HILDA Survey by Wooden and Fok (2013), for example, shows:

(i) while taking work home is relatively common (with almost 23 per cent of Australian workers reporting doing at least some paid work at home each week), for relatively few workers (just five per cent) could home be described as their main location of work;

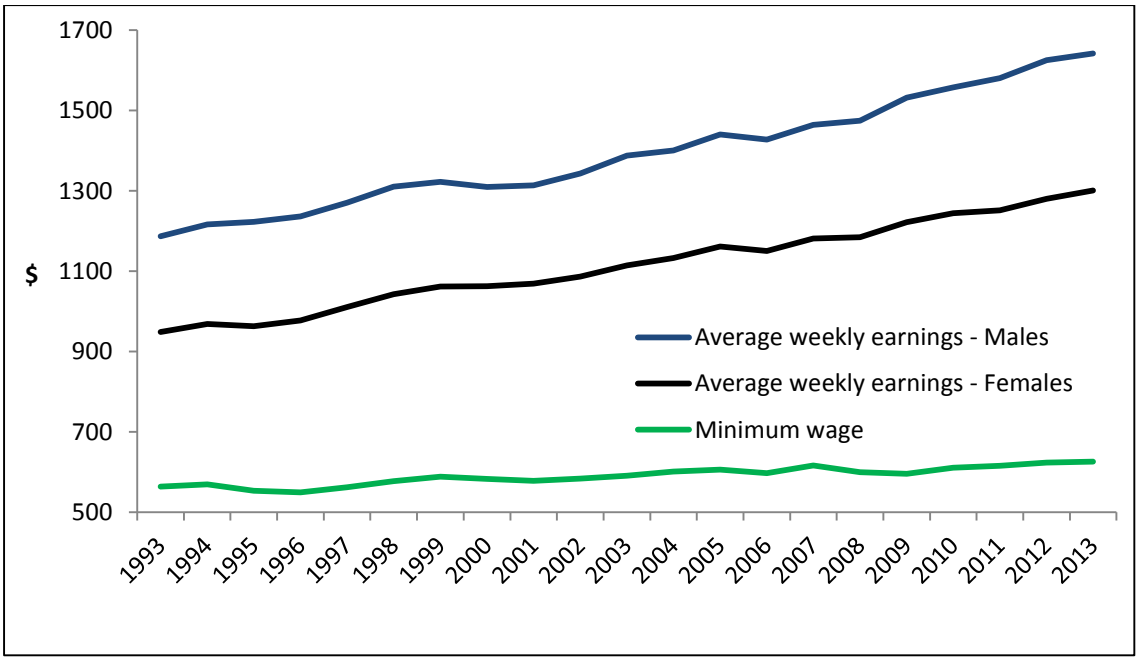
(ii) the majority of this small group of home workers are self-employed—only a little over one per cent of employees spend the majority of their work hours at home; and

(iii) if anything, the incidence of working at home fell over the course of the last decade.

Earnings

Strong growth in real wages has been sustained over the last two decades for both men and women. Figure 5 presents one indicator of this growth, showing that average weekly earnings of full-time employees grew by 38 per cent for males and 37 per cent for females between 1993 and 2013. This is unsurprising in the context of the sustained economic growth experienced over this period. Significantly, however, there has been no convergence in average earnings of male and female full-time employees: the gap was 25 per cent in 1993 and 26 per cent in 2013. Earnings growth has not been restricted to full-time employees, with the ABS Survey of Income and Housing (SIH) showing growth of real hourly earnings of part-time employees between 1994–95 and 2011–12 of 33 per cent for males and 24 per cent for females.

Figure 5: Minimum and average earnings of full-time employees, 1993–2013 (March 2014 prices)



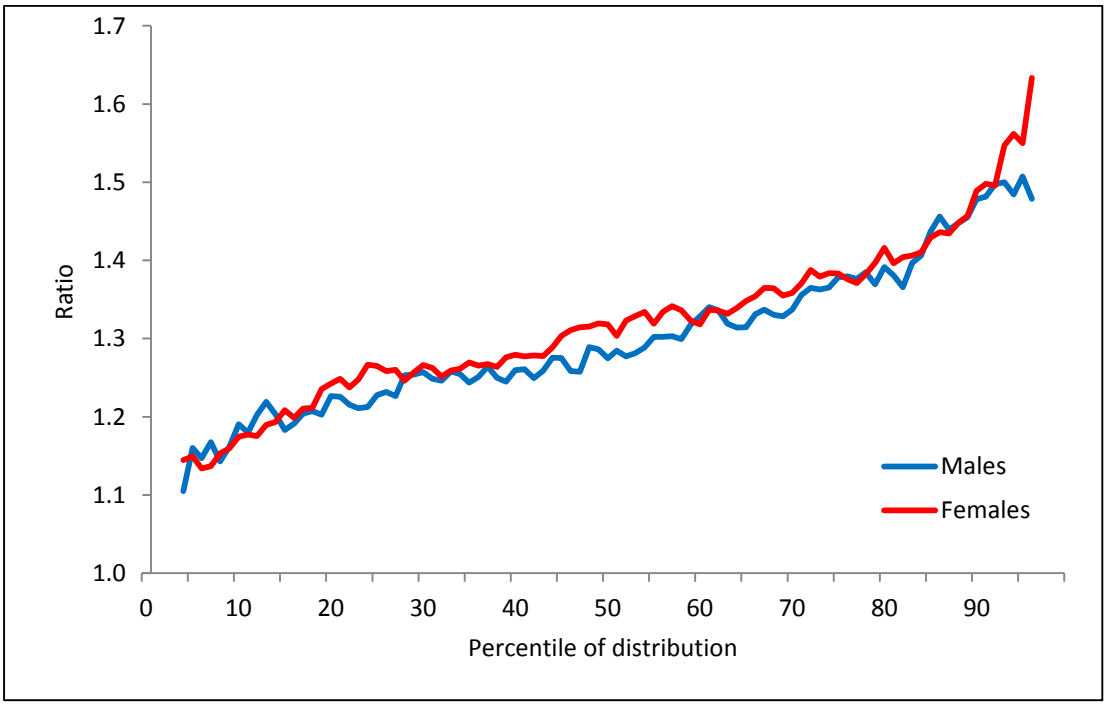
Note: Average weekly earnings are the average of survey estimates from May and November each year, while the minimum wage is the average value over the course of the year.

Sources: Authors' calculations using data on:

- Average weekly earnings: ABS, *Average Weekly Earnings, Australia, Nov 2013* (cat. no. 6302.0), Time series spreadsheets, Table 3: Average weekly earnings (dollars)—original. ABS, *Average Weekly Earnings, States and Australia, May 1994* (cat. no. 6302.0), Table 1 (original series).
- Minimum wages: Cowie and Jefferson (2010) and Fair Work Commission web site: https://www.fwc.gov.au/awards-and-agreements/minimum-wages-conditions/national-minimum-wage-orders.
- Prices: ABS, *Consumer Price Index, Australia, Mar 2014* (cat. no. 6401.0), Time series spreadsheets, Tables 1 and 2: All groups, index numbers and percentage changes.

Figure 5 also presents the adult minimum wage over the 1993 to 2014 period. It too has grown in real terms, although to a much lesser degree than average wages, increasing by 11 per cent between 1993 and 2013. This provides a hint that wage gains have not been uniform across the earnings distribution. Analysis of unit-record data from the SIH indeed finds that wage gains have been highest at the top end of the earnings distribution and lowest at the bottom end. Figure 6 provides an illustration of this trend, showing the percentage change in earnings of full-time employees at each percentile of the distribution. The magnitude of change is clearly increasing in percentile. For example, the 10th percentile increased by just over 15 per cent for both male and female full-time employees, but the 90th percentile increased by nearly 50 per cent. The direct implication is that earnings inequality rose over the two decades. Indeed, the Gini coefficient for earnings of full-time employees increased substantially: from 0.26 to 0.29 for men; and from 0.21 to 0.25 for women. Nonetheless, all points of the earnings distribution were at least 10 per cent higher in 2011–12 than in 1994–95, so the inequality increase derives from wages at the bottom of the earnings distribution growing relatively less, rather than failing to grow or indeed declining.

Figure 6: Ratio of real earnings in 2011–12 to real earnings in 1994–95, by percentile—weekly earnings of full-time employees aged 25 to 64 years



Note: The bottom three and top three percentiles are excluded.

Source: Authors' calculations using the public-release unit record files for the 1994–95 and 2011–12 ABS Survey of Income and Housing.

The drivers of increased earnings inequality in Australia over the last two decades are not well understood. Skill-biased technical change and international trade have been cited internationally as sources of increased earnings inequality (the former more than the latter; see Katz and Autor, 1999), one possible manifestation of which is the changes in occupation structure discussed

earlier. However, while it seems likely that technical change and trade patterns have both contributed to increased earnings inequality in Australia, much about the increase remains unexplained. Increases in inequality have primarily occurred within groups defined by age and educational attainment, whereas technical and trade changes that increase wage dispersion would be expected to increase wage differentials across these groups. Particularly notable is that education earnings premia have remained remarkably stable in Australia in recent decades (Coelli and Wilkins, 2009).

Watson (2014) offers the explanation that the growth in earnings inequality derives from the rise of 'neoliberalism', which is commonly understood to involve deregulation, privatisation and the general prioritisation of the market over the state. While there are a multitude of potential mechanisms by which such changes could impact on inequality, one obvious channel consistent with this hypothesis is the decentralisation of wage setting that has taken place, particularly in the 1990s.

Borland (2011) labelled the first decade of the 21st century the 'quiet decade' with respect to developments in the labour market. Such assessments, however, are somewhat misleading, and do not give enough weight to the sustained rates of high employment growth (which resulted in employment-population ratios reaching record levels in 2008) and real earnings growth over this period. There have also been very important changes to the industrial and occupational composition of employment. The changing patterns of employment, however, have not benefitted all workers equally, and instead have strongly favoured the most skilled and educated. This is also reflected in the patterns of earnings growth, the size of which has been strongly and positively associated with a worker's position in the earnings distribution.

Going forward a major challenge is maintaining a labour force capable of supporting an ageing population. Scope exists for further increases in age-specific labour force participation rates, especially among older people, but it seems unlikely that this will be sufficient to prevent aggregate participation rates from going into decline at some point in the near future. Without a major expansion in immigration, this will require an increase in the productivity of the workforce, pointing to the critical importance of ongoing investment in education and training. Such investment will also be important to continuing real wage growth, particularly in light of Treasury forecasts of deterioration in the terms of trade over coming years (Bullen, Kouparitsas and Krolikowski, 2014). At the same time, the danger remains that the gap between the minority without adequate skills and the rest of the population will widen.

Acknowledgements

This paper makes use of unit record data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA Survey Project was initiated and is funded by the Australian Government Department of Social Services and is managed by the Melbourne Institute of Applied Economic and Social Research. The findings and views reported in this paper, however, are those of the authors and should not be attributed to any of the aforementioned.

Roger Wilkins and Mark Wooden

Melbourne Institute of Applied Economic and Social Research, University of Melbourne.

References

Acemoglu D 2002, Technical change, inequality, and the labor market. *Journal of Economic Literature* 40(1): 7–72.

Australian Council of Trade Unions [ACTU] 2011*, Insecure Work, Anxious Lives: The Growing Crisis of Insecure Work in Australia.* ACTU: Melbourne.

Autor DH and Dorn D 2013, The growth of low-skill service jobs and the polarization of the US labor market. *American Economic Review* 103(5): 1553–1597.

Borland J 2011, The Australian labour market in the 2000s: The quiet decade. In H Gerard and J Kearns (eds), *The Australian Economy in the 2000s: Proceedings of a Conference held in Sydney on 15–16 August 2011* (pp. 165–218). Reserve Bank of Australia: Sydney.

Bullen J, Kouparitsas M and Krolikowski M 2014, Long-run forecasts of Australia's terms of trade. Treasury Working Paper 2014–01. The Australian Government, The Treasury: Canberra.

Coelli M and Wilkins R 2009, Credential changes and education earnings premia in Australia. *The Economic Record* 85(270): 239–259.

Cowie A and Jefferson T 2010, Minimum wage estimates and adjustments in Australia since 1983. Centre for Research in Applied Economics Working Paper Series: no. 201014. Graduate School of Business, Curtin University of Technology: Perth.

Department of Immigration and Border Protection 2014, *Temporary entrants and New Zealand citizens in Australia as at 31 March 2014*. Downloaded from https://www.immi.gov.au/media/statistics/pdf/temp-entrants-newzealand-mar14.pdf.

Gregory R 2014, *The two-step Australian immigration policy and its impact on immigrant employment outcomes*. IZA Discussion Paper No. 8061. IZA: Bonn.

Goos M, Manning A and Salomons A 2009, Job polarization in Europe. *American Economic Review: Papers and Proceedings* 99(2): 58–63.

Katz H and Autor D 1999, Changes in the wage structure and earnings inequality. In O Ashenfelter and D Card (eds), *Handbook of Labor Economics, Volume 3a* (pp. 1464–1555). North Holland: Amsterdam.

Mavromaras K, McGuinness S, O'Leary N, Sloane P and Fok YK 2010, The problem of overskilling in Australia and Britain. *The Manchester School* 78(3): 219–241.

Muysken J and Ziesemer THW 2013, A permanent effect of temporary immigration on economic growth. *Applied Economics* 45(28): 4050-59.

Norris K and Wooden M [eds] 1995, *The Changing Australian Labour Market* (EPAC Commission Paper no. 11). Australian Government Publishing Service: Canberra.

Powell WW and Snellman K 2004, 'The knowledge economy'. *Annual Review of Sociology* 30: 199–200.

Sheehan PJ and Tikhomirova G 1998, The rise of the global knowledge economy. In PJ Sheehan and G Tegart (eds), *Working for the Future: Technology and Employment in the Global Knowledge Economy* (pp. 27–85). Victoria University Press: Melbourne.

Watson I 2014, 'Wage inequality and neoliberalism: insights from quantile regression'. Available at: http://www.ianwatson.com.au/pubs/watson_wage_inequality_8april2014.pdf

Wooden M 1998, 'Is job stability really declining?' *Australian Bulletin of Labour* 24(3): 186–193.

Wooden M 2000, 'The changing skill composition of labour demand'. *Australian Bulletin of Labour* 26(3): 191–198.

Wooden M and Drago R 2009, 'The changing distribution of working hours in Australia'. In J Corbett, A Daly, H Matsushige and D Taylor (eds), *Laggards and Leaders in Labour Market Reform: Comparing Japan and Australia*. Routledge, Abingdon (UK).

Wooden M and Fok Y-K 2013, 'Working at home: whatever happened to the revolution?' In R Wilkins (ed), *Families, Incomes and Jobs, Volume 8: A Statistical Report on Waves 1 to 10 of the Household, Income and Labour Dynamics in Australia Survey*. Melbourne Institute of Applied Economic and Social Research: Melbourne.

Chapter 5

Education and Training

Tom Karmel

Education and training are important in a way which is different from most sectors of the economy. Not only are they important in terms of contributing directly to economic activity—literally millions of students and very substantial numbers of employees—but also because education and training is an investment for the future, not just economic activity in the present. From an economic perspective it is increases in future productivity and the labour market returns of increased wages and better employment prospects that matter. In order to evaluate this investment we need to understand the changing nature of the labour market and the quality and appropriateness of qualifications.

In this paper, I consider the prospects for education and training. One could look at many things—financing, lifelong learning, adult literacy and numeracy, social inclusion to name a few—but I wish to focus on two aspects: the changing nature of the labour market and issues relating to education and training as an industry. The first is fundamental to thinking about education and training as an investment, while any contemplation of the future of education and training needs to canvas the current organisational challenges that the sector is facing.

The changing labour market

From the point of view of education and training the most important change in the labour market is the remarkable increase in the proportion of the work force with qualifications. This phenomenon has been described positively as 'skills deepening' or negatively as 'credentialism'. This is an important distinction: skills deepening has connotations of workers within an occupation becoming more skilled and therefore more productive; credentialism on the other hand implies that increased qualification levels are more about getting a job in a particular occupation, without changing the nature of work or level of productivity in that occupation.

The extent of the increase between 1996 and 2011 in the proportion of people with qualifications can be seen from Table 1.

Table 1: Proportion of employed persons by highest qualification, 1996, 2006 and 2011, per cent

	1996	2006	2011	% point change 1996 to 2011
Higher degree	2.1	3.8	5.1	3.0
Bachelor degree	13.6	18.4	20.9	7.3
Diploma/advanced diploma	8.2	9.0	10.1	1.8
Certificate III & IV level	14.3	18.2	19.5	5.2
Other certificates	10.7	8.6	7.1	-3.6
No non-school qualification	51.0	41.9	37.3	-13.7
Total	**100**	**100**	**100**	

Notes: Higher degree includes doctorates, masters and post-graduate degree level (not further defined); bachelor degrees include bachelor degrees and graduate diploma/graduate certificates; other certificates include certificates I/II, certificates not further defined, and level inadequately described or not stated.

Source: Derived from the Census of Population and Housing, 1996, 2006 and 2011.

Over 15 years the proportions of employed persons with a higher degree, a degree or a certificate III/IV have increased very substantially. And this is not driven by change in the occupational structure of the labour market; we see from Table 2 that the proportion of people with qualifications has increased in every occupational group, even those regarded as relatively low skilled.

Table 2: Changes in the proportion of occupations (ASCO 2 major groups) with qualifications, 1996 and 2011 (percentage points)

	Higher degree	Bachelor degree	Diploma/ advanced diploma	Certificate III & IV level	Other certificates	No non-school qualification
1 Managers and administrators	5.9	10.3	2.5	2.5	-4.2	-17.1
2 Professionals	6.3	7.8	-6.8	2.0	-3.5	-5.8
3 Associate professionals	2.6	8.3	5.2	4.7	-5.8	-15.0
4 Tradespersons and related workers	0.2	1.5	1.9	6.1	-3.5	-6.3
5 Advanced clerical and service workers	1.7	8.0	6.4	9.0	-9.7	-15.4
6 Intermediate clerical, sales and service workers	1.6	5.5	4.5	12.0	-3.9	-19.6
7 Intermediate production and transport workers	0.6	2.0	2.1	7.7	-1.0	-11.5
8 Elementary clerical, sales and service workers	1.1	3.6	2.7	5.4	-1.7	-11.2
9 Labourers and related workers	0.6	2.4	2.0	7.2	-0.5	-11.7
Total	**3.0**	**7.3**	**1.8**	**5.2**	**-3.6**	**-13.7**

Source: Derived from the Census of Population and Housing, 1996 and 2011.

Clearly, the workforce is becoming more highly qualified. The key issue is whether the labour market is changing in a way which is biased toward those with qualifications, such that increasing proportions of people with qualifications are readily absorbed by the labour market.

To throw light on the issue, I employ two approaches. The first looks at the relationship between changes in the quantity of labour for each education level and relative wages. If, for example, the number of university graduates exceeds that 'demanded' by the labour market we would expect to see the wages of university graduates decline in relative terms. The second approach constructs a distribution of jobs, ordered by the 'quality' of the job, and then sees whether those with a particular qualification are maintaining their share of the 'good' jobs. If the expansion in those with a particular qualification is too rapid for the labour market to absorb then we will see a decline in the probability of obtaining a 'good' job—more PhDs driving taxis, for example.

The changing nature of labour demand

The idea is quite simple. We describe the economy as a simple production function,[1] with different types of labour as inputs. On the assumption that individuals are paid their marginal product,[2] an expansion in one type of labour relative to others will result in a decline in their relative wages if there is no technological change. If we observe in fact that an expansion in one type of labour is not accompanied by a decline in relative wages then we deduce that the structure of labour demand has changed toward that type of labour. By comparing changes in quantities of labour with changes in relative wages we infer the extent of change in the structure of labour demand.

[1] The approach is based on Katz and Murphy (1992).

[2] In non-technical terms the marginal product is the additional output that is generated by the addition of a single employee to a firm's workforce. Basic economic theory shows that a profit maximising firm will hire labour up to the point where an individual's wage equals their marginal product.

Tables 3 and 4, based on Survey of Education and Training data for 1997 and 2009, provide a summary of the basic building blocks: the changes in relative quantities of labour (measured in total hours worked by all individuals in the relevant qualification group) and wages. The benchmark group is individuals with year 12 but no post-school qualification.

Table 3: Hours worked by each education category, relative to year 12

	Males		Females	
Type of qualification	**1997**	**2009**	**1997**	**2009**
Postgraduate degree, graduate dip/cert	0.38	0.71	0.41	0.93
Bachelor degree	0.86	1.15	1.07	1.65
Advanced diploma/diploma	0.59	0.70	0.93	1.11
Certificate III/IV and year 12	0.31	0.69	0.06	0.57
Certificate III/IV and not year 12	1.35	1.32	0.16	0.62
Certificate I/II/not defined/unknown and year 12	0.29	0.22	0.45	0.31
Certificate I/II/not defined/unknown and not year 12	0.61	0.27	0.74	0.34
Year 12	1.00	1.00	1.00	1.00
Early school leaver/did not go to school	2.13	1.57	2.00	1.40
Currently attending school	0.03	0.04	0.07	0.07

Source: Karmel (2013).

Table 4: Hourly wage rates by education category relative to year 12, abstracting from changes in the age distribution

	Males		Females	
Type of qualification	**1997**	**2009**	**1997**	**2009**
Postgraduate degree, graduate dip/cert	1.24	1.25	1.31	1.33
Bachelor degree	1.23	1.19	1.27	1.24
Advanced diploma/diploma	1.10	1.11	1.12	1.09
Certificate III/IV and year 12	1.05	1.04	0.92	1.01
Certificate III/IV and not year 12	0.97	0.99	0.88	0.90
Certificate I/II/not defined/unknown and year 12	1.04	1.03	1.05	0.97
Certificate I/II/not defined/unknown and not year 12	0.95	0.89	0.96	0.91
Year 12	1.00	1.00	1.00	1.00
Early school leaver/did not go to school	0.85	0.86	0.89	0.88
Currently attending school	0.65	0.65	0.64	0.73

Source: Karmel (2013).

Thus, for example, in 1997 males with degrees worked hours in aggregate that equated to 86 per cent of those who had completed year 12 but had no post-school qualification, but by 2009 this percentage had increased to 115 per cent. Despite the very significant changes in relative quantities, we see reasonable stability in the relative hourly wage rates. This continues a much longer trend, at least for those with degrees. In fact, wage rates of those with degrees relative to those who had completed year 12 have been stable since the late 1970s.[3]

[3] Karmel (2013) was an update of earlier work, see Karmel (1997a, 1997b).

We can now bring the two sets of figures together—reasonable wage stability but dramatic changes in hours worked by educational category—to derive the inferred change in labour demand (Table 5).

Table 5: Change in labour demand by qualification, relative to year 12, assuming an elasticity of substitution of 1.0, 1997- 2009 (per cent)

Type of qualification	Males	Females
Postgraduate degree, graduate dip/cert	62	80
Bachelor degree	27	41
Advanced diploma/diploma	17	15
Certificate III/IV and year 12	79	212
Certificate III/IV and not year 12	-1	129
Certificate I/II/not defined/unknown and year 12	-11	-12
Certificate I/II/not defined/unknown and not year 12	-63	-50
Year 12	0	0
Early school leaver/did not go to school	-30	-36
Currently attending school	44	16

Source: Karmel (2013).

The figures represent the change in labour demand in the same units as the changes in the relative quantities. So we see that for males labour demand has changed in a way to particularly favour those with a degree or diploma, but also those with a certificate III/IV *and* year 12 (that is, the more skilled certificates III/IV), at the expense of those with lower level qualifications and early school leavers. If anything, the change in labour demand has been even stronger for females, but with the difference that those with a certificate III/IV have benefited.

The shift in demand for those with degrees is a continuation of earlier trends, and reasonably consistent with international experience at least in Anglophone countries. For example, Coelli and Wilkins (2008) found that labour markets in both the US and Australia have remained friendly to graduates, and Greenstone and Looney (2012) found that the returns to college education in the US have been largely constant over the previous 35 years. Boudarbat, Lemieux and Riddell (2010) painted a similar picture for Canada with rising returns to degrees for men over the period 1980-2005. Boothby and Drewes (2010) similarly examined the returns to education in Canada over the period 1980-2005, and found that the labour market has been favourable to graduates. O'Leary and Sloane (2011) found the premium enjoyed by university graduates in Great Britain has remained largely stable between 1997 and 2006 while, in respect of Ireland, McGuiness, McGinty, and O'Connell (2008) found stable returns to degrees between 1994 and 2001.

The increase in the relative demand for those with a certificate III/IV deserves some comment. There is no doubt that there has been a very large increase in the numbers with that qualification, and there is also no doubt that wage relativities have been fairly constant. But it needs to be remembered (see Table 4) that those with a certificate III/IV do not in general command a premium relative to year 12. Thus we appear to have considerable credentialling taking place, with large numbers of people obtaining a certificate III/IV but with no change in productivity. One part of the story would have to be mandating credentials in areas such as aged care, childcare and the finance industry.

Qualifications and occupations

The above analysis looked at the relationship between qualifications and average wages. We now take an occupational focus. Table 6 shows employment growth between 1996 and 2011 by occupational group.

Table 6: Employment growth 1996 to 2011, by ASCO2 major groups (per cent)

	1996	2011	% change
1 Managers and administrators	708626	877325	23.8
2 Professionals	1306709	2091565	60.1
3 Associate professionals	860501	1237677	43.8
4 Tradespersons and related workers	995523	1174805	18.0
5 Advanced clerical and service workers	329673	272064	-17.5
6 Intermediate clerical, sales and service workers	1222762	1763988	44.3
7 Intermediate production and transport workers	660330	784406	18.8
8 Elementary clerical, sales and service workers	677190	912194	34.7
9 Labourers and related workers	666221	741896	11.4
Total	**7427535**	**9855920.3**	**32.7**

Source: Derived from the Census of Population and Housing, 1996 and 2011.

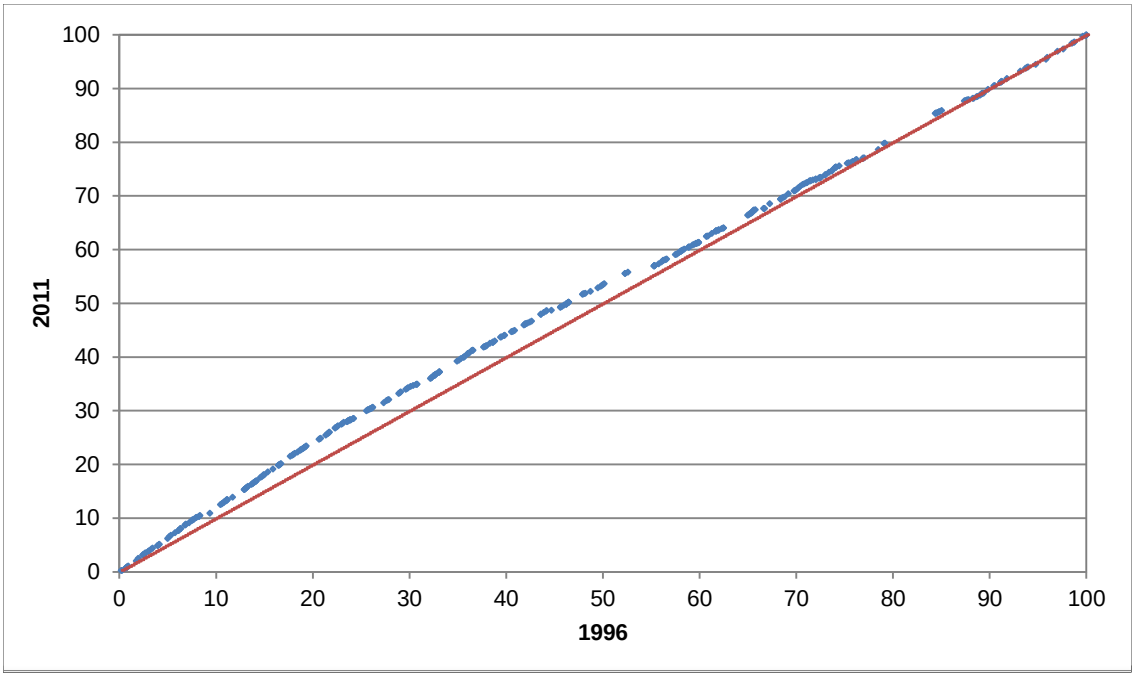
We see that there has been above average employment growth (1996-2011) in two groups which are relatively highly skilled (professionals and associate professionals)—but also in a middling skill occupational group (intermediate clerical, sales and service workers). Similarly below average growth was spread among the occupational groups—managers and administrators, trades and related workers, advanced clerical, sales and service workers, intermediate production and transport workers, and labourers and related workers. Thus there is no absolutely clear bias toward increases in the relative proportion of more skilled occupations.

We can get a better handle on occupational trends by ordering jobs (four-digit ASCO occupations) from the 'best' to the 'worst' and then seeing how the distribution of jobs has changed. The concept of a best or worst job is of course normative, but we can order the distribution of jobs according to an objective index. One such index is based on average wages for full-time jobs in the 2006 Census (Karmel et al, forthcoming).[4]

The first thing to observe is that the employment growth between 1996 and 2011 is somewhat biased toward better jobs. This can be seen from Figure 1 which plots the cumulative share of employment for each four-digit occupation in 2011 on the Y axis against the corresponding value in 1996.

[4] According to this index the occupation at the top of the distribution is medical specialist.

Figure 1: Cumulative shares of employment for each occupation (15 –64 year olds), 1996 and 2011, occupations ordered by income levels



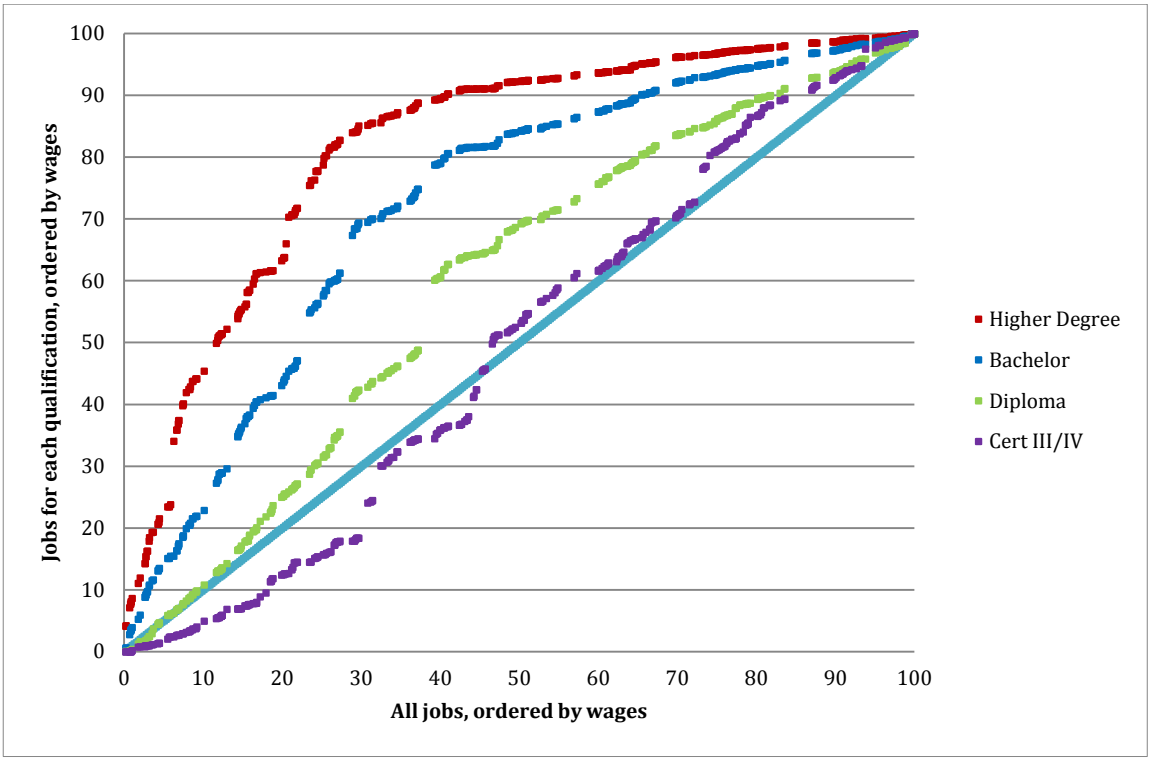
Source: Karmel, Stanwick and Moore (forthcoming).

The broken line corresponding to the cumulative distribution[5] for 2011 is above the 45 degree line. So the occupation which corresponded to, say, the cut off for the top 30 per cent of jobs in 1996 corresponded to the top 35 per cent of jobs in 2011. That is, the better jobs grew faster than the less desirable jobs.

Our interest, however, is primarily in how individuals with certain qualification levels have fared. In Figure 2, we plot cumulative shares of employment in 1996 for those with qualifications—higher degrees, degrees, diplomas and certificates III/IV.

[5] In non-technical terms the cumulative distribution shows the proportion (or percentage) of the population with a value up to a certain point.

Figure 2: Cumulative shares of employment by qualifications, 1996, 25–44 years, occupations ranked by income level



Source: Karmel, Stanwick and Moore (forthcoming).

On the X axis we have the cumulative share of total employment, with each observation corresponding to an occupation (ordered such that the 'top' occupation is nearest the origin). On the Y axis we have analogous points, representing the cumulative share of employment for persons with specified qualifications. As expected, those with a higher degree are most skewed toward the better jobs; in 1996 around 85 per cent of those with a higher degree had jobs in the top three deciles of jobs. By contrast, the analogous figure for those with a certificate III/IV was around 18 per cent.

However, our interest is in how these shares have changed over time. One way of summarising changes is to look at the average percentile value for each qualification group.[6] Table 7 does this for 1996 and 2011, focusing on 'prime age' workers—those aged between 25 and 44 years.

Table 7: Changes in the average job, 1996 to 2011, 25 –44 years, percentile of 1996 job distribution

	Jobs ordered by income		
	Mean 1996	*Mean 2011 (1996 base)*	*Increase in mean percentile (percentile points)*
Higher degree	18	26	8
Bachelor degree	28	30	2
Diploma	41	48	7
Certificate III/IV	51	54	3

Note: 1 represents the best job, 100 the worst.

Source: Karmel, Stanwick and Moore (forthcoming).

[6] The average is obtained by weighting each percentile (defined by occupation) by the share of jobs in that percentile.

We see that the average job for each qualification category has slipped down the distribution—that is the average job in 2011 is an occupation that has lower average income than was the case in 1996. The group most affected is those with a higher degree. Essentially, having a higher degree has become less exclusive and, on average, individuals are obtaining a job lower down the distribution of jobs.

The Census data also allow us to undertake this analysis by field of study. Table 8 shows that there is a clear hierarchy with the average job of someone with a higher degree being better than someone with a degree, which in turn is better than someone with a diploma, and so on. However, there is considerable variation by field of study, although the hierarchy is pretty much maintained within each field of study.

Table 8: Average job, by qualification and field of study, persons 25–44 years, 1996 (1996 job distribution percentiles based on income index)

	Cert III/IV	Diploma	Bachelor	Higher degree
Engineering	47	31	20	15
Education	**	39	31	23
Health	54	42	26	13
Agriculture	62	53	37	32
Architecture and Building	47	33	23	19
Business and Administration	40	41	25	16
Natural and Physical Science	51	38	25	19
Society and Culture	67	54	32	22
Total	51	41	28	18

** There was no one recorded as having a certificate III/IV in the field of education in the 1996 Census data provided to us.

Source: Karmel, Stanwick and Moore (forthcoming).

The final element of the analysis is to see how the distributions have changed between 1996 and 2011 (Table 9).

Table 9: Change in average job, 1996 to 2011, by qualification and field of study, persons 25–44 years, 1996 (1996 job distribution percentiles based on income index)

	Cert III/IV	Diploma	Bachelor	Higher degree
Engineering	-2	2	-1	3
Education	**	14	2	7
Health	12	8	3	7
Agriculture	1	2	0	-5
Architecture and Building	-2	2	1	1
Business, Administration	13	3	5	13
Natural and Physical Science and Information Technology	-8	-1	3	6
Society and Culture and Creative Arts	2	1	2	4
Total	3	7	2	8

** There was no one recorded as having a certificate III/IV in the field of education in the 1996 Census data provided to us.

Source: Karmel, Stanwick and Moore (forthcoming).

The positive entries indicate that the average job has slipped according to the income index. So we see that in every field of study, those with a higher degree in 2011 have obtained on average a poorer job than was the case in 1996, with the exception of agriculture graduates. The worst

affected field of study was business and administration. For those with a degree, the decline in the average quality of job was less, and engineering graduates actually saw a modest improvement. One of the largest declines was for those with a diploma in education. This reflects that a degree has become mandatory for being a teacher. The other examples of significant declines in the average job obtained are those with a certificate III/IV in health and business and administration. This most likely reflects the increase in the credentials required to work in health occupations and finance occupations.

The upshot of this analysis is that there has been a clear bias in developments in the labour market toward the better qualified. That said, the expansion in those with educational qualifications has been such that there have been distributional consequences. As a generalisation, qualifications provide less of a guarantee of a 'good ' job than was the case in previous decades, although the average wage returns have been quite robust.[7]

In terms of looking forward, assuming past trends continue, job growth is likely to favour the better qualified. The Australian Workforce and Productivity Agency has been very bullish about the prospects for those with qualifications and in its National Workforce Development Strategy (2013) concluded that Australia 'could be 2.8 million short of the number of higher skilled qualifications that industry market will demand' (p. 9). However, the continued expansion of higher education and a continuation of the trend to demand ever increasing levels of credentials in government-regulated industries will no doubt result in continued 'skills deepening'. If the future follows the past then the absorption of increasing numbers of better-qualified people should be able to occur without negative consequences. There have to be a number of points of caution, though. First, as a matter of simple arithmetic 'skills deepening' implies that many people with qualifications will be accepting a job of lower 'quality' than would have been the case in earlier generations. Second, one cannot assume without question that the return to, say, a degree will be maintained as even larger proportions of the workforce possess one. For example, Beaudry, Green and Sand (2013) point to a decline in the demand for skills in the US since 2000 even as the supply of educated workers grew. Don Russell (2014) refers to the US Bureau of Labour projections for 2012–2022 which suggest that there is potentially a considerable oversupply of graduates. Similarly, the OECD (2012) raises questions as to how the world-wide labour market will absorb the swelling number of highly educated people. Finally, the new graduate labour market is currently very soft, with the graduate destination survey showing a decline in the proportion of new graduates obtaining full-time employment four months after graduation from around 85 per cent in 2008 to 70 per cent in 2013.[8] This may be a cyclical phenomenon dating back to the global financial crisis which in time will work itself out. On the other hand, with governments constrained by budgetary pressures, it may be an indication of a structural shift with jobs being hard to obtain for new graduates over the longer term.

Institutional issues

There are a number of current issues in education and training that potentially might impact on the quality of qualifications or their number. In the higher education sector, quality has been an issue for some years and leading to the establishment of the Australian Universities Quality Agency (AUQA) in 2000, subsequently replaced by the Tertiary Education Quality and Standards Agency (which itself is in the process of being reviewed). The interest in quality has been driven by the 'massification' of higher education and its commercialisation—the latter driven in

[7] Dockery and Miller (2012) come up with similar conclusions by comparing qualification levels of different generations within occupations.

[8] Of those available for full-time work.

Australia by the large numbers of international students. Both have led to an expansion in the number of providers and the delivery of higher education in non-traditional settings and to students with very varied backgrounds. Indeed the trigger for the creation of AUQA was Greenwich University located in Norfolk Island, a provider offering distance education to older, mostly working students in a rather formulaic manner, and on a commercial basis. More recently, the introduction of uncapped, demand-led funding for domestic students has raised issues about the 'quality' of higher education being delivered to students with poor educational backgrounds (for example, the acceptance of students in some universities with Australian Tertiary Admission Ranks of 40).[9] The assessment of international students with poor education has also been an issue, with allegations of soft marking emerging from time to time. While universities have vigorously defended their standards, arguing that it is the quality of graduates that matters, not input standards, it is clear that there is a perception that the quality of a degree cannot be taken for granted. If there is a significant loss of trust in the quality of a degree, then this has serious implications for the labour market. No longer would employers take degrees at face value from providers who had not built a strong reputation, and we could see the creation of testing agencies to verify the quality of qualifications, at a considerable cost to the economy. We could also see 'price gouging' from the established, traditional providers which could charge higher fees whether or not their teaching was of better quality than other providers.

There are a number of other threats to traditional higher education. The reliance of universities on the flow of funds from international students is an obvious vulnerability given the fickle nature of this market. The intense competition for international and domestic students with demand-driven funding has meant that universities are no longer content to contain their activities in their immediate vicinity. One only has to count the number of universities in downtown Sydney or Melbourne to understand the nature of the competition. Universities have also realised that not every student wants the 'sandstone and ivy' experience and there have been huge investments in virtual learning platforms—but this could be seen as a continuation of off-campus or distance education which date back to the early 20th century. The range of institutions has also increased with a plethora of 'colleges' providing pathways to the universities. Many of these colleges are teaching early years of degrees, and many of them are for profit. There are now considerable numbers of large, well-capitalised commercial providers, such as Navitas. Such providers typically have low-cost structures, including workforces that are less unionised and more flexible than those of the traditional universities.

While relying on income from overseas students is somewhat risky, income from domestic students cannot be taken for granted either. Budgetary pressures for governments are likely to continue, and it is unlikely that the tertiary education sector will be the beneficiary of increasing budgetary largesse in coming years. Social welfare and health outlays are running ahead of underlying economic growth, and this must have a negative effect on tertiary education, particularly with the schools sector commanding what seems to be an ever-increasing share of education outlays.[10]

Another trend that is affecting university behaviour is the increasing importance of league tables. With increasing competition for students, reputation is king and for many this corresponds to where universities are ranked. The irony here is that ranking typically reflects size and research performance, not the quality of teaching.

One development that cannot be overlooked is the birth of 'MOOCs'—massive online open courses—through which world-renowned universities offer courses for free. The question is

[9] The rank purportedly refers to the academic percentile of the year 7 cohort.

[10] School education has had very generous indexation arrangements for many years, and the 'Gonski' reforms imply substantial increases to funding for school education.

whether this phenomenon threatens universities as we know them. Personally, I doubt it. In a sense the idea has been around for at least 100 years, with mass textbooks being used internationally. MOOCS provide content but not credentials, and one would suspect that if the MOOCS delivered by Harvard, for example, lead to Harvard qualifications then the cost of the assessment will be very considerable. However, it is quite possible that universities may take advantage of MOOCS to cut their delivery costs—the MOOCS could negate the need for lectures so that the cost of the course would be the support and assessment costs. This is not so different from teaching from an established textbook.

Another possible threat to the traditional universities is the rise of proprietary qualifications. For some time now, accreditation by Microsoft or CISCO, for example, has had value in the labour market. If these qualifications become more important then perhaps the value of the Australian Qualifications Framework' qualifications will decline. Again, I doubt that this is likely to happen, for the simple reason that if these proprietary qualifications get too important then they will be subsumed within standard qualifications, in the same way that the demands of the professions (medicine, accounting, law, engineering, for example) are met by course structures.

While higher education has its challenges, vocational education and training is arguably more vulnerable. I see the threats coming from two directions. First, the labour market returns to qualifications accrue mostly at higher-level qualifications, notably diplomas and degrees. The long-term trends in the structure of labour demand are most unlikely to reverse this. The risk to the VET sector is that the university sector will colonise the diploma space, leaving the VET sector to deliver certificates. I have argued previously that the VET sector should begin to offer degrees (Karmel 2010), but where this is occurring it is mostly in collaboration with a university. An example of this is the University of Canberra's polytechnic model in which selected degrees are offered at a TAFE (such as Holmesglen) but remain University of Canberra degrees. In a slightly different vein, some of the lower-level qualifications may not have that much of an economic return value. For example, Karmel and Mlotkowski (2010) show that those who complete a retail traineeship earn less than those who do not. Thus it was not that surprising that the number of traineeships declined dramatically when the Commonwealth government changed its incentive payments in 2012. My point is that the value of these qualifications depends very much on the level of government support. Similarly, the existence of some of these qualifications is very much dependent on regulation. As noted earlier, regulation of community care and the finance industry have underpinned many of the qualifications.

The second issue is quality of qualifications. While the higher education sector has 180 or so institutions (including 39 large universities which are members of Universities Australia), the VET sector has around 5000 providers, most of which are quite small, and there has been considerable concerns with the quality of some VET providers. This concern was a major factor behind the creation of the Australian Skills Quality Agency, and the standards-setting body, the National Skills Standards Council (NSSC), now abolished. The NSCC argued that the 'currency' of credentials had to be protected, and that there were particular risks around assessment and the quality of teachers/trainers. Under current arrangements, individual providers could train their own trainers, and assess their own students. The fact that the minimum qualification for being a trainer was a certificate IV (and moreover, unqualified trainers could deliver training if under supervision) opened the sector to potentially poor practice.

The competency-based training packages of the VET sector are themselves a source of contention. While designed by industry, some see them as overly atomised, with undue emphasis on tasks rather than underpinning knowledge. For example, John Buchanan, Leesa Wheelahan and their colleagues argue for 'capabilities' within a family of occupations rather than specific technical competencies.[11] Moreover, the underpinning logic of training packages is

[11] See Wheelahan and Moodie (2011); Wheelahan, Moodie and Buchanan (2012); Yu, Bretherton and Buchanan (2013).

preparation for specific jobs, but in reality the match between field of training and jobs for the majority of graduates is very loose (see Karmel, Mlotkowski and Awoyedi, 2008). Providers see higher education qualifications as more flexible and, therefore, given the choice, many would rather deliver a higher education diploma than a VET diploma.

Concluding comments

In past decades we have seen a dramatic increase in the number of people with qualifications. On the whole, the labour market has absorbed these increases without affecting average returns to qualifications. The implication is that the demand for individuals with qualifications has been increasing, and this has been over and above changes to the occupational structure of the labour market. These trends imply that one can be relatively sanguine that the labour market will continue to 'demand' increased levels of qualifications. However, the current softness of the graduate labour market, the fact that a qualification does not lead to the same 'quality' job as it did earlier, and the role of government regulation underpinning the demand for certain qualifications makes one a little circumspect. One cannot assume that more education and training is automatically a good investment — returns to education and training should be monitored carefully.

The second point to keep in mind is that funding challenges, technological innovation and quality issues will keep the education and training sector on its toes. Education and training is increasingly becoming marketised and this is putting pressure on traditional providers. On the other hand, universities date back to the 12–13th centuries and have proved to be among the most resilient of social institutions. Vocational training—dating back to medieval guilds and working–men's colleges of the 19th century—also has a very long pedigree. No doubt the education and training sector will evolve to cope with all the vicissitudes of the next 15 years.

Tom Karmel

National Institute of Labour Studies, Flinders University.

References

Australian Workforce and Productivity Agency 2013, *Future focus: 2013 National workforce development strategy*.

Beaudry, P, Green, D and Sand, B 2013, *The great reversal in the demand for skill and cognitive tasks*, National Bureau of Economic Research.

Boothby D and Drewes, T 2010, *The payoff: returns to university, college and trades education in Canada*, 1980–2005 CD Howe Institute.

Bourdarbat, B, Lemieux, T and Riddell WC 2010*, The evolution of the returns to human capital in Canada*, 1980–2005, IZA — Institute for the Study of Labor.

Brown, J, Fang, C and Gomes, F 2012, *Risk and returns to education*, National Bureau of Economic Research.

COAG 2012, *National agreement for skills and workforce development*.

Coelli, M and Wilkins, R 2008, *Credential changes and education earnings premia in Australia,* Melbourne Institute of Applied Economics and Social Research.

Dockery, AM, Miller, PW 2012, *Over-education, under-education and credentialism in the Australian labour market*, NCVER.

Graduate Careers Australia 2013, *GradStats: Employment and salary outcomes of recent higher education graduates*, Melbourne.

Greenstone, M and Looney, A 2012, *Regardless of the cost, college still matters,* Brookings Institution.

Karmel, T 1997a, 'Are there too many graduates?', *Journal of Higher Education Policy and Management,* Vol19 No.2.

Karmel, T 1997b, 'Labour demand and educational expansion', *Economic Papers*, Vol 16, No. 1: 14–28.

Karmel, T 2010, 'The future of VET: or Allen Ginsberg revisited', in *The future of VET* (eds, Francesca Beddie and Penelope Curtin), National Centre for Vocational Education Research, Adelaide.

Karmel, T 2013, 'Surely there are too many graduates now?' *Australian Bulletin of Labour Studies*, Volume 39 Issue 2: 59–73.

Karmel, T and Mlotkowski, P 2010, *The impact of wages on the probability of completing an apprenticeship*, National Centre for Vocational Education Research, Adelaide.

Karmel, T, Mlotkowski, P and Awodeyi, T 2008*, Is VET vocational? The relevance of training to the occupations of vocational education and training graduates,* National Centre for Vocational Education Research, Adelaide.

Karmel, T, Stanwick, J and Moore, J (forthcoming), *The return to education: an occupational perspective*, National Centre for Vocational Education Research, Adelaide.

Katz, LF and Murphy, KM 1992, 'Changes in relative wages', 1963–1987: supply and demand factors, *Quarterly Journal of Economics*, 107: 35–78.

McGuinness, S, McGinnity, F and O'Connell, PJ 2008, *Changing returns to education during a boom?: the case of Ireland*, Economic and Social Research Institute.

Murphy, KM and Welch, F 1992, 'The structure of wages'*, Quarterly Journal of Economics* 107: 285–326.

O'Leary, NC, and Sloane, PJ 2011, 'The wage premium for university education in Great Britain during a decade of change', *The Manchester School*, 79, 4 July 2011.

OECD 2012, *How is the global talent pool changin*g? OECD.

Russell, D 2014, 'Reflections on my time in Canberra', Crawford Reflections Lecture 31 March, Crawford School of Public Policy, Australian National University, Canberra.

Wheelahan, L and Moodie, G 2011, *Rethinking skills in vocational education and training: from competencies to capabilities*, NSW Board of Vocational Education and Training, Sydney.

Wheelahan, L, Moodie, G and Buchanan, J 2012, *Revitalising the 'vocational' flows of learning and labour*, NCVER, Adelaide.

Yu, S, Bretherton, T and Buchanan, J 2013, *Defining vocational streams: insights from the engineering, finance, agriculture and care sectors,* NCVER, Adelaide.

Chapter 6

Governance and Public Policy

John Wanna

Leo Tolstoy once wrote: 'Writing laws is easy, but governing is difficult' (War and Peace). That seems an apposite aphorism capturing the situation in which Australian governance and public policy finds itself today and for the foreseeable future.

Governments are *active* but not necessarily *effective*

Australian governments find law-making easy (even under the circumstances of a hung parliament experienced by the previous government) but *governing* is much more difficult and hard to manage. Many of the celebrated policy failures in recent years have emerged not from legislative drafting but from poor policy design and poor implementation (e.g., the Home Insulation Program with its poor design and implementation, the mining (super profit) resource rental tax with its benign and overly optimistic presumptions, the increase in unauthorised migration under Rudd-Gillard fuelled by *ad hoc* easing of restrictions, the parlous state of water management in Australian rivers, the unintended growth in welfare dependency and benefit drift caused by political expediency, and some might even include the carbon tax which taxed the community, cemented compensation packages and yet did little to abate the rate of emissions or change behaviour).

Modern governments are increasingly active yet ineffective in dealing with many of our major social and economic problems and areas of policy responsibility (child welfare, aged care, mental health, alcohol abuse, Indigenous wellbeing, effective education and health services, sustainable energy, climate change and environmental management just to name a few). There is no evidence of a lack of appetite of either politicians or officials in addressing areas they feel need attention—even including forms of social engineering—and it is not clear that the motivation for this activity is entirely down to electoral expectations. Even in fiscally stringent times, governments have continued to show a propensity to commit to long-term unfunded liabilities, locking in future governments and parliaments. There is still a mentality of 'let's try to fix everything' among the political elite, arguably guided today less by ideology and more by a desire to be seen to be doing something and to spawn legacy initiatives.

We need not go so far as to agree with the former US President Ronald Reagan when he asserted that governments *are the problem*, not the solution. But we should recognise that governments often contribute towards the dimensions of the problem, and can make problems worse by their actions or inactions. Governments have their own serious limitations which often prevent them from optimising outcomes; and as an analyst of public policy over many decades, I for one am not as confident that governments will get it right or do what is best. Governments can do great good, but they can also do great harm and damage the sectors they think they are assisting. Arguably, governments are best equipped to deal with issues when they can be standardised or lend themselves to routine administration (such as taxation, entitlement provision, customs, passport control); they perform worst when they are faced with complexity and uncertainty, the non-routine problems, and even with unexpected events. Public policy planning for a future workforce with the appropriate level of skills and productive capacities is more in the latter cluster of complex issues than the former routinised ones.

We also need to remember that we have nine governments (and nine oppositions) in Australia (and 560 local jurisdictions) often encroaching on the policy responsibilities of the others in a fluid interface of 'contested federalism', sometimes labelled as 'pragmatic federalism' (see Hollander and Patapan, 2007). This makes the overall national coordination of any driving forces more difficult and protracted. There may also be limited scope at present for more substantial regional differentiation (especially given our centralist federal system, standardisation,

harmonisation and strong notions of horizontal equity), yet some local differentiation may be beneficial to the overall objectives of a productive economy.

Australia is not alone in wrestling with these strategic and structural issues of governance. Globally many other jurisdictions suffer from this same malaise. Europe is in much the same boat, although some nations have developed serious commitments to long-term educational goals (Scandinavia, Germany). America and Canada are similarly afflicted—even though America's greater educational investment and labour market flexibility provides it with a compensatory agility few other developed nations enjoy. New Zealand made some serious mistakes when it overly deregulated its regulatory regimes after the 1980s, but of late seems to be focusing on the basic fundamentals of a liberal market open trading economy more than Australia has to date.

Are Australian governments *drivers* of change (including their respective capacities with regard to governance)?

Governance and our public policy frameworks can serve both as *drivers of change* (leading, shaping) but also as *followers of change* (responding, coping, ameliorating societal ills and inequities). It is a complex and often contradictory relationship, where governments tend to facilitate initiatives rather than drive change. In many important ways governments and their policies or laws provide the background context in which *other* drivers take centre stage. Governments can provide some continuity and stability, offer certainties, guarantees, incentives, penalties, etc. that are important bedrocks to a modern functioning economy and society. They can mitigate sovereign risk by abiding by the rule of law, preserving institutional integrity, treating cases fairly and equally, providing assurances to stakeholders and the community over commitments or intentions, honouring ongoing agreements, purchases, investments, etc., There is a fundamental role for government in regulation especially in markets, 'thin' markets and in social areas (and in the future this may involve more inter-jurisdictional and hybrid/voluntary forms with government providing regulatory frameworks supplemented by self-regulation and conduct monitoring—health, professions, media, education, sport, advertising, consumer issues).

Yet we often over-estimate the capacity of governments to plan strategically and achieve the objectives they seek. As a 'statist' society, we in Australia generally prefer to consider governments as contributing to the 'solution' benignly and constructively—it is our domestic *weltanschauung*. Yet governments often disappoint perhaps because they cannot find or settle upon a given solution, or even sometimes win agreement about what the nature of the problem is. Governments have a great theoretical or normative potentiality for doing good and assisting good governance. Yet they often shirk their responsibilities to drive appropriate policy responses, offering second or third-best compromises with predictable flaws. There may be many reasons for this. They may not know what to do in a given circumstance, or find it hard to work out a solution in practice amid all the competing pressures, or maybe they can announce a solution but then find it impossible to agree a course of action and stick with it. They may be too timid or reticent, too swayed by expedient politics or too torn between competing alternatives. Sometimes governments may think they know what they want to change in policy terms but be unable to carry it off and impose or facilitate their solution. Or they may be blocked by other powerful socio-economic forces and prevented from acting. Peter Hall (1993) has some nice scenarios in relation to governments and the dimensions of policy change (first, second and third order changes going from routine adjustments to changes in policy instruments, to changing goals, each one attracting different magnitudes of political contestation).

In order to consider being a driver of change (and *wanting* to fulfil this role) we also need to consider the current state of government and its capacities. Clearly, a significant background contextual factor is the current and foreseeable fiscal difficulties which will affect our nation (federal and state) for perhaps the next decade (and longer in many other OECD nations). Public debt is now over $300 billion (gross debt of 20 per cent of GDP which is projected to rise to $450 billion by 2017 or 25 per cent of GDP). Annual deficits for the federal government have averaged around $40–50 billion since 2008, and the deficit currently still hovers around $47 billion for 2013–14. Governments of any persuasion are likely to want to re-balance these budgets in the immediate period and pay down debt significantly over the next decade. This both limits what governments can prospectively commit to (e.g. over the provision for disability care and wellbeing), and forces them to re-evaluate what their current priorities really are (interrogating existing legacies, adapting, replacing). The upside of fiscal strictures is that resource constraints can also propel governments to innovate and make different/difficult choices when otherwise they would not.

Governments internally have changed from being traditional command hierarchies with limited responsibilities to broader institutional actors with networks, complex relations, inter-dependencies etc., but they still often seek to operate in traditional command ways (or do so by default). It is a modern conundrum sometimes difficult to fathom. In many social and economic sectors, governments now feel they have to collaborate to provide services (co-produce, co-design, co-deliver, etc.) but have not acquired the necessary skills and capabilities to be able to do so successfully and effectively, and their bureaucratic and traditional accountabilities may act as a gravitational pull against such endeavours.

The Public Sector Research Centre (2013) has suggested a different set of future norms for government and our patterns of governance. It sees a broad set of transformations with the old statist/public administrative modes of government giving way and being superseded by new norms, relations, organisational characteristics, ways of organising and reviewing services. While improving policy and implementation effectiveness, some of these transformations may be more costly (fiscal pressures) although benefits may eventually flow in the longer-term. Its projections are as follows:

Moving from …	To…..	Explanatory comment
Citizen under control	Citizen in control	De-centred, empowering citizens and community with meaningful control
Governing for citizens	Governing with citizens	Two-way interdependency and multiple initiations of policy and delivery systems
Organisational silos	Organisation networks	Porous agencies, working through/with others, shared responsibilities
Public sector organisations as big, all-in-one giants	Public sector organisations as small, flexible purpose-driven entities	Breakdown of autarky and monopoly, and replacement by customised and differently constituted agents
Government as service provider	Governments as service facilitator/broker/commissioning agent	Different role for govts and more subtle points of facilitation/intervention
Government owning inputs and processes	Governments and citizens owning outcomes	Greater community discretion and outcome-setting replacing govts calling all the shots
Measuring outputs	Measuring outcomes	Substantive quantitative and qualitative evaluations by and for the community
Forced cooperation based on enforcement	Mutual collaboration based on trust	Self-organising relationships for mutual benefit
Trust in 'strong leader'	Trust in each other, the 'servant leader'	Govts performing coordinating role rather than directing role

Source: The Public Sector Research Centre (2013).

This chart can be interpreted as suggesting that a single set of old-style management will be replaced by newer styles and cultures; or it can be interpreted as anticipating that newer styles of management will co-exist and be additional to older styles in government. Yet despite such predictions of major transformational change (the 'nirvana'), in reality governments are often a long way off such root-and-branch recalibrations, and there is evidence that there has been some clawing back of newer managing styles to restore traditional accountabilities. Many traditional public administrators (and ministers) would still consider these transformational imperatives (and opportunities) as subversive cultures threatening old-style administration.

Limitations to government and good governance—critiques

So to consider governance and public policy as drivers of change we should review the immediate limitations on governments and their abilities to drive and make these changes. We

are familiar with the critiques of government and state failure. In relation to our topic the following critiques or limitations might apply.

Governments are ruled by the political cycle: they are dominated by short-term calculations, are reactive/responsive to immediate electoral expectations and pressures; they tend to regard citizens as 'immediate rationalists' interested in instant gratification rather than long-term planning and preparation for future expectancies. Even some supposedly long-term issues (such as environmental protection, the preservation of native forests or even disability care) can in fact be reduced to short-term fads or obsessions which disappear from the attention span relatively quickly.

Governments are motivated by popularity in ways that erode resilience and sustainability; they rarely act in ways that cut across populism or are deeply unpopular; this then places a straitjacket on the kinds of issues governments will be willing to address, and the solutions to such problems. For instance, increasing the aged pension from consolidated revenue is popular among this constituency but does not particularly help provide for sustainable incomes for older Australians. Concern with popularity also limits the attention span of governments and plays to the 24/7 media cycle.

Majoritarian political systems are adversarial in political and policy terms and subsequent governments can unpick the reforms of their predecessors; the 'winner take all' philosophy is problematical for good policy development. There are many areas of wasted policy legacies—policies discontinued, dismantled, aborted, undermined, or entirely re-configured. Adversarial systems tend to build distrust and scepticism of government and temporary policy solutions. In relation to workforce planning, adversarialism militates against long-term planning and workforce strategising.

In considering policy options, governments generally are overly cautious, risk-averse, expedient and prone to back-sliding especially if they meet resistance and the going gets tough (the mining super profits tax or the issue of substantial tax reform might be good examples of this phenomenon).

Many parts of the public service are not 'transformation ready' in the terms of the above table; in my view they are still too insular, hide-bound, perfunctory, complacent, risk-averse and unwilling to embrace transformational change; enduring bureaucratic norms and hierarchic authorities prevail, working to narrow ministerial agendas, fearful of offending the political echelon, and staffed by time-servers not by entrepreneurial doers. Recruitment patterns have made public services more diverse and representative of the community but while still operating on conventions of a career service have arguably reduced flexibility and responsiveness in some sectors.

Governments have denuded most of their internal organic research capacities and much of their policy capacities. They are left to trawl the external sources of research (universities, think tanks, consultants, consulting Google, etc.), but may not have the analytical capacities to make the best choices when confronted with raw data, pre-digested options or a range of alternatives.

There are mounting arguments worldwide that many advanced democracies suffer severe 'democratic deficits'—which can include disaffection, alienation, social exclusion, de-legitimacy, protest and unrest; and that the political system increasingly represents and serves a smaller and smaller set of interests. If this leads to people disengaging from society/public life then governments face greater problems trying to re-engage with these disaffected cohorts (race, ethnicity, regionalism and welfarism may exacerbate these issues).

So, what can governments realistically do?

Governments are resourceful actors with a plethora of potentially powerful policy instruments at their disposal (expenditures and program funding, taxation and fines, tax expenditures or concessions, legislation and regulations, direct provision and ownership, indirect provision and contractual engagement, educational, promotional and marketing campaigns). These instruments are mostly used in immediate policy delivery rather than future planning (although there are successful examples of using instruments to prepare for long-term needs—such as superannuation, and educational completion targets to year 12 and tertiary levels). In federations it is important for the respective jurisdictions to consider which instruments they have at their disposal and where they can make the most impact. For instance, in labour-force planning the Commonwealth does not enjoy sole responsibility or have carriage of the planning issues; it has effective operation of the migration program (supplementing skills shortages, issuing 457 visas, encouraging business migration), and has some but not universal influence over the dimensions and directions of the higher education systems, including provision of partial funding and the administration of overseas student visa programs). States by contrast, with their experience and connections, are often best suited for place-based planning and local labour market interventions.

Governments can create the conditions through which we can plan and anticipate future needs/constraints. They are not necessarily good at this and many of their formal attempts become politicised, ineffective or soon overtaken by events (e.g. the Commission for the Future in 1980s, EPAC in the 1980s, the 2020 Summit of 2008, many state government future planning scenarios, the 'Big Australia' debates, and future workforce projection exercises variously produced by Commonwealth agencies). The federal government once had a specialised Bureau of Labour Market Research and a broader Bureau of Industry Economics (which folded into the Industry Commission/Productivity Commission)—these specialist research agencies performed long-term labour market research—which the Productivity Commission partially does as part of its reference investigations.

Governments have a responsibility in agenda-setting (and 'mind-setting'), defining the issues we ought to be talking about and wrestling with solutions and options. Traditional institutions that *could* play this role are often disappointing or episodic in their attention (e.g., the various parliaments and parliamentary committees, government departments, university research centres) so we tend to rely on specialised bodies with defined mandates (e.g., Productivity Commission, Climate Commission/Council, the Inter-Generational Report exercise, the former Indicative Council, AIHW), but most of these relate solely to economics/fiscal or population issues. There is scope to broaden these commission-type bodies to provide greater strategic direction (including labour market planning) but the problem will always be: what is their substantive connection to the existing policy-making processes and the priorities of the government of the day? On future agendas, governments need to relax their 'control' urges and allow different players to make different cases—encouraging radically different scenarios to be thought through and evaluated (through peer review processes directed at learning, not necessarily formal performance reporting). We might like to encourage states/regions to go in different directions and adopt different scenarios to evaluate their respective effectiveness in anticipating future needs.

Governments are becoming far more sophisticated in ICT/technology and in monitoring activities through software, pattern recognition etc. The 'technology can transform government' movement is very strong in the US, Canada, Europe, Singapore, etc—over e-health, educational access and on-line delivery, one-entry portals, social media, 'open government'—where the bounds of public authority are porous and deliberations take place through joint collaborations.

Having said that, while the promise of tech-enabled governance is conceivable, the actual achievements to date have been generally disappointing.

The challenges for governments if they want to become more systematic and strategic drivers of change—in relation to workforce planning

There are three potential roles governments (plural) could adopt in relation to anticipating and guiding the future skills mix for a productive labour market. These three roles are indicated as follows.

The first concerns governments acting as employers, recruiters and trainers in their own right as a sizeable proportion of the workforce. The effects of the governments' *own supply and demand* for labour and skills on the broader workforce are considerable. Together Australian governments recruit graduates and specialist professionals, engage in extensive training and executive development programs for staff, and sustain many educational and training providers with their demands. Collectively this public sector related workforce constitutes more than 16 per cent[1] of the labour force. Trends within training and skills development in the public sector can also have wider consequences for the economy—for instance, the encouragement of lateral recruitment and opening up jobs/careers to people with private sector and NGO backgrounds; and the recruitment and training of generalists versus key professions and technical skills inside government.

The second potential role governments might perform is to act as *facilitators in identifying future demand and supply factors* and trends. Here the role of governments may include preparing research and analysis of projected needs, arranging discussions with stakeholders and providers, beginning a conversation with the community, identifying key drivers of change/risks and working with potential providers to improve supply/quality.

The third role governments might invest in is in taking a more *directive role as key policy-maker driving demand and supply* for skills in the labour market (national or state). This is a more orchestrated role involving strategic choices, direct investments, articulations between providers and sectors, setting supply targets and monitoring demand.

These three roles are not necessarily mutually exclusive and may be brought together in some complementary way as part of an integrated or multi-faceted national workforce development strategy.

Besides the issue of what roles governments want to perform, there are other ongoing challenges governments need to address to assist long-term labour market planning.

Governments need to invest in consensual approaches where decisions are both enriched and stand the test of time; they need to promote community-wide dialogues over problems/issues and directions, bringing the various political parties to the table—moving towards shared objectives and outcomes. We need to develop notions of shared ownership of problems and their proposed solutions (while allowing scope for some diversity of options). Workplace planning and skills development is not a 'high political' issue so some progress in this direction is possible.

[1] Source: ABS, Employment and Earnings, Public Sector, Australia, 2012-13, Cat. no. 6248.0.55.002.

Governments, stakeholders and communities need to address problems of social marginalisation and exclusion; Indigenous employment and skills is a major blight on our system and as the Prime Minister said recently a huge social cost and loss to GDP.

Governments need to facilitate change by welcoming greater experimental governance (see Charles Sabel's works on this e.g., Sabel, 2010, also Albury, 2011); learning by doing; greater autonomy for frontline deliverers/providers/teachers/trainers—in many policy areas: social disadvantage, schooling, technical education, higher education, Centrelink and job-readiness. Experiments with behavioural economics as is occurring in NSW at present over job-readiness and employability are worth monitoring and developing where effective. Experimentation and innovation are likely to require a greater role for trained professionals with relevant technical and specialist skills (in delivering services in areas of health, education, social policy and welfare).

As the initiators of major strategic planning exercises, governments need to build in more adaptability and agility to future policy stances; there are good techniques for environmental scanning and scenario building/projection testing. Governments should produce projections and intended plans (budgets, employment estimates and housing forecasts, etc.) as a *range* of most likely forecasts (based on variable assumptions and calculations) not as artificially definitive numbers producing linear trends; at present many of these documents are produced to make governments look good, not to be realistic assessments of projected circumstances.

In operational terms, governments will face many workforce challenges in their own sphere of employment and engagement of myriad human resources (including contractual provision, greater reliance on part-time and casual workers, and volunteers); they will need to be 'faster' in responding to changing needs and developments, meaning they will require flatter organisational structures, more streamlined capacities, more agile abilities, to be more tech-enabled. There is much scope for closer engagement with the community and non-government actors through co-design procedures, co-delivery, co-production and the techniques of behavioural economics, if only governments were prepared to accept that they will inevitably have to share the risk/rewards and open up policy processes to a wider range of input.

In conclusion, governments can do many things well and achieve intended outcomes, but also do great damage and harm through neglect, making unwise decisions, or getting it wrong. They are less sensitive to the perverse consequences of their actions/inactions and rarely anticipate the unintended consequences of their policy frameworks or adjustments. In such circumstances governments should be more prepared to experiment and explore alternative options in policy planning (e.g., through random trials, customised experimentation, alternative scenarios), realising that they are unlikely ever to know all the answers into the future but still have some real capacities and technical abilities to assist our social and economic development through better analysis and coordination.

John Wanna

Australian National University.

References and further reading

Albury, D 2011,'Creating the Conditions for Radical Public Service Innovation', *Australian Journal of Public Administration*, Vol 70(3), September: 227–35.

Hall, P 1993,'Policy Paradigms, Social Learning and the State: the case of economic policy-making in Britain', *Comparative Politics*, Vol 25: 275–96.

Hollander, R and H Patapan, 2007, 'Pragmatic Federalism: Australian Federalism from Hawke to Howard', *Australian Journal of Public Administration*, Vol 66(3), September: 280–97.

Public Sector Research Centre 2013, *The Future of Government*, PWC, Sydney, June (PDF).

Sabel, C 2010, *Experimentalist Governance in the European Union*, (with J Zeitlin), Oxford University Press, Oxford.

Chapter 7

Technology and Work

Michelle Nic Raghnaill and Robert C Williamson

Work is central to human existence. It provides for the necessities of life as well as defining what people do and are. Technology and work have been tied together since antiquity, and the dreaming of new technologies that can perform functions that previously were the province of people is at least as old as Hephaestus's 20 golden tripods that could, according to Homer 'run by themselves to a meeting of the gods and amaze the company by running home again' (*Iliad*, xviii, 368*ff.*) Nowadays concerns centre on the factors affecting the adoption of new technologies in the workplace, the degree to which future technologies (in the workplace) can be predicted, and what the future effects of new technologies (especially those centred around information and communication technology) will be. In this paper we will consider the following questions:

1. What are the motivations for technology adoption in the workforce? And how do perceptions of technology affect the motivation to adopt it?
2. How well can one predict future technology, and technology adoption, and how might this impact on our ability to predict workforce impact?
3. How has changing technology impacted the workforce in the past? And what might we generalise from this regarding what might occur in the future, in particular what will be the workforce impact of 'intelligent' information and communications technology?

What are the motivations for technology adoption in the workforce?

There is no single reason for new technology adoption in the workplace as industry, employee and regulator motivations are varied and conflicting. In order to understand the effect new technologies might have on the workplace, it is helpful to distinguish several different motivations for adopting new technology (Table 1).

Table 1: Technology adoption motivation in the workplace

Workplace stakeholder	Motivation to adopt new technology
Industry	Profit (long or short term); perception (influencing consumers about the 'modernity' of their company); responding to pressures from consumers (e.g., web access); bandwagon/fashion effects; OH&S regulation
Employee/union	Decreased work time; safer more amenable work process; convenience
Government / regulator	Respond to public concerns raised; pre-empt problems; recovering or reducing public costs (e.g. pollution)

Source: Authors' work.

Industries are directly answerable to a number of different stakeholders with different priorities. The main drivers to adopt technological innovation include improving profit margins, whether in the form of decreasing capital or labour costs or increasing productivity.

Understanding the behavioural changes that significantly affect technology adoption by the workforce is challenging because of the range of factors involved. The adoption of new technology by the workforce is

heavily dependent on the perceived effect of the technology on the workers' position. Should a new technology be perceived as a workplace threat it is unlikely to be adopted (Abukhzam and Lee, 2010; Riedel, 2014).[1]

Another factor that influences technology adoption in the workplace is regulation. Industrial activity without regulation can lead to adverse results for society because of industrial impacts that do not show up on a business' profit and loss ledger (harmful materials, pollution, etc.). Thus regulation can be seen as a driver of innovation in the workplace because business needs smarter ways to comply with regulation by working with the system or getting around it. Regulation is also a driver of technological innovation particularly when technologies affect occupational health and safety issues. By contrast, regulation can also inhibit technological innovation and increase the cost of a workforce/business; new technologies may seem daunting to a business if they come with new regulatory requirements.

The perception of problems associated with new technologies is also a factor. There is a well-documented asymmetry between risks people are willing to bear (typically those they are familiar with) versus those they are not (P Slovic et al, 1982; Paul Slovic, 1987). Contrast the general acceptance of an average of 1.24 million deaths per year in traffic accidents (World Health Organization, 2014), with the much more widespread worry about nuclear power generation which is responsible for 1000–10000 times fewer deaths per year even taking the most pessimistic analysis of accidents to date (Wang 2011) (Wikipedia 2014b).

Examples of industry uptake of innovative technology

Our first example illustrates a general point that we have seen as important in our larger study on *Technology for Australia's future:* almost all categorisations of technology have fuzzy boundaries. For example, looking back several decades, one would hardly have classified advanced lasers, hyperspectral imaging, sensor networks, atomic clocks, and satellite based positions systems as 'agricultural technologies', but these are now widely used in what has come to be known as 'precision agriculture' (Wikipedia, 2014c).

The agricultural sector has integrated technological innovations such as laser technology and GPS into agricultural machinery to improve profit margins. These innovations increase the efficiency of the machinery and the use of materials as well as decreasing the need for highly skilled labour. Combine harvesters are now equipped with GPS tracking systems to efficiently work the land with minimal human labour. In addition, boom sprays can now detect weeds automatically using infra-red technology without the need for human labour. The technology locates weeds amongst crops and can specifically target unwanted plant species with pesticide (Alberta Farm Machinery Research Centre).

Emerging technologies such as autonomous vehicles have the capacity to transform business sectors and substantially change the nature of work, but their potential impact is very hard to judge prospectively. For example, an innovative use of autonomous airborne drone technology is to deliver packages within cities. If one reads articles on the web about this, one would be forgiven for believing it is about to happen (Bender, 2013). However, the reality is rather different as the company itself says 'This won't happen next week—there's a lot of technical and regulatory stuff to do to make sure it's safe and reliable enough to fly around busy cities—but it will happen!' (Flirtey). Even if the company's optimism is justified and this does in fact come to pass, it is impossible to predict whether it will account for 0.1 per cent of packages

1 An example of workplace adoption driven primarily by employees is the current phenomenon known as BYOD, 'bring your own device' (Wikipedia, 2014a) which is a shorthand for the increasingly common occurrence of workers wishing to use their own smartphones to access corporate IT systems, in contrast to the workplace providing a special device solely under corporate control. The phenomenon illustrates the gradual spread of technologies through all sectors. As unit prices drop, and the perception of ownership as something essential increases, in Western countries one can see BYOD occurring in school education: in the US in 2013, some 89 per cent of high school students had access to internet connected smartphones, and nearly two-thirds of students connected to the internet at home from such devices (Riedel, 2014).

delivered or 99.9 per cent. That will depend upon social acceptability and the market structure, which are nearly impossible to predict far in advance.

The impact of perceptions of technologies on technology adoption

There is a crucial difference between a technology, and a group's *perception* of the technology. A given technology might be empirically very safe compared to alternatives, but it can be perceived otherwise (recall the earlier comparison of motor cars and nuclear power). There are many examples in the literature of both how perceptions matter, and how perceptions were *manipulated*. Two classical examples of manipulation are i) the marketing done by General Electric regarding the electric refrigerator as being superior to the gas fridge because electricity is 'more modern' (Cowan, 1999) and ii) General Motors famous fabrication of the link in consumers' minds between automobile ownership and 'success' (Vintage Everyday, 2014). More recently, one can see the role of perceptions by considering the use of software in the office workplace that can monitor keyboard usage.[2] Even if an employer did this for reasons solely in the employee's interest (reduction of repetitive strain injury by enforcing breaks), the fact that it could, and sometimes is, used to ensure the opposite (no 'goofing off'), means the workers' perception of this technology is likely to be ambivalent at best. These examples show that even if a technology is technically feasible, solves a real problem, and the price is acceptable, without social acceptability it will not be widely adopted.

> *Technology Prediction* The world of A.D. 2014 will have few routine jobs that cannot be done better by some machine than by any human being. Mankind will therefore have become largely a race of machine tenders…
>
> Indeed, the most sombre speculation I can make about A.D. 2014 is that in a society of enforced leisure, the most glorious single word in the vocabulary will have become work! (Asimov, 1964)

In order to foresee the impact of new technologies on the workplace, one needs to be able to foresee new technologies and their impacts more generally. In this section we briefly summarise what is known about our ability to do this.

Is technology prediction possible?

The accurate anticipation of technological change can play an important role in strategic planning for a company or government. Technology prediction and forecasting are used to understand the potential rate and effects of technological change. Over the past 40 years, there have been many quantitative and qualitative techniques developed to predict future technology development: expert opinions, trend analysis, scenarios, horizon scanning, bibliometrics and modelling. Other types of prediction include emerging technology lists, science fiction and 'hypotheses of technological progress' such as Moore's law.

In a study looking at predictions made by Americans between 1890 and 1940, technology predictions were compared to the actual outcomes. The predictions were all of a form that they predicted a binary outcome (something would occur, or it would not). Overall, less than half the 1,550 predictions have been fulfilled or are in the process of fulfilment; one would have predicted as well by tossing a coin. The accuracy of predictions appears at best weakly related to general technical expertise, and unrelated to specific expertise. One expert (or non-expert) appears to be as good a predictor as another. For instance, the domestication of the computer was predicted as highly unlikely. The challenge is that predicting whether a given technology will be widely adopted implicitly relies upon predicting much of society and the economy as a whole and the relationship of the technology to contemporary and future technologies (Wise, 1976b).

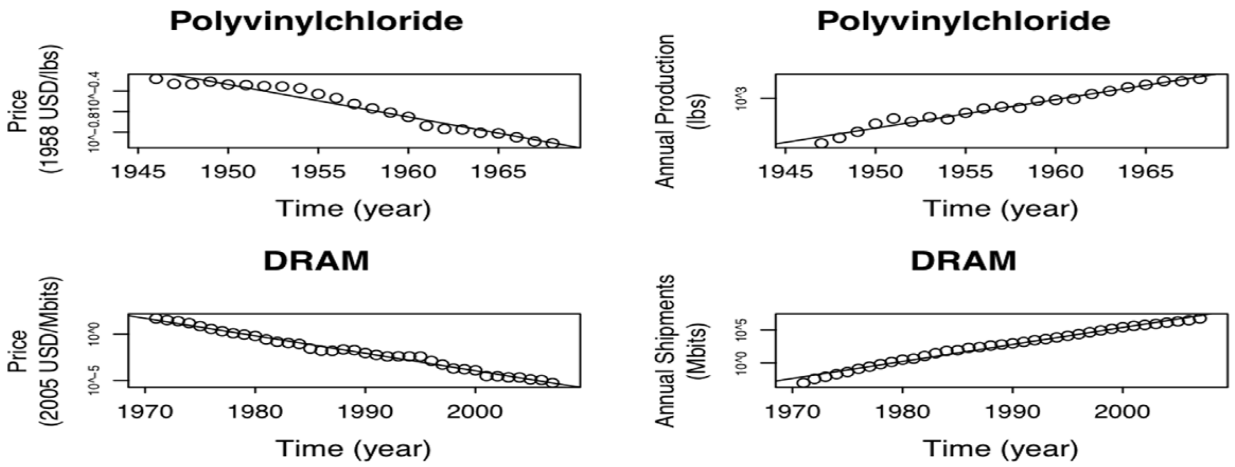
2 There is software such as http://www.publicspace.net/ergonomix/ which is clearly designed for the purpose of helping the worker. But of course exactly the same technology can be used to invade the worker's privacy, which is why it can be perceived negatively.

One way of dealing with the poor track-record of technology prediction is to focus on the s*ocietal problems to be solved*, rather than the *particular technology (technique)* that might be used. An example of this is the set of predictions made by the sociologist SC Gilfillan in the 1937 report to the US president (National Resources Committee (Subcommittee on Technology) 1937). Recognising that the prediction of *which* technology may solve a problem was impossible, he (correctly) predicted that technological means would be found to land aeroplanes in fog. He listed some 25 different technologies that might do the trick. *But he did not predict which one would be successful.* Another of his predictions is worth highlighting. He also predicted (in 1937) that television would be three-dimensional within 10–15 years (prototypes of this technology were in existence already in 1928). As it turns out it is only now that 3D TV is starting to become deployed, and it is likely to be some time yet before it is widely adopted, if ever (BBC, 2013b, 2013a).[3] The reasons for its slow take-up are not technical, nor are they market-related (one can buy well-functioning 3D TV receivers cheaply now). But rather it seems that not many people *want* 3D TV; it lacks social acceptability.

Predictions of technological improvement in the narrow sense are significantly more accurate than predictions of technology adoption (Wise, 1976a). Several models have been proposed to predict specific technological improvement e.g., Wright's Law, Moore's Law, Goddard's Law, etc. In testing the ability of six different postulated laws to predict future costs, Wright's law produced the best forecasts with Moore's law not far behind. Note: The graphs show the logarithm of price as a function of time in the left column and the logarithm of quantity of production as a function of time in the right column, based on industry-wide data.

Nagy and colleagues (2012) illustrate two representative examples for the production and cost of two specific technologies (polyvinylchloride and Dynamic Random Access Memory (DRAM) chips) plotted as a function of time. The results of this analysis show that specific technological progress can be accurately forecastable, with the square root of the logarithmic error growing linearly with the forecasting horizon at a typical rate of 2.5 per cent per year (Nagy et al, 2012).

Figure 1: Two examples of accurate long-term technological prediction.



Note: The graphs show the logarithm of price as a function of time in the left column and the logarithm of quantity of production as a function of time in the right column, based on industry-wide data.

3 The BBC is 'to suspend 3D programming for an indefinite period due to a "lack of public appetite" for the technology'. The Sports network ESPN also closed its 3D sports channel in 2013 because of lack of uptake.

It seems somehow contradictory that these technological parameters can be forecast so well, yet the forecasting of the adoption of new technologies is so difficult. Although hardly a rigorous proof, viewing this conundrum from the perspective of evolutionary theories of technological change offers a simple explanation (that leads to an obvious open question regarding its validity). Evolutionary models of technological change are almost as old as evolutionary models in biology (Nelson and Winter, 1982; Basalla, 1988; Arthur, 2007). They also offer a plausible explanation of 'disruptive' or 'radical' inventions.[4] There is no contradiction between gradual change in the performance characteristic of a technological component and rapid or even 'discontinuous' change in adoption of the technology. Adoption depends on the broader environment (Dosi, 1982; Anderson and Tushman, 1990). As a technology gradually evolves it can reach the point where it is suddenly economically viable and thus takes off (Mokyr, 1990b, 1991; Loch and Huberman, 1999). This phenomenon can be seen to be analogous to the appearance of 'punctuated equilibria' in the biological evolution record. The effect demonstrates the crucial point that it is the overall economic environment that is ultimately responsible for whether a particular technology will take-off and become widely adopted. One cannot predict a technology's impact without predicting the broader economic environment and market.

The economy is complex, by choosing a specific indicator such as cost it is possible to look at the potential effect of future technological innovation on the workforce. The Light Detection Ranging (LIDAR) based system that allows the Google car to create a 360-degree map of its surroundings using light waves currently costs $70,000. The rate of adoption will most likely increase once the technology is more affordable (Silberg et al, 2012). A dramatic decrease in the cost of this technology could have enormous ripple effects on the future workforce by decreasing the need for manned vehicles. However, the likelihood of a significant decrease in the production cost of LIDAR technology (such as the two orders of magnitude decrease predicted by the CEO of LIDAR manufacture company Velodyne) needs to be treated with some scepticism. Achieving a cost decrease of this magnitude would likely require radical design changes. It is much more likely, as was the case for the prediction of technology to aid in the landing of aeroplanes in fog, that different technologies will be developed or perfected to replace the LIDAR. One candidate is multiple camera computer vision, which can presently infer the 3D structure of an environment, but not well enough to replace LIDAR (Brynjolfsson and McAfee, 2014). In any case, one can be reasonably certain that until the cost comes down substantially, such autonomous vehicles will not become widespread.

Technological predictions are usually undertaken for a purpose: most predictions are not made dispassionately – there is often an underlying agenda (Dublin, 1989). For example, in the widely discussed paper forecasting a decline in US economic growth Gordon (2014, page 27) cites some predictions from (Watkins, 1900), and cannot resist the lure of what might be called the 'Nostradamus effect' – interpreting vaguely stated future predictions in a positive light, and carefully selecting which ones to look at to conclude that 'here were enough accurate predictions in this page-long three-column article to suggest that much of the future can be known'. Gordon makes this argument for a reason: he is trying to demonstrate that the rate of technological advance is slowing (as that supports the thesis he is trying to

4 Renowned economist Brian Arthur has written strongly in support of evolutionary models of technological change. Interestingly, and pertinently for the present purpose, while he acknowledges the explanatory power of evolutionary models in many instances, he claims that radical innovations (the ones that have the big and surprising effect) are very different, and not at all well explained by an evolutionary model (Arthur, 2007). Arthur claims that the evolutionary model 'does not hold up for what interests us here: radical invention by deliberate human design. Radar certainly did not emerge from the random variation of 1930s radio circuits'. The case is interesting because in fact radar *did* so emerge, as is well documented in histories of the technology (Swords, 2008). The development of the magnetron was crucial to the improvement of performance to a level where it could be widely used. But radar as a technology had a gradual evolution. And the magnetron itself can be seen as a step in the gradual evolution of vacuum tube devices (Boot and Randall, 1976). There are several general conclusions that can be drawn: inventions that look radical are often not because the earlier history is forgotten by many. A given technology can be substantially improved by developments with other technologies. Hence there is no simple way to draw a sharp boundary around a given technology.

defend).[5] Perhaps the only safe thing to conclude from this is when reading any technological predictions, to ask *why* the author wants to make them in the first place.

There are many reasons (some 100 are identified by Adamson (2010)!) why a new technology will not 'work' or be widely adopted. But in order to predict accurately, it suffices to get three things correct (Christopher Freeman et al, 1982):

1. correctly predict the technical advance (is it actually feasible?);
2. correctly predict the social impact (how the technology will be used?); and
3. correctly predict the future market (because if the price is not favourable, the technology will be replaced by something else).

Most long-term predictions of future technologies fail on at least one of these points.

Predicting the impact of future technologies on the future workforce

Standard supply/demand employment forecasts are a useful tool to understand possible baseline levels of future employment and they can aid in understanding incorrect estimations. These forecasts use existing data on many aspects of society to extrapolate estimates for the future workforce, including: demographic projections, labour force participation rates, future GDP, industry output and productivity trends by sector (to determine employment by industry). Generally, there is no formal feedback or adjustment mechanism to equilibrate the anticipated supplies and demands once a forecast is completed. Standard workforce projections do not incorporate changing behavioural patterns under changing market conditions which can have significant effects on forecasting (i.e., the projection of the number of women entering the workforce) (Richard B Freeman, 2002).

Almost all new technologies affect different groups of people differently. This makes it difficult to infer (for example) the general degree of technological advance from economic indicators. While it is now widely accepted that a large part of the economic growth seen in the last century or two is due to technological advance, when one looks in more fine grained detail, it is harder to see what might happen in future. It has been noted (Gordon, 2014) that in the last three decades 99 per cent of US households have experienced no increase in their real disposable incomes, whereas the incomes of the top one per cent of households have been increasing over those 30 years at an annual average rate of 2.25 per cent. Median household income showed no growth at all for the last 14 years. It can be conjectured that this top one per cent of households have mainly prospered by creating and seizing economic rents, and the overall story is of very poor productivity growth, which does raise the question of how rapid has technological progress been since the 1970s? This difficulty in analysis is generic – the time delay between when technological advances occur, and when the broader economic benefits are seen can be very long indeed; (see Freeman et al, 1982). This effect is particularly acute with general purpose technologies (such as ICT) that have a very diverse applicability (David and Wright, 1999; Lipsey et al, 2005; Bresnahan, 2010).

5 Consider his comments on the use of 'Big Data' (Gordon, 2014, page 33): 'What is lost by the enthusiasts for big data is that most of it is a zero-sum game. The vast majority of big data is being analyzed within large corporations for marketing purposes.' Even if that were true at present (very doubtful), it is almost certainly not going to remain true for the future – the real economic benefit of data analytics lies in the vast amount of data that is *not* marketing (such as bioinformatics, mineral exploration, health care records, etc.) which completely dwarfs the volume available for marketing. To be clear, Gordon may well be right about future economic growth of the US (for the other reasons he argues, especially the increasing income inequality), but his conclusions regarding technological innovation and its effects are quite suspect.

The effect of technology adoption on the workplace

We now consider the various effects that technological change has on the workplace and employment. Given the complexity of the evolution and adoption of technology, and separately the complexity of work in all its forms, it is not surprising that understanding the conjunction is difficult.

Technological change and technological unemployment

> *At least since the Industrial Revolution began in the 1700's, improvements in technology have changed the nature of work and destroyed some types of jobs in the process. In 1900, 41 percent of Americans worked in agriculture; by 2000, it was only 2 percent. Likewise, the proportion of Americans employed in manufacturing has dropped from 30 percent in the post–World War II years to around 10 percent today—partly because of increasing automation, especially during the 1980s. (Rotman, 2013).*

For centuries, technological change has been a pervasive part of society with significant effects on the nature and the number of jobs. There has been a dramatic adoption of new technology in the workplace and an increase in the number of people in paid employment (Volti, 2014, chapters 10–11). While new technologies create *jobs* (plural), there is a substantial concern by workers regarding their particular *job*. The disappearance of existing jobs due to their becoming redundant or unprofitable due to technological change is called 'technological unemployment'. Often seen as a temporary problem that has to be somehow fixed (US Congress Office of Technology Assessment, 1986), as argued long ago it will always be present:

> *The conclusion is inevitable: there is no mechanism within the framework of rational economic analysis that, in any situation, would secure the full absorption of displaced workers and render "permanent" technological unemployment in any sense impossible. How long the unemployment will last can be answered only by "economic biology", which, in an all-embracing economic-sociological approach, tries to evaluate the strength of all forces working in the society. (Neisser, 1942)*

Although technological change disrupted the careers of individuals and the health of particular firms, it also produced opportunities for the creation of new, unrelated jobs (Babbage, 2011). As technological improvements increase demand and lower prices of goods and services, there is increased capacity to stimulate growth in other sectors of the economy (Miller and Atkinson, 2013).

> *While such changes can be painful for workers whose skills no longer match the needs of employers, Lawrence Katz, a Harvard economist, says that no historical pattern shows these shifts leading to a net decrease in jobs over an extended period. Katz has done extensive research on how technological advances have affected jobs over the last few centuries—describing, for example, how highly skilled artisans in the mid-19th century were displaced by lower-skilled workers in factories. While it can take decades for workers to acquire the expertise needed for new types of employment, he says, 'we never have run out of jobs. There is no long-term trend of eliminating work for people. Over the long term, employment rates are fairly stable. People have always been able to create new jobs. People come up with new things to do' (Rotman, 2013).*

The effect of the adoption of technological innovations on the workforce

Over the last two centuries economic development was profoundly affected by major technological innovations including the steam engine (1820–1913), electricity-based technologies (1913–1950), new production organisations (1950–1973) and the IT revolution (1973–present). Each of these so-called general purpose technologies (GPTs) (Bresnahan, 2010) became pervasive in society and therefore had

significant effects on the workforce. Electrification and information and communication technologies are described as general purpose technologies. General purpose technologies are key functional components embodied in hardware that can be applied as elements or modular units of the engineering designs developed for a wide variety of specific operations or processes (i.e., steam engine, electricity, ICT) (David and Wright, 1999; Lipsey et al, 2005; Cantner and Vannucci, 2012, 2013). GPTs are technologies that can affect an entire economy, hallmarks of a GPT include pervasiveness, improvement and innovation promotion (Jovanovic and Rousseau, 2005). They often require remaking of infrastructure environments, business models and cultural norms (RA, 2012).

One does not have to ascribe any determinism to these waves of innovation (they are often referred to as Kondriatev Waves and broad general conclusions are drawn regarding their evolution) for them to be helpful to understand the questions we are considering. The key point for our purposes is that it is primarily the *general purpose nature* of certain technologies that gives rise to clusters of innovations and that explains the apparent waves (Ayres, 1990a, 1990b). This technological interdependence (Rosenberg, 1979) at once makes simplistic models of technological change useless, and explains why the effects of technological innovation can take a long time to be seen.

Historically, technological innovation during the industrial revolution in the form of the steam engine, and later refrigerated transport, drastically lowered the cost of bulk transport over long distances enabling global trade. The global economy was comparatively liberal during this period as global economies and financial systems were in their infancy.

> *The period 1820–1913 was one of very free international trade, with no quantitative restrictions and with mostly low or no tariffs on raw material and food imports, varying degrees of industrial protection, extremely free international movements of labor and capital, and a fixed nominal exchange rate under a gold-sterling-standard (Adelman, 1998).*

The industrial revolution led to unprecedented increases in labor productivity, and per capita income as well as a 30-fold increase in world export volume over almost 100 years (Adelman, 1998).

Table 1: Economic indicators of OECD countries during the Industrial Revolution 1820–1913 compared to 1700–1820

Industrial revolution 1820–1913—OECD countries	
Economic Indicators	Transformative impacts
7x ↑Labour productivity	Creation of global economy
6x ↑ Real per capita income GNP	Creation of financial systems
3x ↑ per capita income	Large intercontinental capital and population movements
66% ↓ Agricultural employment	Patterns of specialised production and trade emerged
30x ↑ World export volume	Creation of a middle class
	New forms of employment
	New forms of politics

Source: Adelman (1998).

There are many factors that lead to resistance towards the adoption of new technologies. A convenient and descriptive collective term coined by the economic historian Joel Mokyr is ‘technological inertia’ (Mokyr, 1990a, 1992, 1998a). A key contributor to technological inertia is resistance by those who believe their current power and status will be eroded. This behavior can sometimes be seen in employers, and sometimes in employees. ‘There is no general rule as to how technological change reallocates power’

(Mokyr, 1992). It is reasonable to expect these forces of technological inertia will continue to play their part in how technology changes the nature of work.

Current technological change in the workforce—information communication technologies

> *The current era is most analogous to the forty-year span of invention-clusters and slow growth preceding the Industrial Revolution. Like the steam-engine of the Industrial Revolution era, the current electronic Communication Revolution is in the process of altering all aspects of the national and global economy, society and polity (Adelman, 1998).*

Nowadays information and communication technology (ICT) has the capacity to alter the status quo just as technological change did during the industrial revolution. ICT has created new employment sectors, high worker mobility (Fallick et al, 2006; Tambe and Hitt, 2014) , new ways of doing business by promoting comparative advantage and driving innovation (Table 3). A report evaluating the impact of the internet on economic growth, jobs and prosperity states ICT creates high paying jobs, comprises a significant share of GDP and drives productivity and GDP growth (Table 2); (McKinsey Global Institute, 2011; Atkinson and Stewart, 2013). The technological interdependence issue raised earlier is illustrated by the fact that 75 per cent of internet impact arises from traditional industries.

Table 2: Economic impacts of ICT

Economic indicators
Two billion internet users worldwide
Internet accounts for 3.4% GDP growth in 13 countries studies and 21% GDP growth of mature countries (2006 – 2011)
2.6 jobs created for every one job lost
10% increase in productivity for small and medium businesses from internet usage
SMEs that heavily use web technologies grow and export 2x as much as others (vs. SMEs with minimal or no online activity)

Source: McKinsey Global Institute (2001).

Table 3: Transformative effects of ICT on industrial structure, industrial organisation and workplace within the OECD countries

Transformative impacts of ICT
Altering working-patterns, new level of decentralization of productive employment
Innovating the technology of long distance communication
Changing international patterns of division of labor
Far reaching changes in economic and social structure; and leading to the eventual transformation of the domestic and global economy, society and institutions
New kinds of transnational firms, engaging in global specialization
Financial and capital markets have become globalized, and respond instantly to changes in any part of the globe

Source: Adelman (1998).

Will robots steal our jobs?

One of the most hotly debated current topics regarding technology and work is that current technological progress, especially automation and artificial intelligence (AI), will lead to structural re-organisation and widespread unemployment. The negative perception or fear is not new, and it is helpful to distinguish two factors: i) technology just advances autonomously, beyond human control; and ii) automation and AI are intrinsically technologies that will benefit the few rather than the many. Regarding the first, which is like the magic brooms in Goethe's 1797 poem *Der Zauberlehrling* (The Sorcerer's Apprentice), this is not a new concern:

> *One symptom of a profound stress that affects modern thought is the prevalence of the idea of autonomous technology – the belief that somehow technology has gotten out of control and follows its own course, independent of human direction (Winner, 1978, page 13).*
>
> *Autonomous technology is ultimately nothing more or less than the question of human autonomy held up to a different light. And those who remain supremely confident about our prospects there have not been paying attention to what is happening everywhere about them (Winner, 1978, page 43).*

Other commentators (e.g., Kelly (2012)) are much more optimistic about the widespread benefits to be had from these modern technologies. The fearful view ignores the fact that the adoption of a new technology depends greatly on social factors, and societies do have a choice, and fatalistically presuming technology is autonomous is simply tantamount to giving up on that choice. Indeed, the different capacities for social change are a major factor in explaining the variability of speed of adoption of new technologies across different societies (C Freeman et al, 1982, pp. 71ff). It is furthermore intrinsically variable; there is no steady smooth rate of progress; see the various charts in C Freeman et al (1982).

In contrast to the evidence of the positive economic effects of ICT, public debate re-surfaces in an ongoing manner correlating technological change to increased unemployment. This is usually against a backdrop of overestimating the ability of computers to substitute for humans and assuming current trends will continue or accelerate (Miller and Atkinson, 2013).

> *Many economists, journalists, and policymakers now routinely claim that technology, instead of being a key driver of increased standards of living, is to blame for our economic doldrums. Throughout history as macroeconomic factors have led to recessions and periods of high unemployment, the same worries about technology and automation have resurfaced (Miller and Atkinson, 2013).*

The fear that 'robots will steal our jobs' may have multiple sources. It may be the perception of the severe conditions the general public endured during the industrial revolution due to the introduction of automated machinery into the workplace. Compared to the present day the industrial revolution was a time of free-market capitalism, there were almost no workforce regulations and very few citizen rights. Dramatic societal re-organisation occurred during the 19th century due to the integration of machinery into society. This led to improved workforce conditions through union development. Or there may be particular fears that robots are somehow not merely going to take our jobs, but may eventually take over the planet (human beings will become superfluous). Whatever the reason, there is much emotive debate about the degree to which robotics and artificial intelligence will turn out to be a good thing for 'the average worker'.

'Robots' can mean many things; for the purpose of this discussion we will consider 'robots' as either automated machinery for manufacturing purposes or artificial intelligence (machines with the capacity to solve difficult problems previously only done by people). Note that by this definition a modern photocopier is arguably a robot.

A recent book written by two MIT economists has amplified the debate that an increased level of automation will significantly decrease employment. They state that the pace of automation is increasing rapidly and it is pushing into white-collar areas of the workforce, jobs that were believed to be beyond the scope of computers (Brynjolfsson and McAfee, 2011).

The concern about robotics varies across countries, in the same way that the current deployment of robotics technology does. One figure states that Germany has twice the robot-worker density (number of robots per 10,000 workers) as the US (Markoff, 2013).

While automation may transform the workforce and eliminate certain jobs it also creates new kinds of jobs, McKinsey reports 2.6 jobs are created for every one lost (McKinsey Global Institute, 2011). In addition, technology-dependant jobs in the IT sector are generally better paid on average as they are highly skilled. In the US in 2011 IT employees earned an average salary of $78,584 which was 74 per cent more than the average US employee ($45,230) (Atkinson and Stewart, 2013).

Much of the more hysterical commentary (e.g., Drum (2013)) is based on an overestimation of what is actually possible with the technology. Some commentators largely take it for granted that 'strong AI' is just around the corner. There is very little evidence of this; it seems largely wishful thinking – most enthusiastic predictions of strong AI are timed to (just) fall within the predictor's lifetime, just in time for them to 'upload themselves' (Armstrong and Sotala, 2012). The very notion of a single form of general intelligence that can be replicated artificially is not acceptable to many technologists. The safest statement seems to be that general AI is 20–30 years away, *and always will be!* In any case, as we shall argue below, focusing on strong AI is a distraction from the more important issue of how to ensure that the benefits of such technological progress is shared more widely amongst the population rather than facilitating yet further concentrations of wealth in a small subset.

Predicting whether jobs will be lost to robots is no easier than the more general prediction of technology, which as we showed above is usually done very poorly. And the introduction of fancy data-analytic techniques does not help. A recent study (Frey and Osborne 2013) uses a Gaussian process classifier to predict how susceptible 702 jobs are to computerisation. This paper reduces all the factors and uncertainties relevant to technology adoption and the workforce into a single probability for a single occupation. Values for occupations that are susceptible to computerisation range from zero (not automatable) to one (fully automatable), the following are some examples; 0.95 nuclear power reactor operators; 0.95 animal breeders; 0.95 jewellers and precious stone and metal workers; 0.54 massage therapists; 0.57 cost estimators; 0.0035 occupational therapists and 0.0049 fabric and apparel patternmakers. The overall conclusion is that 47 per cent of jobs are at risk of computerisation. Were the numbers from this extraordinarily dubious study not widely quoted[6] in the press it would be easy to ignore.

Is it different this time?

Are there any historical forecasts of technological impact on the workforce that have proved accurate? If so what aspects lead to their accuracy?

Many commentators, while recognising that there has been technological unemployment before— and that nevertheless the net social welfare typically improves with advances in technology—believe that this time (robots and AI) is different.[7] It would be interesting to know (we currently do not) to what extent this is merely an artefact of the asymmetry of history and the future: we can understand all the things in the past, because they have happened, but we don't know (and more to the point) cannot really imagine the future. It *might* be that the pattern of technological unemployment will be much worse (it is after all

6 Do a Google search for '47% jobs automated' to see how widely such simplistic and unjustified numbers are believed.

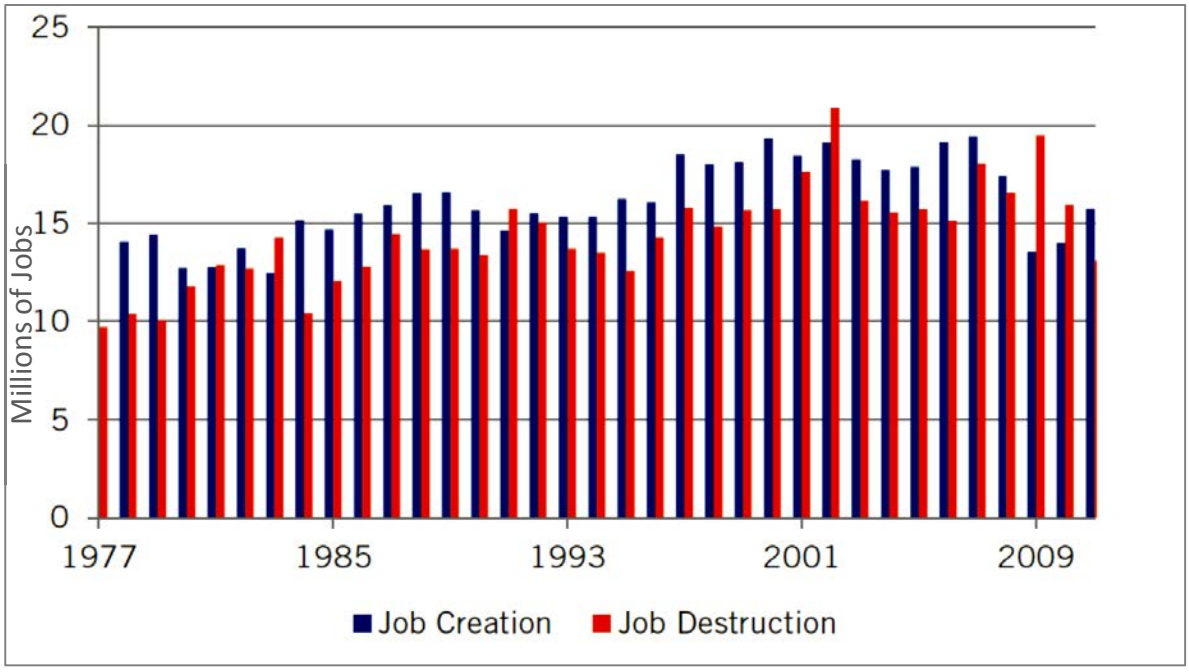
7 Another way of framing the question is whether it is revolution, rather than evolution (Kranzberg, 1985).

logically possible), and since we do not *know* we might pessimistically assume the worst (this seems to generate more compelling headlines). In fact a stronger argument is possible: as Mokyr notes (1998b, footnote 42), even after the fact it is nigh on impossible to say for certain that particular technologies induced substantial technological unemployment: 'None of the theoretical demonstrations that in certain unlikely configurations some (temporary) unemployment can be caused by the introduction of "machinery" is tantamount to a demonstration that such technological unemployment did in fact occur on a large scale.'

The common concern with new technologies is the destruction of jobs. Job destruction happens as a matter of course in the normal running of an economy. Miller and Atkinson show the year's job creation and destruction in the US. As Atkinson says:

> *It should be noted that, in aggregate terms, there is a substantial degree of labor market turnover every year. In other words, there are always lots of jobs destroyed by firms going out of business or downsizing, while new firms are being created and others are growing. The commonly cited statistic for the "number of new jobs created" is a net number; in reality, many more jobs than that were added, but others were also lost. For example, in 2011, 15.7 million jobs were created, but net job creation was only 2.6 million because 13.1 million jobs were destroyed. On average around 15 percent of jobs are newly created every year in developed countries (US department of labor (Bureau of Labor Statistics)). Thus, when we talk about technology destroying jobs, what we are really talking about is technology increasing the job destruction rate relative to the rate of job creation (Miller and Atkinson, 2013).*

Figure 3: US job creation and job destruction



Source: US department of labor (Bureau of Statistics), Miller and Atkinson (2013).

Technological progress and the economy

> *Technological innovation itself creates questions and problems that need to be fixed through further technological progress (Mokyr, 2013)*

A separate, but equally topical, concern is that current new technologies are not only progressing less rapidly but are also contributing less to economic growth.

Gordon (2014) and Vijg (2011) claim that economic growth and technological progress are slowing down and living standards are unlikely to rise much in future. Such conclusions rely on particular ways of quantifying the rate of technological progress for which there is hardly any consensus after half a century of study (Sanders, 1962; Archibugi and Planta, 1996; Issoufou, 2011; National Research Council, 2013). Given what is known regarding technology prediction in complex situations (no better than chance) what would be more useful is an understanding of how technological progress occurred in the past to help with understanding such progress in future. Mokyr suggests an alternative view where technological progress will continue and this will create new jobs that are likely as unimaginable as social media consultants were in 1914.

> *If technology replaces workers, what will the role of people become? From Kurt Vonnegut to Erik Brynjolfsson, dystopias about an idle and vapid humanity in a robotised economy have worried people. There will be disruption and pain, but the new technology will also create new demand for workers, to perform tasks that a new technology creates.*
>
> *In 1914 who could have imagined occupations such as video game programmer or identity-theft security guard? Physical therapists, social media consultants, and TV sports commentators are all occupations created by new technology.*
>
> *It seems plausible that the future, too, will create occupations we cannot imagine, let alone envisage. Furthermore, the task that 20th-century technology seems to have carried out the easiest is to create activities that fill the ever-growing leisure time that early retirement and shorter work-weeks have created. Technological creativity has responded to the growth of free time: a bewildering choice of programmes on TV, the rise of mass tourism, access at will to virtually every film made and opera written, and a vast pet industry are just some examples. The cockfights and eye-gouging contests with which working classes in the past entertained themselves have been replaced by a gigantic high-tech spectator-sports industrial complex, both local and global (Mokyr, 2013).*

Connecting reduced technological progress to decreased US economic growth is a debate lacking conclusive evidence. Gordon's rebuttal (Gordon, 2014) is a working paper which describes the main causes of US economic downturn as four headwinds (demographic shifts, educational attainment, inequality, long-term decrease in the ratio of debt to GDP) and faltering innovation. The topic of this paper has been much debated and gained significant public exposure. Gordon concedes to critics that his prediction of future declining innovation is not provable but points to accurate forecasters of the past who could reliably forecast the future of technological innovation, which our analysis has found to be 50 per cent accurate at best for complex situations (Gordon, 2014). But Gordon also states

> *In this sequel, there is no need to forecast that innovation in the future will "falter," because the slowdown in the rate of productivity growth over the past 120 years already occurred more than four decades ago. This sequel paper explains why the pace of innovation declined after 1972.*

There is a perception, but a lack of evidence, directly linking productivity growth and technological innovation. Literature describes a 'productivity paradox', the apparent contradiction between the remarkable advances in computer power and the relatively slow growth of productivity at the level of the whole economy from 1970–1990 (Brynjolfsson, 1993). Solow is quoted as having said 'You can see

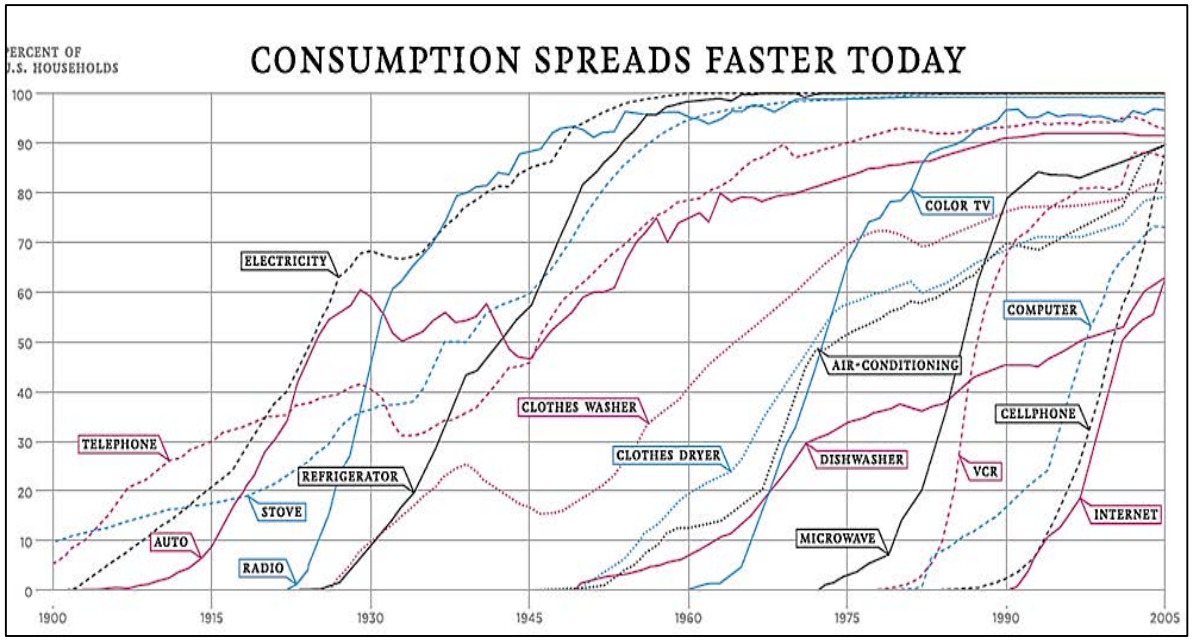
the computer age everywhere but in the productivity statistics' with regard to this topic (Solow, 1987). However the pessimistic view regarding the positive economic impact of new technologies (such as ICT) is soundly refuted when one looks at firm level data (Brynjolfsson, 1993; Brynjolfsson and Hitt, 1998, 2003; Hempell, 2006; Acemoglu et al, 2007; Acemoglu et al, 2014). This illustrates a more general point: one cannot properly understand the impacts of technology if one works at too broad a level; the effects are complex, and vary enormously. One needs instead to work in the 'middle range' (Merton, 1949).

There is a historical precedence for an economic slowdown in a time of pervasive technology adoption. Just over a century ago there was a pronounced slowdown in industrial and aggregate productivity growth between 1890–1913 in Britain and the US during the 'Electrical Age', a time when electrical technology adoption by specific sectors of the workforce was substantial (David, 1990). A comparison between the actual ubiquity of computers in offices by 1990 and the number of dynamos in industry by 1913 could explain these observations: by the early 1920s only slightly more than half of mechanical drive capacity had been electrified (David, 1990).

Electricity vs ICT—workforce lessons from mass adoption of general purpose technologies

Taking a historical view on the workforce effects of a pervasively adopted technology can give insights into the possible effects of current pervasive technology on the workforce. General purpose technologies appear to be adopted slowly. Figure 4 reports 70 per cent of US households had electrical connections over 30 years after its initial availability (by 1929) and 60 per cent of US households adopted the internet in 15 years (Felton 2008). Like all measurements this graph is influenced by the characterisation of its values, such as the initial date of technology availability. The internet is a prime example of a technology with various initial dates of availability. In addition, it is noted that the ICT GPTs are powered by electricity for the most part. Nonetheless pervasive adoption of both electrification and ICT has occurred with significant effects on the workforce.

Figure 4: Percentage of US households adopting various technologies, or technological artefacts

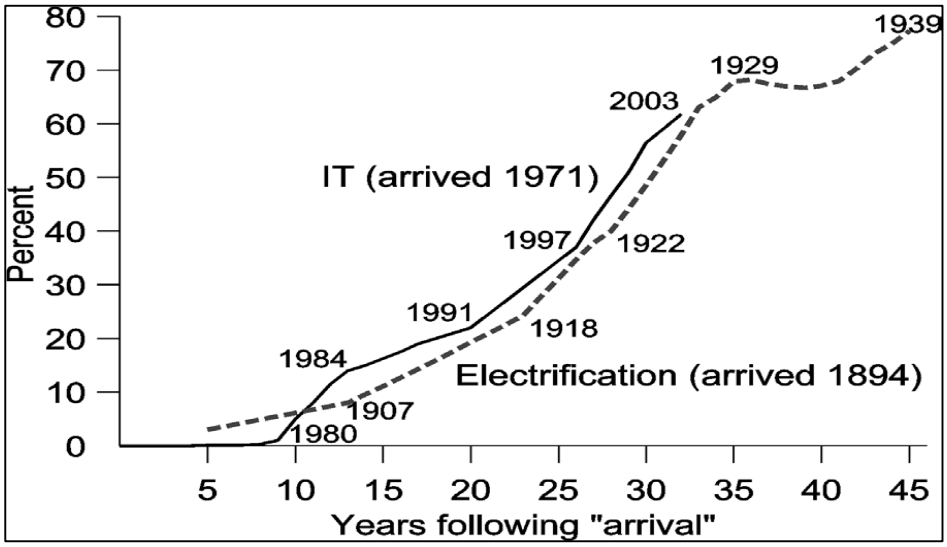


Note: The degree of generality of the various technologies listed varies—comparing dishwasher or cellphone adoption with that of electricity is perhaps a little odd. Furthermore the figures are for *household adoption*, not workplace adoption. The heading (from the original source) is hardly well justified in the data.

Source: Felton (2008).

By comparison, US household electrification and the personal computer (which can be defined as general purpose technology) show similar rates of adoption. Measuring electrification in terms of households obtaining an electric service (from 1894) and the availability of the first PC (1971) shows households adopted electricity approximately as rapidly as they adopted the PC (Figure 5) (Jovanovic and Rousseau 2005). When one looks in a more fine-grained fashion, one sees the variability alluded to earlier (Figure 6).

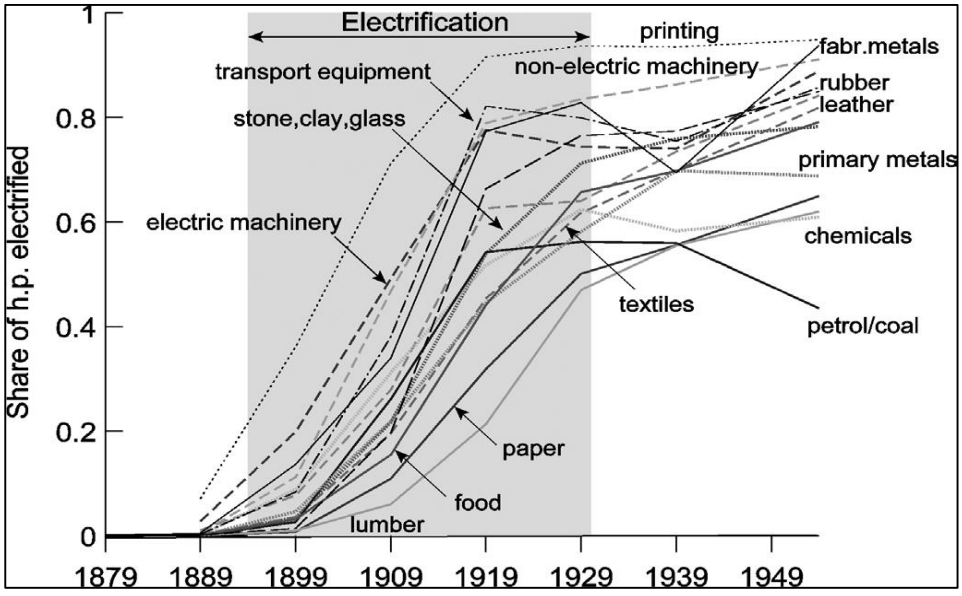
Figure 5: Percentage of households with electric service and PCs during the two GPT eras



Source: Jovanovic and Rousseau (2005).

Figure 6: Rate of adoption of electricity across different sectors

The rate of adoption varies across different industry sectors.



Source: Jovanovic and Rousseau (2005).

Adaption, large employee turnover and survival were hallmarks of the American workforce at the turn of the 20th century. Labour was restive at this time, but only partly due to the pervasiveness of new technologies such as electricity. Most American industries (meat-packing plants, textile mills, machine

works and automobile factories) had a labour turnover of 100 per cent in the first decades of the 20th century, a time of mass adoption of electricity by industry (Rodgers, 1978; Nye, 1992). For example, merely 10 per cent of manufacturing horsepower was derived from electricity in 1905 but by 1925 this electric power in this area jumped to 70 per cent (Goldin and Katz, 1996).

> *The US Department of Labor Statistics found in 1913–1914 that 'normal' labor turnover was 115% a year. It is thus inaccurate to picture a stable workforce labouring together with traditional methods suddenly confronted with new technologies.*

The widespread introduction of electricity brought opportunities and barriers to the workforce just as ICT does now. Electricity allowed American industry managers to maximise economies of scale by constructing large, continuous pace manufacturing plants. The move from mechanical to electrified plants created a safer, quieter, cleaner and brighter workplace overall. By contrast, on an individual employee level new risks included electric shock or electrocution, generally for the young or newly employed. Attitudes to electrification technology at the time were negative as textile workers felt they were expected to complete ever-increasing amounts of work and had nightmares about keeping up (Hall et al, 1986, pp. 270–271). Compare this to the 24/7 perception of ICT in relation to work.

Electrification led to new management practices as university-trained engineers became responsible for managing work process in factories which led to the re-design of production and promoting long-term reliable labour as investment in new electrical machinery made high labour turnover unprofitable; compare this to the rise of code writers now and their effect on business models (Nye, 1992).

Changes in work practices

There are many ways to break down the completion of a piece of work. American Telephone and Telegraph had a strong anti-union policy. The linemen (cable splicers and trouble-shooters) they needed were highly unionised by the early 20th century (due to many factors, WW1 was one of them) and therefore became employed as sub-contractors by American Telephone and Telegraph in order for work to be completed with minimal confrontation between workers and management. Piecework saw a revival in the 1920s in America as almost half the labour force worked on a piecework basis, payment per piece produced as opposed to a daily wage. A main advantage to management was the employee incentive to produce more in a given amount of time. ICT has enabled a current revival in sub-contracting work but is not the sole causative factor (Nye, 1992). Incentives for a revival in sub-contracting work due to ICT include working from any location and ease in locating sub-contractors globally to perform parts of the workload.

Interaction between general economic effects and employment

The general economic effects (concerns such as Solow's paradox) and the worry about technological unemployment, are intimately related – as shown in chapter 7 of Antonelli (1999) there is a strong relationship between high R&D expenditures and low unemployment. High R&D leads to higher rates of innovation, which increases employment opportunities.

We draw some tentative conclusions:

- Technology and work are inextricably linked.
- New technologies affect workers differently.
- Prediction of adoption depends on getting technology, sociology and market right.
- The evolutionary perspective of technological change is helpful for understanding how gradual changes in technology can lead to rapid shifts in adoption, and hence why it is so hard to accurately predict the future adoption of new technologies.
- ICT seems different, but much of that difference can be explained by it being a general purpose technology – one that can be used in every industry sector, albeit adopted at different rates.
- The evidence is still far from clear regarding productivity and employment effects of ICT and other recent technologies.
- Work is important for people's identity as well as earning a living. Thus there will always be resistance to taking away people's identity.
- High R&D leads to higher rates of innovation, which increases employment opportunities.
- There are many stakeholders, not just management, who affect the adoption of new technologies in the workplace.
- Modern information and communication technologies are argued by many to be fundamentally different to earlier technologies in terms of the effect they will have on work. However the evidence is ambiguous at best.

New technologies can be adopted and adapted by society in many ways. What seems to matter more is the degree to which the benefits are shared or hoarded by the few (Acemoglu and Robinson, 2012). There is *always* choice in the development and adoption of new technologies. Feenberg (1999, p, 131) goes so far as to say 'technology should be considered as a new kind of legislation, not so very different from other public decisions'. Acemoglu has argued that recent (the last several decades) technological change has been 'skill-biased' (differentially benefitting those with greater skills) and this partially explains the widening wage spread that has been observed in many countries (Acemoglu, 2000). He argues (p. 9)

> *we are most likely not in the midst of a 'technological revolution'; what has changed is not necessarily the overall rate of progress, but the types of technologies that are being developed.*

He concludes, as do we, by observing that 'how technical change and institutional change interact are important areas for future research'. His subsequent and recent book *Why Nations Fail* (Acemoglu and Robinson, 2012) suggests a broader conclusion: insofar as new technologies continue to be the 'lever of riches', as Joel Mokyr (1990a) has felicitously put it, the crucial choice is to what extent are the economic benefits shared by the many or hoarded by the few; the latter seems a much more substantial concern than technological advance per se.

The very technologies about which there is most concern (information and communication technologies) also hold the most promise of enhancing democratic free speech (de Sola Pool, 1983); the personal computer revolution, arising from the Homebrew computer club (Slattery, 2007) illustrates the extent to which humanistic and egalitarian concerns can be powerful influences in the development of technologies (Illich, 1973).

All this reinforces one of Melvin Kranzberg's 'laws' of technology and history:

> *Although technology might be a prime element in many public issues, nontechnical factors take precedence in technology-policy decisions (Kranzberg, 1986).*
>
> *Thus the most important issue regarding technology and work is well summarised in The Economist:*
>
> *[T]he benefits of technological progress are unevenly distributed, especially in the early stages of each new wave, and it is up to governments to spread them. In the 19th century it took the threat of revolution to bring about progressive reforms. Today's governments would do well to start making changes needed before their people get angry (The Economist, Editorial, 18 January 2014).*

Michelle Nic Raghnaill

Australian Academy of Science and NICTA, Australia's Information Communications Technology (ICT) Research Centre of Excellence

Robert C Williamson

Australian National University and NICTA.

References

Abukhzam, M and A Lee 2010, 'Workforce Attitude on Technology Adoption and Diffusion'. *The Built & Human Environment Review 3.*

Acemoglu, D 2000, *Technical change, inequality, and the labor market*, National Bureau of Economic Research.

Acemoglu, D, P Aghion, C Lelarge, J Van Reenen and F Zilibotti 2007, 'Technology, Information, and the Decentralization of the Firm'. *The Quarterly Journal of Economics* 122(4): 1759–1799.

Acemoglu, D, D Autor, D Dorn, GH Hanson and B Price 2014, *Return of the Solow Paradox? IT, Productivity, and Employment in US Manufacturing. IZA Discussion paper series*. Bonn, Institute for the Study of Labor (IZA). January.

Acemoglu, D and JA Robinson 2012, *Why Nations Fail: The Origins of Power, Prosperity, and Poverty.* New York, Crown Publishers.

Adamson, G 2010, *One hundred reasons socially beneficial technology might not work.* IEEE International Symposium on Technology and Society (ISTAS), IEEE.

Adelman, I 1998, 'The genesis of the current global economic system'. In *Handbook on the Globalization of the World Economy*. Edited by A Levy, Edward Elgar.

Alberta Farm Machinery Research Centre 2014, 'The Detectspray Spraying System' from http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/eng7995/$file/The_Detectspray_Spraying_System.PDF?OpenElement

Anderson, P and ML Tushman 1990, 'Technological Discontinuities and Dominant Designs: A Cyclical Model of Technological Change'. *Administrative Science Quarterly* 35: 604–633.

Antonelli, C 1999, *The Microdynamics of Technological Change*. London, Routledge.

Archibugi, D and M Planta 1996, 'Measuring technological change through patents and innovation surveys'. *Technovation* 16(9): 451–519.

Armstrong, S and K Sotala 2012, How We're Predicting AI—or Failing To. In *Beyond AI: Artificial Dreams.* Edited by J Romportl, P Ircing, E Zackova, M Polak and R Schuster. Pilsen, University of West Bohemia: 52–75.

Arthur, WB 2007, 'The structure of invention'. *Research Policy* 36(2): 274–287.

Asimov, I, 'Visit to the World's Fair of 2014', in *New York Times (Review of Books),* 16 August 1964, http://www.nytimes.com/books/97/03/23/lifetimes/asi-v-fair.html

Atkinson, RD and LA Stewart 2013, *The economic benefits of Information and Communications Technology*, The Information Technology and Innovation Foundation. 14 May 2013 http://www2.itif.org/2013-tech-economy-memo.pdf

Ayres, RU 1990a, 'Technological Transformations and Long Waves. Part 1'. *Technological Forecasting and Social Change* 36: 1–37.

Ayres, RU 1990b, 'Technological Transformations and Long Waves. Part II'. *Technological Forecasting and Social Change* 37: 111–137.

Babbage 2011, 'Difference Engine: Luddite legacy'. *The Economist.* 2011, 4 November http://www.economist.com/blogs/babbage/2011/11/artificial-intelligence

Basalla, G 1988, *The evolution of technology*, Cambridge University Press.

BBC 2013a, 3D sport channel on ESPN to close after three years.
http://www.bbc.co.uk/news/entertainment-arts-22886822

BBC 2013b, BBC 3D programming 'on hold' indefinitely.
http://www.bbc.co.uk/news/entertainment-arts-23195479

Bender, A 2013, 'Drones to deliver parcels in Australia starting in March' from
http://www.techworld.com.au/article/528994/drones_deliver_parcels_australia_starting_march/ .

Boot, HAH and JT Randall 1976, 'Historical Notes on the Cavity Magnetron'. *IEEE Transactions on Electron Devices* 23(7): 724–729.

Bresnahan, T 2010, 'General Purpose Technologies'. In *Handbooks in Economics*. Edited, Elsevier. 2: 761–791.

Brynjolfsson, E 1993, 'The productivity paradox of information technology'. *Communications of the ACM* 36(12): 66–77.

Brynjolfsson, E and LM Hitt 1998, 'Beyond the Productivity Paradox: Computers are the Catalyst for Bigger Changes'. *Communications of the ACM* 41(8): 49–55.

Brynjolfsson, E and LM Hitt 2003, 'Computing Productivity: Firm-Level Evidence'. *MIT Sloan School of Management Working Paper*, Massachusetts Institute of Technology. 139. June

Brynjolfsson, E and A McAfee 2011, *Race Against The Machine*. Lexington, Massachusetts, Digital Frontier Press.

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

Cantner, U and S Vannucci 2012, 'A New View of General Purpose Technologies'. *Jena Economic Research Papers*. Jena. 2012–054.

Cantner, U and S Vannucci 2013, 'General Purpose Technologies as Emergent Properties, and the 'Technological Multiplier' Hypothesis: First thoughts on an evolutionary approach to General Purpose Technologies', Faculty of Economics and Business Administration, Friederich-Schiller-University, Jena. http://www.wiwi.uni-jena.de/eic/files/JERWCantnerVannuccini.pdf

Cowan, RS 1999, 'How the refrigerator got its hum'. In *The social shaping of technology*. Edited by D MacKenzie and J Wajcman, Open University Press.

David, PA 1990, 'The dynamo and the computer: An historical perspective on the modern productivity paradox'. *The American Economic Review* 80(2): 355–361.

David, PA and G Wright 1999, 'General Purpose Technologies and Surges in Productivity: Historical Reflections on the Future of the ICT Revolution'. *International Symposium on Economic Challenges of the 21st Century in Historical Perspective*. Oxford.
http://core.kmi.open.ac.uk/download/pdf/7371288.pdf

de Sola Pool, I 1983, *Technologies of Freedom: On Free Speech in an Electronic Age.* Cambridge, Massachusetts, The Belknap Press.

Dosi, G 1982, 'Technological paradigms and technological trajectories: a suggested interpretation of the determinants and directions of technical change'. *Research policy* 11(3): 147–162.

Drum, K 2013, 'Welcome, Robot Overloads. Please Don't Fire Us?' *Mother Jones*. 13 May 2013
http://www.motherjones.com/print/223026

Dublin, M 1989, *Futurehype: The Tyranny of Prophecy.* New York, Viking Penguin.

Fallick, B, CA Fleischman and JB Rebitzer 2006, 'Job-hopping in Silicon Valley: some evidence concerning the microfoundations of a high-technology cluster'. *The Review of Economics and Statistics* 88(3): 472–481.

Feenberg, A 1999, *Questioning Technology*. New York, Routledge.

Felton, N 2008, Consumption spreads faster today. Visualizing Economics—Adoption of New Technology Since 1900. http://visualizingeconomics.com/blog/2008/02/18/adoption-of-new-technology-since-1900

Flirtey. 'Delivery. But Way Better'. Retrieved 21 April 2014, from http://www.flirtey.com/about/.

Freeman, C, J Clark and L Soete 1982, *Unemployment and Technical Innovation: A Study of Long Waves and Economic Development.* London, Frances Pinter.

Freeman, RB 2002, 'The World of Work in the New Millennium'. In *What the Future Holds: Insights from Social Science.* Edited by RN Cooper and R Layard. Cambridge, Massachusetts, The MIT Press: 157–178.

Goldin, C and LF Katz 1996, 'Technology, Skill, and the Wage Structure: Insights from the Past'. *The American Economic Review* 86(2): 252–257.

Gordon, RJ 2014, *The Demise of US Economic Growth: Restatement, Rebuttal, and Reflections*. Cambridge, Massachusetts, National Bureau of Economic Research. February

Hall, JD, R Korstad and J LeLoudis 1986, 'Cotton Mill People: Work, Community, and Protest in the Textile South, 1880–1940'. *The American Historical Review* 91(2): 245–286.

Hempell, T 2006, *Computers and Productivity: How Firms Make a General Purpose Technology Work*. Heidelberg, Physica-Verlag.

Illich, I 1973, *Tools for conviviality*, Harper & Row, New York.

Issoufou, S 2011, *A Direct Measure of Technical Change and its Economic Implications*. PhD thesis, University of California, Berkeley.

Jovanovic, B and PL Rousseau 2005, 'General Purpose Technologies'. In *Handbook of Economic Growth.* Edited by P Aghion and SN Durlauf, Elsevier. 1B: 1182–1207.

Kelly, K 2012, 'Better Than Human: Why Robots Will—And Must—Take Our Jobs'. *Wired*. 24 December 2012 http://www.wired.com/2012/12/ff-robots-will-take-our-jobs/all/

Kranzberg, M 1985, 'The Information Age: Evolution or Revolution'. In *Information Technologies and Social Transformation.* Edited by BR Guile. Washington DC, The National Academies Press: 35–54.

Kranzberg, M 1986, 'Technology and History: "Kranzberg's Laws"'. *Technology and Culture* 27(3): 544–560.

Lipsey, RG, KI Carlaw and CT Bekar 2005, *Economic Transformations: General Purpose Technologies and Long-Term Economic Growth*. Oxford, Oxford University Press.

Loch, CH and BA Huberman 1999, 'A punctuated-equilibrium model of technology diffusion'. *Management Science* 45(2): 160–177.

Markoff, J, 'Robot Makers Spread Global Gospel of Automation', in *The New York Times*, 23 January 2013, http://www.nytimes.com/2013/01/24/technology/robot-makers-spread-global-gospel-of-automation.html?_r=0

McKinsey Global Institute 2011, *Internet matters: The Net's sweeping impact on growth, jobs and prosperity*, McKinsey and Company.

Merton, RK 1949, 'On Sociological Theories of Middle Range'. In *Social Theory and Social Structure*. Edited by RK Merton. New York, Simon and Schuster.

Miller, B and RD Atkinson 2013, *Are robots taking our jobs, or making them?,* The information technology and innovation foundation. 2013 http://www2.itif.org/2013-are-robots-taking-jobs.pdf

Mokyr, J 1990a, *The lever of riches: Technological creativity and economic progress*, Oxford University Press, USA.

Mokyr, J 1990b, 'Punctuated equilibria and technological progress'. *The American Economic Review* 80(2): 350–354.

Mokyr, J 1991, 'Evolutionary Biology, Technological Change, and Economic History.' *Bulletin of Economic Research* 43(2): 127–149.

Mokyr, J 1992, 'Technological inertia in economic history.*' Journal of Economic History* 52(2): 325–338.

Mokyr, J 1998a, 'Invention and rebellion: why do innovations occur at all? an evolutionary approach. Conference on minorities and economic growth'. Bar Ilan University, Elsevier Publishers, Amsterdam: 179–203. 2 June 1997

Mokyr, J 1998b, 'The political economy of technological change. In *Technological Revolutions in Europe: Historical Perspectives'.* Edited. Northampton, Massachusetts, Edward Elgar: 39–64.

Mokyr, J 2013, 'Is technological progress a thing of the past?' *VOX: Research-based policy analysis and commentary from leading economists*, from http://www.voxeu.org/article/technological-progress-thing-past.

Nagy, B, J Doyne Farmer, QM Bui and JE Trancik 2012, 'Statistical Basis for Predicting Technological Progress'. *PloS one* 8(2): 1–7. e52669 http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0052669 - pone-0052669-g006

National Research Council 2013, *Capturing Change in Science, Technology, and Innovation: Improving Indicators to Inform Policy,* The National Academies Press.

National Resources Committee (Subcommittee on Technology) 1937, *Technological Trends and National Policy, including the social implications of new inventions*. Washington, United States Government Printing Office.

Neisser, HP 1942, '"Permanent" Technological Unemployment: "Demand for Commodities Is Not Demand for Labor"'. *The American Economic Review* 32(1): 50–71.

Nelson, RR and SG Winter 1982, *An Evolutionary Theory of Economic Change*. Cambridge, Massachusetts, Belknap press.

Nye, DE 1992, *Electrifying America: Social Meanings of a New Technology*, 1880–1940. Cambridge, Massachusetts, MIT Press.

RA 2012, 'General purpose technologies: The revolution to come'. *The Economist.* http://www.economist.com/blogs/freeexchange/2012/04/general-purpose-technologies

Riedel, C 2014, '10 Major Technology Trends in Education.' *THE Journal (Transforming Education Through Technology*). http://thejournal.com/articles/2014/02/03/10-major-technology-trends-in-education.aspx

Rodgers, DT 1978, *The work ethic in Industrial America, 1850–1920*. Chicago, University of Chicago.

Rosenberg, N 1979, 'Technological interdependence in the American economy'. *Technology and Culture* 20(1): 25–50.

Rotman, D 2013, How Technology Is Destroying Jobs. *MIT technology review*. June http://www.technologyreview.com/featuredstory/515926/how-technology-is-destroying-jobs/

Sanders, BS 1962, Some difficulties in measuring inventive activity. In *The Rate and Direction of Inventive Activity: Economic and Social Factors*. Edited, NBER: 53–90.

Silberg, G, R Wallace, G Matuszak, J Plessers, C Brower and D Subramanian 2012, *Self-driving cars: The next revolution*, KPMG and Center for Automotive Research: 10–15. https://http://www.kpmg.com/US/en/IssuesAndInsights/ArticlesPublications/Documents/self-driving-cars-next-revolution.pdf

Slattery, M 2007, 'Lee Felsenstein and the Convivial Computer.' *Convivial Tools*, from http://conviviality.ouvaton.org/spip.php?article39.

Slovic, P 1987, 'Perception of risk.' *Science* 236(4799): 280–285.

Slovic, P, B Fischhoff and S Lichtenstein 1982, 'Why study risk perception?' *Risk analysis* 2(2): 83–93.

Solow, R, 1987, 'We'd better watch out' (review of Manufacturing Matters: The Myth of the Post-Industrial Economy), in *New York Times Book Review,* 12 July 1987.

Swords, SS 2008, *Technical History of the Beginnings of Radar*. London, The Institution of Engineering and Technology.

Tambe, P and LM Hitt 2014, 'Job Hopping, Information technology Spillovers, and Productivity Growth'. *Management Science* 60(2): 338–355.

US Congress Office of Technology Assessment 1986, *Technology and Structural Unemployment: Reemploying Displaced Adults.* Washington, DC, United States Government Printing Office.

US department of labor (Bureau of Labor Statistics) Business Employment Dynamics 2013, http://www.bls.gov/bdm/

Vijg, J 2011, *The American Technological Challenge: Stagnation and Decline in the 21st Century*, Algora.

Vintage Everyday 2014, 'Vintage Automobile Ads.' Retrieved 21 April, 2014, from http://www.vintag.es/2012/03/vintage-automobile-ads.html.

Volti, R 2014, *Society and Technological Change*. New York, Worth Publishers.

Wang, B 2011, Deaths per TWH by energy source. *NextBigFuture*. nextbigfuture.com

Watkins, JE, Jr 1900, 'What may happen in the next 100 years'. *The Ladies Home Journal*.

Wikipedia 2014a, Bring your own device (BYOD). 18/02/2014 http://en.wikipedia.org/wiki/Bring_your_own_device

Wikipedia 2014b, 'List of Nuclear and Radiation Accidents by Death Toll'. from http://en.wikipedia.org/wiki/List_of_nuclear_and_radiation_accidents_by_death_toll.

Wikipedia 2014c, Precision agriculture. http://en.wikipedia.org/wiki/Precision_agriculture

Winner, L 1978, *Autonomous technology: Technics-out-of-control as a theme in political thought*, The MIT Press.

Wise, G 1976a, 'The accuracy of technological forecasts, 1890–1940.' *Futures* 8(5): 411–419.

Wise, G 1976b, Technological Prediction, 1890–1940 PhD Thesis, Boston University.

World Health Organization 2014, 'Global Health Observatory: Number of Road Traffic Deaths' from http://www.who.int/gho/road_safety/mortality/traffic_deaths_number/en/ .

Annexure

Annexure: Workshop Attendance List

Social, demographic and cultural trends and consumer preferences	
Peter McDonald (Chair)	Crawford School of Public Policy
Kaarin Anstey	ANU Centre for Research on Ageing, Health and Wellbeing
Peter Browne	Swinburne University of Technology
Jane Caro	Jara Consulting
Andrew Dettmer	AWPA
Bill Martin	University of Queensland
Peter Spearritt	University of Queensland
Labour force, industrial and workplace trends	
Jeff Borland (Chair)	University of Melbourne
John Buchanan	University of Sydney
Gerald Burke	Monash University
Rebecca Edwards	University of Sydney
Tom Karmel	Formerly NCVER
Sally Sinclair	National Employment Services Association
Jim Stanford	Unifor
Mark Wooden	Melbourne Institute
Stephanie McKew (Observer)	Office of the Minister for Industry
Economic and financial trends and globalisation	
David Gruen (Chair)	Treasury
Carol Austin	Contango
Mark Cully	Department of Industry
John Edwards	AWPA
John Fitzgerald	Swinburne University
Nitin Gupta	Australian National University
Jenny McGregor	Asialink
David Orsmond	Reserve Bank of Australia
Mark Thirlwell	Austrade
Technology, science, innovation and sustainability	
Bob Williamson (Chair)	NICTA
John Bell	ACIL Allen consulting
Margot Brereton	Queensland University of Technology
Philip Bullock	AWPA

Matthew Dunbabin	Queensland University of Technology
Gerard Goggin	University of Sydney
Warwick Graco	Australian Taxation Office
Ron Johnston	University of Sydney
Simon Kaplan	NICTA
Graciela Metternicht	University of NSW
Robin Shreeve	AWPA
Governance and public policy	
John Wanna (Chair)	Australian National University
Sue Beitz	AWPA
Meredith Edwards	University of Canberra
Peta Furnell	Department of Industry
Michael Keating	
Ian Marsh	Australian National University
Peter McKay	QLD Public Service Commission
Ruth Medd	Women on Boards
Laura Tingle	Australian Financial Review
Andrew Swanson (Observer)	Academy of the Social Sciences in Australia

DRIVERS OF CHANGE FOR THE AUSTRALIAN LABOUR MARKET TO 2030

ISBN (Online PDF) – 978-0-9925829-0-6
ISBN (Print) – 978-0-9925829-1-3

WWW.ASSA.EDU.AU

ACADEMY OF
THE SOCIAL SCIENCES
IN AUSTRALIA