Victoria University Employment Forecasts

2017 edition

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This report was written to accompany the 2017 Victoria University Employment Forecasts, a comprehensive and detailed set of medium-term forecasts of employment in Australia commissioned by most of Australia's state and territory governments. The forecasts were prepared at Victoria University's Centre of Policy Studies by Dr Janine Dixon, with valuable assistance from Dr Longfeng Ye.

The Centre of Policy Studies' employment forecasting project, now in its 24th year, was led by Dr Tony Meagher until his retirement in 2013, and the project still benefits greatly from his advice and expertise.

The author is grateful to Adjunct Associate Professor Chandra Shah for his feedback on this report.

Parts of this paper are reproduced from an unpublished 2016 information paper by the same author.

Centre of Policy Studies, Victoria University

Abstract

Over the next eight years, employment in Australia will grow to almost 14 million jobs, a net increase of some 1.6 million jobs. In which industries and regions will these jobs be? What occupations will the workers perform? The labour market in Australia is constantly changing. It is unlikely that these questions will have the same answers in 2025 that they have today.

The Victoria University Employment Forecasting (VUEF) project attempts to address these questions, in the context of a macroeconomic model that has the capacity to incorporate detailed structural and demographic change. As a generation of baby-boomers retires and a new generation – many with degree-level qualifications in management and commerce, society and culture, health and other fields – enters the workforce, the service industries will continue to dominate. The modelling finds that just three industry divisions – health care and social assistance, professional services, and education and training – will account for more than half of employment growth over the next eight years. Accordingly, employment in the professional occupations will continue to grow strongly, adding almost 600,000 jobs to employ 3.4 million people, or a quarter of the workforce, by 2025.

A gradual reversal of some of the adverse conditions affecting employment in the manufacturing and agricultural sectors will see a return to positive, albeit modest, growth rates in these sectors.

High urban population growth forecasts and the dominance of growth in the service industries mean that more than 75 per cent of employment growth, or a net increase of 1.2 million jobs, will be in the capital cities. Melbourne and Sydney will account for just over half of the forecast growth in national employment.

Full or partial subscriptions to the 2017 edition of the detailed VUEF database are now available from the Centre of Policy Studies at Victoria University.

JEL: J21, J23, J24, J11

Key words: employment, forecast, occupation, industry, skill, Australia, regions, CGE model

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Commonly used terms

"2017" etc	Refers to financial year ending June 2017 unless otherwise specified
ANZSCO	Australian and New Zealand Standard Classification of Occupations. Number in brackets refers to level of classification where relevant (1 = major group, 2 = sub-major group, 3 = minor group; 4 = unit group)
ANZSIC	Australian and New Zealand Standard Industrial Classification (2006). Number in brackets refers to level of classification where relevant (1 = division, 2 = sub-division, 3 = group; 4 = class)
ASCED	Australian Standard Classification of Education
CGE	Computable General Equilibrium
GDP	Gross Domestic Product
Labour force	Persons working or actively seeing work, also referred to as "workforce"
NDIS	National Disability Insurance Scheme
ORES	ORANI Regional Extension System
Participation rate	The proportion of the working age population working or actively seeking work
Skill	Unless otherwise indicated, "skill" refers to the highest post-school qualification held by an individual or cohort
Terms of trade	Ratio of export price index to import price index
Unemployment rate	The proportion of the labour force that is unemployed, that is, without work in the reference week, actively looking for work in the previous four weeks, and available to start work in the reference week
VU Model	Victoria University CGE Model, a MONASH-style model of the Australian economy (Dixon and Rimmer 2002)
VUEF	Victoria University Employment Forecasts
VUEF Model	Suite of programs and data, including VU Model, used to estimate VUEF
Working age population	Population aged over 15. (Note that we assume no upper limit on working age)

Executive Summary

Over the next eight years, employment in Australia will grow by some 1.6 million jobs, to almost 14 million. In which industries and regions will these jobs be? What occupations will the workers perform? The labour market in Australia is constantly changing. It is unlikely that these questions will have the same answers in 2025 that they have today.

The Victoria University Employment Forecasting (VUEF) project attempts to address these questions, in the context of a macroeconomic model that has the capacity to incorporate detailed structural and demographic change. The model draws on a comprehensive range of inputs, including macroeconomic and demographic data, labour market statistics, education statistics, commonwealth and state economic and demographic forecasts, and expert industry forecasts.

The VUEF forecasts are very detailed, covering 214 industries, 358 occupations, 57 regions and several other classifications. The full forecast database, commissioned by most of Australia's state and territory governments, is available on a subscription basis from the Centre of Policy Studies at Victoria University. Partial subscriptions are also available.

The following are some key messages from the forecasts:

The workforce will be more educated. Every year, the workforce contains fewer people with no post school qualifications. As a generation of baby-boomers retires, a new generation – many with degree-level qualifications in management and commerce, society and culture, health and other fields – will enter the workforce. The number of workers with degree-level qualifications is forecast to grow by 1 million by 2025. These workers will perform professional and managerial occupations, primarily in the service industries.

Service industries and professional occupations will be dominant. Three industry divisions – health care and social assistance, professional services, and education and training – will account for more than half of employment growth over the next eight years. Accordingly, employment in the professional occupations will continue to grow strongly, adding almost 600,000 jobs to employ 3.4 million people, or a quarter of the workforce, by 2025.

Growth in manufacturing and agriculture will recover. A gradual reversal of some of the adverse conditions affecting employment in the manufacturing and agricultural sectors will see a return to positive, albeit modest, growth rates in these sectors.

Urbanisation of employment will continue. The dominance of service industries and high urban population growth forecasts mean that more than 75 per cent of employment growth, or 1.2 million jobs, will be in the capital cities. Melbourne and Sydney will account for just over half of the forecast growth in national employment.

1 Background and introduction

Early versions of the CoPS employment forecasting methodology were documented by Meagher et al (1996, 2000, 2011). In its early days, the employment forecasting project incorporated external macroeconomic forecasts from various external agencies, including at times Syntec and Access Economics. The model made efficient use of computing power, estimating highly disaggregated forecasts of employment in a staged process, in which forecasts for occupations and qualifications were based on forecasts of industry employment from a CGE model.

Advances in computing have meant that more aspects of the model are now run simultaneously. Giesecke et al (2011, 2015) adopted an integrated approach in modelling the labour market of Vietnam, in which forecasts of qualifications were input into the model. Qualification supply imposed a restriction on occupation supply, and workers were assumed to choose an occupation based on the relative wages of the occupations for which they were qualified.

The current VUEF qualification supply specification is similar to that of Giesecke et al. Qualification, occupation and industry forecasts are now produced in the core CGE model, and not by auxiliary programs such as the Labour Market Extensions used by Meagher et al (2000). This paper describes the current form of the VUEF model, in the context of the 2017 version of the employment forecasts.

The paper begins by describing the model as a framework in which a large body of macroeconomic, demographic, labour market and industry data is brought together in a single comprehensive framework. Key inputs to and outputs from the model are described in subsequent sections.

Macroeconomic forecasts are described along with other inputs and assumptions to the model. Some macroeconomic forecasts are adopted from external sources and others are derived within the model. Although they are model outputs, the macroeconomic forecasts are described alongside other model inputs because they are an integral part of the background to the detailed employment forecasts.

The 2017 forecasts are described in Section 3. The full set of forecasts is available electronically on a subscription basis. The forecasts include the following seven key matrices of base year (2017) data and forecasts for the period 2018-2025:

- Region x Industry x Occupation;
- Region x Occupation x Level of qualification;
- Region x Occupation x Field of qualification;
- Region x Level of qualification x Field of qualification;
- Region x Occupation x Demographic status;
- Region x Occupation x Hours worked; and
- Region x Demographic status x Hours worked.

The paper finishes with conclusions in Section 4.

2 The model

2.1 Overview of VUEF

The VUEF model is in fact a family of models, centred on the VU CGE Model of the Australian economy (closely related to the MONASH model, Dixon and Rimmer (2002)). The links between the VU CGE model and various auxiliary programs are illustrated in Figure 1. As shown in Figure 1, the VUEF model brings together a large body of demographic data, employment data, and macroeconomic data, as well as forecasts from government and industry bodies, into a single set of detailed employment forecasts for Australia and its regions. Some of the main data sources are listed in Table 1. This section provides an overview of the VUEF model, and a discussion of the inputs and assumptions underlying the model.

The VUEF system diagram (Figure 1) colour-codes the parts of the VUEF model, including the CGE model runs and other calibration processes (pink), input data (blue), and intermediate data estimates (yellow). In the centre of the diagram are two CGE simulation runs: an historical simulation (2010 to 2017) and a forecast simulation (2017 to 2025).

The purpose of the VU historical CGE simulation is twofold. Firstly, it facilitates the estimation of a detailed, timely database that is consistent with the most recent observations of economic conditions. These are described by macroeconomic aggregates including GDP or total employment, and also incorporate detailed labour market statistics including employment by industry and occupation. The database is also consistent with detailed but less recent data, such as input-output data or census data. Secondly, the historical simulation is used to estimate changes in structural variables, such as tastes and production technologies, following Dixon and Rimmer (2002). These structural estimates also feed into the forecast process.

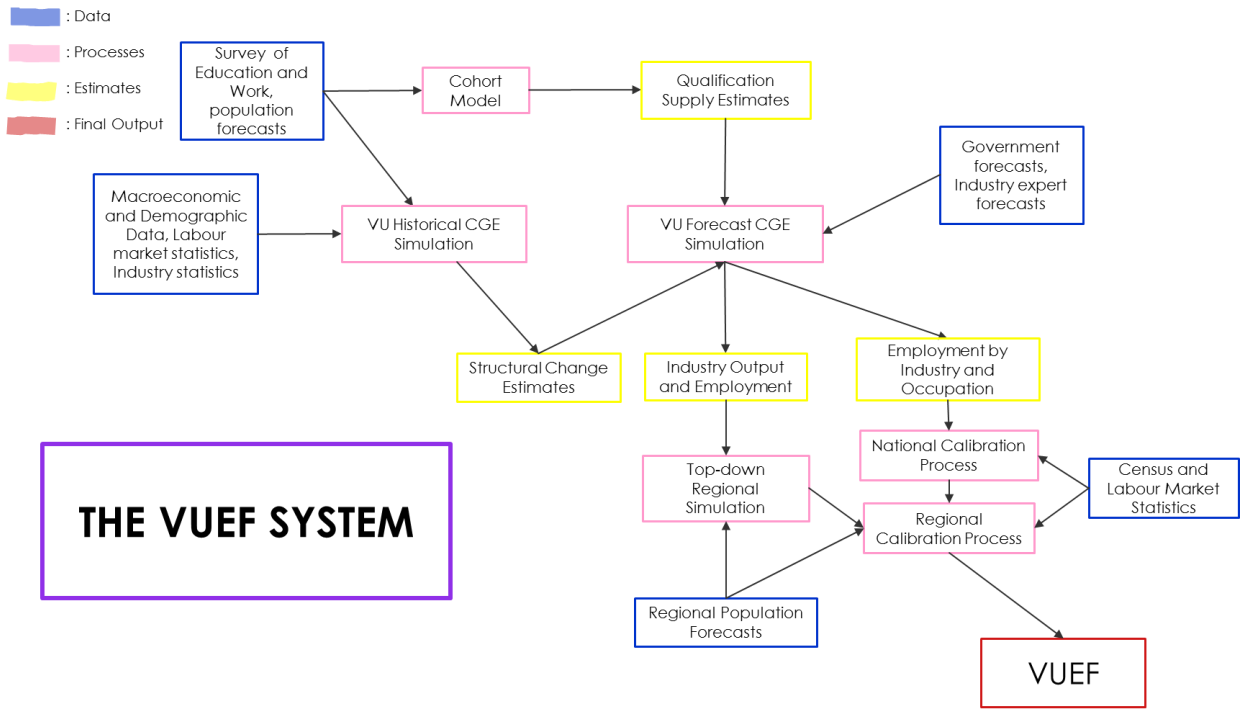

Figure 1: The VUEF estimation system

ABS SOURCES	
Census of Population and Housing, 2011	Employment by: Industry (4) and occupation (4) Occupation (4) by demographic group Occupation (4) by hours worked Hours worked by demographic Occupation (4) by qualification level and field Demographic by region (LGA) Industry (4) by region (LGA)
Survey of Education and Work (6227.0)	Highest post-school qualification by level and age Highest post-school qualification by field and age.
Labour force detailed quarterly (6291.0.55.003)	Industry (3) by state by sex Occupation (4) by state by sex Occupation (1) by Industry (1) by sex Occupation (2) by age (10) by sex Occupation (1) by age (5) Occupation (1) by hours worked
National accounts (5206.0)	GDP (real and nominal), consumption (public and private), investment (aggregate and dwellings), exports, imports, terms of trade, CPI
Labour force (6202.0)	Aggregate employment, aggregate labour supply, unemployment rate, average hours worked per person
Balance of Payments and International Investment Position (5302.0)	Current account deficit
Wage price index (6345.0)	Real wage
Demographic Statistics (3101.0)	Total population, working age population, aged population
Population Projections 2012 base (3222.0)	Population forecasts by age and sex, Series C
Australian Industry (8155.0)	Output per employee by Industry (1)
Input-output tables (5209.0)	
International Trade in Goods and Services (5368.0)	Imports by commodity
NON-ABS SOURCES	
State demographer forecasts	Population by region and state
State and federal budget forecasts	Forecast GDP, unemployment rate, ratios of budget deficit and government revenue to GDP, selected state government investment.
Inter-generation report	Participation rates by age and sex (forecast), average hours worked per person (forecast).
Resources and Energy Quarterly	Volume and value of commodity exports: Coal, Oil and Gas, Iron Ores, and Other Metal ores. Historical and forecast.
Tourism Research Australia forecasts	Volume of tourism exports (forecast)

Table 1: Main sources of input data for VUEF

The VU forecast CGE simulation is the process in which forecast employment is estimated by industry and occupation from 2018 to 2025. The forecast CGE simulation combines many sets of inputs: estimates of structural change derived from the historical simulation, skill supply estimates derived

from the cohort model, various official macroeconomic and demographic projections, and forecasts from industry bodies

Output from the CGE simulation is processed through several auxiliary programs. The national calibration processes transform the estimates from the input-output industry classification used in the CGE models to the more familiar ANZSIC industry classification. At this stage, the data is also disaggregated by demographic group and average weekly hours worked.

The VU model is a national model, treating the Australia as an open, single region economy. To generate regional estimates, a top-down regional simulation based on the ORES method (Dixon et al 1982) is used. Regional forecasts are calibrated to regional population estimates provided by the state governments.

The national and regional estimates are passed through a final regional calibration process to generate the VUEF Master database. This database includes seven key matrices of base year (2017) data and forecasts for the period 2018-2025:

- Region x Industry x Occupation;
- Region x Occupation x Level of qualification;
- Region x Occupation x Field of qualification;
- Region x Level of qualification x Field of qualification;
- Region x Occupation x Demographic status;
- Region x Occupation x Hours worked; and
- Region x Demographic status x Hours worked.

For context, various tables of historical data dating back to 1991 are also included in the VUEF Master database. Two versions of each series are provided: original and filtered. The series are smoothed using the Hodrick-Prescott filter (Hodrick and Prescott, 1997) which removes spurious variation from each series. The filtered series are used as inputs to VUEF. An example of original and smoothed data for employment in the allied health industry in Victoria is given in Figure 2 below.

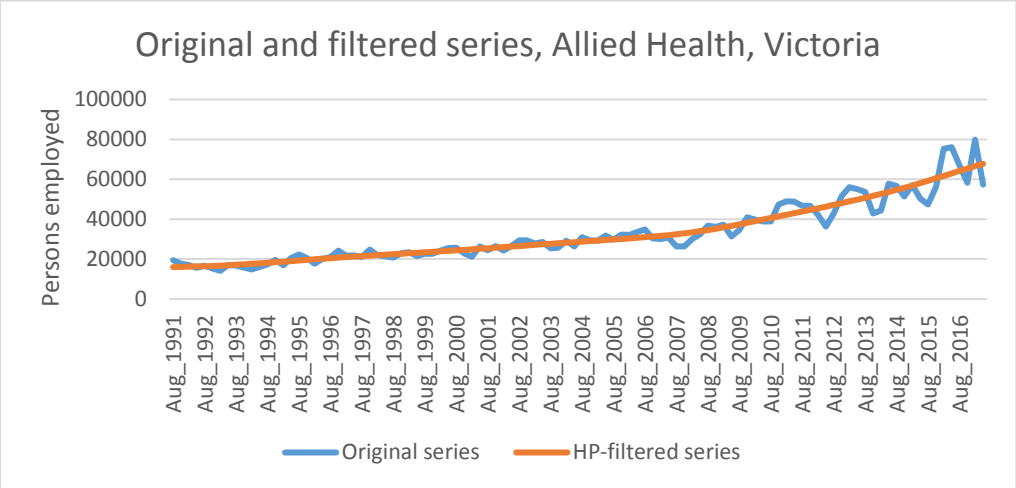

Figure 2: Original data and Hodrick-Prescott filtered data, employment in the allied health industry, Victoria, 1991-2017. Source: ABS and author's calculations

The remainder of this section is arranged as follows. It begins with a more detailed description of the two VU CGE model simulations: the historical and forecast simulations. We describe key features of this process including population forecasts, macroeconomic forecasts, structural change estimates, and industry forecasts based on expert opinion.

Working backwards, the next section describes the cohort model used to derive qualification supply estimates, an important input to the CGE model. The final section moves to the end of the process, describing the top-down regional simulation method used to generate regional forecasts. The national and regional calibration processes are not described in detail in this paper.

2.2 The VU historical and forecast CGE simulations

2.2.1 Population, labour force and aggregate employment

Aggregate employment in VUEF is calibrated to be consistent with various external forecasts. We begin with a population forecast that is based on forecasts from both ABS and state governments. From this forecast, the estimate of labour force (persons working or actively searching for work) is derived using participation rates by demographic group from the Commonwealth Treasury's Intergeneration Report (Commonwealth of Australia, 2015). Aggregate employment is derived by subtracting the number of unemployed. The projected path for the unemployment rate is calibrated to projections in the 2017-18 Commonwealth Budget (Commonwealth of Australia, 2017).

2.2.1.1 Population

Following the 2011 census, the ABS produced three sets of population projections (ABS 2013), by single-year age-group and sex. ABS notes that

"The projections are not intended as predictions or forecasts, but are illustrations of growth and change in the population that would occur if assumptions made about future demographic trends were to prevail over the projection period."

--ABS, 2013

The three projected scenarios reflect different sets of assumptions on fertility, mortality and migration. Figure 3 below shows a comparison of the three projections over the period 2012 to 2016 and the differences between the projections and the estimated population over that period. It shows that that the range of ABS forecasts did not encompass the estimated population in 2015 or 2016. The estimated population is now less than the projected population even for Series C, which is at the bottom of the projected range. Given that the Series C projection is now the closest to the estimated population, VUEF is calibrated to the Series C projected growth rates through the forecast period.

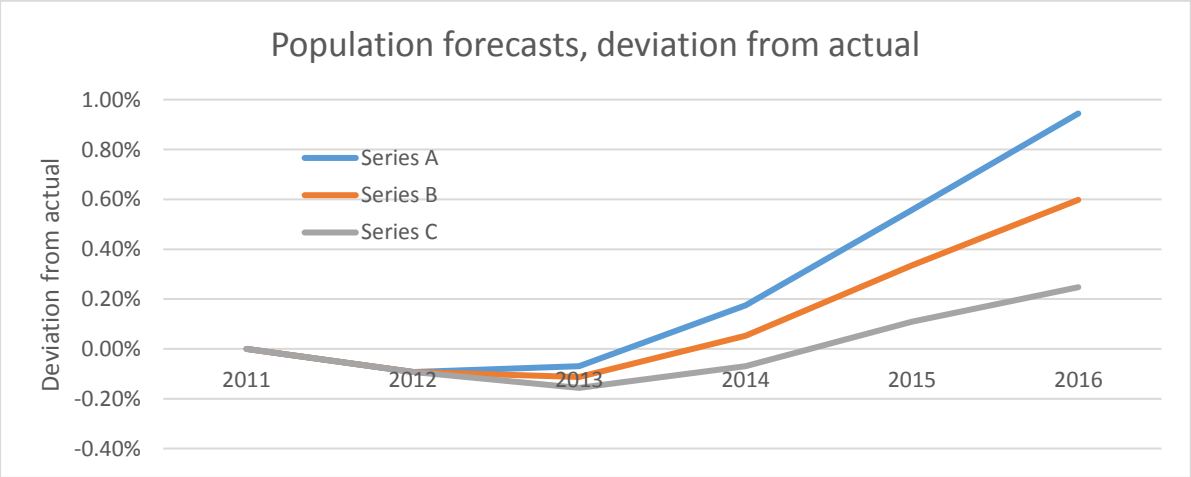

Figure 3: Population forecast series A, B, and C, deviation from actual population 2012-16. Source: ABS 3101.0 and 3222.0 and author's calculations

2.2.1.2 Participation and labour force

The Commonwealth Treasury's Intergeneration Report (Commonwealth of Australia 2015) contains detailed projections of participation rate by 5-year age-group and sex. These projections are combined with the population projections, also by age and sex, to evaluate the aggregate labour force underlying the VUEF forecasts.

Figure 4 shows that the aggregate participation rate is projected to remain at around 65 per cent through the forecast period. Although the aggregate participation rate will remain fairly constant, there are significant compositional changes projected in the workforce not revealed by the aggregate participation rates. The proportion of the workforce aged 60 and above will increase, meaning that there will be a greater proportion of the population in the lower-participation age groups. Offsetting this, participation rates for males aged 55 and above, and for females aged 45 and above, are projected to increase over the forecast period.

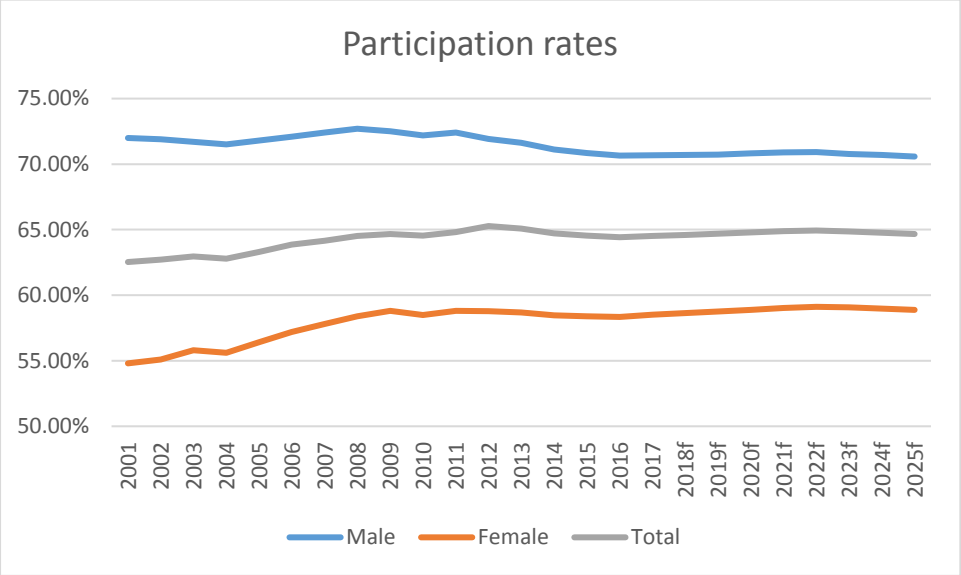

Figure 4: Participation rates. Sources: ABS (6202.0) and Commonwealth of Australia Intergeneration Report

2.2.1.3 Unemployment

The unemployment rate (trend) in June 2017 stood at 5.6 per cent. Following Commonwealth Budget projections, we assume that unemployment will gradually fall, reaching 5.25 per cent in 2021 (Budget Overview, Table 2). We assume that the unemployment rate remains at this level for the remainder of the forecast period.

Over the forecast period, average annual working-age population growth of 1.47%, average annual growth in the participation rate of 0.03%, and an average fall in the rate of unemployment of 0.06% per year implies average annual growth in aggregate employment of 1.57%. The contributions to growth are illustrated in Figure 5 below.

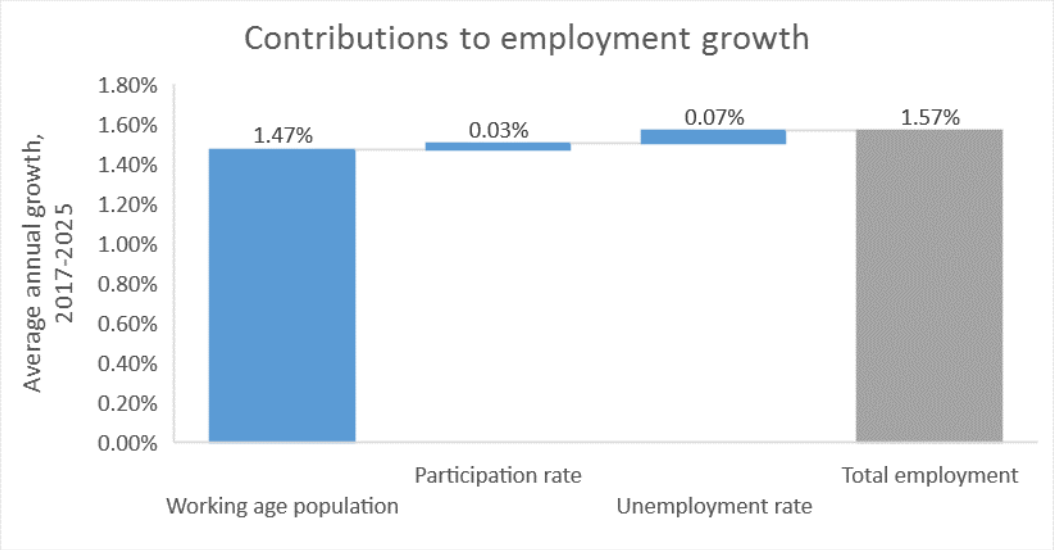

Figure 5: Contributions to employment growth. Sources: ABS, Commonwealth Treasury and author's calculations

2.2.1.4 Regional estimates

Forecasts for the regions are based on population forecasts from state government agencies in each state. State forecasts are adjusted slightly to ensure consistency with the national forecasts as described above. Sources for the state forecasts are summarised in Table 2 below.

State	Source	Notes
NSW	NSW Treasury	Aggregate employment calibrated to NSW treasury forecasts. LGA population forecasts aggregated to NSW planning regions.
Vic	Department of Environment, Land, Water and Planning	LGA forecasts aggregated to SA4 regions.
Qld	Queensland government	LGA forecasts aggregated to SA4 regions. Medium series.
SA	Department of Planning, Transport and Infrastructure, SA	Statistical Division regions mapped to SA4 regions. Medium Series.
WA	Department of Planning, WA	LGA forecasts aggregated to WA planning regions. Band A projections (lowest in range).
Tas	Tasmanian Treasury	LGA forecasts aggregated to SA4 regions.
NT	NT Treasury	Regional forecasts aggregated to SA4 regions.
ACT	ACT Treasury	Projection for ACT as a whole.

Table 2: State population forecasts

2.2.2 Macroeconomic context

Over the historical period (2010-17) GDP grew at an average 2.6% per annum. In VUEF it is forecast to grow at the much the same rate over the forecast period (2017-25). This forecast growth rate is contingent on employment growth of 1.6% per annum, as described earlier, growth in capital stocks of 2.9% per annum, and a contribution from total factor productivity growth of 0.5% per annum.

Investment growth has been negative since 2013, however in the forecast period it is projected to recover, which will facilitate the required growth in capital stocks.

Total factor productivity growth refers to growth in GDP in excess of the inputs of labour, capital and land. It stems from more efficient production, which may be attributed to better technology, reduced red tape or regulatory burden, and a more educated workforce. In developed countries, total factor productivity growth is generally low, and has been particularly low over the last decade, as shown in Figure 6. In light of this, the productivity growth assumed for the VUEF forecasts is quite optimistic. Yet the commonwealth treasury forecasts that the GDP growth rate will return to 3 per cent by 2019, so this optimistic assumption has been adopted in order to avoid deviating too significantly from the treasury forecasts.

Figures 7 and 8 illustrate GDP broken down into its expenditure components: household consumption, investment, government consumption, exports and imports. The domestic expenditure measures shown in Figure 7 shows that after a boom which peaked in 2013, investment has declined, but is expected to recover in line with GDP growth over the forecast period.

Household and government expenditure grow at the same rate through the forecast period by assumption. At an annual average of 2.4%, the growth rate for household and government consumption is somewhat less than the GDP growth rate. By assumption, the current account deficit is fixed over the forecast period. This requires an increase in the domestic savings rate. The model is also calibrated to reflect the commonwealth treasury's return to surplus, with the residual burden of national savings attributed to households. Overall, less funds are available to government and households for consumption, so the growth rate of private and public consumption is lower than the growth rate of GDP.

Measures of trade are shown in Figure 8. The model forecasts reflect the commonwealth treasury assumption on the forecast path for the terms of trade, viz:

"The terms of trade are projected to remain flat at around their 2005 level from 2020-21."

--Commonwealth of Austalia, 2017

Through 2016-17, the average terms of trade was 14 per cent above its 2005 level (assumed to be the average through 2005-06). The forecast falling terms of trade, and consequent devaluation of the domestic currency, implies cheaper exports in foreign currency terms, and facilitates an increase in the trade balance over the forecast period. Although imports grow less quickly than exports, import growth also exceeds GDP growth over the forecast period.

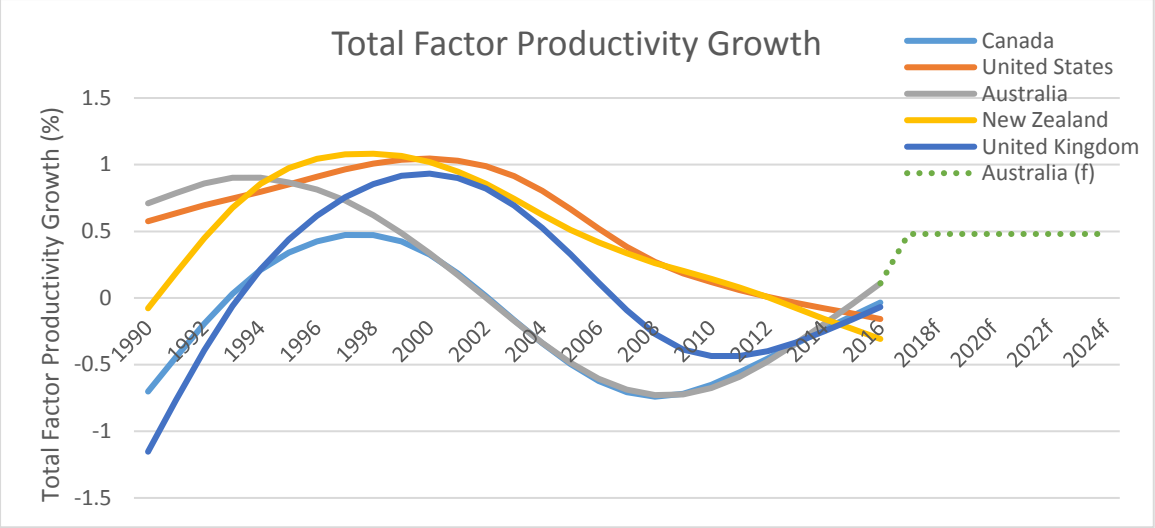

Figure 6: Total factor productivity growth (smoothed), international comparison, 1990-2016. Source: TED database and author's calculations

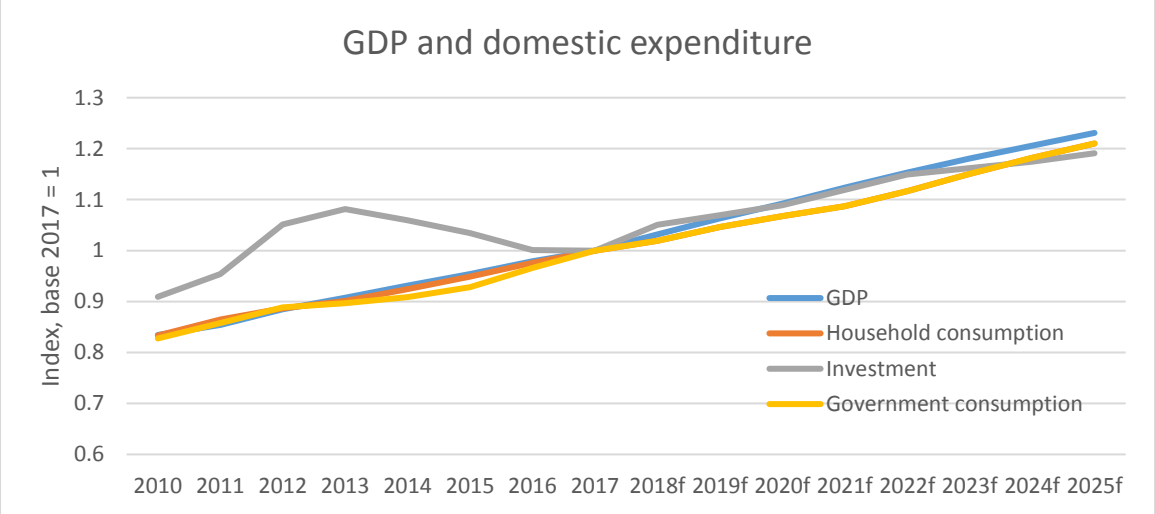

Figure 7: GDP and domestic expenditure, 2010-2025. Source: ABS (2010-17) and VUEF model (2018-2025)

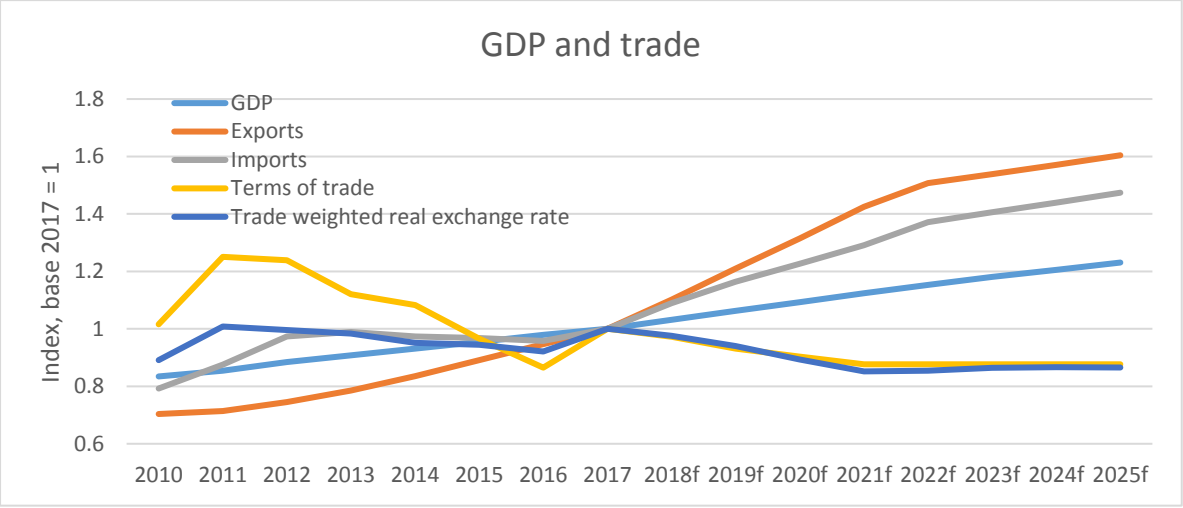

Figure 8: GDP and measures of trade, 2010-2025. Source: ABS (2010-17), VUEF model (2018-2025) and commonwealth treasury (terms of trade 2018-2025).

The macroeconomic conditions forecast have some influence on the composition of employment forecast. For example, relatively weak growth in household expenditure will subdue growth in employment in household-oriented industries such as health, retail and other services. The construction sector is closely linked to investment growth, and trade-exposed sectors will be affected by movements in the real exchange rate. These impacts will be discussed further in the section on employment forecasts.

2.2.3 Structural change estimates

In the context of VUEF, structural change refers to outcomes (e.g. output, employment) that are not attributable to changes in economic activity, incomes or relative prices. Such outcomes are instead attributed to factors such as changes in tastes (including preferences for imports), production technology, government expenditure policies, or conditions on world markets. Structural change may be revealed by running the VU CGE model in historical mode (Dixon and Rimmer 2002). The CGE model contains a set of equations to estimate changes in employment, output and prices, given an underlying set of taste preferences and production technology possibilities. In the historical simulation, causality is reversed. Observations of employment, output and some prices are imposed on the model, and the model solves for changes in tastes and technology, thereby revealing the changes in these structural variables that must have been necessary for the observed outcomes in employment and output to have occurred. The remainder of this section gives an overview of the VUEF estimates of structural change.

2.2.3.1 Occupation bias

Estimates of occupation bias are calculated by first modelling the change in occupation employment that would occur in response to growth in industry employment and growth in skill supply, with no occupational bias. At the simplest level, we might assume that an expansion in industry employment of 2 per cent would comprise an increase of 2 per cent in employment of each occupation used in that industry. Assuming that industries grow at the different rates, and that each industry employs occupations in different proportions, this simple approach does not imply that in aggregate, all occupations grow at a uniform rate. For example, strong growth in the retail industry leads to strong growth in sales occupations, while weak growth in the education sector leads to weak growth in the teaching occupations.

Adding more complexity, differences in the growth rates of the skill groups that supply each occupation will lead to different rates of occupational wage growth, influencing the occupational composition of each industry's employment.

For the model to reproduce observed occupation employment over the period 2010 to 2017, we introduce an endogenous variable, which represents occupational bias. The bias may occur in response to changes in technologies or tastes. Figure 9 shows that the positive occupational bias over 2010 to 2017 existed in favour of community and personal services workers and managers, while labourers and technicians and trades workers suffered negative bias. This is broadly consistent with the "Oxford List" (Frey and Osborne, 2013) which ranks occupations according to their susceptibility to automation.

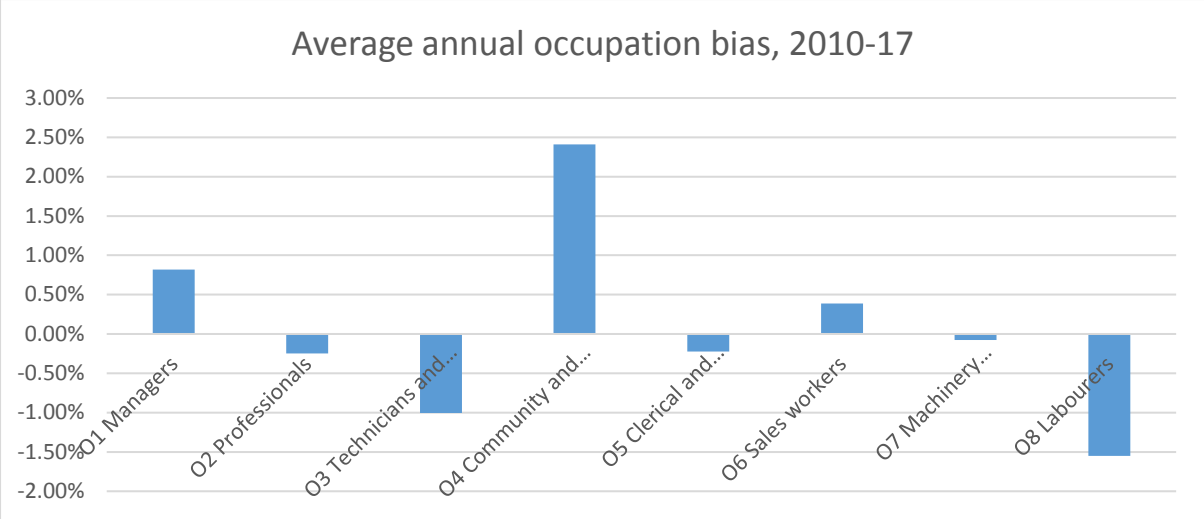

Figure 9: Average annual occupation bias, 2010-17. Source: VU model simulation

The major-group occupation aggregation conceals some interesting instances of occupational bias. For example, the clerical and administrative workers major group appears to be neutral when viewed as an aggregate. Figure 10 however reveals negative bias against minor groups such as personal assistants, keyboard operators, and clerical and office support workers, and positive bias towards contract, program and project administrators and general clerks. This may suggest a change in the composition of office staff towards occupations that are more highly skilled and generalised, and against narrow specialisations such as typing and reception.

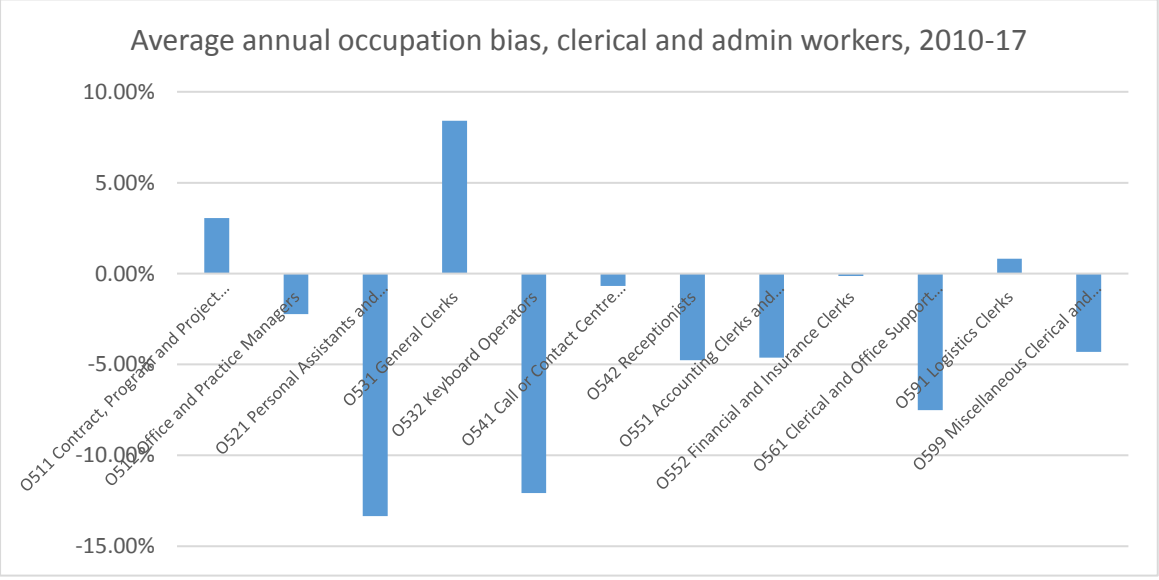

Figure 10: Average annual occupation bias, clerical and administrative workers, 2010-17. Source: VU model simulation

A second example is the occupation major group for sales workers. Again, at the major group level, the occupation bias appears close to neutral. However, the disaggregation to minor groups shows a negative bias against checkout operators and office cashiers, and insurance agents and sales representatives. Anecdotally, these occupations have suffered from technological displacement. The overall neutral result for sales workers must be taken in the context of the retail sector as a whole. Slow growth in employment of sales workers, in the context of slow growth in the retail sector as a whole, does not indicate occupation bias against sales workers.

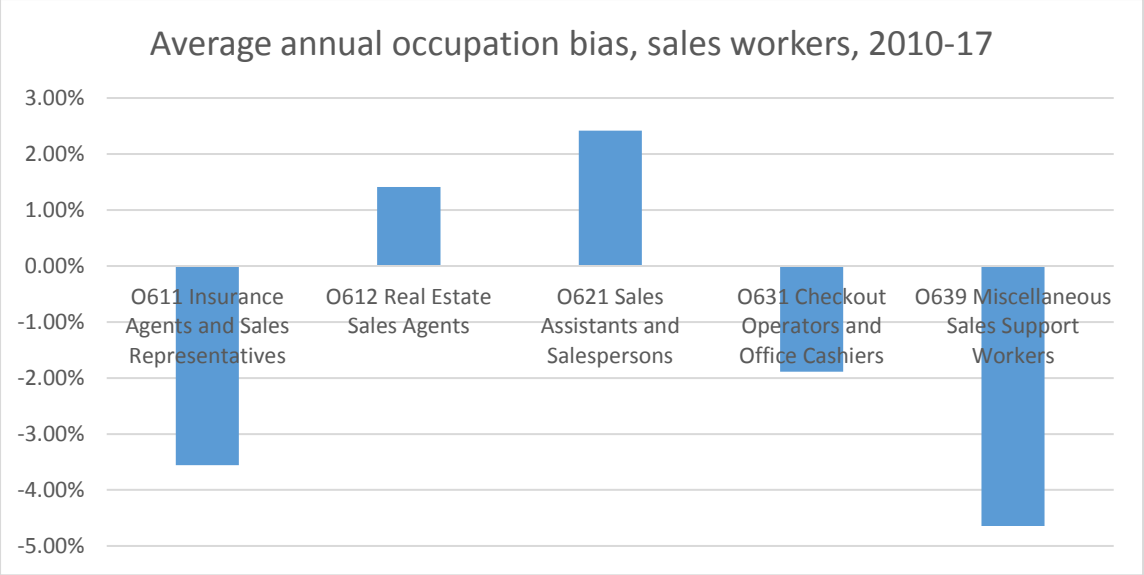

Figure 11: Average annual occupation bias, sales workers, 2010-17. Source: VU model simulation

2.2.3.2 Demand for goods and services

Demand for goods and services in the VU model is derived by adding together demand by industries, investors, households, the rest of the world (exports) and government, where each of these agents has its own demand function. The demand functions include explanatory variables such as:

- industry output and investment (the output of an industry will determine its demand for goods and services inputs, likewise its investment expenditure will determine demand for inputs to capital creation, such as construction or machinery);
- household income (to determine household demand for commodities);
- government expenditure decisions;
- economic growth in export destinations;
- prices (this is particularly important for export demand);
- prices of competing imports, which are assumed to be substitutable for local varieties; and
- changes in tastes (households), technology (industries), and preferences for substitution to imports (all users).

The model is calibrated such that all markets clear, so demand for each commodity must equate to industry supply. The VU historical simulation is run to reproduce observed industry employment over the period 2010-17, which is closely related to industry output. The historical simulation also reproduces observed import volumes for manufactured commodities. With most explanatory variables listed above already tied down by macroeconomic conditions, the observations for industry employment and commodity imports are accommodated by changes to household tastes and industry technologies, and changes to import substitution preferences.

The historical simulation revealed interesting results for import preferences for manufactured commodities, illustrated in Figure 12. Positive results indicate an increased preference for imports. The historical simulation reveals positive results for almost all manufactured commodities. Overall, results were larger for light manufactures and construction materials, and relatively small for food products and high-tech equipment. However, there were some exceptions: among food products, preferences clearly increased for imported dairy products, bakery products and wine, spirits and tobacco. While preferences for imports of high-tech equipment increased only slightly (possibly

because import penetration was already very high), preferences for pharmaceutical goods (another "high-tech" manufactured good) increased very strongly.

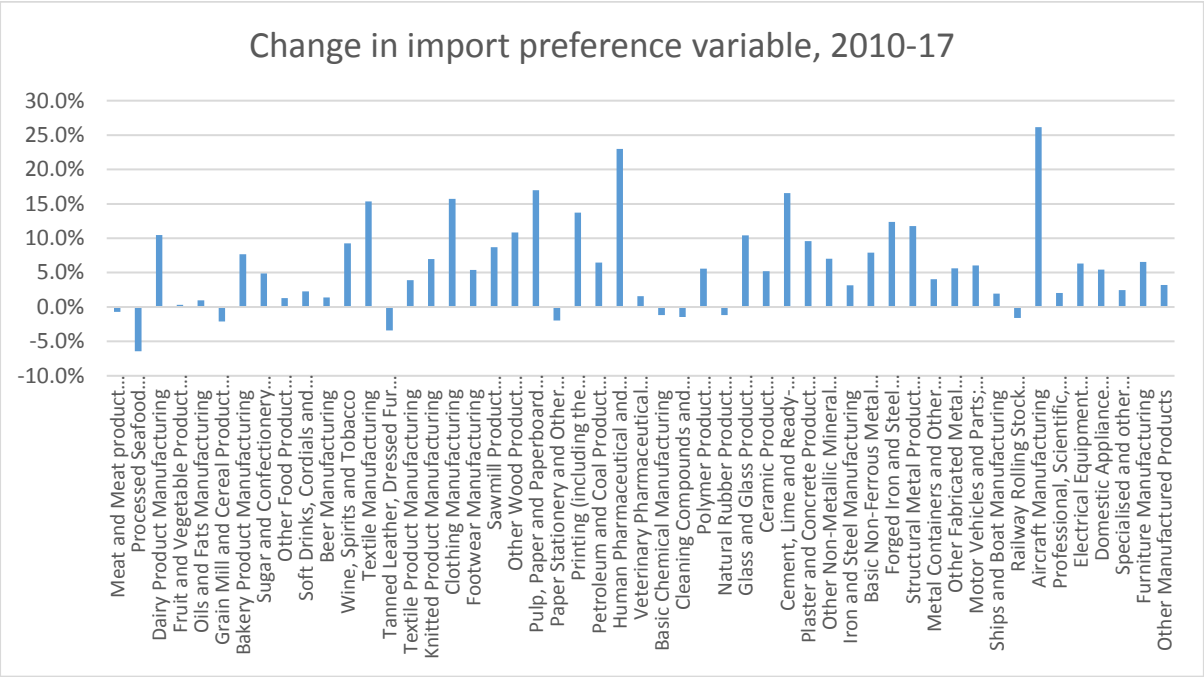

Figure 12: Average annual change in import preference variable, 2010-17, manufacturing input-output categories. Source: VUEF model.

The momentum of some of the recent demand-side changes is assumed to carry forward into the forecast period, at a diminishing rate. In particular, we assume that ongoing growth in imports of manufactured commodities will continue to displace domestic production, and that trends in household and export demands for agriculture, manufacturing and some services will continue.

Trends in occupational bias are not carried forward in the current version of VUEF.

2.2.4 Industry expert forecasts

In some cases, industry specific forecasts from external agencies are imposed on the model. In general, we impose forecasts for measures such as output, exports or prices, and the model is used to evaluate industry employment.

2.2.4.1 Mining

Forecasts for export volumes of Coal, LNG, Iron Ore and Other Metal Ores are sourced from the Commonwealth Department of Industry (DoI 2017). These forecasts are accommodated by shifting the export demand schedules for each commodity. Figure 13 shows that the peaks of the export booms for iron ore and coal have passed, while there is still strong growth ahead in exports of oil and gas (primarily liquefied natural gas, or LNG).

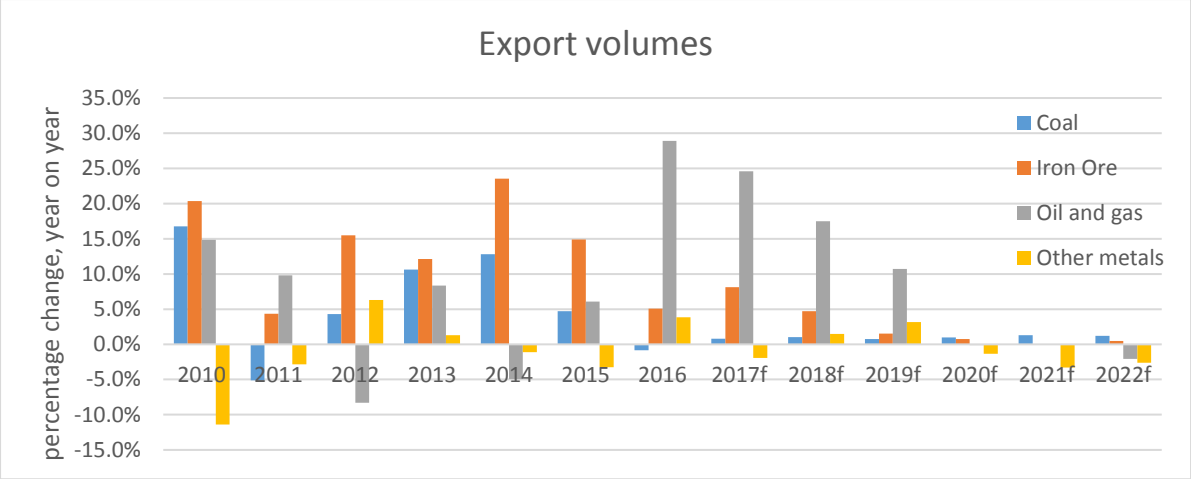

Figure 13: Mining commodity export volumes, year-on-year percentage change, 2010-2022. Source: Commonwealth Department of Industry, 2017.

2.2.4.2 NDIS

The roll-out of the commonwealth government's National Disability Insurance Scheme (NDIS) is set to double expenditure on disability services over the next three years. Key activities in the NDIS include residential disabled care, community disabled care, allied health and administrative activities. The VU model database was augmented to represent each of these activities separately, using data from a variety of sources recommended by the National Disability Insurance Agency (NDIA), which administers the NDIS.

The NDIS activities were bundled into a single commodity consumed by households. The NDIS roll-out was accommodated in the model by imposing a large change in household tastes – that is, households were assumed to autonomously decide to allocate a proportion of their budgets to expenditure on the NDIS. The transfer of government funds to participating households was not explicitly modelled but is implicitly covered by the model's government budget and expenditure settings.

2.2.4.3 Tourism

International tourism is treated in the VU model as an export of a bundle of services, including accommodation, food and beverage services, air transport and other services. Tourism Research Australia (TRA 2017) forecasts that the volume of tourism exports will grow by 6.7 per cent per annum over the coming decade. This forecast is accommodated by shifting the export demand schedule for the tourism commodity.

2.2.4.4 Motor vehicles

The withdrawal of motor vehicle manufacturing activity from Australia was almost complete by the end of the 2016-17 financial year. This has been accommodated in the VU model by assuming that (i) the capital stock is decommissioned, a departure from the usual model assumption that capital stock can only decline through depreciation, and (ii) that local production is replaced completely by imports. The second point is necessary to avoid a fall in motor vehicle use, and the impacts that this would have on other activities including road transport, fuel use and motor vehicle servicing, repair and maintenance.

2.3 Qualification supply estimates and cohort model

2.3.1 Historical data

Data from the ABS survey of education and work is used to project skill acquisition over the forecast period. Using annual data from 2008 to 2016, changes in head-counts of skill level and field are ascribed to a cohort effect and an acquisition effect.

The cohort effect is what would occur if everyone in the workforce retained his or her existing qualification level and field from the previous year. This is calculated by simply assuming that each individual in the workforce is one year older than he/she was in the previous year. In ten-year age cohorts for example, one tenth of the age group is assumed to move into the next age group.

The acquisition effect is the difference between the cohort effect and the observed qualification levels and fields. For example, every year a group of workers from the 15-19 age group enters the 20-24 age group. Very few (less than 1%) of these workers have a Bachelor's degree, yet around 15 per cent of the 20-24 age group have a Bachelor's degree. This difference between the cohort effect and observation is attributed to acquisition of new qualifications in the 20-24 age group. The term "acquisition" is used to refer to the labour force as a whole. That is, the labour force acquires a new Bachelor degree worker if he or she is a new entrant to the labour force (regardless of whether the qualification is newly acquired by the individual), or if an existing participant in the labour force upgrades his or her qualification to Bachelor's degree.

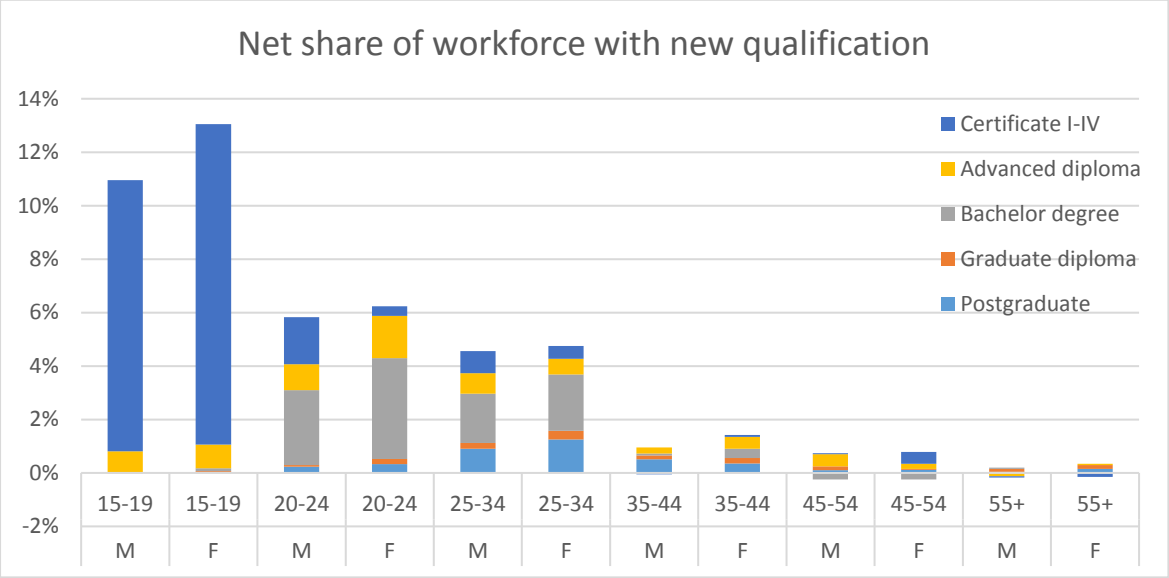

Figure 14: Net share of workforce with new qualification, level of qualification by age and sex, average 2008-2016. Source ABS 6227.0 and author's calculations

Figure 14 shows the proportion of the workforce in each demographic that is assumed to have acquired a new qualification in the last year, averaged over the period 2008 to 2016. From Figure 14 we can see that this proportion is highest among younger workers, and falls away significantly after the age of 35 for both men and women. At all ages however, the majority of workers carry over their qualification from the previous year.

Workers aged 19 and below acquiring new qualifications are most likely to acquire a Certificate I-IV or an Advanced Diploma. Males aged 20 to 24 are more likely than females of the same age to acquire a Certificate, while females in this age group are more likely to obtain a Bachelor's degree. Bachelor's

degrees are generally obtained by workers of both sexes between the ages of 20 and 34, while postgraduate degrees are more likely to be acquired after the age of 25.

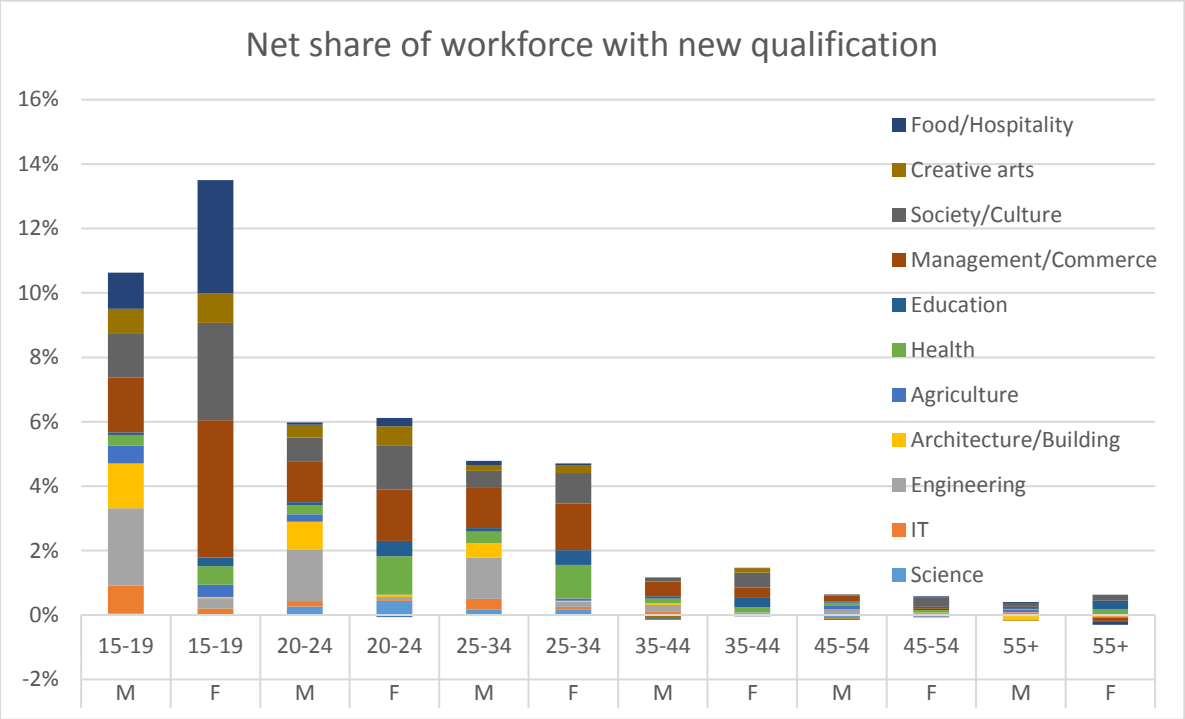

Figure 15: Net share of workforce with new qualification, field of qualification by age and sex, average 2008-2016. Source ABS 6227.0 and author's calculations

The interpretation of Figure 15 is similar to that of Figure 14, except that Figure 15 shows qualification acquisition by main field of study. There are clear differences in fields of study by age group and sex. At every age, engineering, architecture and building and IT qualifications are more popular with males, while qualifications in health and society and culture are more popular with females. Before the age of 34, management or commerce qualifications are more popular with females. Beyond 35, management or commerce qualifications begin to make up a significant proportion of qualification acquisition for males. Qualification acquisitions in food and hospitality are significant in the 15-19 age group.

In principle the totals in Figures 14 and 15 should match. However, an exact match is not possible. As we are unable to follow individual workers through the sample, individual behaviour may only be inferred from changes in demographic cohorts. If, for example, an individual who already has a Bachelor's degree in Engineering acquires a Bachelor's degree in Management, this will appear as a skill acquisition in the qualification field data (a new qualification in Management), but not in the qualification levels data, as the worker has not changed the level of his or her qualification.

2.3.2 Skill forecasts

The estimates for qualification acquisition by age and sex are interfaced with population projections by age and sex to form the skill projections that are input into the VU model. The cohort effect is calculated by assuming that a proportion of each demographic will retain their qualification level from

one year to the next. The acquisition effect is calculated by assuming that a proportion of each demographic will acquire new qualifications as indicated above.

Figure 16 shows that growth rates will be greater, the higher the skill level, with growth in postgraduate qualifications the highest. Note however that growth rates can paint a misleading picture, particularly where the base is small. Figure 17 shows the composition of employment growth over the forecast period, illustrating more clearly that the largest contribution (by level) will be from bachelor's degrees, and the largest contributions (by field) will be from management and commerce, and society and culture.

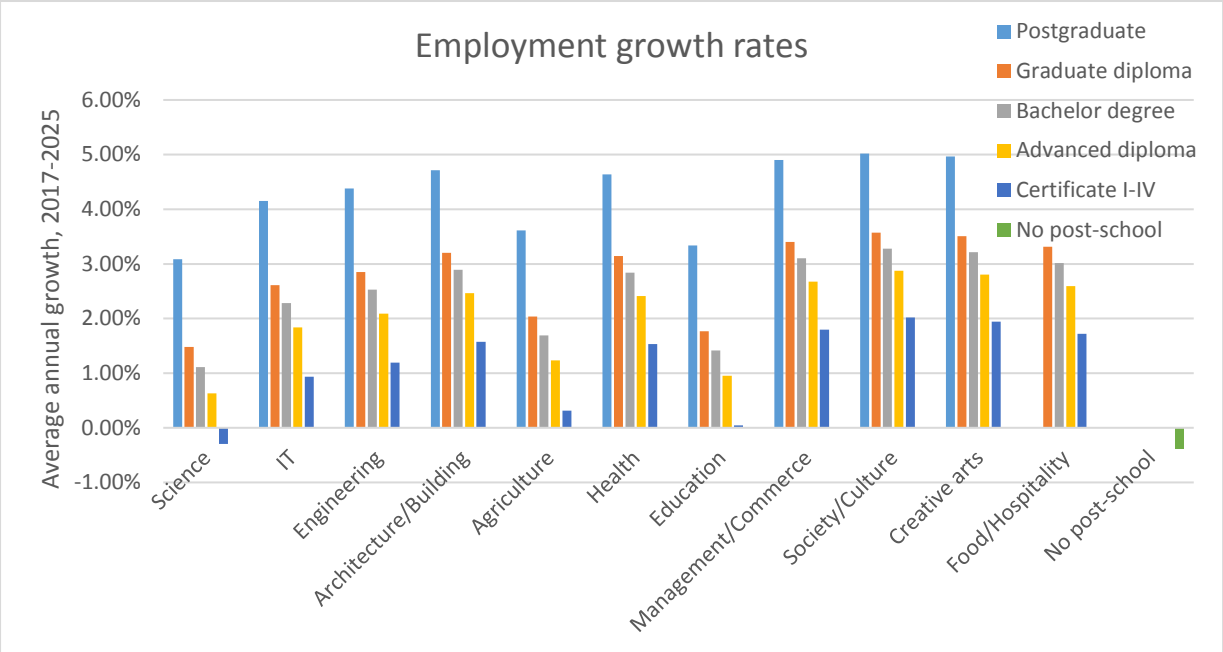

Figure 16: Projected employment growth rates by skill, 2017-2025. Source: author's calculations

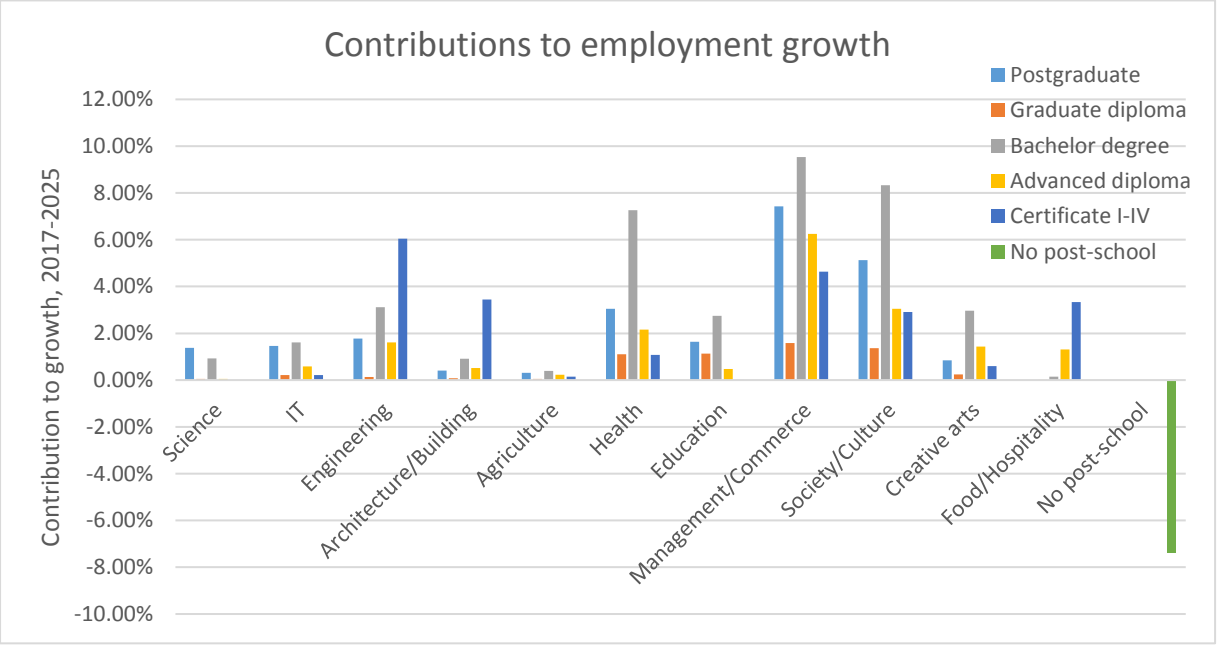

Figure 17: Projected contribution to employment growth by skill, 2017-2025. Source: author's calculations

2.4 Regional forecasts

Regional estimates are generated using a tops-down regional disaggregation technique. Giesecke and Madden (2013a, 2013b) give a detailed technical description of the methodology. The essence of it is that every sector can be classified as either "national" or "local". The performance of "national" sectors is the same across all regions, for example, if the national model finds that output of "Chemical Manufacturing" declines by 10 per cent, then it declines by 10 per cent in every region. The performance of "local" sectors is dependent on the performance of the region in which they are situated. In our example, local industries in a region heavily dependent on the declining "Chemical Manufacturing" sector will also decline. This regional modelling method has built-in checks and balances, so that regional activity adds to national activity in every sector.

National sectors are assumed to be those which produce traded commodities. For these sectors, the region of origin is assumed not to be an important determinant of output. With an extremely disaggregated industrial structure, the risk of the inappropriate attribution of activities to the regions is low. For example, it would be incorrect to attribute net growth in "agriculture" uniformly across all regions if in fact activity in dairy had increased while wheat had declined. With a more disaggregated approach, we can correctly attribute dairy and wheat separately to their appropriate regions, perhaps finding that agriculture in dairy-intensive regions increases while agriculture in wheat-intensive regions declines.

The main data source for regional estimation is the census. Employment classified by industry and region gives a good indication of the regional distribution of industries. The current version of the CoPS top-down regional disaggregation model is based on census data for ASGS SA4 regions, with each capital city region aggregated into a single region. Capital city regions are aggregated to minimise leakage due to differences in workers' place of residence and place of work.

The tops-down methodology is supplemented with the use of region-specific forecasts of population. Along with regional industry activity, the regional population forecasts from the various state demographers are used to explain household consumption, and hence some local industry activity, in the regional model.

In addition to population forecasts, VUEF adopts aggregate employment forecasts from NSW and WA. The WA forecast is adopted from the WA state budget. The NSW forecast, provided by the Department of Premier and Cabinet, are derived from the NSW Treasury's long term fiscal pressures model, and underpinned by the NSW Intergeneration Report (NSW Treasury 2016). Average annual employment growth in NSW over the VUEF forecast period (2018-2025) is forecast by NSW Treasury to be 1.11%, almost half of a percentage point below the annual growth rate forecast of 1.57% for national employment. Because of the size of the NSW economy, one implication of this is that forecast annual growth in the remaining states is relatively strong, averaging 1.80%.

3 The employment forecasts

3.1 Industries

3.1.1 Overview

VUEF industry forecasts are calculated at the 3-digit ANZSIC group level, which comprises 214 industries. Figure 17 summarises these forecasts into the 19 ANZSIC divisions. The vertical bar at 2017 marks the transition from historical to forecast employment.

Throughout the 1990's, manufacturing was the nation's largest employer. Since 2002 it has been overtaken, first by retail, and next by the rapidly-expanding health sector, which is now 75% larger than manufacturing. Construction passed manufacturing in 2010, close to the height of the mining-related construction boom, and more recently, employment in both professional, scientific and technical services and education and training has overtaken manufacturing. These changes are an illustration of the changing nature of employment in Australia, which has become distinctly more service-oriented as a result of strong income growth, changes in technology, and greater manufacturing capacity and better transport links to many of our Asian trading partners.

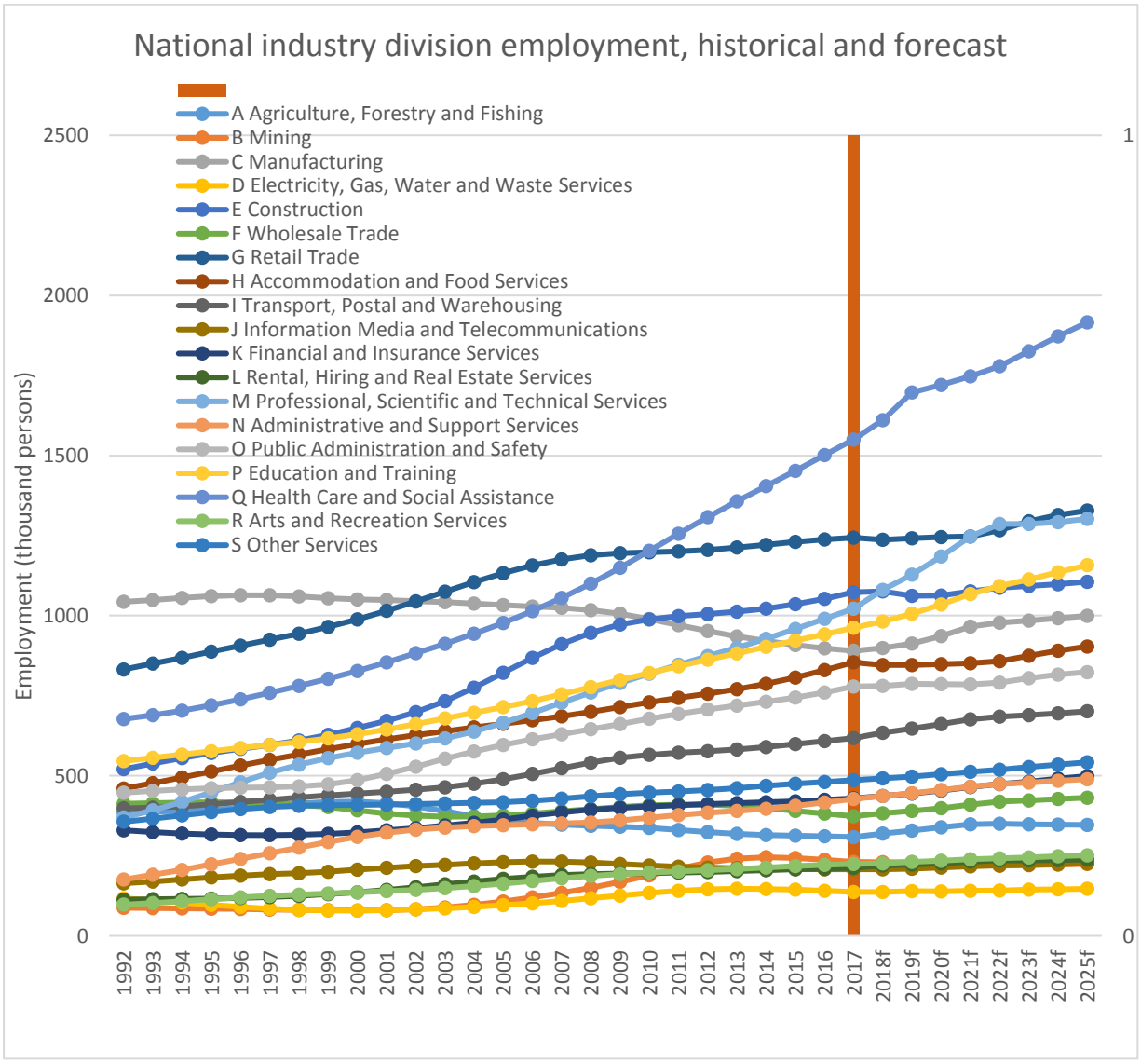

Figure 18: National employment by industry division (historical data is smoothed), 1992-2025. Sources: ABS (1992-2017) and VUEF model (2018-2025)

The pace of industry employment growth will continue to change and vary between industries through the forecast period. The more significant variations and changes are listed in Table 3 under three categories: the strong growth industries, the slow growth industries, and the improving industries, for which a reversal of recent declining in growth is forecast. Comment on this selection of industries follow.

Strong growth	Slow growth	Improving growth
M Professional, Scientific and Technical Services P Education and Training Q Health Care and Social Assistance	B Mining E Construction H Accommodation and Food Services O Public Administration and Safety	A Agriculture, Forestry and Fishing C Manufacturing F Wholesale Trade

Table 3: Key industry growth forecasts. Source: VUEF model

3.1.2 Strong growth industries

Industry divisions M, P, and Q are forecast to have the strongest employment growth through the forecast period. These divisions are made up of service industries that face relatively low technological disruption to employment, and relatively low import competition. All three divisions employ highly qualified workers and are well-suited to a workforce that is supplying a growing proportion of degree-qualified workers.

Growth rates for these industries do not differ greatly from recent performance. Continued strong growth in Division Q (Health and social services) will cement its position as the nation's largest employer. An acceleration in Division Q employment growth in the near term reflects the implementation phase of the NDIS.

The "strong growth" industry divisions accounted for 29 per cent of Australian jobs in 2017, and are forecast to account for 32 per cent by 2025. These three divisions are forecast to add more than 800 thousand jobs over the eight-year forecast period, accounting for more than half of national employment growth.

3.1.3 Slow growth industries

All of the "slow growth" industries are forecast to experience growth rates that are both lower than the national average, and lower than they have been in recent history.

Jobs in Division B (Mining) accounted for around 1 per cent of Australian employment throughout the 1990's and early 2000's. It climbed to above 2 per cent from around 2012 to 2016. Over the forecast period, mining export volumes will be strong. However, mining activity is not very labour intensive, and much of the expansion will be facilitated not by a larger labour force, but by capital installed over the last decade. The mining industry's share of national employment will fall from its current level of 1.9 per cent to around 1.65 per cent over the forecast period.

The growth rate for employment in Division E (Construction) is forecast to remain below the national average, as it has been for most of this decade. Throughout the 1990's and early 2000's, Division E accounted for between 7 and 8 per cent of Australian jobs. During the mining construction boom years, this increased to around 9 per cent. With a fairly bland forecast for investment, in contrast to the sharp rise and fall that has occurred so far this decade (Figure 7), construction employment will return to a slightly lower share of national employment, falling back to 8 per cent of national employment over the forecast period.

Employment growth in Division H (Accommodation and Food services) is forecast to be weak, despite strong growth forecasts for international tourism. While international tourism is beneficial to growth in Division H, accommodation and food services depend primarily on the household sector, where expenditure growth is relatively subdued. The impact of subdued growth in aggregate household expenditure falls disproportionately on non-necessities such as accommodation and food services.

The impact of slow growth in domestic expenditure is also apparent in government expenditure, with below-average employment growth forecast for Division O (Public Administration and Safety). Slow growth in Division O is a consequence of the expenditure restraint assumed to achieve a return to surplus on the government budget over the next four years.

3.1.4 Improving industries

Of the divisions where employment is forecast to grow appreciably faster than it has in recent history – Agriculture (Division A), Manufacturing (C), and Wholesale (F) – none are forecast to grow at a very high rate relative to national employment. Rather, the forecasts indicate a reversal in declining employment, with divisions A and C experiencing negative employment growth over the last decade or longer.

Employment in Agriculture has declined since around 2000. The millennium drought had a devastating impact, with employment declining by 20 per cent in the decade ending 2010. The ability of the sector to recover was then negatively affected by the high exchange rate associated with the mining boom – so-called "Dutch Disease" conditions. In this context, the fall in agricultural employment over the historical period is not necessarily indicative of a long-term structural decline. Employment in agriculture is forecast to grow at an average of 1.5 per cent per annum over the forecast period, reflecting strong growth in export markets and a falling exchange rate. Adverse weather conditions are assumed not to occur over the forecast period.

Employment in Manufacturing has also declined since the turn of the century. This can be attributed to three factors. Firstly, there is saturation: as the population grows richer, it spends a smaller proportion of its resources on manufactured goods and a larger proportion on services. It follows that the economy also devotes a smaller proportion of resources, including labour, to the production of manufactured goods. Secondly, there is competition from imports. This has intensified as the capacity to produce and transport manufactured goods at low cost from large emerging economies has increased over the last decade, as revealed in the changes to import preference variables reported in section 2.2.3.2. Furthermore, local manufacturers found it particularly difficult to compete through the late 2000's and early teens, with the exchange rate reaching high levels as a result of the mining boom. Thirdly, there is automation. To produce a certain volume of manufactured goods, particularly those requiring simple or repetitive processes, fewer workers are required.

In forming a forecast view, each of these three factors is taken into account. The household expenditure function in VUEF accounts for the saturation effect. The macroeconomic conditions, including the declining exchange rate forecast, determine import competition along with the projected changes in import preferences described in section 2.2.3.2. The impact of automation is captured by growth in industry capital stocks. Automation is also evident in the occupation bias results reported in 2.2.3.1, which indicate that a bias against Labourers and Technicians and Trades occupations, both important occupation groups in the manufacturing workforce, has existed in recent history. However, this bias was not extrapolated into the forecast period.

The forecast reversal in manufacturing employment growth is mainly attributable to more favourable macroeconomic conditions. The declining exchange rate forecast helps local manufacturing in two

ways: it makes manufacturing exports, such as many food products, more competitive on world markets, and it makes import-competing activities, such as domestic appliances and furniture, more competitive in the local market.

Furthermore, the import preference effects weaken as manufacturing becomes more specialised. For example, employment in textiles, clothing and footwear has already declined so much that there is little scope for it to decline further. At this stage, changes in import preferences become meaningless. Similarly, employment in motor vehicle manufacturing has fallen as a result of the closures of several major manufacturing plants, which limits the scope for it to fall further in the forecast period.

Without wishing to read too much into unfiltered data, there is some evidence that employment in manufacturing is beginning to increase. ABS data shows that employment in manufacturing in May 2017 was over 900,000 persons, an increase of 47,000 persons over the previous 18 months. As shown in Figure 19, this increase has yet to persist for long enough to show in the filtered series.

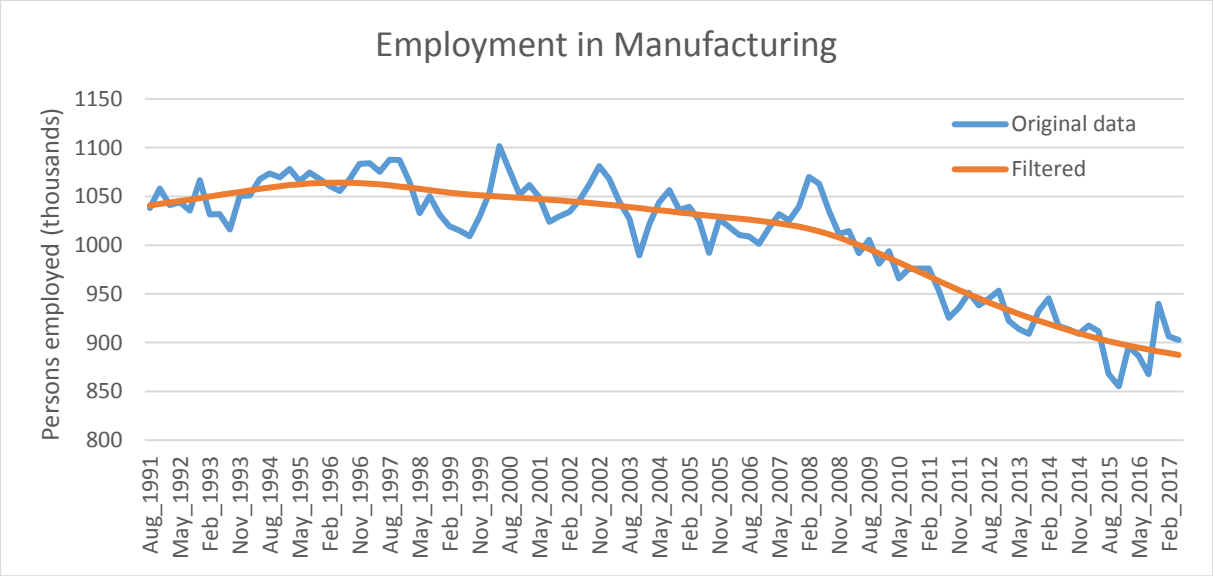

Figure 19: Employment in Division C Manufacturing, original and filtered data, 1991-2017. Source: ABS and author's calculations.

The Wholesale division (F) is closely linked to activity in manufacturing (both domestic and imported) and agriculture. Wholesale is primarily a margin commodity. Almost 90 per cent of the sales income in the Wholesale division is derived from facilitating sales of manufactured goods, with a further 7 per cent derived from facilitating sales of agricultural output. Employment in wholesale tends to fluctuate but a clear downward trend has been evident since around 2010. This is underscored by negative growth in real per capita incomes and the consequent weak growth in demand for manufactured products.

Employment growth in wholesale is forecast to turn around, with moderate but positive growth over the forecast period in line with the forecast recoveries in manufacturing and agriculture.

In conclusion, macroeconomic conditions over the last decade in Australia have been characterised by a boom and bust cycle in the terms of trade and investment leading to a temporarily high exchange rate and a consequent temporary loss of competitiveness in manufacturing and agriculture. These conditions exacerbated the weak performance of the agricultural sector caused by adverse weather

conditions throughout the early 2000's. The forecast period should see a return to more standard macroeconomic conditions and a moderate recovery in these sectors.

However, the performance of the "improving industries", which will add around 200,000 jobs over the forecast period, is dwarfed by the "strong growth industries", Health, Professional services and Education, which will add more than 800,000 jobs and account for more than half of all employment growth over the forecast period.

3.2 Occupations

The VUEF model recognises that every industry has its own composition of employment by occupation. For example, the predominant occupations of workers in the retail sector are the sales occupations, while the predominant occupations of workers in the construction sector are the trade and technician occupations. The evolution of aggregate employment by occupation is attributable to changes in both the relative sizes of industries and changes in the composition of employment within industries.

In 1991, the three largest occupation groups (ANZSCO major groups) in Australia – professionals, technicians and trades workers, and clerical and administrative workers – were of a similar size, each with 1.2 to 1.4 million workers. In 2017, these are still Australia's three largest occupations, but employment in the professional occupations is now around 80 per cent larger than employment in either clerical and administrative occupations or technical and trades occupations. Employment in the managerial occupations has also grown strongly to be on a par with the clerical and trades occupations.

The very diverse Professional occupations group includes business professionals such as accountants and sales and management professionals, legal professionals, health professionals including medical and allied health practitioners and nurses, education professionals including teachers and university lecturers, and professionals in design, engineering, science, transport, ICT and the arts. Past growth in professional occupations has manifest not only in the strong-growth divisions Q (Health), M (Professional services) and P (Education), but also outside these industries. Within some industry divisions – particularly finance and insurance and public administration – the proportion of workers in professional occupations has increased, while it has not fallen significantly in any sector.

Over the forecast period, as the workforce continues to become more educated, the professional occupations are forecast to contribute the most to growth, accounting for 35 per cent of employment growth, or almost 600,000 jobs.

Among the lower skilled occupations, growth in employment of labourers, machinery operators and drivers and sales workers will continue to be sluggish. Low skilled workers may find more opportunities in the community and personal services occupations in the strongly growing Health care and social assistance sector.

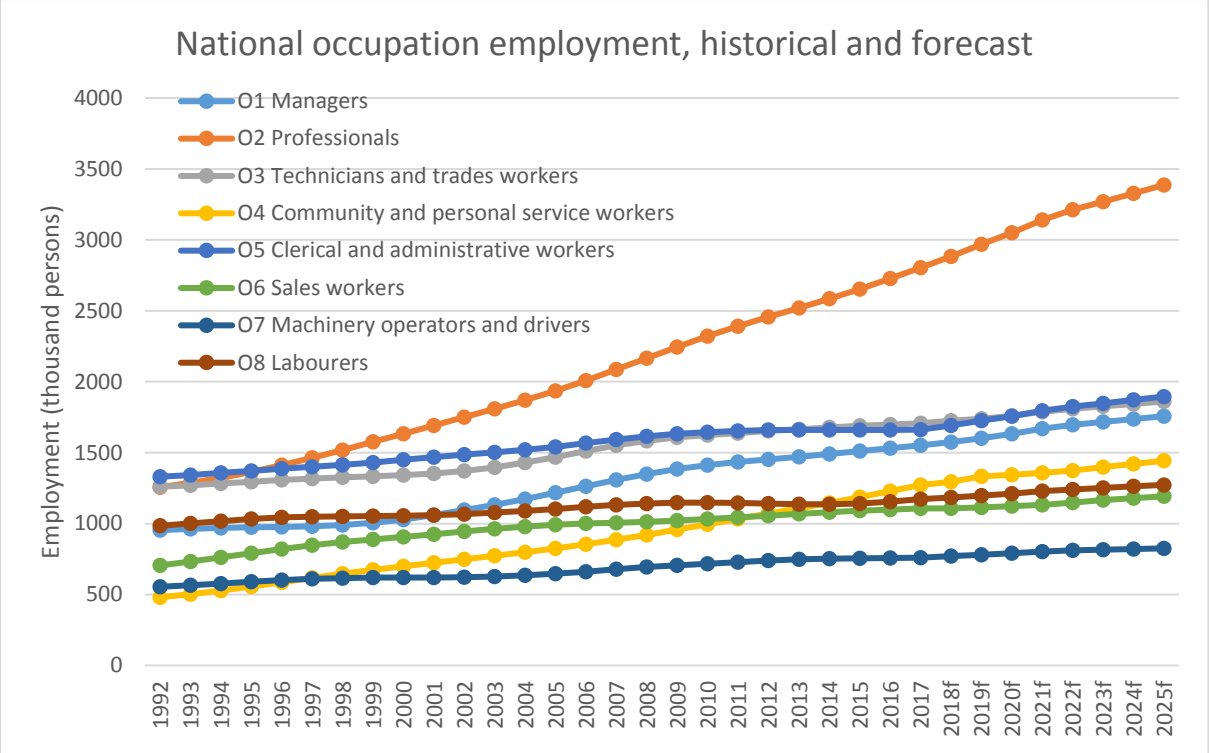

Figure 20: National employment by occupation major group (historical data is smoothed), 1992-2025. Sources: ABS (1992-2017) and VUEF model (2018-2025)

3.3 Regions

For each of the trade-exposed industries (known as "national" industries), the top down regional disaggregation attributes national industry growth rates to the industry in every region in which it operates. Regional growth rates for locally oriented industries, such as health and community services, depend on regional population growth and the overall performance of the regional economy, which is affected by the performance of the national industries operating in the region.

Figure 21 shows aggregate employment growth for capital cities and other areas for every state. In most cases, the relatively high population forecasts and high concentration of the strong-growth Professional Services industries in urban areas lead to stronger growth in the capital cities. The one exception is Queensland, for which the population growth forecasts are strongest for regions other than Brisbane, including Ipswich, Gold Coast, Moreton Bay North and Moreton Bay South.

As flagged earlier, forecasts for aggregate employment in NSW are calibrated to match exactly to forecasts provided by the Department of Premier and Cabinet. The forecast for average annual employment growth in NSW is just 1.11%, almost half of a percentage point below the annual growth rate forecast of 1.57% for national employment. In order to accommodate the NSW growth forecast in the context of a much higher national growth forecast, the original model estimates of growth in most of the other states was adjusted upward.

An alternative approach would have been to have adjusted the national forecast downward. However, strong justification would be required to deviate from the national forecast which is based on ABS population forecasts and detailed projections of participation rates from the Commonwealth Treasury. The approach will be revisited in the 2018 version of VUEF.

Figure 21: Employment growth rate forecasts, 2017-2025, capital cities and other regions. Source: VUEF Model

Figure 22 attests to the dominance of health, professional services and education in the capital cities in employment growth over the forecast period. Of all jobs created in all industries and regions, one in six will be in the health sector in capital cities. Health, professional services and education will be the largest contributors to growth both within and outside capital cities, accounting for around half of new jobs in both areas.

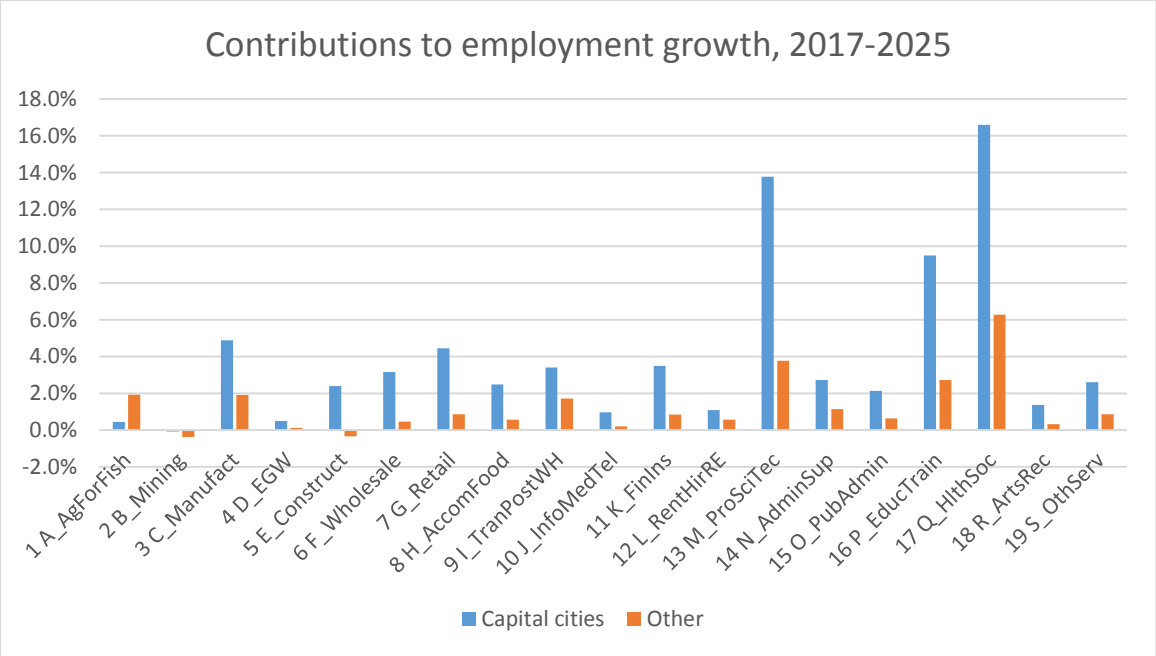

Figure 22: Contributions to employment growth, industry and region, 2017-2025. Source: VUEF model

4 Conclusions

The Australian labour market grows at around 200,000 jobs per year. Over an eight-year forecast horizon, VUEF provides a framework in which to determine the likely characteristics of the additional 1.6 million jobs that will be added to the workforce in the context of domestic economic growth, technological change, a changing world economy and a more educated workforce.

We find the workforce will become more educated, with bachelor degree-qualified workers the biggest growth category in the workforce in the forecast period. The proportion of the workforce with no post-school qualification will decline, as retiring workers, many of whom hold no post-school qualification, are replaced with younger workforce entrants who are more likely to obtain post-school qualifications.

The macroeconomic environment will be characterised by moderate economic growth, with a lower exchange rate facilitating a growing share of export activities including mining, agriculture and related manufacturing activities, and education. The corollary of this is that growth in domestic expenditure (both private and public) will be low relative to overall economic growth. Despite this, much of the growth in employment will be concentrated in service industries with strong links to domestic expenditure. This is because much of the export growth will occur in more capital-intensive activities and have relatively little impact on employment.

Over the forecast period, three industry divisions will account for more than half of all employment growth. Health, Professional services and Education are all service industries with strong indicators of growth. All three sectors use the professional occupations, enabling them to absorb a large part of the growing tertiary-qualified workforce. The implementation of the NDIS and the ageing of the population underlie strong growth in the health sector, while the export markets for both education and professional services sectors will expand as a result of a lower exchange rate. Professional occupations will account for more than one-third of employment growth over the forecast period.

Following detailed population forecasts provided by state government agencies, the VUEF forecasts concur that the majority of employment growth will occur in urban areas. The strong-growth services sectors are important to growth in both capital cities and other areas; however, overall growth in population and employment outside capital cities is slower. Both rural and urban areas will become more reliant on the service sectors for employment over the forecast period.

The results reported in this paper represent only a summary of the detailed information contained in the full VUEF database. This paper demonstrates the capacity of the VUEF model to generate detailed forecasts in the context of a macroeconomic model of the Australian economy. The forecasts, updated annually, are of considerable interest to state government agencies and the wider community.

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