RESEARCH REPORT

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Future job openings for new entrants by industry and occupation

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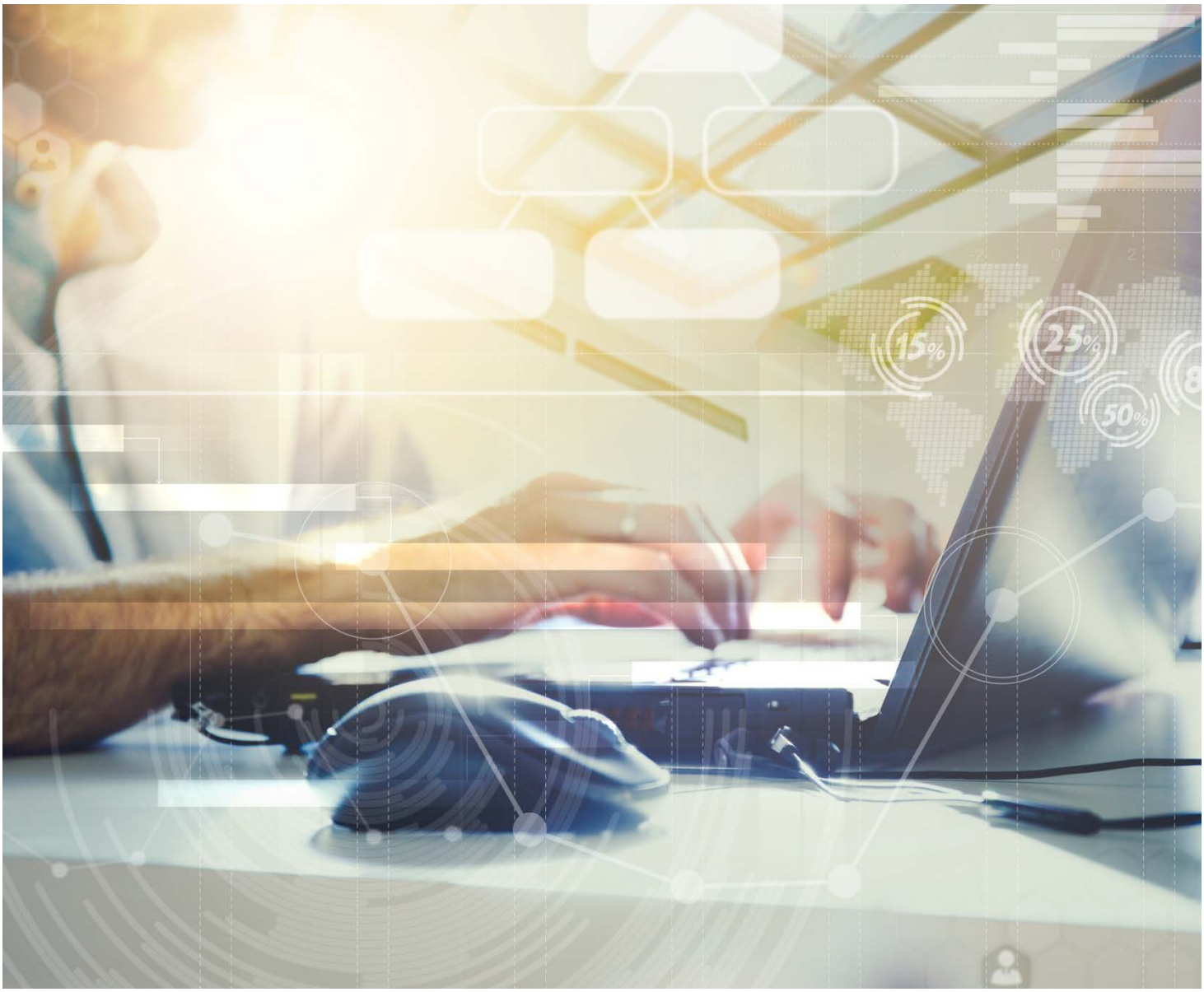

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About the research

Future job openings for new entrants by industry and occupation

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This research provides forecasts of job openings by occupation and industry for new entrants to the Australian labour market. It does this by combining two employment-related estimates:

- employment growth (or decline) in the industry or occupation
- replacement needs; that is, the new workers required due to worker retirement or those leaving the occupation.

This information may be useful to various stakeholder groups. Students and career advisors, for example, might use the information to make choices about occupational paths to follow, while policymakers might use the forecasts for long-term planning in education and training, as well as for workforce development purposes.

The researchers use a dynamic general equilibrium model to forecast employment by industry and occupation at high levels of detail. The forecasts from this model, as with forecasts from any other model, have a degree of uncertainty associated with them (Richardson & Tan 2007). That being said, many countries around the world continue to use labour market forecasts to guide planning.

Key messages

- The total number of job openings over the forecast period 2017 to 2024 will be about 516 600 per year (4.1 million in total), with more than half of these resulting from replacement demand.
- The results show employment continuing to shift towards higher-skill jobs in the labour market, with a slight acceleration in this trend with higher productivity growth.
- The highest number of job openings, 121 700 per year (973 600 in total), will be in professional occupations. The second highest, 71 300 per year (570 600 in total), will be for managers. These figures reflect the demand in higher skill levels.
- In some occupations, a high proportion of the job openings is due to replacement demand rather than employment growth. Very high replacement demand is seen in occupations with low entry requirements and low wages, which to date have typically attracted young people, who stay in the occupation for short periods. Examples due to replacement demand include hospitality workers, checkout operators and cashiers, and food preparation assistants (75.6%. 89.4% and 80.9%).
- Replacement demand is high for occupations with relatively older workforces, a consequence of workers' proximity to retirement. An example of high retirement-replacement demand includes farmers and farm managers, with 63.3% of the 80 900 job openings (10 100 per year).

- Reasonably high proportions of job openings due to replacement demand are also found amongst technicians and trade workers (for example, 60.4% for bricklayers, carpenters and joiners and 61.1% for automotive electricians and mechanics). This can have training implications. As experienced workers leave, there are fewer available to supervise apprentices. Additionally, as apprenticeship training takes time, and completion rates can be low, sufficient recruitment is needed to avoid future shortages.
- The analyses demonstrate the importance of considering replacement demand when assessing job openings for new entrants. Job openings can reflect future job opportunities; they can also provide a way to assess future training needs where training is required in an occupation.

Dr Craig Fowler
Managing Director, NCVER

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Executive summary

Consistent with recent trends, the modelling predicts higher growth in occupations requiring higher levels of education and training.

This report provides forecasts of job openings for new entrants to the Australian labour market by occupation and industry for the period 2017 to 2024. Job openings in an occupation are a result of growth in the occupation and the need to replace workers retiring from, or permanently leaving, the occupation. The forecasts provide job seekers, students and career advisors with information on future job opportunities, and helps them to make informed choices about which education and training courses to undertake. Policymakers may use the forecasts for long-term planning in education and training and workforce development.

These employment forecasts — achieved through modelling — reflect the industrial and occupational structure of the economy as it adjusts to changes in technology, business investment decisions, government spending, household preferences and international trade. The outsourcing of services by firms, globalisation and the offshoring of jobs have an additional effect on the structure of the economy, as may the reorganisation of firms and the adoption of new human resource management practices.

The report considers two scenarios for the Australian economy: the first and most likely scenario is based on historic paths to date; and the second, on high productivity. In the first scenario, we model the most likely outcome for the Australian economy, given all of the information available at 30 June 2016. In the high-productivity scenario, we assume a higher productivity growth than in the most likely scenario.

Method

This method for forecasting job openings uses three steps. In the first step, VU[1], a dynamic computational general equilibrium model, is used to forecast employment (headcounts) and expansion demand, by industry and occupation. Next, replacement demand is forecast. Finally, the results from the two stages are combined to derive forecasts of job openings.

The VU model incorporates a wide variety of information including:

- population statistics and projections, historical labour force data and input-output tables from the Australian Bureau of Statistics (ABS)
- macro forecasts from the Australian Treasury and other macro analysts
- forecasts of the volume and prices of commodities from the Australian Government Department of Industry, Innovation and Science[2]
- forecasts of changes in technology and consumer tastes derived from unpublished trends calculated by the Centre of Policy Studies, Victoria University.

1 The origin of VU is the MONASH model, whose development goes back to 1993 in the Centre of Policy Studies (CoPS) at Monash University. In turn, the development of MONASH stems from the ORANI model, first developed in the mid-1970s. However, the current version of VU includes significant advances over the MONASH model.

2 Prior to the recent restructure of the public service, the Bureau of Resources and Energy Economics provided this information.

Replacement demand provides a measure of the number of added workers required in an occupation as a consequence of worker retirement or those who permanently leave the occupation. A cohort-component method is used in combination with a time series method to forecast replacement demand. The model uses data from the ABS.

The third step combines results from the first two steps to obtain job openings. If employment increases in an occupation, then job openings in the occupation are the sum of expansion demand and replacement demand. On the other hand, if employment decreases, then job openings equal replacement demand. Job openings can provide a measure of the minimum number of additional people to train in instances where training is required in the occupation.

Results

Most likely scenario

The VU model forecasts the gross domestic product (GDP) to grow, on average, by 2.7% per year between 2017 and 2024. By comparison, GDP grew 2.8% per year between 2011 and 2016. The forecasts reflect the overall pattern of weak investment and slow growth in productivity observed here and overseas over the last several years. Had it not been for population growth, the economic outlook for Australia would be weaker.

Forecasts of employment

The VU model produces forecasts of employment (headcounts) by industry and occupation. Total employment will increase from 11.8 million in 2016 to 13.7 million in 2024. This represents an increase of 1.87 million people in employment, or 15.8%. On a year-on-year basis, employment will increase, on average, by 1.8% between 2016 and 2024, compared with the historical increase of 1.4% between 2011 and 2016.

Consistent with recent trends, the results suggest a bias in employment growth towards occupations requiring higher levels of education and training. In particular, employment for professionals will increase by 2.4% per year, to 3.3 million in 2024. This means that almost a quarter of all workers will be in a professional occupation in 2024. Among professionals, the highest rate of increase in employment will be for accountants, auditors and company secretaries (2.9% per year), likely due to growth in industries that demand these occupations.

The strong growth in demand for midwifery and nursing professionals (2.5% per year) reflects the strength of the health care and social assistance sector, in particular residential care and social assistance, which receives a boost in the model through government expenditure on the implementation of the National Disability Insurance Scheme (NDIS). Other occupations which also see a growth in demand from the implementation of the NDIS and population ageing are health and welfare support workers (2.3% per year), child carers (2.6% per year) and personal carers and assistants (2.4% per year).

While the growth in employment for many trade and technician occupations will be weaker than average for all occupations because of continuing weakness in construction, the demand generated through the rollout of the National Broadband Network (NBN) will mean the demand for information and communication technologies and

telecommunications technicians will continue to grow strongly (2.2% per year). The weakness in construction, as well as the slowdown in mining, will also affect the demand in their low-skill occupations (for example, construction and mining labourers). On the other hand, the low Australian dollar will mean recovery in some subsectors of manufacturing, especially where there is a strong preference for 'Made in Australia' products (for example, food and beverages, pharmaceuticals and speciality high-technology equipment).

The highest number of job openings will be in professional occupations, followed by managers.

Retail trade's share of total employment will slightly decline from 10.6% in 2016 to 9.7% in 2024. This is mainly associated with the overall household expenditure on manufactured goods,[3] which has been weak and is underscored by stagnation in wage growth and a gradual reallocation of the household budget towards the higher costs of services, utilities and health care. The growth in employment in the sector, relative to growth in output, has also been weak in recent years, due to technical changes in the sector (for example, automation and the rise in online shopping). The continuation of these trends in tastes and technology leads to the weakness in the sector over the forecast period and consequently below-average growth in demand for retail managers and sales workers.

Job openings

The total number of job openings over the forecast period of 2017 to 2024 will be about 4.1 million, with more than half of these resulting from replacement demand. On average, there will be 516 600 job openings per year.

The highest numbers of job openings, 121 700 per year (973 600 in total), will be in professional occupations, with replacement demand the source of 40.8% of these. Within professionals, the numbers of job openings per year for school teachers and midwifery and nursing professionals will be 15 400 (123 300 total) and 16 200 (129 600 total), respectively. However, replacement demand will be the source of a larger proportion of job openings for school teachers (64.2%) compared with midwifery and nursing professionals (49.6%). Replacement demand will be the source of less than 40% of all job openings in 16 of 23 professional occupations.

The second highest number of job openings, 71 300 per year (570 600 in total), will be for managers. Of these, construction, distribution and production managers had the highest number of job openings, with 10 500 per year (84 000), followed by farmers and farm managers, at 10 100 per year (80 900 total), with replacement demand the source of 53.8% and 63.3% of these, respectively. Of interest, farmers and farm managers have a much older workforce than most other occupations, which means it has a relatively higher replacement rate than other occupations. However, the rate may be slightly over-estimated, as many farmers tend to continue working past the age of 70 years, the cut-off age in the modelling for compulsory retirement. Other high numbers of job openings were for business administration managers, with 8700 per year (70 000 total), and retail managers, with 8400 per year (66 800 total). The remaining seven categories of managers ranged from an average of 2100 to 7300 per year (17 100 to 58 700 in total).

3 Manufactured goods are largely discretionary in the household budget.

Job openings for technicians and trades workers will be 57 800 annually (total 462 000), with half of these resulting from replacement demand. In some trades, replacement demand will be the source of a much higher proportion of job openings; for example, 60.4% for bricklayers, carpenters and joiners and 61.1% for automotive electricians and mechanics. Much of the replacement demand in such occupations will likely be from experienced workers leaving, which may have implications for training formats, as fewer experienced workers will be available to supervise new apprentices. By contrast, replacement demand will be the source of only 23.3% of job openings for information and communication technologies and telecommunications technicians. The relatively low replacement rate for this occupation is not only because its workforce is relatively young, but also because of the current high demand in the information and communication technologies sector from the rollout of the National Broadband Network. The high demand means that existing workers are less likely to leave for alternative occupations, and employers tend to retain their current workforce.

Personal carers and assistants, and hospitality workers are the two largest occupations among community and personal service workers. Job openings in these two occupations will be 13 600 and 20 400 per year (108 600 and 162 900 in total), respectively. Replacement demand will be the source of a much higher proportion of job openings for hospitality workers than for personal carers and assistants (around three-quarters compared with just fewer than half). The hospitality worker occupation, like a number of occupations in the retail trade, has low entry requirements, pays low wages and employs large numbers of young people, who stay in the occupation for short periods. The combination of these factors means turnover is high in the occupation. Another 108 400 job openings in total will be available for health and welfare support workers (6400 per year) and child carers (7100 per year).

Replacement demand will be the source of about half (53.3%) of the 68 700 job openings per year (549 900 in total) for clerical and administration workers. This proportion will be much higher for some occupations in this group; for example, 63.8% for receptionists.

Job openings for sales workers will be 58 300 per year (total 466 400), with replacement demand a major source of these (77.7%). About two-thirds of these job openings will be for sales assistants and salespersons, with around 80% being a result of replacement demand. Job openings for checkout operators and office cashiers will be somewhat fewer (9500 per year, 76 400 total), but the source of most of these will be replacement demand (89.4%). The high replacement rate for the occupation is a product of its very young workforce (60% is under 25 years), who stay in the occupation for relatively short periods.

Job openings for machinery operators and drivers will be 26 100 per year (total 208 500), with 6800 per year (54 400 total) of these for truck drivers. About 60% of job openings for truck drivers will be the result of replacement demand.

Replacement demand will be the source of two-thirds of the 51 400 job openings per year (410 900 total) for labourers. About a half of these job openings will be for food preparation assistants (14 200 per year, 113 700 total) and cleaners and laundry workers (12 400 per year, 98 900 total). While replacement demand will be the source of 56.5% of job openings for cleaners and laundry workers, it will be the source of 80.9% of job openings for food preparation assistants.

High-productivity scenario

The high-productivity scenario assumes that productivity makes an additional contribution to gross domestic product (GDP) growth, of 0.4 percentage points, compared with the most likely scenario, and that aggregate employment remains unchanged. For simplification, the model assumes that productivity improvement affects the technical efficiency of all industries equally, which may be unrealistic, and the impact on industry growth will also vary because of demand factors. The simulation also forecasts a small devaluation of the Australian dollar and a small net shift in the distribution of employment towards professional, scientific and technical services and manufacturing and away from retail trade, and health care and social assistance. At the minor occupation level, the shift is generally, although not always, towards higher-skill occupations, which suggests some skill-biased technical change and some substitution of labour with technology.

Concluding remarks

The results show employment continuing to shift towards higher-skill jobs in the Australian labour market, with a slight acceleration in this trend with higher productivity growth. In most occupations, replacement demand contributes more to job openings than does expansion demand. Public policy on education and training could focus on those job openings where training takes some time to complete. Training for jobs in occupations with high turnover could be the responsibility of employers.

The magnitude of these forecasts is indicative. They provide a basis for planning workforce development and for identifying where to focus public subsidies. The information adds to the existing labour market information enabling individuals, employers and training agencies to make informed decisions.

Many assumptions underpin the modelling. Clearly, changing the assumptions of key variables in any model will generate a different set of forecasts. For example, any revisions of Australia's current and projected population and labour force are likely to affect forecasts.

We can never be certain about the future, but using the information we have to anticipate what a prospective labour market might look like may prove beneficial.

Introduction

Every day, people, firms and public institutions are making choices about jobs and education and training: students and parents are making decisions about the education and training they or their children might undertake; job seekers and migrants are assessing their prospects of finding jobs in different occupations and making decisions on whether to retrain. Similarly, firms are making decisions on recruitment and human resources management, and education and training authorities are assessing whether to revise vocational education and training (VET) programs and whether to offer incentives to attract students into specific fields. Countries are making decisions on how to support workforce development and whether to invest in more education to attract direct foreign investments. All of these decisions depend on the labour market information available at the time, although the information may be imperfect. Many are medium- to long-term decisions: individuals, firms and authorities are not preparing themselves for the current labour market but for several years into the future.

Labour market information is important for the efficient operation of dynamic and complex labour and training markets and, as discussed in a later section, this information can have an important role in reducing skills imbalances. Research shows that persistent skills imbalances can affect productivity growth.

While we can never be certain about what will happen in the future, using the information we currently have to anticipate what a prospective labour market may look like may prove beneficial (Rihova 2016; Wilson et al. 2016; OECD 2016; United States Bureau of Labor Statistics 2012; Shah & Burke 2005; Neugart & Schömann 2002).

Future employment patterns reflect the structural changes of a dynamic economy as it adjusts to changes in technology,[4] business investment decisions, government spending, consumer preferences[5] and international trade. The outsourcing[6] of services by firms, globalisation, the 'gig economy' and the offshoring of jobs have an additional effect on the structure, as does the reorganisation of firms and the adoption of new human resource management practices.[7] Structural adjustment often means the elimination of old jobs and the creation of new ones, as well as changes in the industrial and occupational distribution of employment.

4 Changes in technology, such as the use of machines or software, have the potential to increase worker productivity so that the same amount of work requires fewer or no workers. Technology can also generate a demand for workers with different types of skills sets.

5 Changing consumer preferences for one product or service over another can affect the occupational share of employment in an industry. For example, as demand for carpeting decreases because of the rising popularity of other types of flooring materials, the demand for carpet installers will decrease in the construction industry.

6 Firms sometimes contract support functions to other firms instead of hiring their own workers. This can drive down the use of those workers in the firms that outsource the work but may increase use in another industry if the work is outsourced domestically; for example, schools outsourcing cleaning services to firms specialising in providing cleaning services.

7 Any type of change in job duties that produces the same output may increase or decrease the utilisation of some occupations relative to others; for example, law firms hiring paralegals to do some of the tasks of lawyers, as well as legal secretaries.

Of particular interest for many is whether the broad trends in labour demand observed in recent years will continue and, if not, where to expect significant changes.

Replacement needs are often a significant source of job opportunities, but are often not taken into account.

This report is an attempt to answer the following specific questions about the Australian labour market:

- What will the level of employment be over the medium- to long-term?
- In which industries and occupations will employment grow?
- What will be the impact of permanent job separations, including retirements, on job openings?

The answers to these questions will provide information on the job opportunities arising from future growth and replacement needs in each industry and occupation. Replacement needs are often a larger source of job opportunities than growth in many occupations but may not be considered when assessing job opportunities. The information presented here will supplement other sources describing the labour market, sources designed to assist individuals and institutions to make decisions on jobs and education and training, including what training should receive public subsidy. Wide access to good-quality labour market information is even more pertinent now that Australia has moved towards a demand-driven tertiary education and training system. The experience of many countries suggests that labour market forecasts can form a basis for intelligent and informed debate, as well as support better matching of education and training with jobs (Rihova 2016).

Scope of this report

This report provides forecasts of demand in the Australian labour market for the period 2017 to 2024. It uses economic forecasting models to identify likely future patterns in the level, composition and sources of labour demand and in the industrial and occupational distribution of employment. The report provides forecasts of job openings, a result of growth and replacement demand, by occupation and industry. Replacement demand results from retirements and turnover from permanent occupational separations. The information in this report fills an important gap in the considerable labour market information that all levels of government already make available.

We consider two scenarios for the Australian economy: first, most likely, and second, high productivity. In the first scenario, we model the most likely outcome for the Australian economy, given all of the information, including prospective, available on 30 June 2016. In the second scenario, we assume a higher growth in productivity than in the first scenario.

We use the latest version of the VU dynamic computational general equilibrium model to produce the forecasts. The model is one of the most advanced of its kind for modelling a complex economy like that of Australia. The model's initial development goes back more than 30 years and ongoing research ensures it is continuously improved. We use a model based on cohort-component and time series methods to forecast replacement demand by

occupation.[8] Many countries use variants of this method to forecast replacement demand.

Structure of the report

The structure of this report is as follows. In the next chapter, we describe the international practice on forecasting employment and job openings by industry and occupation. Here we also briefly document the type of labour market information produced in Australia and its purposes. In the following chapter, we describe the models used to forecast future job openings in Australia in two scenarios for the economy: the most likely scenario and the higher-productivity scenario. This chapter includes the results from estimating the models. The penultimate chapter looks at labour markets and skills imbalances and mismatches. Finally, we offer some concluding remarks.

8 The model was initially developed in the late 1990s at the then Centre for the Economics of Education and Training (CEET) at Monash University.

International practice in modelling labour demand

This report produces a form of quantitative modelling forecasts. In this chapter we briefly outline how this method aligns with the available range of labour forecasting tools. We also briefly note the extent of labour market information tools used for communicating labour market information in Australia.

The detail, quality and type of labour and training market information available can vary significantly across countries. This is because approaches to producing such information varies, reflecting the perceptions of what is desirable, as well as the practical limitations (financial, expertise and data) of what is feasible (Bakule et al. 2016; OECD 2016). With better data collection and advances in economic modelling, both the approaches and the limitations have changed substantially since the end of the Second World War.

Some of the main approaches to anticipating future demand for labour and skills include:

- surveys of employers
- qualitative methods
- sectoral studies
- quantitative modelling at the national and sometimes regional level.

Table 1 shows the strengths and weaknesses of the different approaches. Scientifically conducted employer-based surveys can be a source of important information about employers' perspectives on labour and skills demand within firms. While they provide information about the present, and perhaps the short-term future, they are generally not suited for medium- to long-term forecasting, and consequently their use for the purposes of providing prospective information about the labour market is uncommon. Green, Machin and Wilkinson (1998) show that employers can be inconsistent in their interpretation of the various notions of skills shortages — skills gaps, recruitment difficulties and hard-to-fill vacancies — in self-reported employer surveys.

Qualitative methods are an alternative to collecting information about the likely future trends in the labour market. The methods can include focus groups, roundtables, scenario development and 'Delphi-type' approaches. The success of qualitative methods in providing useful foresight depends on the quality of the inputs from key experts and stakeholders and the way in which these are integrated. The potential outcomes include participants developing future scenarios, including those they wish to commit themselves to implementing.

Sectoral studies focus on a specific industry sector or an occupation for the analysis. Interactions with the rest of the economy are often difficult to incorporate in these analyses. The studies sometimes combine qualitative and quantitative methods and include sector or occupation details that are difficult to incorporate in an economy-wide model. Examples of sectoral studies in Australia include Shah and Long (2003) for nursing

and caring occupations; Shah and Long (2010) for the service industries; and Weldon, Shah and Rowley (2015) for teachers.

Quantitative modelling, in the context of labour and training market information, refers to large-scale multi-sectoral analyses of the national or a regional economy, the aim being to produce medium- to long-term forecasts by industry and occupation (and sometimes by qualification). The modelling incorporates a multitude of complex interactions among different parts of the economy. At various stages of the modelling there may be a need for qualitative expert input. Expert judgment may also play a role in tweaking model assumptions in the light of initial results.

Table 1 Advantages and disadvantages of different approaches to anticipating future supply and demand for labour and skills

Approach	Advantages	Disadvantages
Surveys of employers	Direct assessment of demand, recruitment difficulties, skills gaps and shortages	May be subjective and inconsistent; may focus on the current rather than the future; understanding of concepts may vary across respondents; requires careful interpretation of results; only represents the formal economy
Qualitative methods	Holistic, direct involvement of users, fewer initial set-up costs and data needs	Inconsistent; can be subjective; high risk of being non-systematic
Sectoral studies	Focused on the specific sector or occupation; focus on a single sector means that it is easier to combine qualitative and quantitative approaches	Partial; may not cover all sectors; inconsistent across whole economy; ignores interactions between sectors
Quantitative modelling	Comprehensive; consistent; multi-sectoral; systematic; transparent; provides a quantitative base for other approaches; provides a solid basis for qualitative approach.	Data-intensive; costly; may provide misleading impression of precision; requires expert modellers; can only include variables that can be quantified and for which data are available.

Source: Adapted from Bakule et al. (2016).

The focus of this report is on quantitative labour demand forecasts, and a brief outline of the common elements of the methods for producing these forecasts in a selected number of countries is available in the support document to this report (available at <https://www.ncver.edu.au>).[9] Also in the support document we provide more details of the methods used in three countries: the United States, the European Union and Canada. All three, particularly the US, have a long history of research and development in this area.

Labour market information in Australia

The national and state/territory governments produce a range of labour market information in Australia, some for wider dissemination — to inform individuals, training providers and employers about the current and future labour market — and other

9 Many forecasting systems now model both the demand side and the supply side of the labour market. Demand and supply modelling are typically undertaken independent of each other and not integrated within a single framework to account for the endogeneity between the supply and the demand. Integration thus remains an open methodological issue to this day.

material for internal planning and policymaking.[10] Some state-based labour market and training information online portals include links to Australian Government websites.

Private organisations also produce labour market information, but much of this is generally not available to the public. Occasionally, labour market modelling informs specific government reviews or enquiries on training reform and workforce skilling and development. The modelling produces information about the likely future structure of employment by industry and occupation and the demand for skilled labour that will follow. Sometimes the modelling extends to assessing the supply of skilled labour to determine possible future imbalances in the supply and demand. Shah and Burke (2006) provided forecasts of the supply and demand for skilled labour for the National Training Reform Taskforce. The former Australian Workforce and Productivity Agency modelled various scenarios of the Australian economy to investigate the additional, or reduced, demand for skilled labour and the implications for the training budget in each scenario (Australian Workforce and Productivity Agency 2012). Keating (2008) also uses information from models of the supply and demand for skills to inform his review of skills and workforce development in South Australia, including future challenges in this respect.

A full review of the type of information that a selection of jurisdictions produce, the source of the information, and the use made of it is available in the support document to this report (available at <https://www.ncver.edu.au>).

10 Jurisdictions often provide detailed information relating to the training market: training required for entry into specific occupations; prices and government subsidies to undertake the training; and lists of training providers.

Forecasts of job openings, 2017–24

This chapter provides forecasts of job openings in Australia for the period 2017 to 2024. It considers two scenarios for the Australian economy: most likely and high productivity. The first scenario is assessed as being the most likely outcome for the Australian economy. As we show later, our process for assessing the most likely scenario is more complex than simply extrapolating trends in employment. In the second scenario, the assumption is a higher growth in productivity than in the first scenario. Below, we first briefly describe the method for forecasting job openings by industry (86 groups) and occupation (97 groups). Next, we present the forecasting results for our most likely scenario, followed by our high-productivity scenario.

Method

The method for forecasting job openings is in three stages. In the first stage, we construct a model to forecast expansion demand for Australia using a dynamic computational general equilibrium model. Next, we forecast replacement demand. Finally, we combine the results from the first two stages to derive forecasts of job openings. Each of these steps is now addressed in more detail.

Expansion demand

The demand for labour depends on a multitude of interrelated factors, including macroeconomic factors affecting the domestic economy, as well as those of the economies of Australia's major trading partners; the level of capital investment and its allocation across industries; the rate of technological change; and changes in government policies. Developments in one industry thus have ripple effects in other industries. Modelling the demand for labour and all the interactions in the economy that affect it requires bringing all of these factors together in a rational and coherent way. We do this using the VU model, a dynamic computational general equilibrium model of the Australian economy.[11]

Dynamic general equilibrium models are economy-wide models based on the concept that all economic agents exhibit optimisation behaviour. They build up to the macro economy from microeconomic foundations; for example, consumers are assumed to maximise utility, while firms are assumed to maximise profits, subject to resource constraints, preferences and production possibilities. The model can also examine the effect of a policy shock in equilibrium, which is when supply equals demand in all markets.

11 The origin of VU is the MONASH model, whose development goes back to 1993 in the Centre of Policy Studies (CoPS) at Monash University. In turn, the development of MONASH stems from the ORANI model, first developed in the mid-1970s. However, the current version of VU includes significant advances over the MONASH model.

Unlike ordinary computational general equilibrium models, which are only useful for analysing the impact of policy 'shocks' on the economy (for example, to study the economy-wide effects of reducing tariffs in the manufacturing industry), the dynamic versions of the models have additional strong forecasting capabilities. This is because they have more detailed specification of intertemporal (dynamic) relationships, greater use of up-to-date, as well as historical trend, data, and enhancements that allow input of forecasts from specialist agencies (Dixon, Parmenter & Rimmer 2000).

The VU model is configured to produce Victoria University employment forecasts (VUEF), which is a system of interconnected models of the labour market, with forecasts of employment by industry, occupation, region, qualification, demographics and hours worked as the output. In this report, the focus will be on forecasts of employment by industry and occupation.

Box 1 on page 23 shows the main elements of the VU model. The outputs of the VU model are recursive in the sense that the output for one year forms the base data for the following year. In the model, the linkages between industries are not merely through transactions with one another, but also through competition for resources, in particular the national supply of labour.

Estimating the VU model requires extensive data from a variety of sources. At the core of these requirements are input—output tables[12] of the Australian economy from the Australian Bureau of Statistics. As the period between publications of these tables is rather long, they tend to lose their currency quite quickly. In the VU model, this problem is resolved by calibrating the tables with the use of other recently released economic data.[13] As a by-product, the calibration process reveals the underlying structural changes in the economy, such as changes in productivity, consumer preferences, savings rates, willingness to invest and conditions in the world economy.

The VU model produces forecasts in response to likely structural changes or 'shocks', updating the database from one financial year to the next through a series of simulations. The shocks result from:

- expert opinion
- assumptions about future productivity growth (based on recent Australian and international experience)
- significant announcements affecting future economic activity (for example, the closure of local car manufacturing)
- anticipated activity in the construction industry, as indicated through data on building approval
- continuation of structural changes, identified through calibration of the database.

12 Input—output tables show the sale and purchase relationships between producers and consumers within an economy.

13 These data include the national accounts; gross domestic product; private and public consumption; investment; international trade; the terms of trade and industry value added; population; participation and unemployment rates; the wage price index; and the consumer price index.

Expert opinion included is:

- forecasts of the value and volume of commodity production and exports (Australian Government Department of Industry, Innovation and Science)
- population projections (ABS and state and territory governments)
- forecasts of taxation and government expenditure and projections of labour force participation rates (Australian Treasury).

Until about 2010, the MONASH model, the predecessor to VU, included unconstrained labour supply (Meagher & Pang 2011).[14] In its current version, the VU model links the supply of labour by occupation to an exogenously determined supply of skills provided to the labour force (Wittwer & Dixon 2015).[15] It builds on VU's existing framework, whereby industry demand is the source of demand for labour. The supply side of the labour market is explicit now. The formulation enables feedback within the model from the consequences of labour supply shortages or surpluses.

The model produces relative wages between occupations because the supply of labour to occupations is constrained by partitioning the workforce by skill groups. Based on initial occupation shares, each skill group supplies labour to an occupation. These change in response to changes in relative occupational wage movements. While movements away from the initial shares are typically small, in a dynamic setting large changes may accumulate over time.[16] It is assumed that industry demand for labour from a particular occupation will increase with a decline in the relative wage but that the supply of labour to the occupation will also decline. The market achieves equilibrium when supply matches demand. This formulation introduces a key rigidity, whereby workers' capacity for changing occupations is limited.

The data for estimating the VU model are collected by the Centre of Policy Studies (CoPS) at Victoria University, which maintains and updates the database required for this purpose.

14 Dixon & Rimmer (2003) introduced constraints on the composition of labour supply in the MONASH model by explicitly modelling the transition of workers from one labour force status to another over each period of the simulation using information on relative wages and workers' occupational preferences.

15 Level and field of qualification define the skill groups. The VU model projects the growth in the number of people with particular skills in the labour force using historical data with adjustments for demographic changes.

16 The model provides a solution in between two extremes of fixed relative wages and fixed occupational shares.

Box 1 Main elements of the VU model for employment forecasts

Macroeconomic forecasts of the Australian economy are a major input into the model. The Centre of Policy Studies uses an in-house macro model to produce these forecasts. Inputs for this model include population projections (sourced from the ABS and state and territory agencies); projections of labour force participation rates and unemployment rates (sourced from the Australian Treasury); household consumption data; government budget information; and data on investment, trade, exchange rate and technological change.

Disaggregation of final demand (GDP) into demand by various decision-making agents – producers (over a hundred industries), investors, households, government and export (overseas firms) – is the next step in the modelling. In the model, the agents make optimal decisions on the supply and use of commodities (corresponding to the industries) and factor inputs (land, labour and capital), and whether to source commodity purchases from the domestic economy or imports. These include cost minimisation by producers, utility maximisation by households and allocation of investment funds in response to risk-adjusted rates of return. Policy generally drives government decisions on purchases. Another set of relationships in the model describes the price system. Zero profit condition on producers drives basic prices. Adding relevant margins and taxes generates purchaser prices. Finally, the model includes a set of market-clearing relationships to ensure equilibrium in the supply and demand for each commodity produced. These relationships are sufficient to determine the price and quantity of every produced commodity within the system.

For non-produced commodities – that is, factor inputs and imports sourced from outside Australia – the relationships are sufficient to explain price or quantity, but not both. In relation to these commodities, the model assumes that the supply of land is fixed (may shift between uses); labour supply is determined through a series of relationships with links to Australia's population; industry-specific supply of capital is determined by links to lagged values of capital stock and investment; and foreign currency prices of imports are determined outside the system.

Macroeconomic accounting identities involving the gross domestic product, the terms of trade, the real exchange rate and other key macroeconomic indicators are part of the model specification.

Exogenous variables, besides those in factor markets, determined outside the system of relationships described above, are also included in the model. These variables relate to changes in production technology; changes in household tastes; changes in preferences between imported and domestic goods; changes in government policy relating to taxation, the budget and composition of expenditure; changes in international trading conditions (shifts in export demand schedules and foreign currency prices of imports); and changes in investor risk premium.

Aggregate demand for labour by industry is a function of total industry output (which in turn is a function of the demand for the industry's output); the industry's capital stocks; changes in productivity; and the labour cost to the industry, relative to other inputs.

Occupational labour demand is a function of aggregate demand for labour, changes in the occupational wage relative to the average wage and changes in relative occupational productivity.

Replacement demand

As already discussed, an important source of job opportunities in an occupation arises when workers retire or permanently leave the occupation.[17] In many occupations, these job opportunities are more than those that result from growth in the occupation.

There are two concepts of replacement demand — total and net (Shah & Burke 2001; US Bureau of Labor Statistics 2008; see box 2). Our focus is on net replacement. Henceforth, for simplicity, replacement demand refers to net replacement demand.

Box 2 Concepts of replacement demand

Total replacement demand measures the total number of job openings resulting from flows of workers from an occupation, irrespective of the numbers entering over the same period. The measure provides an indication of all job opportunities in the occupation, but because experienced workers seeking to re-enter the occupation will also fill some of the jobs, it is not a good indicator of opportunities for new entrants.

Net replacement demand provides a measure of the number of new and relatively younger workers required in an occupation due to workers retiring or permanently leaving the occupation. From the perspective of education and training planning, it is a much more important measure, as it indicates the job opportunities for new entrants.

Except in occupations with a high turnover (usually with large numbers of young workers, such as food preparation assistants), most replacement requirements result from age-related retirements from the occupation. Replacement needs, when added to job openings due to growth, roughly approximate the opportunities for workers wishing to enter the occupation for the first time. As new workers to an occupation often need training, this provides an indication of the minimum number of workers to train.

We use the cohort-component method, which has demographic applications,[18] to estimate occupational replacement rates. Many countries use this method or a variant of it (see, for example, Shah & Burke 2001 for Australia; Sexton et al. 2001 for Ireland; US Bureau of Labor Statistics 2008 for the United States, Bijlsma et al. 2016 for the Netherlands; and Cedefop 2012 for Europe). This method is popular because mobility data for directly estimating replacement rates are often unavailable.

The cohort-component method compares the employment of a cohort, defined by age, and sometimes gender, in an occupation at two points five years apart (labour force data are usually available by five-year age groups) to calculate the net change in the size of the cohort. While a decrease in the size of the cohort indicates net separation from the occupation over the five-year period, an increase indicates zero separations. For example, if the size of the 20 to 25 years age cohort in an occupation increases from

17 The calculation of replacement demand is generally by occupation, and sometimes by qualification. It makes little sense to calculate replacement demand by industry because workers in an industry have heterogeneous job mobility patterns. For example, in the health sector, the job mobility patterns of nurses working in hospitals are likely to be substantially different from those of food preparation assistants in hospital kitchens.

18 For applications of the method in demography, see Davenport & O'Leary (1992); Kippen & McDonald (2000); Pollard, Yusuf & Pollard (1974); Shryock & Siegel (1980).

2600 in 2010 to 3000 in 2015, then net separations from the occupation are zero.[19] On the other hand, if the size of the cohort decreases to 2200 in 2015, then net separations would equal 400 over the five-year period. The sum of net separations across all cohorts provides an estimate of replacement demand in the occupation. If employment in an occupation is declining, then not all workers leaving the occupation need replacing and, therefore, replacement needs equal the sum of separations less the decline in employment.

In most occupations, net separations occur only from the older age groups, usually above age 55 years,[20] a pattern typically reflecting retirements. In occupations that typically have relatively low entrance requirements and pay relatively low wages, net separations occur from younger age groups. Young workers often take jobs in such occupations while in education or training. On completion of their training, they often transfer to occupations related to their training, which generally pay more.

To project replacement demand, we multiply the net separation rate by the respective cohort employment in the base period. The sum of net separations over all cohorts yields the replacement demand.

In practice, an individual net separation rate may be inappropriate for use in projecting, because of the high level of volatility in the employment data at this level of disaggregation from one period to the next. To smooth out the data, including the business cycle, we create a time series of net separation rates for each cohort using employment data from the labour force of surveys for the period 1987 to 2016. We then use time series methods to forecast each time series independently.[21] As the oldest age category in the data is 70 years or older, we assume all workers retire at the age of 70 years.

Job openings

Job openings for new entrants in an occupation are a result of growth in the occupation and replacement demand. In occupations where employment is not expanding in our model, replacement demand is the only source of job openings. The measure provides a lower bound for the number of people to train, if indeed training is required, because some people who complete the specific training do not enter the occupation for which they qualify. As a result, more workers would need to train to ensure that the minimum number enter the occupation.

19 To estimate this, we compare the employment of 20 to 24-year-olds in 2010 with the employment of 25 to 29-year-olds in 2015.

20 Among female cohorts, net separations may also occur at ages when they generally bear and look after children.

21 The model includes adjustment for the changing structure of the labour force by age and gender, although the size of the effect of this is relatively small.

Results for the most likely scenario

This section provides a summary of the results for the most likely scenario. We use data that were available as at June 2016 to estimate the models.

Macroeconomic context

Changes in Australia's population and economy through to 2024 will affect both employment in general and job opportunities for new entrants to the labour market. Between 2016 and 2024, Australia's working-age population[22] will increase by approximately 2.7 million, or 13.8%, and, because of the ageing of the baby boomer generation, almost half of this increase will be of those aged 55 years or older (ABS 2013).[23] In 2024, 34.9% of the working-age population will be 55 years or older compared with 32.9% in 2016.

The labour force participation rate will increase slightly for men, from 70.7% in 2016 to 70.9% in 2024. In the same period, the participation of women will increase from 58.5% to 59.2%. Based on projections in the *Intergenerational report* (Australian Treasury 2015), the participation in both groups will increase more among the older age groups. The model assumes the unemployment rate to decline gradually, to 5.5%, which is consistent with forecasts in the 'Pre-election economic and fiscal outlook 2016' (Australian Department of Finance 2016).

An important measure of a country's prosperity is the terms of trade, the ratio of export prices to import prices. Australia's terms of trade declined more than 30% between 2011 and 2016, mainly because of the downturn in mining. Consistent with forecasts in the 2016—17 Australian Government budget papers, the VU model assumes only a slight improvement in the index over the forecast period.[24]

The model forecasts the real trade-weighted exchange rate[25] for the Australian dollar to decline, as shown in figure 1. This is a more robust measure than the US$/A$ rate for modelling the Australian economy. The main influences on the trade-weighted exchange rate are Australia's terms of trade; net foreign indebtedness; real interest differentials, relative to those of other major economies; and domestic investment booms that could not be adequately financed by domestic savings (Blundell-Wignall, Fahrer & Heath 1993).

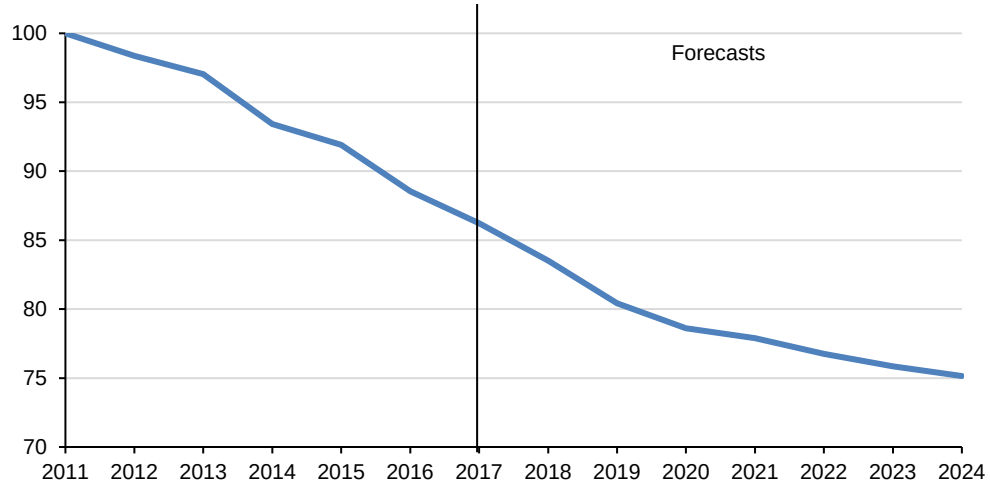
22 The working-age population includes individuals aged 15 years or older.

23 The estimated resident population at June 2016 was 232 000 less than the population projection (series B) (ABS 2016).

24 Since our models were estimated in September 2016, there has been an some improvement in the terms of trade (ABS 2017a).

25 Australia's trade-weighted exchange rate is the average of the Australian dollar's exchange rate with respect to the currencies of its major trading partners, weighted by its share of trade with each country.

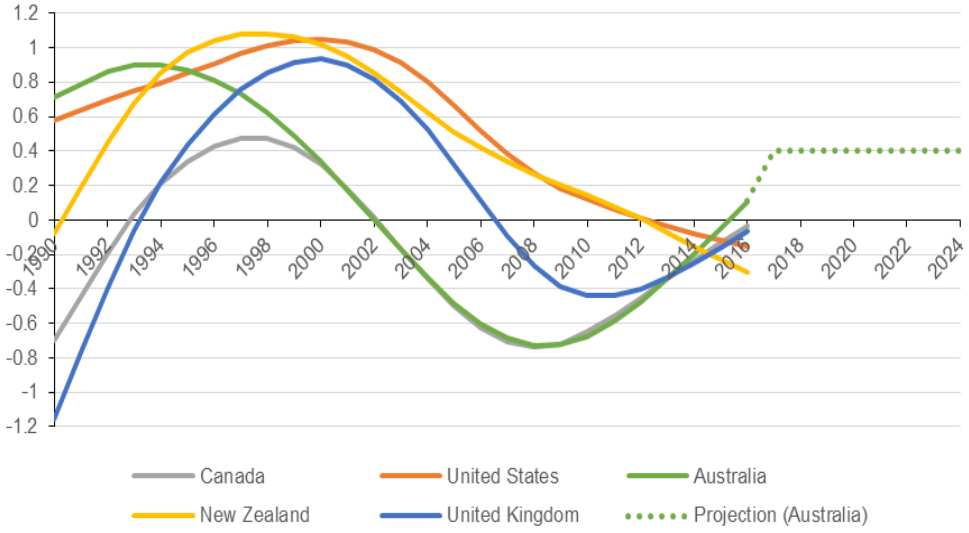
Figure 1 Real trade-weighted exchange rate, 2011–16 (actual) and 2017–24 (forecasts) (index = 100 for 2011)



Source: Victoria University employment forecasts.

In the model, the GDP is a function of labour, capital and productivity growth.[26] We assume that productivity growth in Australia will add about 0.4 percentage points to the growth in GDP each year in the forecast period. This is the average productivity growth for the decade leading to the mining boom in 2004. Compared with the recent performance of Australia's and other developed economies when productivity growth has been poor, this is a reasonably optimistic assumption (see figure 2).

Figure 2 Productivity[1] growth in Australia and in similar economies, 1990–2016 (actual) and 2017–24 (forecasts) (%)



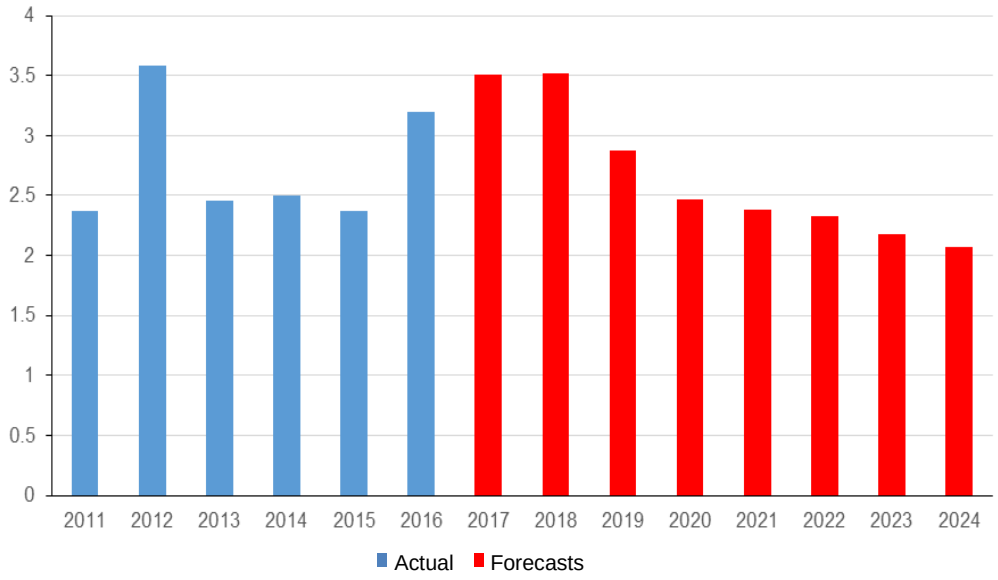
Notes: 1 Total factor productivity.
Data smoothed using Hodrick-Prescott filter to remove cyclical fluctuations.
Source: The Conference Board Total Economy Database (1990–2016).

The model forecasts GDP growth to peak at about 3.5% in 2017 and 2018 and then to fall gradually to around 2% in 2024 (see figure 3). By comparison, between 2011 and 2016, only twice did GDP growth exceed 3%. The weakness in the economy after 2019 is starker when the per capita GDP growth is examined (see figure 4). In other words, without the

26 This is multifactor productivity growth, which measures an industry's output relative to the value of all of the inputs of labour, capital and materials. It is a way to track overall efficiency in production.

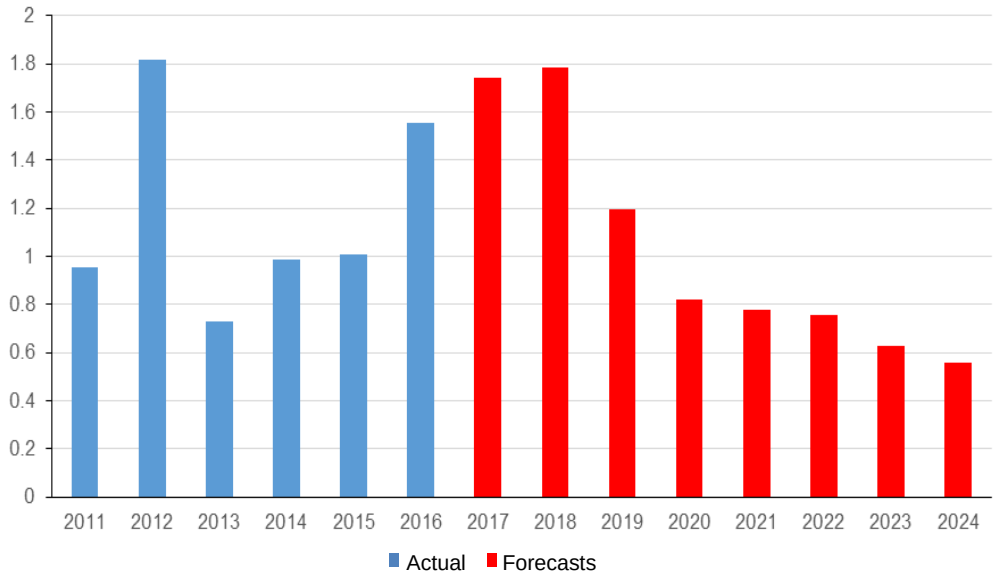
strong population growth, GDP growth after 2019 would be lower than indicated in figure 3.

Figure 3 Growth in GDP in Australia, 2011–16 (actual) 2017–24 and (forecasts), constant prices (%)



Source: Victoria University employment forecasts.

Figure 4 Growth in GDP) per capita in Australia, 2011–16 (actual) and 2017–24 (forecasts), constant prices (%)



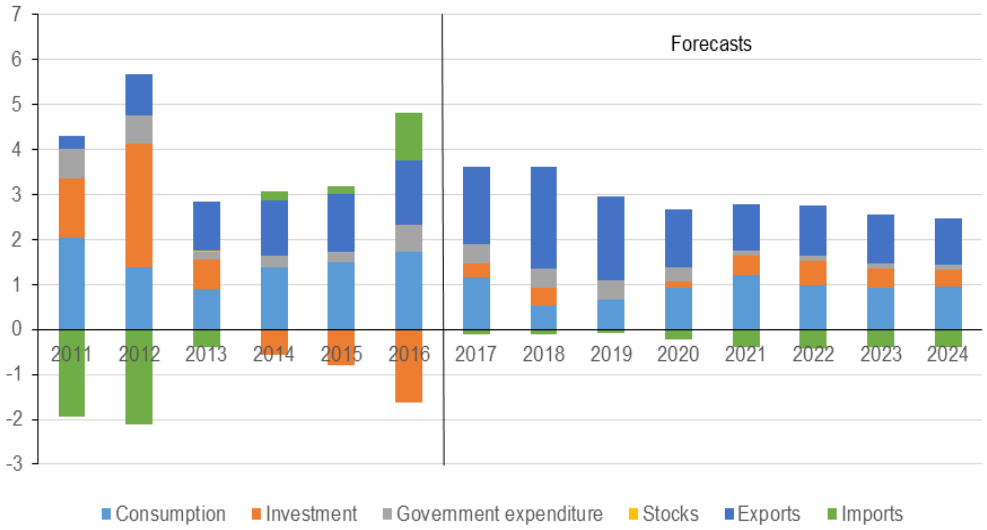
Source: Victoria University employment forecasts.

The VU model calculates the contributions of the major components of the economy to the overall growth in GDP. Figure 5 shows the contribution of consumption, investment, government expenditure, stocks,[27] exports and imports to GDP growth between 2011 and 2024. While imports are generally a drag on the GDP growth, it is not always the case. For example, imports of productivity-enhancing equipment have the potential to improve productivity and hence GDP growth. Imports can also increase competition in

27 Stocks measure accumulation of inventory. Its contribution to GDP growth is usually very small.

the domestic economy and consequently increase efficiency. The sluggish growth in wages is the likely source of the declining contribution of consumption to GDP growth in 2018 and 2019. After making a significant contribution to GDP growth between 2011 and 2013, investment's contribution was negative between 2014 and 2016. Investment growth will be sluggish in the forecast period and expected to make a negligible contribution to GDP growth in 2019.

Figure 5 Contributions to Australia's growth in gross domestic product (GDP), 2011–16 (actual) and 2017–24 (forecasts), constant prices (percentage point)



Source: Victoria University employment forecasts.

Employment forecasts

The VU model produces forecasts of employment (headcounts) by industry and occupation. Total employment will increase from 11.8 million in 2016 to 13.7 million in 2024. This represents an increase of 1.9 million people in employment, or 15.8%. For the year-on-year basis, employment will increase, on average, by 1.8% between 2016 and 2024, compared with the historical increase of 1.4% between 2011 and 2016.[28]

Forecasts by occupation

Table 2 shows employment forecasts for major occupation groups. The forecasts for minor occupation groups are in table A1 in appendix A. Consistent with recent trends, the results suggest a bias in employment growth towards occupations requiring higher levels of education and training. In particular, employment for professionals will increase by 2.4% per year, to 3.3 million in 2024. This means almost a quarter of all workers will be in a professional occupation in 2024.

School teachers will be the largest professional occupation, employing 438 700 people. The growth in school teacher numbers will be slower (1.3% per year) than for all professionals. The numbers for accountants, auditors and company secretaries will increase by 53 100 from 2016 to 2024, an increase of 2.9% per year. Similarly, the

28 The Australian Government Department of Employment's latest employment projections suggest an average annual growth of 1.6% over the five years to 2022 (see <http://lmip.gov.au/default.aspx?LMIP/IndustryInformation>).

employment of midwifery and nursing professionals, another large professional occupation, will grow strongly, 65 300 in total, or 2.5% per year.

Employment for managers will grow at 2% per year, which is a little above average for all occupations. The two largest occupations in this group, construction, distribution and production managers (which will employ 291 100 in 2024) and retail managers (which will employ 264 800 in 2024), will experience growth rates of only 1.8% and 1.2%, respectively.

Employment for technicians and trades workers will grow at below-average rate (1.6% per year). However, the demand generated through the rollout of the NBN will mean strong demand for information and communication technologies and telecommunications technicians (2.2% per year). On the other hand, the demand for many types of construction tradespersons will remain weak due to the subdued demand from construction (see discussion below).

The expected increasing demand from the aged care sector and the National Disability Insurance Scheme rollout will fuel the need for more community and personal service workers. In particular, demand will grow rapidly for health and welfare support workers (2.3% per year), child carers (2.6% per year) and personal carers and assistants (2.4% per year).

Employment for most clerical and administration workers will increase at about average rate, but for machine operators and drivers the increase will be at below-average rate due to the slowdown in the mining and construction industries (see discussion below).

The subdued demand in the retail trade industry means the demand for sales workers will grow at well below average rate (1.1% per year), with their share of total employment dropping from 9.4% in 2016 to 8.9% in 2024. Sales assistants and salespersons, the largest occupation among sales workers, will employ 802 800 persons in 2024, which represents an increase of 0.9% per year from 2016. Employment for checkout operators and cashiers will grow even more slowly (0.8% per year).

Employment for labourers will also grow at below-average rate (1.5% per year). Cleaners and laundry workers, the largest occupation in this group, will employ 311 800 in 2024, an increase of 1.9% per year from 2016. Not surprisingly, with the slowdown in mining, the demand for construction and mining labourers, while still positive, will grow at below-average rate (0.9% per year).

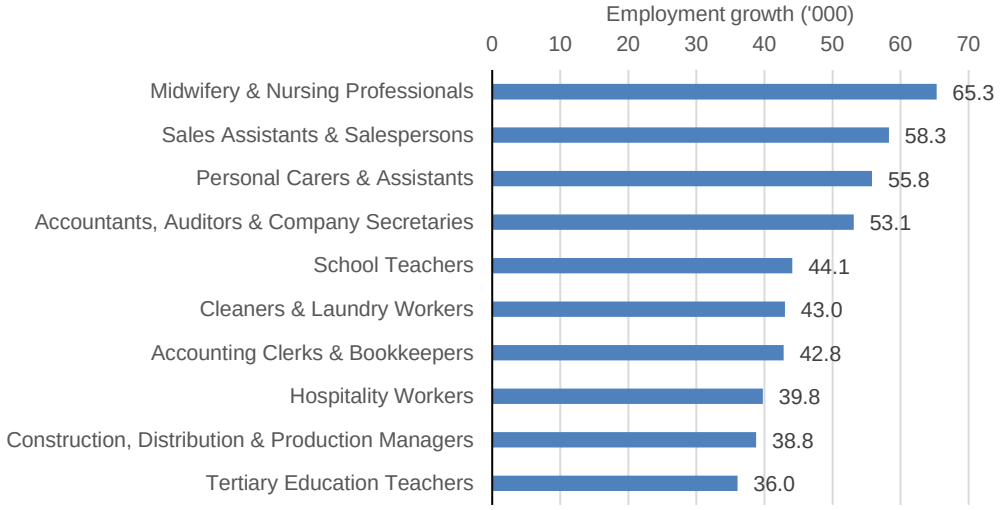
Table 2 Employment by occupation (major), Australia, 2016 (actual[1]) and 2024 (forecast): most likely scenario

Occupation (ANZSCO 1-digit)	Employment ('000)		% distribution		Average year-on-year % change	
	2016	2024	2016	2024	2011–16	2016–24
Managers	1537	1805	13.0	13.2	1.4	2.0
Professionals	2712	3288	22.9	24.0	2.5	2.4
Technicians and trades	1712	1939	14.4	14.1	0.9	1.6
Community and personal service workers	1230	1430	10.4	10.4	3.6	1.9
Clerical and administration	1661	1918	14.0	14.0	0.1	1.8
Sales workers	1117	1221	9.4	8.9	1.4	1.1
Machinery operators and drivers	753	849	6.4	6.2	0.6	1.5
Labourers	1129	1270	9.5	9.3	-0.3	1.5
Total	**11 852**	**13 720**	**100.0**	**100.0**	**1.4**	**1.8**

Notes: 1 Filtered using Hodrick-Prescott method to remove cyclical fluctuation.
ANZSCO = Australian and New Zealand Standard Classification of Occupations.
Source: Victoria University employment forecasts.

Figure 6 shows the 10 occupations, at the minor level, with the highest increase in employment between 2016 and 2024. The growth in these 10 occupations represents about a quarter of total employment growth. In absolute terms, midwifery and nursing professionals will see the highest increase, followed by sales assistants and salespersons numbers.

Figure 6 Ten occupations (minor) with highest employment growth, Australia, 2016–24: most likely scenario



Source: Victoria University employment forecasts.

Forecasts by industry

Table 3 shows that the employment growth to 2024 will be positive in all industries, but its distribution will be uneven. Forecasts at industry subdivision level can be found in table A2 in appendix A. The largest growth will be in professional, scientific and technical services, with employment increasing by almost a quarter, or 244 000, to 2024. The average year-on-year growth (2.8%) in the sector will be lower than it has been in the recent past (3.2%).

The largest employing sector will be the health care and social assistance services, employing 1.8 million people, or 13.4% of total employment, in 2024. This partly reflects the growing share of health expenditure in household budgets. The largest growth within the sector will be in residential care and social assistance. We include in the model the effect of the implementation of the National Disability Insurance Scheme as a stimulus to government expenditure on residential care and social assistance. A link between the trends in the proportion of the population aged over 65 years and household and government preferences in spending on health care reflects the expenditure on health care associated with the ageing of the population.

Employment in agriculture, forestry and fishing will benefit from the lower value of the Australian dollar relative to the currencies of Australia's major trading partners and expanding export opportunities through free trade agreements (FTA) with countries in East Asia.

The overall employment in mining will grow at below-average rate. With the decline in iron ore and coal prices over the last few years, the construction of new mines will diminish significantly, although production will continue in existing mines. Notwithstanding the recovery in some key commodity export prices in 2016, particularly iron ore, driven in part by expectations of ongoing stimulus to meet China's GDP growth targets, prices are weaker than seen over recent years. The implication is that the terms of trade for Australia will remain lower for a while. There is still a risk that increases in commodity prices in 2016 may not be sustainable. However, current prices are more representative of longer-term averages than the extraordinary peaks experienced during the last mining boom (Australian Government 2016).

Labour utilisation in mining is usually most intense at the construction phase. It then tapers down to some lower equilibrium level during the production phase. Some types of employment opportunities will be reduced with increasing automation in mining operations. However, employment will grow in the oil and gas extraction subsector.

Employment in manufacturing steadily declined from about 2007 until early 2016. However, our modelling suggests employment in this industry will increase strongly (2.5% per year) in the forecast period. Apart from a decline in employment of 17,700 in transport equipment manufacturing, which includes the car industry, employment in most other subsectors of manufacturing will increase. In particular, employment growth will be strong in machinery and equipment manufacturing (6% per year) and in basic chemical and chemical products manufacturing (4.1% per year).[29] Some workers laid off from transport and equipment manufacturing will probably find work in machinery and equipment manufacturing, as the two sectors have similar occupation profiles. The falling value of the Australian dollar (reflected in the terms of trade) makes exports of manufactured goods, especially where there is strong preference for 'Made in Australia' products (for example, food and beverages, pharmaceuticals and speciality high-technology equipment), more competitive and increases their demand. At the same

29 Recently released statistics from the ABS show employment in manufacturing grew by 3.1% in the 2016—17 financial year (ABS 2017b). Nevertheless, we advise caution with respect to the forecasts of employment in manufacturing and suggest further monitoring and research to understand the sources of growth in the industry.

time, locally manufactured products will replace imports as these become relatively more expensive. Growing awareness of the opportunities for exporting manufactured goods as a consequence of Australia's signing of a number of free trade agreements will assist growth in the industry. Despite the expected cooling of activity in building construction in general, residential construction typically has a 'long tail' of demand for related goods and services, which will continue to generate demand in manufacturing and other industries (Australian Industry Group 2017).

Employment growth in all areas of construction will slow, especially building construction. This is partly a result of the assumption in the model that dwelling investment will be lower in the later years of the forecast period.

While employment growth in wholesale trade will be at about the average rate, growth in retail trade will be below the average rate. Retail trade's share of total employment will decline from 10.6% in 2016 to 9.7% in 2024. The growth in the sector is mainly associated with the overall household expenditure on manufactured goods,[30] which has been weak and is underscored by stagnation in wage growth and a gradual reallocation of the household budget towards services, utilities and health care. The growth in employment in the sector, relative to growth in output, has also been weak in recent years, pointing to technical changes in the sector, including the adoption of automation technologies and the increase in online shopping's share of the total retail trade sector.[31] In our forecasts, we carry forward these trends in tastes and technology, leading to weak growth in retail trade employment over the forecast period. Online shopping, on the other hand, may have a positive effect on transport, postal and warehousing through more demand for delivery and postal services.

The continuing rollout of the National Broadband Network and the ensuing demand for internet services will drive the growth in employment in information, media and telecommunications. Employment in the sector will increase 2.6% per year to 2024.

Employment will grow at above-average rate in education and training. The sector will employ 1.1 million people in 2024, which represents an average annual increase of 2.2% from 2016. The percentage growth will be much higher in the tertiary education than in the pre-school and school education sectors.[32] A significant factor in the expected growth in tertiary education is inflows of international students to Australia. The current Australian Government policies will slow the growth in spending on education, while the constraint implicit in getting the budget into surplus by early 2020s will slow the growth in employment in pre-school and school education. In early childhood, reforms (for example, the adoption of the Early Years Quality Framework) leading to improved child-to-teacher ratio are generally already in place and so further demand from this source will slow. The continuing stagnation in wage growth has the potential to affect demand for early childhood education.

30 Manufactured goods are largely discretionary in the household budget.

31 Online shopping from overseas sites is probably included as imports in the national accounts.

32 Further research could investigate the sources of growth in employment in tertiary education. One possible source could be the increasing proportion of part-time workers in the sector. The proportion of workers working part-time increased from 37% in 2011 to 39.7% in 2017 (ABS 2017b).

The weak growth in employment in public administration and safety is a consequence of the model reflecting the Australian Government budget projections of a return to surplus by 2019—20.[33]

Table 3 Employment by industry (division), Australia, 2016 (actual[1]) and 2024 (forecast): most likely scenario

Industry (ANZSIC division)	Employment ('000)		% distribution		Average year-on-year % change	
	2016	2024	2016	2024	2011–16	2016–24
Agriculture, forestry and fishing	316	373	2.7	2.7	-0.9	2.1
Mining	240	264	2.0	1.9	2.8	1.2
Manufacturing	887	1081	7.5	7.9	-1.8	2.5
Electricity, gas, water and waste	145	161	1.2	1.2	0.7	1.2
Construction	1046	1129	8.8	8.2	0.9	1.0
Wholesale trade	379	439	3.2	3.2	-1.6	1.9
Retail trade	1253	1325	10.6	9.7	0.9	0.7
Accommodation and food	824	970	7.0	7.1	2.1	2.1
Transport, postal and warehousing	617	744	5.2	5.4	1.6	2.4
Information media and telecommunications	207	253	1.7	1.8	-0.9	2.6
Financial and insurance	423	505	3.6	3.7	0.7	2.2
Rental, hiring and real estate	213	246	1.8	1.8	1.5	1.8
Professional, scientific and technical	989	1233	8.3	9.0	3.2	2.8
Administrative and support	412	489	3.5	3.6	1.8	2.2
Public administration and safety	745	752	6.3	5.5	1.4	0.1
Education and training	937	1113	7.9	8.1	2.2	2.2
Health care and social assistance	1512	1845	12.8	13.4	3.8	2.5
Arts and recreation	226	253	1.9	1.8	2.4	1.4
Other	480	545	4.1	4.0	1.3	1.6
Total	**11 852**	**13 720**	**100.0**	**100.0**	**1.4**	**1.8**

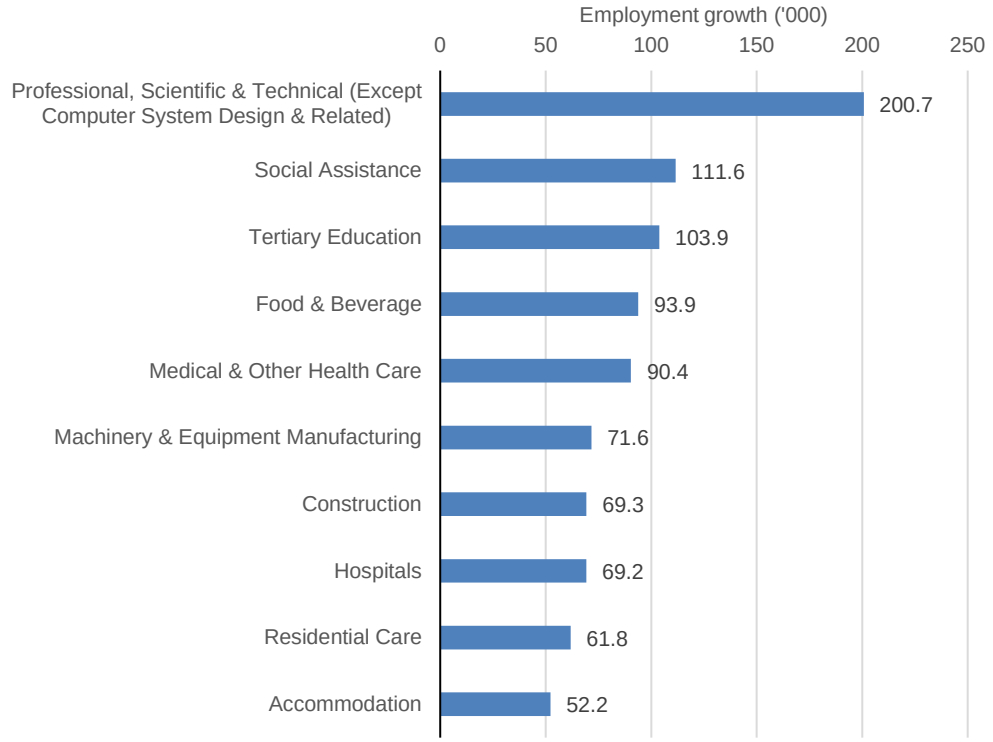
Notes: 1 Filtered using Hodrick-Prescott method to remove cyclical fluctuation.
ANZSIC = Australian and New Zealand Standard Industrial Classification.

Source: Victoria University employment forecasts.

Figure 7 shows the ten industries, at the subdivision level, with the highest employment increase between 2016 and 2024. The professional, scientific and technical (except computer system design and related) industry will employ the greatest number of additional people in 2024 by comparison with the number in 2016. By contrast, the industry with the second highest increase will employ only about half as many additional people.

33 The latest trend data on employment show a decline of 3% in the sector between August 2016 and August 2017 (ABS 2017b). We advise caution with respect to the forecasts for this sector.

Figure 7 Ten industries (subdivision) with highest employment growth, Australia, 2016–24: most likely scenario



Source: Victoria University employment forecasts.

Expansion demand, replacement demand and job openings

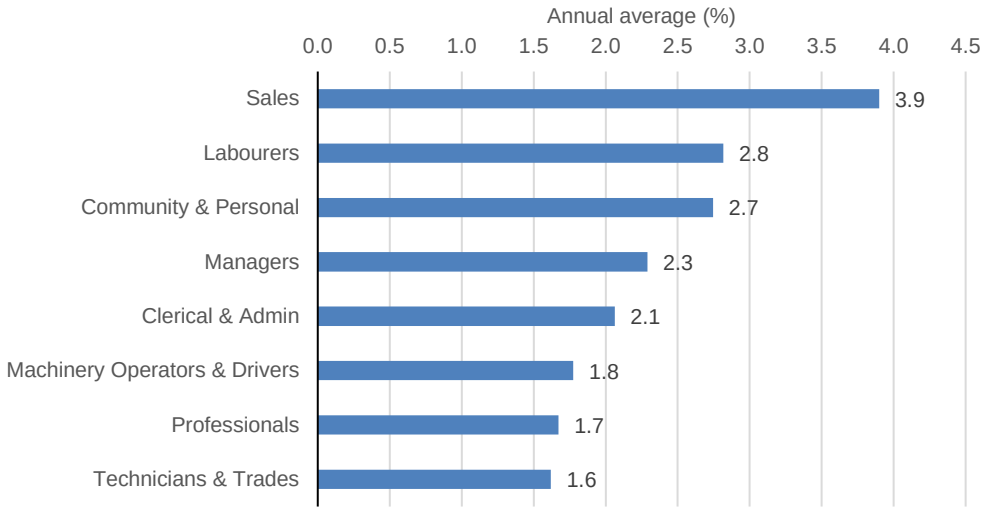
We use a model outside the VU framework to produce forecasts of replacement demand by occupation.[34] Figure 8 shows the annual replacement demand rate by major occupation. The rates by minor occupation are available in table A3 in appendix A. The replacement rates are higher for occupations in which workers stay for relatively short periods. Sales workers and labourers are two such occupation groups. These occupations typically have low entry requirements, do not pay well and employ large numbers of young people, many of whom are often training for other occupations at the same time. Many workers in these occupations leave when they finish training for their preferred occupation and, therefore, turnover is typically high in these occupations. Replacement rates can also be higher for occupations with older workforces. For example, the school teacher workforce is older than that of business and systems analysts and programmers and consequently it has a higher replacement demand rate: 2.4% compared with 1%.[35] The method for calculating replacement demand assumes all workers in an occupation retire when they reach 70 years of age. This means that replacement demand may be an over-estimate for occupations in which a substantial number of workers continue to work past the age of 70 years.

34 We produce estimates of replacement demand at the ANZSCO 3-digit level and then aggregate up to 1-digit.

35 In 2017, 19.3% of school teachers were aged 55 years or older compared with 10.1% of business analysts, systems analysts and programmers.

Forecasts of job openings for new entrants are the sum of expansion demand and replacement demand. When employment contracts in an occupation, the source of job openings is only replacement demand.

Figure 8 Replacement rate forecasts by occupation (major), Australia, 2017–21



Source: Authors.

Forecasts of job openings by occupation

Table 4 shows forecasts of job openings by major occupation groups. It indicates that the total number of job openings for new entrants over the eight-year period from 2017 and 2024 will be about 4.1 million, with more than half of these resulting from replacement demand. On average, there will be 516 600 job openings per year. Forecasts of job openings at the minor occupation level are in table A4 in appendix A.

In the eight years to 2024, the highest numbers of job openings, on average 121 700 per year (973 600 in total), will be in professional occupations, with replacement demand the source of about 40.8% of these jobs. Within professionals, the numbers of job openings for school teachers (15 400 per year, 123 300 total) and midwifery and nursing professionals (16 200 per year, 129 600 total) will be about the same. Even though the replacement rate for both occupations is about the same (2.4%), replacement demand will be the source of 64.2% of job openings for school teachers compared with only 49.6% for midwifery and nursing professionals. The latter occupation will experience a higher growth in employment because of the expanding health and caring sector. Replacement demand will be the source of less than 40% of all job openings in 16 of 23 professional occupations.

The second highest number of job openings, 71 300 per year on average (570 600 in total), will be for managers. Of these, 10 100 per year (80 900 total) will be for farmers and farm managers, with replacement demand the source of 63.3% of these openings. The age profile of farmers and farm managers is on average much older than the rest of the workforce. In 2016, about half of them were 55 years or older, with a significant

proportion over 70 years.[36] The model for replacement demand assumes all people retire at age 70 years. As a result, the replacement rate for farmers and farm managers, at 3.4%, is much higher than the 2.2% total across all occupations. As many farmers tend to continue working past the age of 70 years, this means that in this case our model will over-estimate the actual replacement rate for this occupation. Consequently, our forecasts of job openings for farmers and farm managers may, to a certain extent, be over-optimistic.

Job openings for retail managers will number 8400 per year on average (66 800 in total), with replacement demand the source of around two-thirds of these openings and growth the source of one-third.

In 2016, 14.4% of all workers worked as technician or trade workers, but only 11.2% of all job openings over the next eight years (462 000 in total, 57 800 annually) will be for them. Replacement demand will be the source of about half of these job openings. In some trades, replacement demand will be the source of a much higher proportion of job openings; for example, replacement demand will be the source of 60.4% of job openings for bricklayers, carpenters and joiners (39 800 total available, 5000 annually) and 61.1% for automotive electricians and mechanics (32 400 total jobs available, 4100 per year). Much of the replacement demand in these occupations will be from experienced workers leaving, which may have implications for training, as fewer experienced workers will be available to supervise new apprentices.

By contrast, replacement demand will be the source of only 23.3% of job openings for information and communication technologies and telecommunications technicians (14 600 total job openings, 1800 per year). At 0.7%, the occupation has one of the lowest replacement rates. The relatively low replacement rate for the occupation is not only because its workforce is relatively young, with only 16.5% of the workforce 50 years or older in 2016, but also because of the current high demand in the information and communication technologies sector resulting from the rollout of the National Broadband Network. The high demand means that existing workers are less likely to leave for alternative occupations, and employers tend to retain their current workforce.

Personal carers and assistants, and hospitality workers, are the two largest occupations in the community and personal service workers group. Job openings in these two occupations are forecast to be 108 600 and 162 900 respectively (on average, 13 600 and 20 400 per year). While the replacement rate for the former is 2.2%, the rate for the latter is 5.3%. As a result, replacement demand is the source of nearly three-quarters of all job openings for hospitality workers compared with about half for personal carers and assistants. The hospitality worker occupation, like a number of other occupations in the retail trade, has a low entry requirement, pays low wages and employs large numbers of young people, who stay in the occupation for short periods. The combination of these factors means turnover is high in the occupation. Job openings for health and welfare support workers and child carers will total around 108 400 over the next eight years.

36 Unpublished data: various ABS Labour Force Surveys (cat.no.6291.0), 2015—16. In 2016, 13.5% of farmers and farm managers were 70 years or older.

Replacement demand will be the source of 53.3% of the 549 900 job openings for clerical and administration workers over the next eight years (68 700 annually). The occupation with the largest number of job openings, 12 200 per year on average (97 600 in total), will be accounting clerks and bookkeepers. However, the occupation with the largest source of job openings from replacement demand will be that of receptionists, with 63.8% from replacement demand and 36.2% from expansion demand.

Job openings for sales workers will total 466 400 (58 300 per year), with replacement demand the source of 77.7%. Just less than two-thirds of these job openings will be for sales assistants and salespersons, with four out every five a result of replacement demand. Job openings for checkout operators and office cashiers will be somewhat fewer, at 9500 per year (76 400 in total), but the source of most of these will be replacement demand (89.4%). The replacement rate for the occupation, at 6.4%, is one of the highest rates for any occupation. This is largely because most workers in the occupation are young, with 60% under 25 years, and most stay in the occupation for a relatively short period.

Job openings for machinery operators and drivers will total 208 500 (26 100 per year). The largest number will be for truck drivers, 6800 per year (54 400 in total), with replacement demand accounting for 59.7%. Job openings for plant operators (stationary and mobile) will total 56 900 (7200 per year). Replacement demand will proportionally be a larger source of job openings for stationary plant operators (62.7%) than for mobile plant operators (45.3%).

Replacement demand will be the source of two-thirds of the 410 900 (51 400 per year) job openings for labourers. About a half of these job openings will be for food preparation assistants (14 200 per year, 113 700 total) and cleaners and laundry workers (12 400 per year, 98 900 total). While replacement demand will be the source of 56.5% of job openings for cleaners and laundry workers, it will be the source of 80.9% of job openings for food preparation assistants.

Table 4 Job openings by occupation (major), Australia, 2017–24: most likely scenario

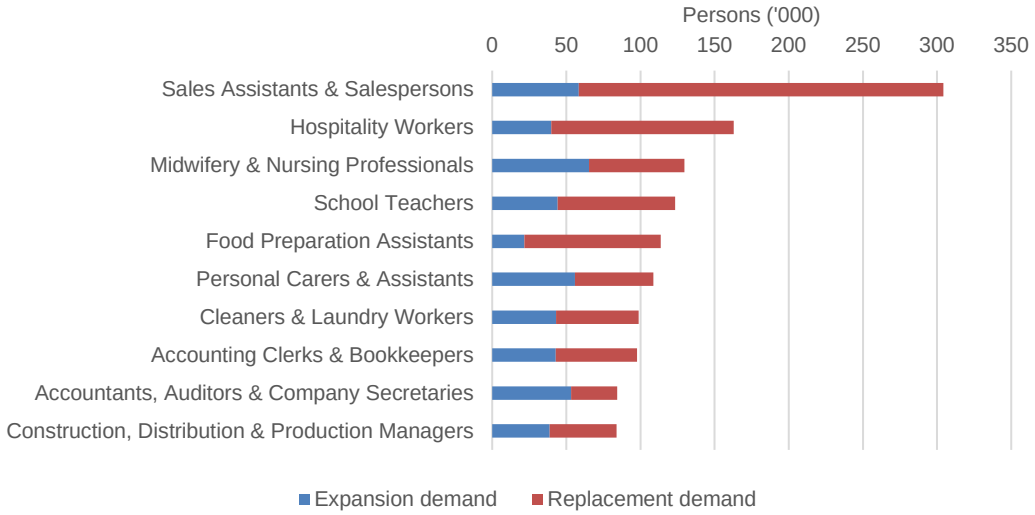
Occupation (ANZSCO 1-digit)	Job openings 2017–24 ('000)			Job openings annual average 2017–24 ('000)			Rep. demand
	Exp. demand	Rep. demand	Total	Exp. demand	Rep. demand	Total	% of total
Managers	267.6	303.0	570.6	33.5	37.9	71.3	53.1
Professionals	576.0	397.6	973.6	72.0	49.7	121.7	40.8
Technicians and trades	227.1	235.0	462.0	28.4	29.4	57.8	50.9
Community and personal service workers	199.8	291.3	491.1	25.0	36.4	61.4	59.3
Clerical and administration	256.6	293.3	549.9	32.1	36.7	68.7	53.3
Sales workers	104.1	362.2	466.4	13.0	45.3	58.3	77.7
Machinery operators and drivers	95.4	113.1	208.5	11.9	14.1	26.1	54.3
Labourers	140.9	270.0	410.9	17.6	33.7	51.4	65.7
Total	1867.5	2265.4	4132.9	233.4	283.2	516.6	54.8

Notes: Exp. = expansion.
Rep. = replacement.

Source: Victoria University employment forecasts and authors.

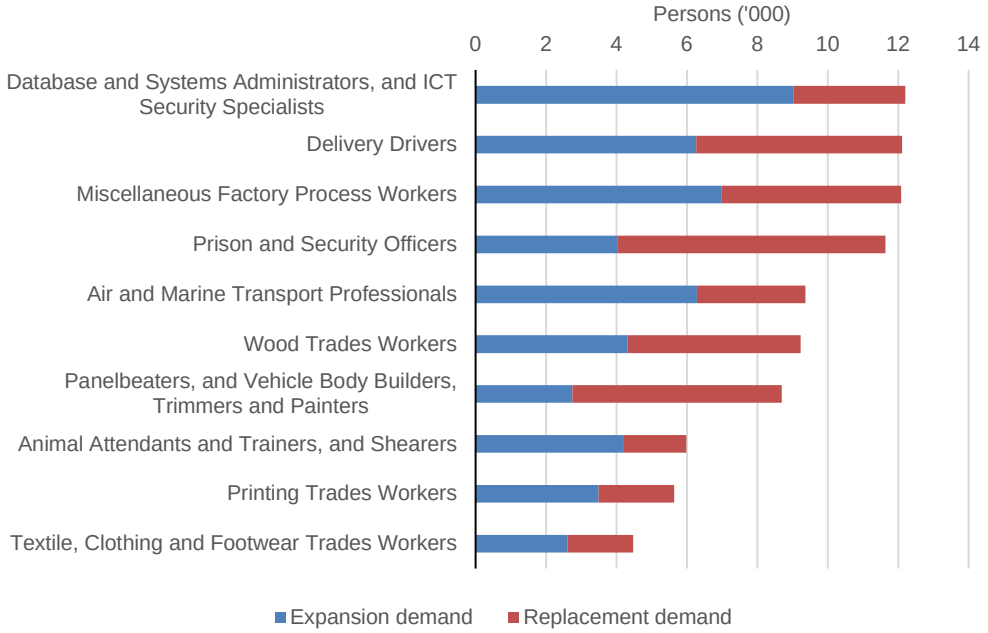
Figures 9 and 10 show the occupations with the highest and lowest job openings, respectively. The figures illustrate the relative importance of expansion demand and replacement demand as a source of job openings for new entrants.

Figure 9 Occupations (minor) with the highest job openings, 2017–24, Australia: most likely scenario



Source: Authors.

Figure 10 Occupations (minor) with the lowest job openings, 2017–24, Australia: most likely scenario



Source: Authors.

Estimates of job openings by industry

Table 5 shows the forecasts of job openings at the industry level. These are approximations based on each industry's occupational shares.[37] The highest number of job openings over the eight years, 595 100 (74 400 per year), will be in the largest industry of health care and social assistance, with replacement demand the source of 48.7% and industry growth the source of 51.3% of these openings. Retail trade will have the second highest number of job openings, totalling 464 000 (58 000 per year), of which replacement demand will be the source of 72.7%. The results for these two industries reflect their different occupational composition. Health care and social assistance employs proportionately more workers in professional occupations, which generally have lower replacement rates. By contrast, retail trade, as well as accommodation and food, employs quite large numbers of young workers in occupations with low entry requirements and low wages. Workers in these occupations have typically short tenure, leading to high occupational replacement rates.

Table 5 Job openings by industry (division), Australia, 2017–24: most likely scenario

Industry (ANZSIC division)	Job openings 2017–24 ('000)			Job openings annual average 2017–24 ('000)			Rep. demand
	Exp. demand	Rep. demand	Total	Exp. demand	Rep. demand	Total	% of total
Agriculture, forestry and fishing	51.0	71.8	122.9	6.4	9.0	15.4	58.5
Mining	37.2	36.9	74.0	4.6	4.6	9.3	49.8
Manufacturing	137.3	146.6	284.0	17.2	18.3	35.5	51.6
Electricity, gas, water and waste	22.5	21.6	44.1	2.8	2.7	5.5	49.0
Construction	126.1	152.2	278.3	15.8	19.0	34.8	54.7
Wholesale trade	58.7	64.7	123.4	7.3	8.1	15.4	52.4
Retail trade	126.7	337.3	464.0	15.8	42.2	58.0	72.7
Accommodation and food	117.8	280.4	398.2	14.7	35.1	49.8	70.4
Transport, postal and warehousing	94.2	107.6	201.8	11.8	13.5	25.2	53.3
Information media and telecommunications	38.9	29.6	68.5	4.9	3.7	8.6	43.2
Financial and insurance	79.5	70.9	150.4	9.9	8.9	18.8	47.1
Rental, hiring and real estate	33.1	37.7	70.8	4.1	4.7	8.8	53.3
Professional, scientific and technical	201.0	135.3	336.3	25.1	16.9	42.0	40.2
Administrative and support	67.3	72.8	140.1	8.4	9.1	17.5	51.9
Public administration and safety	109.3	110.0	219.3	13.7	13.8	27.4	50.2
Education and training	155.3	176.2	331.5	19.4	22.0	41.4	53.1
Health care and social assistance	305.1	290.0	595.1	38.1	36.2	74.4	48.7
Arts and recreation	36.1	41.4	77.5	4.5	5.2	9.7	53.4
Other	70.4	82.4	152.8	8.8	10.3	19.1	53.9
Total	**1867.5**	**2265.4**	**4132.9**	**233.4**	**283.2**	**516.6**	**54.8**

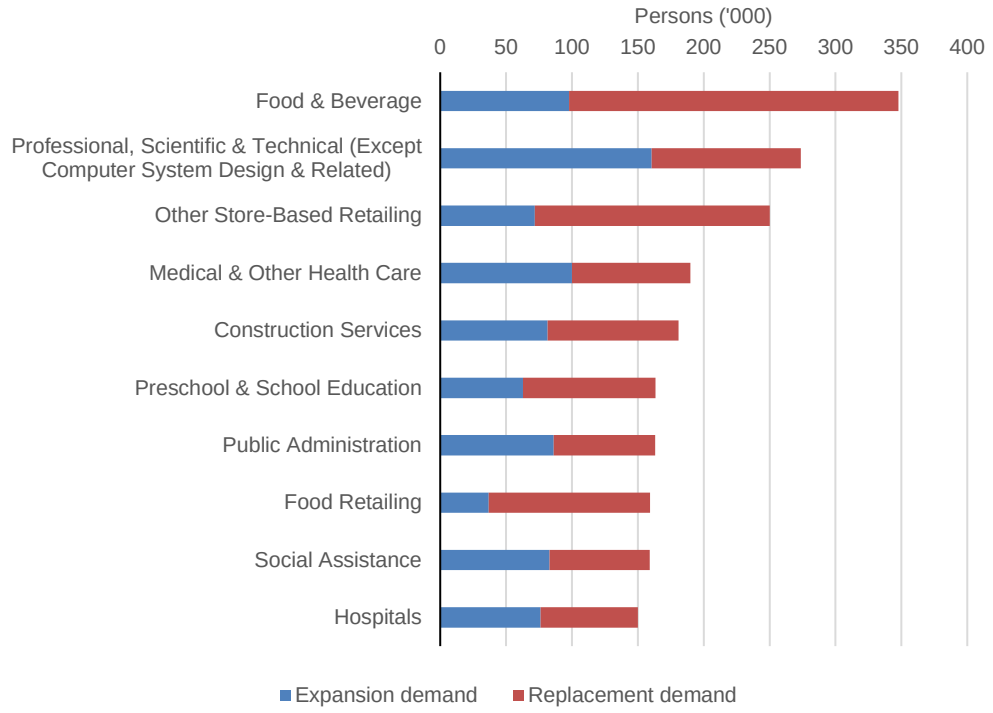
Notes: Exp. = expansion.
Rep. = replacement.

Source: Victoria University employment forecasts and authors.

37 As a result, job openings from expansion demand calculated from the industry level forecasts may diverge slightly from those reported here.

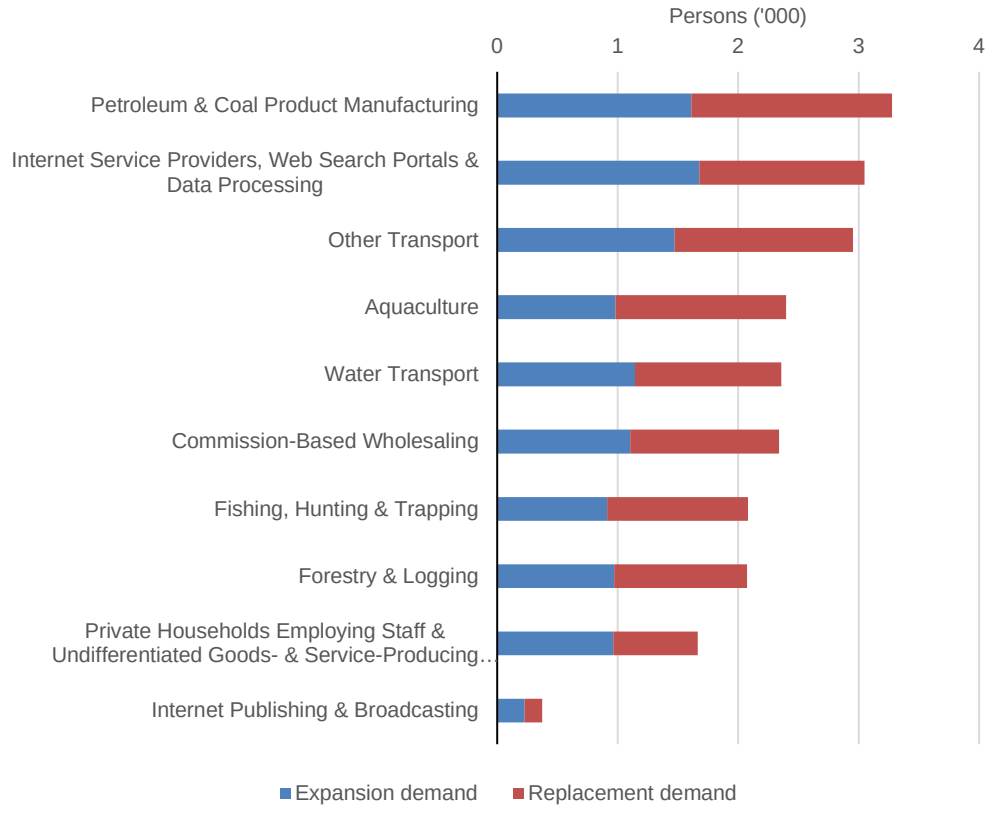
Figures 11 and 12 show the industry sectors with the highest and lowest job openings, respectively.

Figure 11 Industries (subdivision) with the highest job openings, Australia, 2017–24: most likely scenario



Source: Authors.

Figure 12 Industries (subdivision) with the lowest job openings, Australia, 2017–24: most likely scenario



Source: Authors.

Results for high-productivity scenario

The high-productivity scenario assumes that productivity makes an additional contribution to the growth in GDP of 0.4 percentage points, compared with the most likely scenario. We assume that aggregate employment in the scenario will be the same as it is in the most likely scenario. As discussed in the introduction, productivity increase can result from a number of sources: from changes in technology, such as the use of machines or software; from reducing skills mismatch; and from changes in business practices and product mix. The current version of the VU model does not model these factors individually. Instead, the model assumes that the productivity improvement affects the technical efficiency of all industries equally, although the impact on industry growth will vary because of demand factors. Stronger productivity growth not only leads to higher GDP growth but also to an increase in both domestic consumption and exports.

There is also a small devaluation in the currency, leading to lower production costs, although this is partially offset by higher domestic incomes and wages. This puts upward pressure on local prices and leads to changes in the pattern of demand. The constraint on aggregate employment means that the effect of higher productivity can only be manifested in some level of redistribution of employment across industries and occupations compared with the most likely scenario.

Below we focus on the net gain (loss) in job openings by occupation and industry in the high-productivity scenario compared with that in the most likely scenario.[38] The source of these changes is largely expansion demand. Figures 13 and 14 show these net changes by occupation (major) and industry (division), respectively.

At this level of occupational aggregation, there will be a net gain of 32 500 job openings in five occupation groups and a similar corresponding net loss of 33 100 in three.[39] In the overall scheme of things, these are small changes. The gaining occupation groups can generally, although not always, be characterised as high-skill and the net losing groups as low-skill. This suggests a skill-biased employment change in the high-productivity growth scenario compared with the most likely scenario.

At the division level, 14 industries will have a net gain in job openings and five will have a net loss. The largest net gains will be in professional, scientific and technical services and manufacturing; the largest net losses will be in health care and social assistance, and retail trade. The productivity growth results from the substitution of labour with technology.

Manufacturing is able to expand in the domestic market (through import substitution), as well as in the export market (currency devaluation). As output is unlikely to increase in sectors such as health care and social assistance, they tend to shed workers. Despite the positive effect of household expenditure on retail trade, resulting from high productivity, job openings in the sector decline. This suggests that the reduction in employment from the adoption of technology in the sector more than offsets any employment increase from increased in demand.

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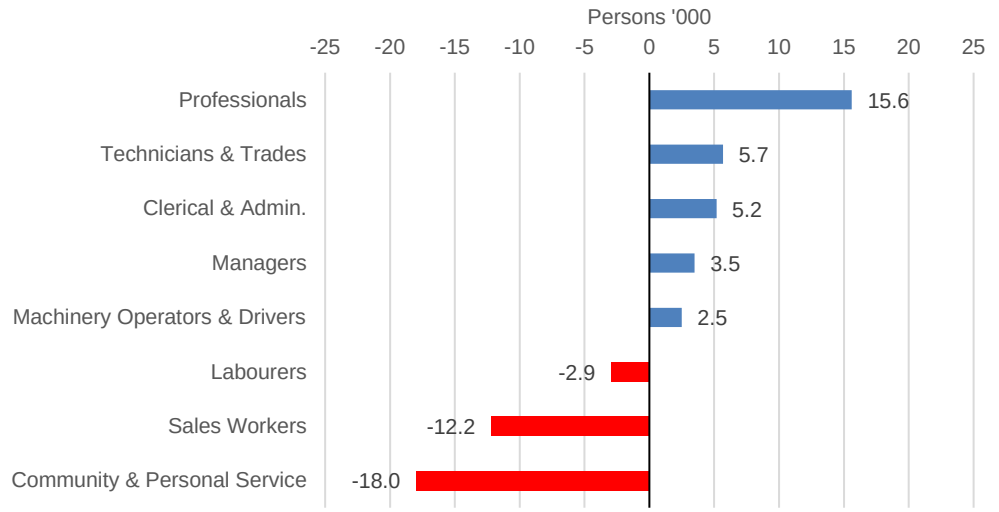
38 Detailed results for the high-productivity scenario are available on request from the authors.
39 The small discrepancy between the net gain and net loss is due to rounding errors.

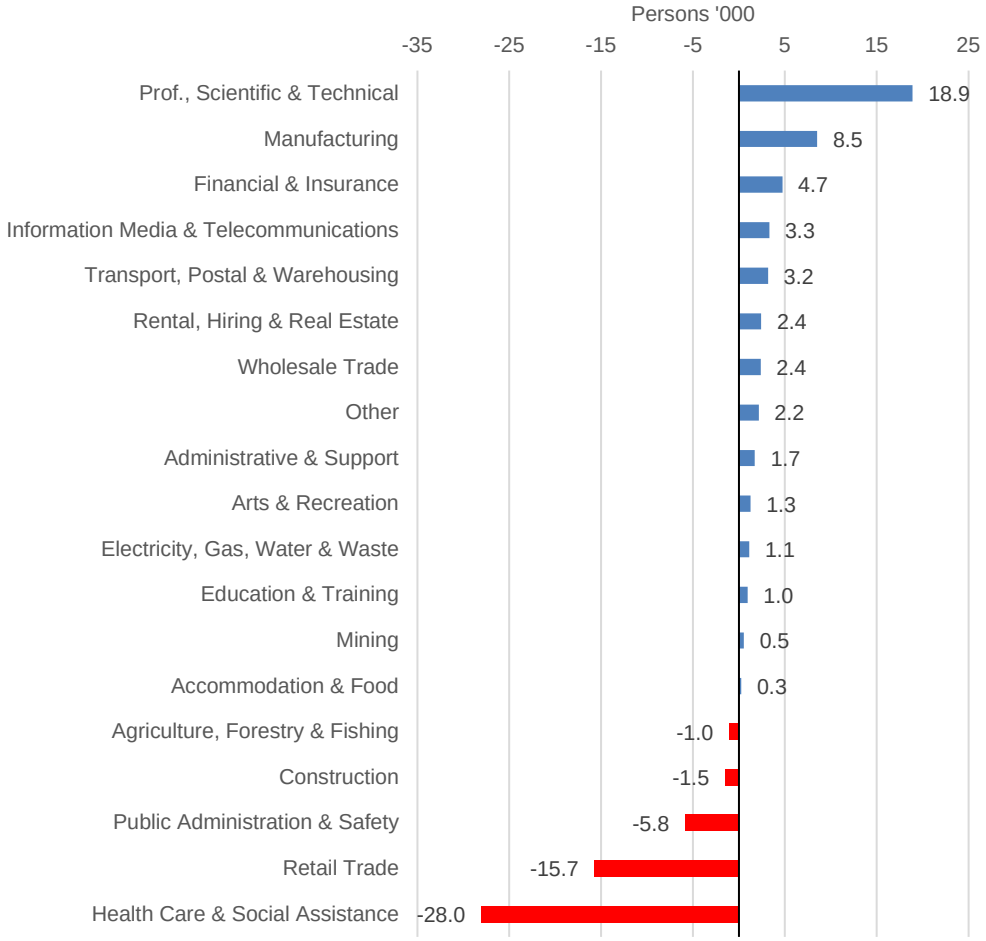
Aggregating occupations and industries tends to cancel out the net gains and losses in job openings, as well as mask some of the details in the changes between the two scenarios. At the minor occupation level, the net gain in job openings is about 75 000, with a corresponding similar net loss (see footnote 38). Figure 15 shows some of the minor-level occupations with the largest net gains and the largest net losses in job openings. Similar results at the industry level (subdivision) are in figure 16. Figure 15 suggests a net loss in job openings for school teachers and midwifery and nursing professionals. All else being equal, this can only happen with an increase in the pupil-to-teacher and patient-to-nurse ratios, but these ratios are generally determined by policy and not by the market. This means that the modelling assumption of uniform productivity growth across all sectors in the high-productivity scenario does not accurately reflect the Australian labour market, and suggests cautious use of the estimates.

Figure 13 Net gains (losses) in job openings by occupation (major), Australia, 2017–24: high-productivity scenario relative to the most likely scenario



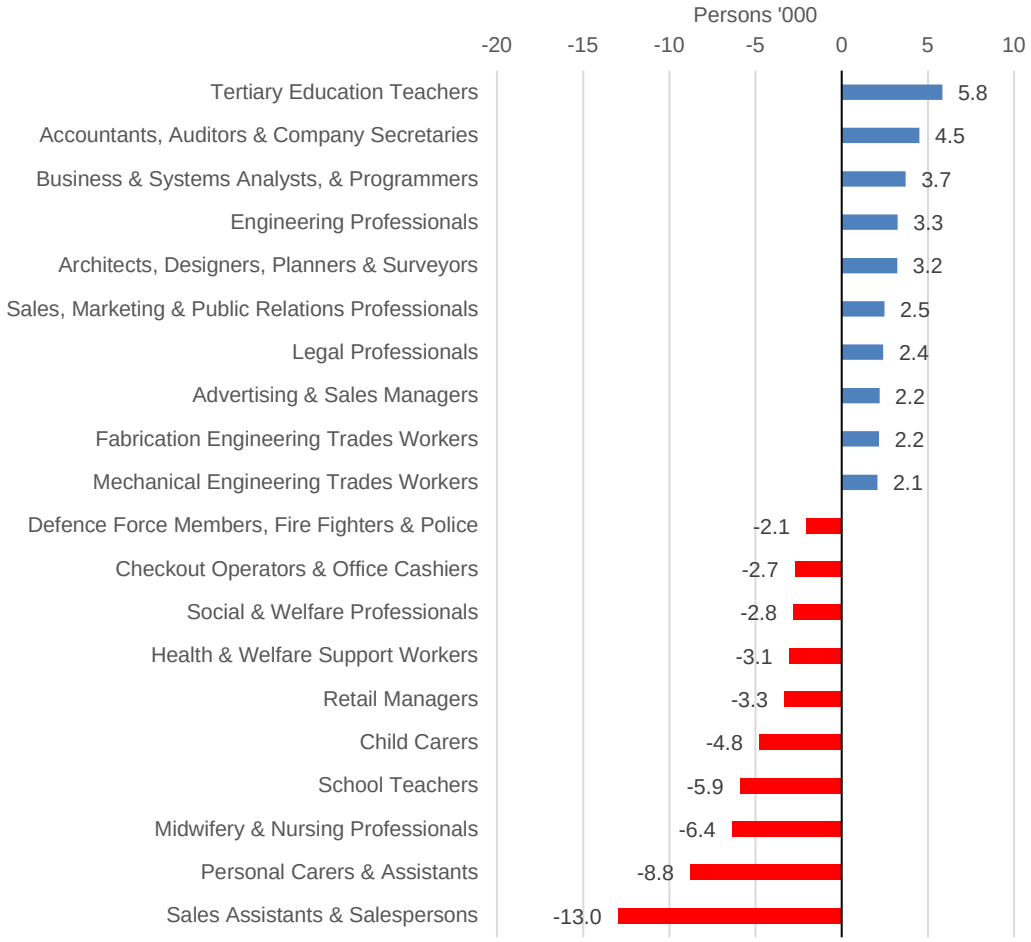
Source: Authors.

Figure 14 Net change in job openings by industry (division), Australia, 2017–24: high-productivity scenario relative to the most likely scenario



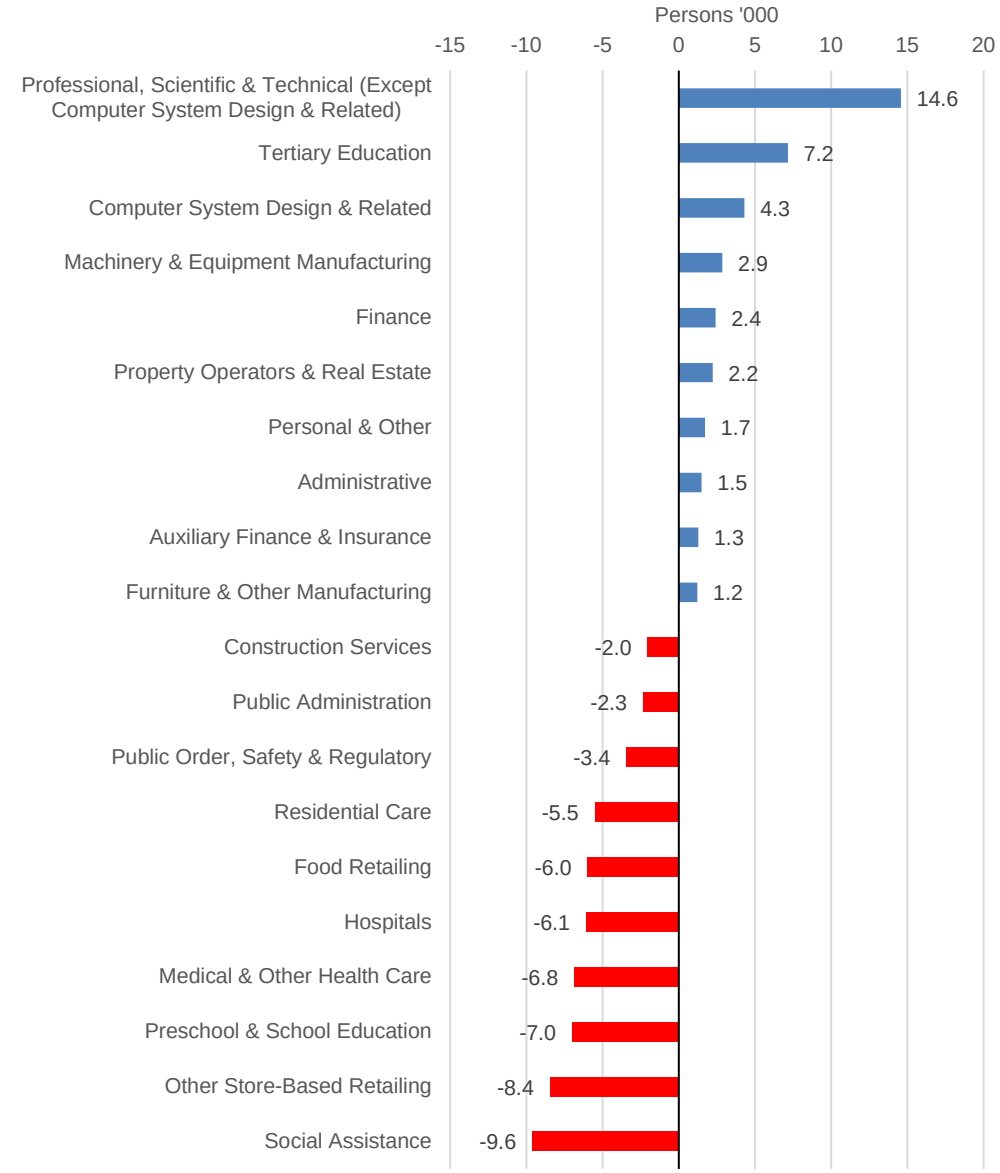
Source: Authors.

Figure 15 Occupations (minor) with the highest net gains (losses) in job openings, Australia, 2017–24: high-productivity scenario relative to the most likely scenario



Source: Authors.

Figure 16 Industries (subdivision) with the highest net gains (losses) in job openings, Australia, 2017–24: high-productivity scenario relative to the most likely scenario



Source: Authors.

Labour market information, skills imbalances and productivity

In this chapter we briefly discuss labour markets and how our forecasts could be useful for interpreting current activity in the labour market. We cover labour market imperfections, skills imbalances and skills mismatch.

In a perfectly competitive neoclassical labour market, price and quantity adjust until the market clears, such that imbalances in the supply and demand for skills do not persist. Firms adapt production processes to the available stock of human capital, and workers seek the amount and type of training currently required (or foreseen) in an economy (Hartog 2000). Underpinning this model is the assumption of perfect information, including that relating to the future structure of employment.

The labour market is thus perpetually in a state of flux, meaning that at any point in time the supply and demand for skills will be in imbalance. Furthermore, tasks performed within occupations also change with advances in technology, which adds to the changing supply and demand for skills. Labour markets are thus rarely perfect and labour market information is imperfect and often asymmetrical.

Skill imbalances are a reflection of the imperfections in the functioning of the labour and training markets and include factors that impede the market-clearing function of wage adjustment.[40] Lack of transparency in the labour and training markets, including in the links between education and training and job opportunities, is another important source of inefficiency and leads to skills imbalance. In reality, students, workers, employers and training institutions may lack information about prospective skills requirements in the labour market. In the presence of incomplete information and the time lag between the decision to enter education or a worker training program and that of entering the labour market, individuals may under- or over-estimate employment prospects, leading to skills imbalances (Heijke & Borghans 1998; Shah & Burke 2005).

Perfect matching between skills demand and supply is neither feasible nor necessary, especially when a one–to-one relationship often does not exist between the skills sets people have and jobs (Rihova 2016).[41] Nevertheless, public access to high-quality and timely labour market information is a key factor for ensuring individuals and enterprises adapt to changing demand for skills (International Labour Organization, Organisation for Economic Co-operation and Development & World Bank Group 2014). Effective adaptation reduces the risk of persistent skills imbalances, as the longer the imbalances exist, the higher the potential cost to the economy.

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40 The time lag associated with wage adjustment can be affected by contracts of employment between employers and employees, centralised wage-setting arrangements, wage controls and social welfare provisions and other institutional rigidities (OECD 1994). Delays by employers in accepting the need for wage adjustment and the reluctance to disturb existing wage structures in order to raise the rates for new employees with the required skills can also retard the process of wage adjustment (Arrow & Capron 1959).

41 A perfect match may in fact be detrimental, particularly when it is low-skills equilibrium, which then prevents further skills development and results in constraints to country competitiveness and social prosperity.

Investigations into the economic cost of skills imbalances tend to make a distinction between skills shortages and skills mismatches. A skills shortage occurs when there is an insufficient supply of appropriately qualified workers willing to work under prevailing employment conditions, particularly current wage rates (Shah & Burke 2005). Persistent skills shortages can affect labour productivity[42] growth (Haskel & Martin 1993; Bennett & McGuinness 2009). A skills surplus arises when there is an excess of supply, but most research tends to focus on the shortage, even though a persistent skills surplus also has an economic cost.

Skills mismatches, on the other hand, occur when the current skills of existing workers do not match the skills required in jobs (OECD 2016).[43] Skills shortages can be a cause of a skills mismatch when employers hire workers without the required skills for jobs because appropriately skilled workers are unavailable. Employers may, however, invest in on-the-job training to address the skills deficiency of these workers. Conversely, when there is a shortage of jobs, workers may accept jobs for which they are over-qualified.

The investigation of skills mismatch on productivity uses both indirect and direct methods. The indirect method uses workers' wages and other correlates of workers' productivity (for example, job satisfaction, absenteeism and turnover). The results from using wages as a measure of productivity show under- (over-) educated workers' wages, and hence productivity, to be lower (higher) than those of workers who are adequately educated. However, the research is inconclusive about the link between mismatch and productivity when other correlates of workers' productivity are used as proxy.[44]

Two studies, Mahy, Rycx and Vermeylen (2015) and Kampelmann and Rycx (2012), show the direct effect of mismatch on productivity at the firm level. They show a positive effect of over-qualification on firm-level productivity among firms in Belgium and a negative effect of under-qualification. Over-qualification had a stronger effect for firms with a higher share of high-skilled jobs in high-tech or knowledge-based industries. Adalet McGowan and Andrews (2015) investigated the direct effect of mismatch on productivity at the industry level. They found that a higher level of skills and qualifications mismatch is associated with lower productivity at the industry level.[45] An interesting result from this research was that a higher skills mismatch is associated with lower labour productivity through a less efficient allocation of resources.[46]

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42 The measure of labour productivity is hours per unit of output.

43 Skills mismatch is generally defined using skills (for example, literacy, numeracy and problem-solving) or education (for example, years of education, qualification level and field of study). The former is a more robust measure. OECD (2013) shows that one-third of workers in OECD countries experience qualification mismatch and one-sixth skills mismatch, and only 10% mismatched on both measures.

44 For a review, see Mahy, Rycx & Vermeylen (2015).

45 The effect on productivity was larger due to over-skilling and under-qualification. Allen & van der Velden (2001) suggest that skill and qualification mismatch can have different implications for productivity.

46 Adalet McGowan & Andrews (2015) suggest that when the share of over-skilled workers is higher in an industry, the more productive firms find it more difficult to attract skilled labour and gain market shares at the expense of less productive firms.

Concluding remarks

This report provides forecasts of job openings in the Australian labour market for new entrants by occupation and industry between the years 2017 and 2024. Two scenarios of the Australian economy are simulated.

The first, the most likely scenario, is consistent with the outcome assessed to be the most likely for the Australian economy. It is consistent with the major macroeconomic parameters forecast by the Australian Government at June 2016. In this scenario, we assume that productivity increases growth in GDP by 0.4 percentage points per year over the forecast period, with overall GDP increasing, on average, 2.7% per year between 2017 and 2024. Total employment (headcount) will increase from 11.8 million in 2016 to 13.7 million in 2024, an increase of 1.9 million, or 15.8%. This is a little more than the growth in the working-age population, which will grow by 13.8% over the same period.

The occupational structure of employment in this scenario will shift over time towards professionals and away from sales workers. The industrial structure will also shift over time towards professional, scientific and technical services, health care and social assistance and manufacturing (although there will be a decline in vehicle manufacturing) and away from construction, retail trade and public administration and safety.

Between 2017 and 2024, job openings for new entrants will total 4.1 million, with 54.8% from replacement demand. In this model, the sources of job openings in an occupation are expansion demand and replacement demand from retirement and job turnover. In some occupations, replacement demand will be the source of a much higher proportion of job openings. Many such occupations have low entry-level requirements, pay low wages and employ large numbers of young people, who stay for relatively short periods before moving on to occupations in their chosen long-term career, for which they may have been undertaking training. Replacement demand is also high for occupations with relatively older workforces, although the assumption that all workers retire at age 70 years may also be a factor in this for a few occupations.

In the high-productivity scenario, productivity's contribution to GDP growth is 0.8 percentage points, which is twice as much as in the most likely first scenario, but with aggregate employment still constrained to be the same. The model assumes that productivity improvement affects the technical efficiency of all industries equally, although the impact on industry growth will vary because of demand factors. Stronger productivity growth not only leads to higher GDP growth but also to an increase in both domestic consumption and exports and a small devaluation of the Australian dollar. The increase in productivity growth shifts the distribution of employment and job openings slightly towards high-skill jobs, which suggests a skill-biased technical change. Industries that gain employment are professional, scientific and technical services, and manufacturing, while those that lose employment are health care and social assistance and retail trade. In health care and social assistance, because output cannot increase, the effect is net job losses. Net loss in job openings for midwifery and nursing professionals, for example, means an increase in patient-nurse ratios, which are, however, dependent on policy, rather than being market-driven. This suggests that the assumption of uniform productivity growth across all industries in the model may not reflect Australian labour markets accurately.

The analyses demonstrate the importance of considering replacement demand when assessing job openings for new entrants. Job openings reflect more than simply growth in employment. They can also provide a more realistic way to assess future training needs where required for an occupation. Some jurisdictions are already using such information to prioritise areas where public investment in training should occur.

These forecasts provide a benchmark to initiate discussion and inform policy, although they are indicative, not prescriptive, of potential future structures of employment. They represent a view of the sort of employment patterns to expect in Australia in the medium term. In practice, the forecasts can usefully form part of a suite of information sources, which together provide a holistic view of the labour market for policymakers in education and training.

The information on future job opportunities given in this report may be useful for individuals making decisions on investment in education and training. The dissemination of this information would therefore be beneficial, although its method of presentation would require careful consideration to avoid confusion with related information from other sources. The Productivity Commission (2017) notes that, while the Australian Government has taken some steps to overcome information barriers, the burgeoning number of websites risks a confusing maze of information, working against the purpose for which such sites exist.

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Appendix A

Table A1 Employment by occupation (minor), Australia, actual (2016) and forecast (2024): most likely scenario

Occupation (ANZSCO 3-digit)	Employment ('000)			Average year-on-year % change	
	2011	2016	2024	2011–16	2016–24
Managers					
Chief Exec., Gen. Mngrs & Legislators	111.7	118.9	143.2	1.3	2.4
Farmers & Farm Mngrs	185.7	171.9	201.6	-1.5	2.0
Advertising & Sales Mngrs	129.8	137.0	166.3	1.1	2.5
Business Admin. Mngrs	147.6	152.1	184.5	0.6	2.4
Const., Distr. & Prod. Mngrs	228.1	252.3	291.1	2.0	1.8
Edu., Hlth. & Welfare Services Mngrs	58.6	72.1	87.4	4.2	2.5
ICT Mngrs	43.5	59.9	72.7	6.6	2.5
Misc. Specialist Mngrs	44.4	54.1	63.7	4.0	2.1
Accomm. & Hospitality Mngrs	99.8	110.4	132.7	2.0	2.3
Retail Mngrs	231.8	240.8	264.8	0.8	1.2
Misc. Hospitality, Retail & Service Mngrs	153.4	167.9	196.9	1.8	2.0
Professionals					
Arts Profs	37.3	38.4	44.7	0.6	1.9
Media Profs	52.4	61.2	76.3	3.2	2.8
Accountants, Auditors & Company Secretaries	182.6	206.5	259.6	2.5	2.9
Financial Brokers, Dealers, & Investment Advisers	85.4	92.0	110.3	1.5	2.3
Human Res. & Training Profs	89.6	84.8	102.2	-1.1	2.4
Information & Organisation Profs	126.7	146.1	175.3	2.9	2.3
Sales, Marketing & Public Relations Profs	111.9	126.6	154.8	2.5	2.5
Air & Marine Transport Profs	22.5	22.9	29.2	0.4	3.1
Architects, Designers, Planners & Surveyors	116.1	121.4	149.0	0.9	2.6
Engineering Profs	133.1	138.8	170.4	0.9	2.6
Natural & Physical Science Profs	97.5	101.0	123.0	0.7	2.5
School Teachers	345.2	394.6	438.7	2.7	1.3
Tertiary Education Teachers	84.9	88.4	124.4	0.8	4.4
Misc. Education Profs	49.0	56.7	69.4	3.0	2.5
Health Diag. & Promotion Profs	77.2	90.4	107.6	3.2	2.2
Health Therapy Profs	62.7	75.8	92.9	3.9	2.6
Medical Practitioners	75.2	101.2	124.7	6.1	2.6
Midwifery & Nursing Profs	245.9	300.5	365.8	4.1	2.5
Bus. & Sys. Analysts & Progs	129.6	147.7	180.8	2.6	2.6
Database & Systems Admin. & ICT Security Specialists	37.1	46.6	55.6	4.7	2.2
ICT Network & Support Profs	47.0	52.2	63.1	2.1	2.4

Table A1 Contd.

Occupation (ANZSCO 3-digit)	Employment ('000)			Average year-on-year % change	
	2011	2016	2024	2011–16	2016–24
Legal Profs	73.3	89.2	111.8	4.0	2.9
Social & Welfare Profs	111.7	129.3	158.7	3.0	2.6
Technicians and Trade Workers					
Agr., Medical & Sci. Tech.	50.0	49.7	56.9	-0.1	1.7
Building & Engineering Tech.	121.2	131.4	151.2	1.6	1.8
ICT & Teleco. Tech.	56.5	57.6	68.8	0.4	2.2
Auto. Electricians & Mechanics	100.9	113.0	125.6	2.3	1.3
Fabrication Eng. Trades	89.7	84.1	96.7	-1.3	1.8
Mech. Eng. Trades	137.2	145.4	170.1	1.2	2.0
Panel Beaters & Vehicle Body Builders, Trimmers & Painters	33.1	33.1	35.9	0.0	1.0
Bricklayers, Carpenters & Joiners	154.3	158.3	174.1	0.5	1.2
Floor Finishers & Painting Trades	57.7	55.3	61.1	-0.9	1.3
Glaziers, Plasterers & Tilers	71.7	73.6	81.0	0.6	1.2
Plumbers	79.6	84.8	94.6	1.3	1.4
Electricians	134.0	153.2	169.6	2.7	1.3
Electronics & Teleco. Trades	90.6	88.5	100.7	-0.5	1.6
Food Trades	156.8	172.0	196.3	1.9	1.7
Animal Attendants, Trainers, & Shearers	26.6	28.9	33.1	1.6	1.7
Horticultural Trades	89.0	92.7	103.1	0.8	1.3
Hairdressers	56.8	63.3	70.9	2.2	1.4
Printing Trades	24.2	18.3	21.8	-5.4	2.2
Text., Clothing & Foot. Trades	15.8	12.3	14.9	-5.0	2.4
Wood Trades	32.6	33.3	37.6	0.4	1.5
Misc. Technicians & Trades	59.1	63.0	75.0	1.3	2.2
Community and Personal Services Workers					
Health & Welfare Support	112.4	127.1	152.4	2.5	2.3
Child Carers	109.2	146.3	178.9	6.0	2.6
Education Aides	71.8	87.1	92.6	3.9	0.8
Personal Carers & Assistants	216.1	262.4	318.3	4.0	2.4
Hospitality	233.8	270.1	309.9	2.9	1.7
Defence Force Members, Fire Fighters & Police	68.9	76.4	80.5	2.1	0.6
Prison & Security Officers	65.1	68.3	72.3	1.0	0.7
Personal Service & Travel	88.0	97.0	116.0	2.0	2.3
Sports & Fitness	67.6	95.6	109.2	7.2	1.7
Clerical and Administrative Workers					
Contract, Prog. & Project Admin.	98.6	125.6	146.3	5.0	1.9
Office & Practice Managers	150.2	155.3	180.5	0.7	1.9
Pers. Assistants & Secretaries	135.1	100.7	116.6	-5.7	1.8
General Clerks	179.8	247.5	281.6	6.6	1.6
Keyboard Operators	75.0	49.4	56.4	-8.0	1.7

Table A1 Contd.

Occupation (ANZSCO 3-digit)	Employment ('000)			Average year-on-year % change	
	2011	2016	2024	2011–16	2016–24
Call/Contact Centre Info. Clerks	101.9	100.9	114.3	-0.2	1.6
Receptionists	174.0	172.8	199.7	-0.1	1.8
Accounting Clerks and Bookkeepers	289.2	267.9	310.7	-1.5	1.9
Financial and Insurance Clerks	111.7	111.7	131.9	0.0	2.1
Clerical & Office Support	105.7	93.1	109.1	-2.5	2.0
Logistics Clerks	118.6	125.1	145.1	1.1	1.9
Misc. Clerical & Administrative	113.5	111.3	125.6	-0.4	1.5
Sales Workers					
Insurance Agents & Sales Rep.	115.5	106.8	123.8	-1.6	1.9
Real Estate Sales Agents	75.9	89.0	101.9	3.2	1.7
Sales Assist. & Salespersons	659.4	744.5	802.8	2.5	0.9
Checkout Ops. & Off. Cashiers	138.3	130.6	138.6	-1.1	0.8
Misc. Sales Support	53.6	46.1	54.0	-3.0	2.0
Machine Operators and Drivers					
Machine Operators	63.9	56.3	65.4	-2.5	1.9
Stationary Plant Operators	106.1	107.7	117.8	0.3	1.1
Mobile Plant Operators	142.1	129.8	146.2	-1.8	1.5
Automobile, Bus & Rail Drivers	87.7	95.5	110.5	1.7	1.8
Delivery Drivers	41.6	48.7	54.9	3.2	1.5
Truck Drivers	172.0	188.1	210.1	1.8	1.4
Storepersons	115.9	127.1	143.7	1.9	1.5
Labourers					
Cleaners & Laundry	261.9	268.8	311.8	0.5	1.9
Construction & Mining Labourers	164.5	162.9	175.5	-0.2	0.9
Food Process	60.0	57.7	64.3	-0.8	1.4
Packers & Product Assemblers	100.7	95.4	107.1	-1.1	1.5
Misc. Factory Process	54.2	44.1	51.0	-4.1	1.9
Farm, Forestry & Garden	111.9	119.4	136.8	1.3	1.7
Food Preparation Assistants	158.2	170.2	191.9	1.5	1.5
Freight Handlers & Shelf Fillers	89.2	72.2	77.1	-4.2	0.8
Misc. Labourers	147.2	138.5	154.5	-1.2	1.4
Total	**11 071.5**	**11 852.4**	**13 719.9**	**1.4**	**1.8**

Source: ABS (2017b) (filtered by CoPS using Hodrick-Prescott method to remove cyclical fluctuation) and Victoria University employment forecasts.

Table A2 Employment by industry (subdivision), Australia, actual (2016) and forecast (2024): most likely scenario

Industry (ANZSIC subdivision)	Employment ('000)			Average year-on-year % change	
	2011	2016	2024	2011–16	2016–24
Agriculture	289.8	277.0	326.6	-0.9	2.1
Aquaculture	4.0	6.1	7.3	8.7	2.3
Forestry & Logging	6.8	6.0	7.8	-2.5	3.4
Fishing, Hunting & Trapping	6.5	5.9	8.0	-2.0	3.8
Agriculture, Forestry & Fishing Support	23.3	21.2	23.7	-1.9	1.4
Coal Mining	49.4	51.7	50.2	1.0	-0.4
Oil & Gas Extraction	17.7	30.0	47.4	11.1	6.5
Metal Ore Mining	79.1	78.2	85.2	-0.1	1.1
Non-Metallic Mineral Mining & Quarrying	13.4	13.8	16.7	0.7	2.5
Exploration & Other Mining Support	50.2	66.2	64.5	5.8	-0.3
Food Product Manufacturing	206.7	204.8	230.3	-0.2	1.5
Beverage & Tobacco Product Manufacturing	30.7	35.1	46.0	2.7	3.4
Textile, Leather, Clothing & Footwear Manufacturing	46.4	37.8	48.7	-4.0	3.2
Wood Product Manufacturing	44.4	45.4	52.8	0.4	1.9
Pulp, Paper & Converted Paper Product Manufacturing	18.8	12.2	16.0	-8.4	3.5
Printing (incl. the Reproduction of Recorded Media)	53.5	39.0	46.7	-6.1	2.3
Petroleum & Coal Product Manufacturing	9.2	9.3	11.3	0.2	2.4
Basic Chemical & Chemical Product Manufacturing	47.3	51.9	71.7	1.8	4.1
Polymer Product & Rubber Product Manufacturing	38.2	32.3	41.5	-3.3	3.2
Non-Metallic Mineral Product Manufacturing	39.5	34.4	39.3	-2.7	1.7
Primary Metal & Metal Product Manufacturing	93.3	71.3	79.8	-5.2	1.4
Fabricated Metal Product Manufacturing	62.8	57.3	73.4	-1.8	3.1
Transport Equipment Manufacturing	93.7	79.3	61.6	-3.3	-3.1
Machinery & Equipment Manufacturing	126.4	120.3	191.9	-1.0	6.0
Furniture & Other Manufacturing	60.8	56.6	70.2	-1.4	2.7
Electricity Supply	63.2	64.0	73.2	0.3	1.7
Gas Supply	11.2	17.7	17.3	9.5	0.0
Water Supply, Sewerage & Drainage	36.6	29.6	33.9	-4.1	1.7
Waste Collection, Treatment & Disposal	29.4	34.2	36.1	3.1	0.7

Table A2 Contd.

Industry (ANZSIC subdivision)	Employment ('000)			Average year-on-year % change	
	2011	2016	2024	2011–16	2016–24
Building Construction	237.5	268.9	275.2	2.5	0.3
Heavy & Civil Engineering Construction	71.9	78.4	85.9	1.8	1.1
Construction Services	690.4	698.6	768.0	0.2	1.2
Basic Material Wholesaling	104.2	93.6	107.8	-2.1	1.8
Machinery & Equipment Wholesaling	107.4	107.1	125.2	0.0	2.0
Motor Vehicle & Motor Vehicle Parts Wholesaling	26.2	26.1	29.9	-0.1	1.7
Grocery, Liquor & Tobacco Product Wholesaling	70.3	64.4	74.1	-1.7	1.8
Other Goods Wholesaling	93.6	80.7	93.9	-2.9	1.9
Commission-Based Wholesaling	8.9	6.7	7.8	-5.5	1.9
Motor Vehicle & Motor Vehicle Parts Retailing	94.3	100.0	105.5	1.2	0.7
Fuel Retailing	36.1	36.7	38.7	0.3	0.7
Food Retailing	392.1	405.0	426.0	0.6	0.6
Other Store-Based Retailing	662.2	692.6	734.1	0.9	0.7
Non-Store Retailing & Retail Comm.-Based Buying/Selling	14.3	19.3	20.6	6.3	0.8
Accommodation	106.4	111.3	163.5	0.9	4.9
Food & Beverage	637.5	712.8	806.6	2.3	1.6
Road Transport	234.8	267.1	308.7	2.6	1.8
Rail Transport	44.9	39.7	47.0	-2.4	2.1
Water Transport	8.2	6.2	7.9	-5.6	3.1
Air & Space Transport	54.4	56.5	82.2	0.8	4.8
Other Transport	10.5	7.7	9.9	-6.0	3.2
Postal & Courier Pick-up & Delivery	96.3	95.2	115.0	-0.2	2.4
Transport Support	69.6	85.9	103.3	4.3	2.3
Warehousing & Storage	52.5	58.6	69.7	2.2	2.2
Publishing (except Internet & Music Publishing)	44.5	34.0	43.2	-5.2	3.0
Motion Picture & Sound Recording Activities	26.5	30.1	38.7	2.6	3.2
Broadcasting (except Internet)	27.4	27.4	35.3	-0.1	3.2
Internet Publishing & Broadcasting	0.9	1.1	1.3	3.3	2.2
Telecommunications	91.3	93.3	111.4	0.4	2.2
Internet Service Providers, Web Search Portals & Data Processing	9.5	9.1	10.7	-0.7	2.0
Library & Other Information	15.9	11.9	12.9	-5.6	1.0
Finance	209.6	207.2	252.8	-0.2	2.5
Insurance & Superannuation Funds	87.4	91.1	107.2	0.8	2.1
Auxiliary Finance & Insurance	111.4	124.9	144.6	2.3	1.8

Table A2 Contd.

Industry (ANZSIC subdivision)	Employment ('000)			Average year-on-year % change	
	2011	2016	2024	2011–16	2016–24
Rental & Hiring (except Real Estate)	47.3	41.2	51.8	-2.7	2.9
Property Operators & Real Estate	149.8	171.4	194.1	2.7	1.6
Professional, Scientific & Technical (except Computer System Design & Related)	684.8	791.5	992.3	2.9	2.9
Computer System Design & Related	161.7	197.3	240.5	4.1	2.5
Administrative	189.8	201.3	244.7	1.2	2.5
Building Cleaning, Pest Control & Other Support	187.8	211.0	244.3	2.4	1.8
Public Administration	479.5	523.7	523.3	1.8	0.0
Defence	30.2	26.1	26.3	-2.8	0.1
Public Order, Safety & Regulatory	185.0	195.6	202.3	1.1	0.4
Preschool & School Education	494.6	527.5	562.8	1.3	0.8
Tertiary Education	231.0	241.7	345.6	0.9	4.6
Adult, Community & Other Education	116.9	168.2	204.8	7.6	2.5
Hospitals	374.8	380.6	449.8	0.3	2.1
Medical & Other Health Care	370.2	515.2	605.6	6.8	2.0
Residential Care	194.8	220.5	282.2	2.5	3.2
Social Assistance	315.2	395.7	507.3	4.7	3.2
Heritage Activities	30.4	35.1	38.6	2.9	1.2
Creative & Performing Arts Activities	40.7	42.2	46.8	0.8	1.3
Sports & Recreation Activities	102.2	121.3	135.3	3.5	1.4
Gambling Activities	27.5	27.6	32.3	0.0	2.0
Repair & Maintenance	222.9	230.5	265.2	0.7	1.8
Personal & Other	224.5	244.7	274.8	1.7	1.5
Private Households Employing Staff & Undifferentiated Goods-& Service-Producing Activities of Households for own Use	3.6	4.7	5.4	5.9	1.6
Total	**11 066.2**	**11 852.4**	**13 719.9**	**1.4**	**1.8**

Source: ABS (2017b) (filtered by CoPS using Hodrick-Prescott method to remove cyclical fluctuation) and Victoria University employment forecasts.

Table A3 Net replacement rate forecasts by occupation (minor), Australia

Occupation (ANZSCO 3-digit)	Annual net replacement rate 2017–24 (%)
Chief Executives, General Managers and Legislators	1.8
Farmers and Farm Managers	3.4
Advertising and Sales Managers	1.8
Business Administration Managers	2.8
Construction, Distribution and Production Managers	2.1
Education, Health and Welfare Services Managers	3.0
ICT Managers	0.9
Miscellaneous Specialist Managers	1.6
Accommodation and Hospitality Managers	2.5
Retail Managers	2.1
Miscellaneous Hospitality, Retail and Service Managers	2.1
Arts Professionals	2.2
Media Professionals	0.8
Accountants, Auditors and Company Secretaries	1.7
Financial Brokers and Dealers, and Investment Advisers	2.2
Human Resource and Training Professionals	1.8
Information and Organisation Professionals	1.6
Sales, Marketing and Public Relations Professionals	1.0
Air and Marine Transport Professionals	1.5
Architects, Designers, Planners and Surveyors	1.1
Engineering Professionals	1.0
Natural and Physical Science Professionals	1.4
School Teachers	2.4
Tertiary Education Teachers	2.4
Miscellaneous Education Professionals	1.8
Health Diagnostic and Promotion Professionals	1.4
Health Therapy Professionals	1.2
Medical Practitioners	1.3
Midwifery and Nursing Professionals	2.4
Business and Systems Analysts, and Programmers	1.0
Database and Systems Administrators, and ICT Security Specialists	0.8
ICT Network and Support Professionals	1.4
Legal Professionals	0.9
Social and Welfare Professionals	1.7
Agricultural, Medical and Science Technicians	2.0
Building and Engineering Technicians	1.9
ICT and Telecommunications Technicians	0.7
Automotive Electricians and Mechanics	2.1
Fabrication Engineering Trades Workers	1.5
Mechanical Engineering Trades Workers	1.8
Panel Beaters, and Vehicle Body Builders, Trimmers and Painters	2.2
Bricklayers, and Carpenters and Joiners	1.8
Floor Finishers and Painting Trades Workers	2.0
Glaziers, Plasterers and Tilers	1.3
Plumbers	1.4
Electricians	1.1
Electronics and Telecommunications Trades Workers	1.7
Food Trades Workers	1.6
Animal Attendants and Trainers, and Shearers	0.7

Table A3 Contd.

Occupation (ANZSCO 3-digit)	Annual net replacement rate 2017–24 (%)
Horticultural Trades Workers	1.0
Hairdressers	2.6
Printing Trades Workers	1.3
Textile, Clothing and Footwear Trades Workers	1.7
Wood Trades Workers	1.8
Miscellaneous Technicians and Trades Workers	1.4
Health and Welfare Support Workers	2.3
Child Carers	1.8
Education Aides	2.2
Personal Carers and Assistants	2.2
Hospitality Workers	5.3
Defence Force Members, Fire Fighters and Police	2.2
Prison and Security Officers	1.3
Personal Service and Travel Workers	1.6
Sports and Fitness Workers	1.9
Contract, Program and Project Administrators	1.7
Office and Practice Managers	2.0
Personal Assistants and Secretaries	2.0
General Clerks	1.4
Keyboard Operators	1.9
Call or Contact Centre Information Clerks	2.1
Receptionists	3.2
Accounting Clerks and Bookkeepers	2.4
Financial and Insurance Clerks	2.0
Clerical and Office Support Workers	1.9
Logistics Clerks	2.0
Miscellaneous Clerical and Administrative Workers	2.0
Insurance Agents and Sales Representatives	2.3
Real Estate Sales Agents	2.0
Sales Assistants and Salespersons	4.0
Checkout Operators and Office Cashiers	6.4
Miscellaneous Sales Support Workers	3.0
Machine Operators	2.1
Stationary Plant Operators	1.9
Mobile Plant Operators	1.2
Automobile, Bus and Rail Drivers	2.3
Delivery Drivers	1.4
Truck Drivers	2.0
Storepersons	1.4
Cleaners and Laundry Workers	2.4
Construction and Mining Labourers	2.4
Food Process Workers	2.0
Packers and Product Assemblers	2.0
Miscellaneous Factory Process Workers	1.4
Farm, Forestry and Garden Workers	1.8
Food Preparation Assistants	6.4
Freight Handlers and Shelf Fillers	3.4
Miscellaneous Labourers	1.8
Total (all occupations)	**2.2**

Source: Authors.

Table A4 Job openings by occupation (minor), Australia, 2017–24: most likely scenario

Occupation (ANZSCO 3-digit)	Job openings 2017–24 ('000)			Job openings annual average 2017–24 ('000)			Rep. demand
	Exp. demand	Rep. demand	Total	Exp. demand	Rep. demand	Total	% of total
Managers							
Chief Exec., Gen. Mngrs & Legislators	24.3	19.1	43.4	3.0	2.4	5.4	44.0
Farmers & Farm Mngrs	29.7	51.2	80.9	3.7	6.4	10.1	63.3
Advertising & Sales Mngrs	29.3	21.8	51.1	3.7	2.7	6.4	42.7
Business Admin. Mngrs	32.4	37.5	70.0	4.1	4.7	8.7	53.6
Const., Distr. & Prod. Mngrs	38.8	45.2	84.0	4.8	5.6	10.5	53.8
Edu., Hlth. & Welfare Services Mngrs	15.4	19.3	34.7	1.9	2.4	4.3	55.7
ICT Mngrs	12.8	4.5	17.3	1.6	0.6	2.2	25.8
Misc. Specialist Mngrs	9.6	7.5	17.1	1.2	0.9	2.1	43.8
Accomm. & Hospitality Mngrs	22.2	24.3	46.5	2.8	3.0	5.8	52.3
Retail Mngrs	24.0	42.8	66.8	3.0	5.4	8.4	64.1
Misc. Hospitality, Retail & Service Mngrs	29.0	29.7	58.7	3.6	3.7	7.3	50.6
Professionals							
Arts Profs	6.3	7.2	13.5	0.8	0.9	1.7	53.3
Media Profs	15.0	4.1	19.2	1.9	0.5	2.4	21.5
Accountants, Auditors & Company Secretaries	53.1	31.1	84.2	6.6	3.9	10.5	36.9
Financial Brokers, Dealers, & Investment Advisers	18.3	17.9	36.2	2.3	2.2	4.5	49.5
Human Res. & Training Profs	17.4	13.4	30.8	2.2	1.7	3.9	43.5
Information & Organisation Profs	29.2	20.2	49.4	3.7	2.5	6.2	40.9
Sales, Marketing & Public Relations Profs	28.2	10.7	38.9	3.5	1.3	4.9	27.6
Air & Marine Transport Profs	6.3	3.1	9.4	0.8	0.4	1.2	32.9
Architects, Designers, Planners & Surveyors	27.6	11.5	39.1	3.4	1.4	4.9	29.5
Engineering Profs	31.5	12.4	43.9	3.9	1.6	5.5	28.2
Natural & Physical Science Profs	22.0	12.8	34.7	2.7	1.6	4.3	36.7
School Teachers	44.1	79.2	123.3	5.5	9.9	15.4	64.2
Tertiary Education Teachers	36.0	20.1	56.1	4.5	2.5	7.0	35.8
Misc. Education Profs	12.6	9.1	21.8	1.6	1.1	2.7	42.0
Health Diag. & Promotion Profs	17.2	11.3	28.6	2.2	1.4	3.6	39.7
Health Therapy Profs	17.2	8.2	25.4	2.1	1.0	3.2	32.4
Medical Practitioners	23.5	11.5	35.1	2.9	1.4	4.4	32.9
Midwifery & Nursing Profs	65.3	64.2	129.6	8.2	8.0	16.2	49.6
Bus. & Sys. Analysts & Prog.	33.1	13.5	46.6	4.1	1.7	5.8	29.0
Database & Systems Admin., & ICT Security Specialists	9.0	3.2	12.2	1.1	0.4	1.5	26.1
ICT Network & Support Profs	10.9	6.4	17.3	1.4	0.8	2.2	37.0
Legal Profs	22.6	6.9	29.5	2.8	0.9	3.7	23.3
Social & Welfare Profs	29.4	19.3	48.7	3.7	2.4	6.1	39.6

Table A4 Contd.

Occupation (ANZSCO 3-digit)	Job openings 2017–24 ('000)			Job openings annual average 2017–24 ('000)			Rep. demand
	Exp. demand	Rep. demand	Total	Exp. demand	Rep. demand	Total	% of total
Technicians and Trades Workers							
Agr., Medical & Sci. Tech.	7.2	8.6	15.8	0.9	1.1	2.0	54.3
Building & Engineering Tech.	19.8	21.0	40.8	2.5	2.6	5.1	51.6
ICT & Teleco. Tech.	11.2	3.4	14.6	1.4	0.4	1.8	23.3
Auto. Electricians & Mechanics	12.6	19.8	32.4	1.6	2.5	4.1	61.1
Fabrication Eng. Trades	12.6	10.7	23.3	1.6	1.3	2.9	45.9
Mech. Eng. Trades	24.8	22.7	47.5	3.1	2.8	5.9	47.8
Panel Beaters, & Vehicle Body Builders, Trimmers & Painters	2.8	5.9	8.7	0.3	0.7	1.1	68.4
Bricklayers, Carpenters & Joiners	15.8	24.0	39.8	2.0	3.0	5.0	60.4
Floor Finishers & Painting Trades	5.9	9.4	15.3	0.7	1.2	1.9	61.6
Glaziers, Plasterers & Tilers	7.3	8.0	15.3	0.9	1.0	1.9	52.1
Plumbers	9.7	10.3	20.0	1.2	1.3	2.5	51.4
Electricians	16.4	14.6	31.0	2.0	1.8	3.9	47.2
Electronics & Teleco. Trades	12.2	12.7	24.9	1.5	1.6	3.1	51.0
Food Trades	24.3	23.5	47.8	3.0	2.9	6.0	49.1
Animal Attendants, Trainers, & Shearers	4.2	1.8	6.0	0.5	0.2	0.7	29.6
Horticultural Trades	10.4	8.1	18.4	1.3	1.0	2.3	43.8
Hairdressers	7.6	13.8	21.4	1.0	1.7	2.7	64.4
Printing Trades	3.5	2.1	5.6	0.4	0.3	0.7	38.0
Text., Clothing & Foot. Trades	2.6	1.9	4.5	0.3	0.2	0.6	41.5
Wood Trades	4.3	4.9	9.2	0.5	0.6	1.2	53.2
Misc. Technicians & Trades	12.0	7.8	19.7	1.5	1.0	2.5	39.4
Community and Personal Services Workers							
Health & Welfare Support	25.4	26.1	51.5	3.2	3.3	6.4	50.7
Child Carers	32.6	24.3	56.9	4.1	3.0	7.1	42.7
Education Aides	5.5	15.5	21.0	0.7	1.9	2.6	73.8
Personal Carers & Assistants	55.8	52.7	108.6	7.0	6.6	13.6	48.6
Hospitality	39.8	123.1	162.9	5.0	15.4	20.4	75.6
Defence Force Members, Fire Fighters & Police	4.0	13.6	17.6	0.5	1.7	2.2	77.1
Prison & Security Officers	4.0	7.6	11.6	0.5	0.9	1.5	65.3
Personal Service & Travel	19.0	13.2	32.2	2.4	1.7	4.0	41.0
Sports & Fitness	13.6	15.1	28.7	1.7	1.9	3.6	52.6
Clerical and Administrative Workers							
Contract, Prog. & Project Admin.	20.7	18.3	39.0	2.6	2.3	4.9	47.0
Office & Practice Managers	25.2	26.7	51.9	3.2	3.3	6.5	51.4
Pers. Assistants & Secretaries	15.9	17.0	32.9	2.0	2.1	4.1	51.6
General Clerks	34.1	28.7	62.8	4.3	3.6	7.8	45.6

Table A4 Contd.

Occupation (ANZSCO 3-digit)	Job openings 2017–24 ('000)			Job openings annual average 2017–24 ('000)			Rep. demand
	Exp. demand	Rep. demand	Total	Exp. demand	Rep. demand	Total	% of total
Keyboard Operators	7.0	8.0	15.0	0.9	1.0	1.9	53.2
Call/Contact Centre Info. Clerks	13.3	18.3	31.6	1.7	2.3	3.9	57.8
Receptionists	27.0	47.6	74.6	3.4	5.9	9.3	63.8
Accounting Clerks and Bookkeepers	42.8	54.8	97.6	5.4	6.8	12.2	56.1
Financial and Insurance Clerks	20.2	19.3	39.5	2.5	2.4	4.9	48.9
Clerical and Office Support Workers	16.0	15.1	31.1	2.0	1.9	3.9	48.6
Logistics Clerks	20.0	21.0	41.0	2.5	2.6	5.1	51.2
Misc. Clerical & Administrative	14.3	18.6	32.9	1.8	2.3	4.1	56.5
Sales Workers							
Insurance Agents & Sales Rep.	17.0	20.8	37.8	2.1	2.6	4.7	55.0
Real Estate Sales Agents	12.9	15.3	28.2	1.6	1.9	3.5	54.3
Sales Assist. & Salespersons	58.3	246.0	304.3	7.3	30.8	38.0	80.8
Checkout Ops. & Off. Cashiers	8.1	68.3	76.4	1.0	8.5	9.5	89.4
Misc. Sales Support	7.9	11.8	19.7	1.0	1.5	2.5	59.9
Machine Operators and Drivers							
Machine Operators	9.1	9.9	19.0	1.1	1.2	2.4	52.0
Stationary Plant Operators	10.0	16.9	26.9	1.3	2.1	3.4	62.7
Mobile Plant Operators	16.4	13.6	30.0	2.1	1.7	3.8	45.3
Automobile, Bus & Rail Drivers	15.0	19.3	34.3	1.9	2.4	4.3	56.2
Delivery Drivers	6.3	5.8	12.1	0.8	0.7	1.5	48.2
Truck Drivers	21.9	32.5	54.4	2.7	4.1	6.8	59.7
Storepersons	16.6	15.2	31.8	2.1	1.9	4.0	47.9
Labourers							
Cleaners & Laundry	43.0	55.9	98.9	5.4	7.0	12.4	56.5
Construction & Mining Labourers	12.6	31.9	44.4	1.6	4.0	5.6	71.7
Food Process	6.6	9.8	16.4	0.8	1.2	2.1	59.9
Packers & Product Assemblers	11.7	15.8	27.5	1.5	2.0	3.4	57.4
Misc. Factory Process	7.0	5.1	12.1	0.9	0.6	1.5	42.3
Farm, Forestry & Garden	17.4	17.9	35.3	2.2	2.2	4.4	50.8
Food Preparation Assistants	21.7	92.0	113.7	2.7	11.5	14.2	80.9
Freight Handlers & Shelf Fillers	5.0	20.2	25.2	0.6	2.5	3.1	80.3
Misc. Labourers	16.0	21.4	37.4	2.0	2.7	4.7	57.2
Total	**1867.5**	**2265.4**	**4132.9**	**233.4**	**283.2**	**516.6**	**54.8**

Notes: Exp. = expansion.
Rep. = replacement.

Source: Victoria University employment forecasts and authors.

Table A5 Job openings by industry (subdivision), Australia, 2017–24: most likely scenario

Industry (ANZSIC subdivision)	Job openings 2017-2024 ('000)			Job openings annual average 2017–24 ('000)			Rep. demand
	Exp. demand	Rep. demand	Total	Exp. demand	Rep. demand	Total	% of total
Agriculture	44.9	65.6	110.6	5.6	8.2	13.8	59.4
Aquaculture	1.0	1.3	2.3	0.1	0.2	0.3	56.7
Forestry & Logging	1.0	0.9	1.9	0.1	0.1	0.2	48.5
Fishing, Hunting & Trapping	0.9	1.0	2.0	0.1	0.1	0.2	53.3
Agriculture, Forestry & Fishing Support	3.2	2.9	6.2	0.4	0.4	0.8	47.8
Coal Mining	6.6	7.3	13.9	0.8	0.9	1.7	52.4
Oil & Gas Extraction	7.5	6.0	13.4	0.9	0.7	1.7	44.5
Metal Ore Mining	11.5	11.9	23.4	1.4	1.5	2.9	50.8
Non-Metallic Mineral Mining & Quarrying	2.0	2.2	4.2	0.2	0.3	0.5	53.1
Exploration & Other Mining Support	9.6	9.5	19.1	1.2	1.2	2.4	49.7
Food Product Manufacturing	27.8	39.3	67.1	3.5	4.9	8.4	58.6
Beverage & Tobacco Product Manufacturing	5.9	6.5	12.4	0.7	0.8	1.6	52.1
Textile, Leather, Clothing & Footwear Manufacturing	6.5	6.5	13.0	0.8	0.8	1.6	50.0
Wood Product Manufacturing	6.4	7.1	13.6	0.8	0.9	1.7	52.6
Pulp, Paper & Converted Paper Product Manufacturing	2.1	2.0	4.0	0.3	0.2	0.5	49.1
Printing (incl. the Reproduction of Recorded Media)	6.9	5.8	12.7	0.9	0.7	1.6	45.8
Petroleum & Coal Product Manufacturing	1.6	1.5	3.1	0.2	0.2	0.4	47.4
Basic Chemical & Chemical Product Manufacturing	9.6	8.5	18.1	1.2	1.1	2.3	46.9
Polymer Product & Rubber Product Manufacturing	5.4	5.4	10.8	0.7	0.7	1.3	50.1
Non-Metallic Mineral Product Manufacturing	4.8	5.4	10.2	0.6	0.7	1.3	52.7
Primary Metal & Metal Product Manufacturing	10.1	10.1	20.2	1.3	1.3	2.5	49.8
Fabricated Metal Product Manufacturing	9.0	9.2	18.2	1.1	1.1	2.3	50.5
Transport Equipment Manufacturing	9.8	9.3	19.0	1.2	1.2	2.4	48.8
Machinery & Equipment Manufacturing	22.6	20.9	43.5	2.8	2.6	5.4	48.0
Furniture & Other Manufacturing	8.7	9.2	18.0	1.1	1.2	2.2	51.4
Electricity Supply	10.5	9.0	19.5	1.3	1.1	2.4	46.4
Gas Supply	2.9	2.6	5.4	0.4	0.3	0.7	47.4
Water Supply, Sewerage & Drainage	4.6	4.5	9.1	0.6	0.6	1.1	49.2
Waste Collection, Treatment & Disposal	4.6	5.5	10.1	0.6	0.7	1.3	54.6
Building Construction	33.6	40.9	74.5	4.2	5.1	9.3	54.9
Heavy & Civil Engineering Construction	11.0	11.9	22.9	1.4	1.5	2.9	52.1
Construction Services	81.6	99.3	180.9	10.2	12.4	22.6	54.9

Table A5 Contd.

Industry (ANZSIC subdivision)	Job openings 2017–24 ('000)			Job openings annual average 2017–24 ('000)			Rep. demand
	Exp. demand	Rep. demand	Total	Exp. demand	Rep. demand	Total	% of total
Basic Material Wholesaling	13.6	16.9	30.5	1.7	2.1	3.8	55.4
Machinery & Equipment Wholesaling	18.1	16.7	34.8	2.3	2.1	4.4	48.0
Motor Vehicle & Motor Vehicle Parts Wholesaling	3.7	4.9	8.6	0.5	0.6	1.1	56.8
Grocery, Liquor & Tobacco Product Wholesaling	9.3	11.2	20.6	1.2	1.4	2.6	54.5
Other Goods Wholesaling	12.9	13.8	26.7	1.6	1.7	3.3	51.7
Commission-Based Wholesaling	1.1	1.2	2.3	0.1	0.1	0.3	51.2
Motor Vehicle & Motor Vehicle Parts Retailing	11.8	21.1	33.0	1.5	2.6	4.1	64.1
Fuel Retailing	3.5	11.6	15.2	0.4	1.5	1.9	76.8
Food Retailing	36.9	122.3	159.2	4.6	15.3	19.9	76.8
Other Store-Based Retailing	71.7	178.5	250.2	9.0	22.3	31.3	71.3
Non-Store Retailing & Retail Comm.-Based Buying/Selling	2.7	3.8	6.4	0.3	0.5	0.8	58.3
Accommodation	20.1	30.4	50.5	2.5	3.8	6.3	60.2
Food & Beverage	97.7	250.0	347.7	12.2	31.3	43.5	71.9
Road Transport	37.5	47.6	85.1	4.7	5.9	10.6	55.9
Rail Transport	6.2	6.9	13.1	0.8	0.9	1.6	52.6
Water Transport	1.1	1.1	2.2	0.1	0.1	0.3	48.5
Air & Space Transport	11.4	9.9	21.3	1.4	1.2	2.7	46.5
Other Transport	1.5	1.4	2.8	0.2	0.2	0.4	48.1
Postal & Courier Pick-up & Delivery	14.5	17.3	31.8	1.8	2.2	4.0	54.3
Transport Support	13.5	14.8	28.3	1.7	1.9	3.5	52.4
Warehousing & Storage	8.5	8.7	17.2	1.1	1.1	2.2	50.8
Publishing (except Internet & Music Publishing)	6.9	4.4	11.3	0.9	0.6	1.4	38.9
Motion Picture & Sound Recording Activities	6.0	4.7	10.7	0.7	0.6	1.3	44.3
Broadcasting (except Internet)	6.0	3.1	9.1	0.7	0.4	1.1	34.5
Internet Publishing & Broadcasting	0.2	0.1	0.4	0.0	0.0	0.0	36.6
Telecommunications	16.1	14.3	30.4	2.0	1.8	3.8	47.1
Internet Service Providers, Web Search Portals & Data Processing	1.7	1.2	2.9	0.2	0.2	0.4	42.0
Library & Other Information	2.1	1.6	3.7	0.3	0.2	0.5	44.0
Finance	39.5	34.5	74.0	4.9	4.3	9.2	46.6
Insurance & Superannuation Funds	16.3	15.1	31.5	2.0	1.9	3.9	48.0
Auxiliary Finance & Insurance	23.7	21.3	45.0	3.0	2.7	5.6	47.4
Rental & Hiring (except Real Estate)	6.1	8.6	14.7	0.8	1.1	1.8	58.4
Property Operators & Real Estate	26.9	29.1	56.0	3.4	3.6	7.0	51.9

Table A5 Contd.

Industry (ANZSIC subdivision)	Job openings 2017–24 ('000)			Job openings annual average 2017–24 ('000)			Rep. demand
	Exp. demand	Rep. demand	Total	Exp. demand	Rep. demand	Total	% of total
Professional, Scientific & Technical (except Computer System Design & Related)	160.4	113.3	273.7	20.1	14.2	34.2	41.4
Computer System Design & Related	40.6	22.1	62.6	5.1	2.8	7.8	35.2
Administrative	35.4	34.3	69.7	4.4	4.3	8.7	49.2
Building Cleaning, Pest Control & Other Support	31.9	38.5	70.5	4.0	4.8	8.8	54.7
Public Administration	86.1	77.1	163.2	10.8	9.6	20.4	47.2
Defence	4.4	3.7	8.0	0.5	0.5	1.0	45.8
Public Order, Safety & Regulatory	18.8	29.2	48.1	2.4	3.7	6.0	60.8
Preschool & School Education	62.8	100.6	163.4	7.9	12.6	20.4	61.6
Tertiary Education	63.4	45.5	108.9	7.9	5.7	13.6	41.8
Adult, Community & Other Education	29.1	30.0	59.2	3.6	3.8	7.4	50.8
Hospitals	76.2	73.7	149.9	9.5	9.2	18.7	49.2
Medical & Other Health Care	99.9	90.0	189.9	12.5	11.2	23.7	47.4
Residential Care	46.0	50.2	96.2	5.8	6.3	12.0	52.2
Social Assistance	83.0	76.1	159.1	10.4	9.5	19.9	47.8
Heritage Activities	5.8	5.1	10.9	0.7	0.6	1.4	46.7
Creative & Performing Arts Activities	7.8	6.2	14.0	1.0	0.8	1.7	44.4
Sports & Recreation Activities	18.3	22.3	40.6	2.3	2.8	5.1	54.9
Gambling Activities	4.2	7.9	12.1	0.5	1.0	1.5	65.1
Repair & Maintenance	30.7	39.1	69.8	3.8	4.9	8.7	56.0
Personal & Other	38.7	42.6	81.3	4.8	5.3	10.2	52.4
Private Households Employing Staff & Undifferentiated Goods- & Service-Producing Activities of Households for Own Use	1.0	0.8	1.7	0.1	0.1	0.2	43.9
Total	**1867.5**	**2265.4**	**4132.9**	**233.4**	**283.2**	**516.6**	**54.8**

Notes: Exp. = expansion.
Rep. = replacement.

Source: Victoria University employment forecasts and authors.

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