



Australian Government
Productivity Commission

The economywide impacts
of migration – general
equilibrium modelling

Migrant Intake into Australia
Technical Supplement B

April 2016

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The Productivity Commission

The Productivity Commission is the Australian Government's independent research and advisory body on a range of economic, social and environmental issues affecting the welfare of Australians. Its role, expressed most simply, is to help governments make better policies, in the long term interest of the Australian community.

The Commission's independence is underpinned by an Act of Parliament. Its processes and outputs are open to public scrutiny and are driven by concern for the wellbeing of the community as a whole.

Further information on the Productivity Commission can be obtained from the Commission's website (www.pc.gov.au).

The economywide impacts of migration — general equilibrium modelling

This technical supplement provides details of the modelling undertaken to analyse the economywide impact of Australia's migrant intake.

The modelling adopts a scenarios approach to quantify the possible impacts of net overseas migration (NOM) on the Australian population and the Australian economy. These scenarios do not represent policy options — they are illustrative of the effects of NOM. Four main scenarios are considered.

- *Business-as-usual scenario.* This scenario is used to illustrate the implications of NOM at a long-term historical average rate of 0.6 per cent of the population. NOM is assumed to converge from the recent historically high level to the annual historical average of 0.6 per cent of the population by 2025.¹ Migrants are assumed to have the same demographic characteristics (concentrated in the 20 to 40 year old age groups) and occupation profile as the current migrant intake, and the same labour market characteristics as the Australian labour force.
- *Zero NOM scenario.* In this scenario, NOM is assumed to be zero from 2016 onwards; illustrating the effects of natural population increases alone. This scenario can be interpreted as the effect of natural population growth on the size of the population, workforce participation and output per person. The difference between this scenario and the business-as-usual scenario can be interpreted as the contribution of migration to the economy over the projection period.
- *0.3 per cent NOM scenario.* This scenario assumes that NOM converges to 0.3 per cent of the population by 2025.
- *1 per cent NOM scenario.* This scenario assumes that NOM is set at 1 per cent of the population from 2016 onwards. This is consistent with settings over the decade to 2014.

In addition to these scenarios, three scenarios examine the sensitivity of results to the age and occupational profile (skill level) of NOM. All other assumptions are identical to the business-as-usual scenario.

- *Age sensitivity scenario.* Assumes that NOM has the same demographic composition as the Australia population.

¹ All years in this technical supplement, unless otherwise indicated, are in Australian financial years, ending 30 June of the year quoted.

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- *Skilled occupations scenario.* Assumes that 30 per cent of the NOM workforce are reallocated to skilled and semi-skilled occupations broadly defined as: managers; professionals; technicians and trades workers; and community and personal service workers.²
 - *Lower-skilled occupations scenario.* Assumes that 30 per cent of the NOM workforce are reallocated to semi-skilled and low-skilled occupations, broadly defined as: clerical and administrative workers; sales workers; machinery operators and drivers; and labourers.

Sensitivity testing is also undertaken around three levels of NOM, defined in terms of numbers of migrants rather than as a proportion of the population. Specifically, where NOM is assumed to:

- decline to 100 000 persons each year by 2026 and to remain at that level until 2060
- remain at 200 000 persons each year per year through to 2060
- rise to 250 000 persons each year by 2026 and to remain at that level until 2060.

Section B.1 describes the modelling approach adopted and B.2 the derivation of the business-as-usual scenario, which forms the starting point for all scenarios. Section B.3 provides additional detail on model projections.

B.1 Modelling approach

The modelling framework

The Commission has used a regional computable general equilibrium (CGE) model — the Victoria University Regional Model (VURM) — to analyse the potential impacts of NOM on Australia’s demography and economy.³ For the purpose of this inquiry, VURM includes additional detail to model NOM and the consequences of demographic change for government expenditure on health, aged care and education by age group. This version is named VURM-MI (Migrant Intake).

To assess the economywide impacts of migration, it is necessary to model how the flow of migrants to the economy affects the Australian population, the labour force and subsequently national demands for goods and services, production and trade.

In the literature, extensive use has been made of CGE models to assess the economywide impacts of migration in Australia.

² Occupations are described in Attachment 1.

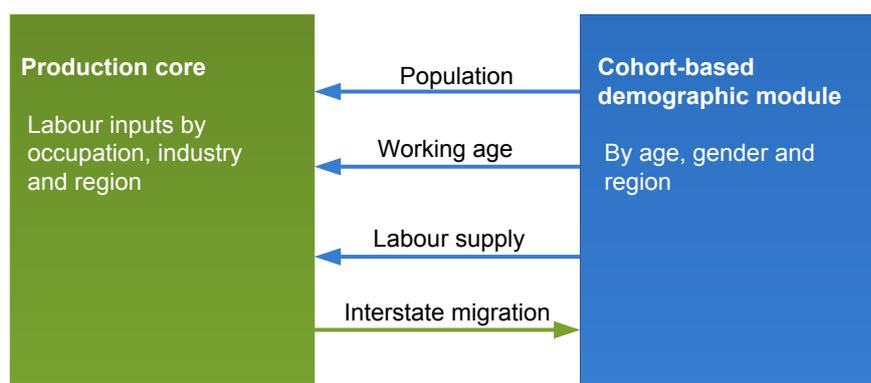
³ VURM was formerly known as the Monash Multi-Regional Forecasting (MMRF) model.

- In 2006, the Commission contracted the Centre of Policy Studies (CoPS) at Monash University to use the MONASH model to analyse the impact of an increase in skilled immigration (PC 2006a).
- Also in 2006, Giesecke (2006) extended the work published in PC (2006a), analysing the impact of skilled immigration, including the impact on income distribution.
- In 2013, the Centre for International Economics modelled the implications of skilled immigration in New South Wales (The CIE 2013).
- In 2015, the Migration Council Australia commissioned Independent Economics to examine the economic impact of migration over a 35 year period to 2050 (Migration Council Australia and Independent Economics 2015).
- In 2016, the Centre of Policy Studies used a modified version of the model TERM to examine the labour market displacement effects of Australia’s temporary skilled visa program (Tran et al. forthcoming).

VURM-MI is applied in its *dynamic* mode to explore the evolution of the population through natural increase and NOM and their effects on growth in the economy through changes in labour force participation and labour productivity over time. Under the dynamic approach, the scenarios focus on the path of the economy with alternative assumptions on the annual rate of NOM over the period 2016 to 2060.

The assumed paths of changes in labour productivity and other variables are based on historical data at the sectoral level. Changes in population are estimated using the cohort-based demographic module of VURM-MI (figure B.1).

Figure B.1 **Stylised representation of VURM-MI**



A detailed description of the theoretical structure of the model is provided in Adams, Dixon and Horridge (2015).

The modelling in context

Like any other economic model, VURM–MI is a simplification of complex economic interactions. The model does not account for social and environmental conditions that can affect Australia’s demography, consumption choices, labour supply, and production and trade. In addition, the model does not account for the emergence of new activities and products, or developments in global financial markets that can affect the cost of capital, global population or economic changes.

The modelling approach, nevertheless, seeks to capture the direct relationships relevant to economywide impacts of migration. The direct effects of NOM are imposed on the model as exogenous shocks on the population and on the labour force by occupation, which produce projected flow-on effects on production, consumption, and government revenue and expenditure.

As the scenarios modelled reflect migrant movements imposed on the model, they should *not* be interpreted as the effects of future policy decisions. Rather, they illustrate the effects of the combination of a large number of assumptions embodied in VURM-MI and in the scenarios implemented.

The dynamics underlying VURM-MI are consistent with assuming ‘adaptive’ expectations where industries adjust gradually to changes. Under this approach, industry capital depreciates progressively and accumulates to equilibrate returns on capital with expected rates, based on historical averages. There is, therefore, a lag between new arrival of migrants and new capital investment. And the modelling abstracts from the possibility that firms anticipate changes and adjust employment, investment and output accordingly.

The behavioural parameters included in VURM-MI determine the responsiveness of producers and consumers to changes in relative prices (including wages). This version uses the standard parameter values (see below).

The compilation of the model database is based on many simplifying assumptions needed to translate and calibrate available statistical information into a consistent database representing complex interactions in the economy. The demographic and economic projections presented are not forecasts or predictions. These projections reflect a scenario given the structure of the model and input assumptions.

Extensions to VURM for this inquiry

Modelling of net overseas migration (NOM)

NOM can directly affect the Australian economy by changing the size of the population, its age and gender structure as well as the size and composition of the labour force.

In VURM–MI, detailed assumptions about NOM are introduced in terms of age and gender of migrants and assumptions about the state or territory in which they arrive. This process is outlined in box B.1.

Box B.1 Operation of the demographic module

The demographic module models the effect of demographic changes on subsets of the population, based on age, gender and region (referred to as 'cohorts'). This makes it a 'cohort component' model. It uses a 'stock-flow' approach to calculate regional populations by age and gender. The 2014 database consists of the estimated resident population (ERP) for 1616 age, gender and region cohorts as at 30 June 2013 comprising of:

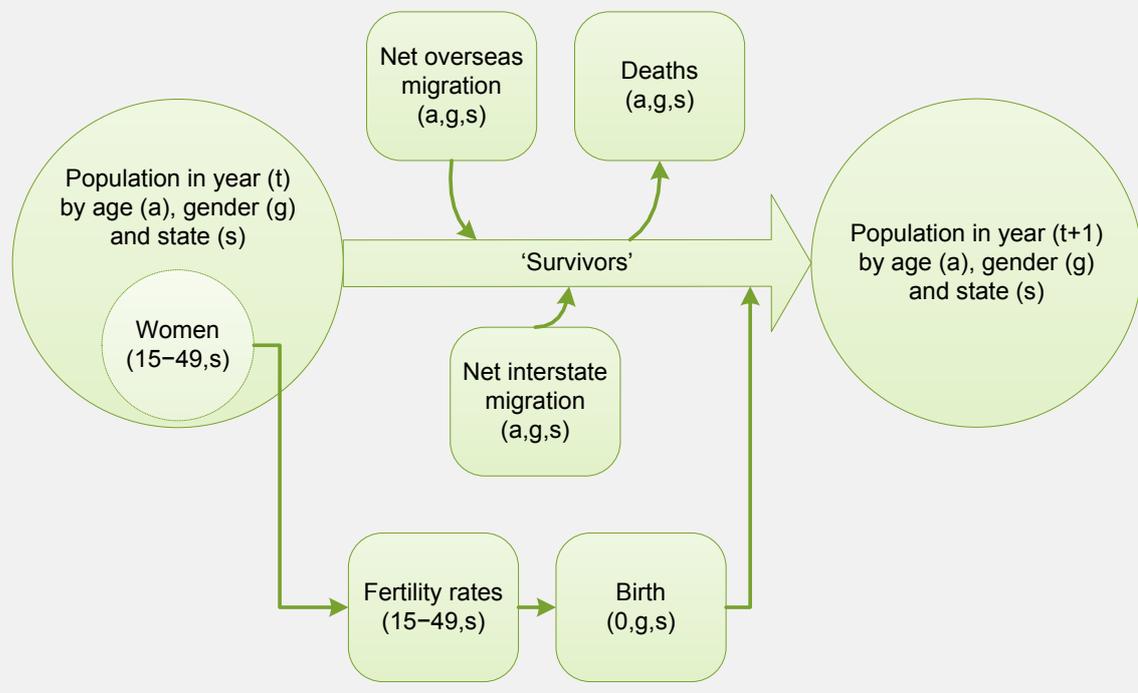
- 101 age groups — 100 single year age cohorts (0 years old to 99 years old) and an open ended 100 years and over cohort
- two genders — male and female
- eight regions — New South Wales, Victoria, Queensland, South Australia, Western Australia, Tasmania, the Northern Territory and the Australian Capital Territory.

The cohort data that underpin the database for the new demographic module are sourced from the ABS (2014a, 2014b).

Each year, the number of people in each age, gender and region cohort changes according to: the net inflow from NOM (immigration less emigration); the net inflow from interstate migration; deaths; and births.

People who do not die or leave the region are one year older by the end of the simulation year and join the next age cohort. The demographic module determines population, working-age population and labour supply.

Stylised representation of the demographic module



In the standard model, migrants are assumed to enter the labour force with age-gender characteristics of the migrant population and to display the same characteristics as the general population with respect to age-specific fertility and age-specific labour force participation rates. Migrants are also assumed to initially reside in and join the labour force

of the region of disembarkation, have the region's average occupational characteristics at the time of arrival, and display the same unemployment rates by region and occupation.

For the purpose of this inquiry, the VURM has been modified to allow for migrants to enter the labour force with:

- age and gender (age-gender) characteristics of either the migrant population or of the Australian population
- occupation employment characteristics different to those of the Australian labour force.

The business-as-usual scenario uses these modifications to project the economic impact of NOM with the current age-gender and occupational structure of NOM. Key model code changes are listed in Attachment 2 of this technical supplement.

Modelling government finances

The terms of reference ask the Commission to consider the Australian and state and territory government finance implications of migration. An important means by which NOM affects governments finances is through its effects on expenditures that relate directly to demography including health, aged care and education, in addition to the Age Pension. NOM also affects government revenues including personal income taxes and goods and services taxation (GST) through higher economic activity.

In VURM-MI, Age Pension payments are indexed to the population over 65 years and the projected wage index. Under this setup, Age Pension payments are responsive to the effect of NOM on the demographic structure of the population.

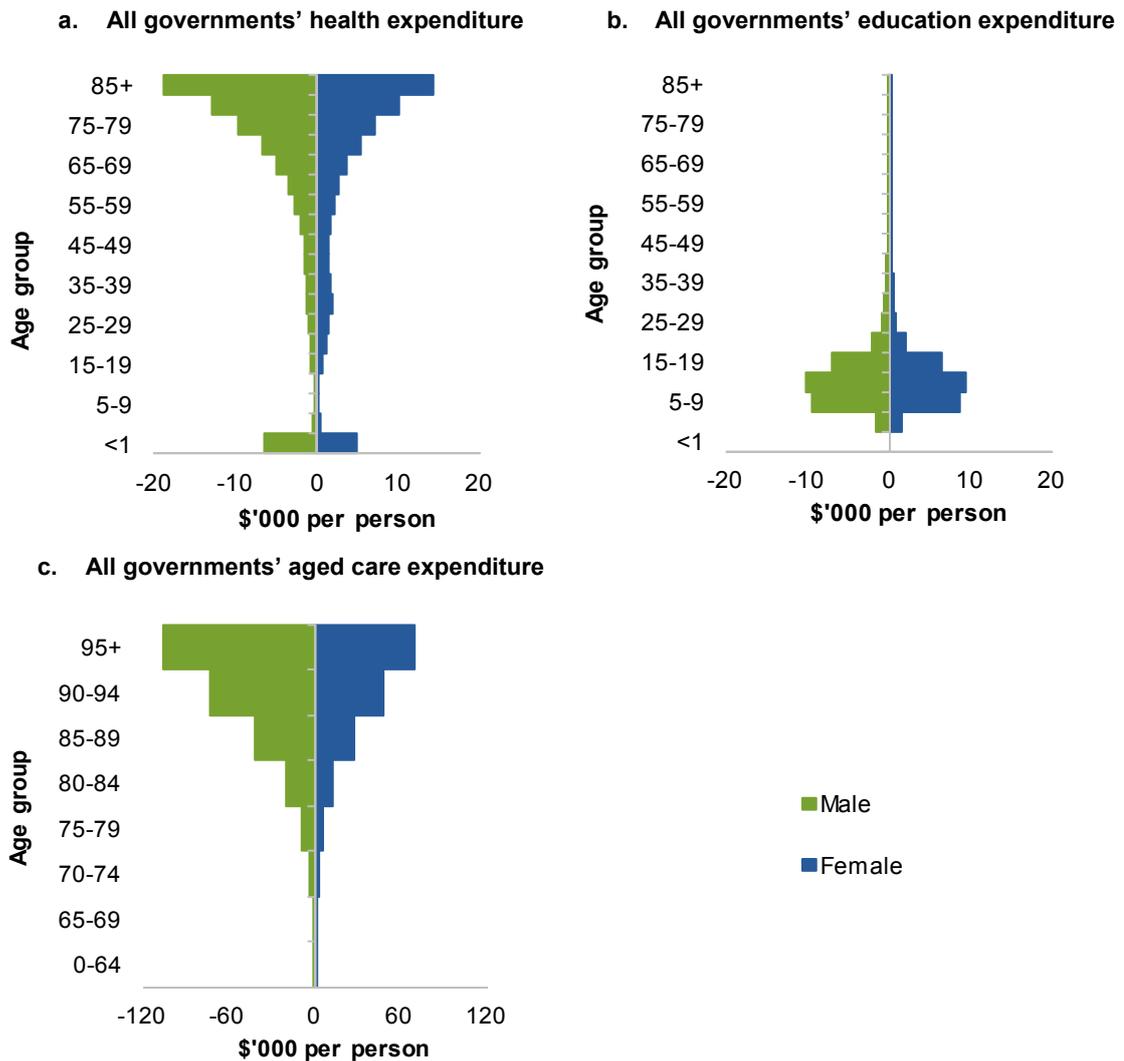
VURM-MI also varies real government final consumption expenditure⁴ on education, health and aged care services in response to changes in national aggregate real household final consumption spending per person and per person government expenditure on education, health and aged care.

Per person government expenditures on health, education and aged care are assumed to vary with age, giving rise to 'expenditure pyramids' in figure B.2. These per person government expenditures for health, education and aged care are sourced from the Commission's (2013) *An Ageing Australia* report, adjusted to 2014 prices and scaled to be consistent with the database's population and aggregate government final consumption

⁴ Final consumption expenditure of general government includes the net expenditure on goods and services by public authorities (other than those classified as public corporations), but excludes transfer payments such as social benefits and expenditure which results in the creation of fixed assets or inventories or in the acquisition of land and existing buildings or second-hand assets. It comprises expenditure on compensation of employees (other than any employees producing capital goods), goods and services (other than fixed assets and inventories) and consumption of fixed capital. Expenditure on repair and maintenance of roads is included (ABS, *Australian System of national Accounts, Concepts, Sources and Methods 2014*, Cat. No. 5216.0, Glossary).

expenditure levels for these items. The pyramids show how government expenditures per person on these services are sensitive to the population age structure, with the profiles for health and aged care being weighted towards the older age groups and education towards the younger.

Figure B.2 Health, education and aged care costs to governments vary by age and gender
2014



Source: Productivity Commission estimates based on PC (2013).

The main additional equations included in VURM-MI to implement this theory are listed in Attachment 2 of this technical supplement.

The economic environment (model closure)

To examine the effect of migration on the economy involves running the model through time in a series of one-year recursive-dynamic steps. Each step involves gradual adjustments in capital and labour markets to changes in the economic conditions.

The modelling undertaken for this inquiry is based on assumptions affecting the level and distribution of economic activity.

- The size and age structure of the population in each state and territory changes according to state-specific assumptions about fertility, life expectancy and NOM.
- The aggregate supply of labour is determined by region-specific working age population and labour force participation rates, as well as by the unemployment rate by region and occupation.
- Employment by region, industry and occupation gradually responds to changes in the working age population, its participation in the labour force and real after tax wages accruing to households (governing labour supply).
- Employment by region, industry and occupation also responds to changes in the costs and prices of regional industries and the real cost of labour to those industries (governing labour demand).
- Investment, and with it the capital stock, in each industry responds gradually to differences between expected and actual rates of return. Expected rates of return are determined by values in the database. In each region, real government investment is assumed to move in line with real private investment. Real Australian Government investment is assumed to move in line with national real private investment.
- Household consumption by state is determined by state post-tax household disposable income and the average propensity to consume or save. With household propensity to consumer fixed, expenditure on individual products varies according to relative prices and household disposable income.
- Nominal government expenditure (including government consumption and other outlays) moves in line with the underlying drivers of government expenditure activity (such as population, unemployment, aggregate economic activity and prices).
- Average tax rates are assumed to remain fixed so that revenue moves in line with the various tax bases. The budget position is held fixed as a share of gross domestic product (GDP) or gross state product (GSP) through the use of lump-sum transfers to, or from, households.
- The aggregate terms of trade is assumed to decline to its long-run trend by 2018 and then remain fixed thereafter, while the price of individual exported products in domestic and foreign currency prices can vary with changes in the relative competitiveness of exporting industries. Import prices are assumed to be fixed in foreign currency prices.
- Growth in labour productivity for each industry returns from its current 2014 growth rate to its longer-term average by 2018, and is applied in each region.

-
- The model index of consumer prices (CPI) is the model numeraire while the nominal foreign currency exchange rate varies. All domestic prices in the projection period are therefore real prices relative to the model CPI.

Further detail of the assumptions made in the business-as-usual scenario are described in PC (forthcoming).

As far as practicable, the modelling assumptions are aligned with historical experience in Australia. There is inevitable uncertainty around these assumptions used to produce these projections. Generally, as the validity of assumptions are more uncertain over longer time periods, more caution is needed in interpreting results that are well into the future.

Model parameters

In CGE models such as VURM-MI, some of the key parameters driving the adjustment to an external shock are the responsiveness of trade volumes and the responsiveness of labour and capital between activities and across regions to changes in relative prices. Parameters include:

- export demand elasticities
- domestic-import substitution elasticities
- primary factor substitution elasticities, and occupational transformation elasticities (supply-side) and substitution elasticities (demand-side).

The standard VURM parameter values have been used.

Export demand elasticities

Export demand elasticities govern the extent to which world prices respond to changes in export volumes — the larger the elasticities, the smaller the price declines for a given increase in export volume.

In year-to-year simulations, the reference value of minus five (-5) adopted by the CoPS is applied. This value assumes that Australia has some influence over prices it receives for its produce on global markets in the short term. For example, Australian producers might be able to increase prices in the short term by withholding supply of commodity exports. However, this capability would not be expected to continue in the long term. This is because other commodity exporters may respond to higher prices by increasing their own supply, or major importers may turn to domestic production — that is, in general, Australia is a price taker.

Domestic-import substitution elasticities

Domestic-import substitution elasticities determine the degree of substitutability between domestically produced and imported products (Armington elasticities). More specifically, the elasticities determine the sensitivity of demand for:

- imports in response to changes in the price of imports relative to the price of domestic products
- domestic products in response to changes in the price of domestic products relative to the price of imports.

The values adopted in this study are the standard values incorporated by the CoPS in VURM. The values range between 0 (for products with low import volumes) and 10 (for products with a high degree of substitutability).

Primary factor substitution and occupational mobility parameters

Factor substitution elasticities determine the degree to which labour and capital inputs can be substituted for each other in production. The values for year-to-year simulations in VURM are 0.5 for all industries.

VURM also includes elasticities governing the degree of substitutability in the use of labour in the eight different occupations in production. The values for year-to-year simulations are 0.35. The selection of these values reflects an assumption that employers have some flexibility to alter the occupational mix used in production on a year-to-year basis.

Transformation elasticities determine the extent to which the supply of labour, including immigrant labour, can move between the eight occupational groups. The value for year-to-year simulations is set at 0.1. The selection of this value reflects an assumption that, on a year-to-year basis, employees have limited potential to change their occupation.

Model database

The database used for this inquiry was created from the standard VURM database, which aligns with the 2009-10 ABS *Input-Output Tables* (CoPS 2015).⁵ The database has been updated to 2014 based on population, terms of trade and other changes over the period 2010 to 2014. For the purposes of this documentation, financial years are identified in terms of the final year, for example 2013-14 is described as 2014.

⁵ Industries, commodities and occupations are listed in Attachment 1.

B.1 Modelling the business-as-usual scenario

This section outlines key aspects of the business-as-usual scenario.

The key demographic assumptions of the projections compared to data for 2014 are reported in table B.1. The demographic projections are based on current age, region and gender-specific fertility, life expectancy projections and annual rate of NOM. These assumptions are consistent with inputs into other demographic projections and result in population in the order of 40 million by 2060 in the business-as-usual scenario.

Table B.1 Key demographic assumptions

	<i>Units</i>	<i>VURM variable</i>	<i>2014</i>	<i>Beyond 2025</i>
Starting population	million	natpop	23	na
Total fertility rate ^a	births per woman	NATFR	1.96	converges to 1.86
Male births per 100 female births ^a		POPALPHA	105.7	105.7
Life expectancy at birth ^a	years	ex@1	83	converges to 93
NOM	'000	Projectnom	206	0.6% of population

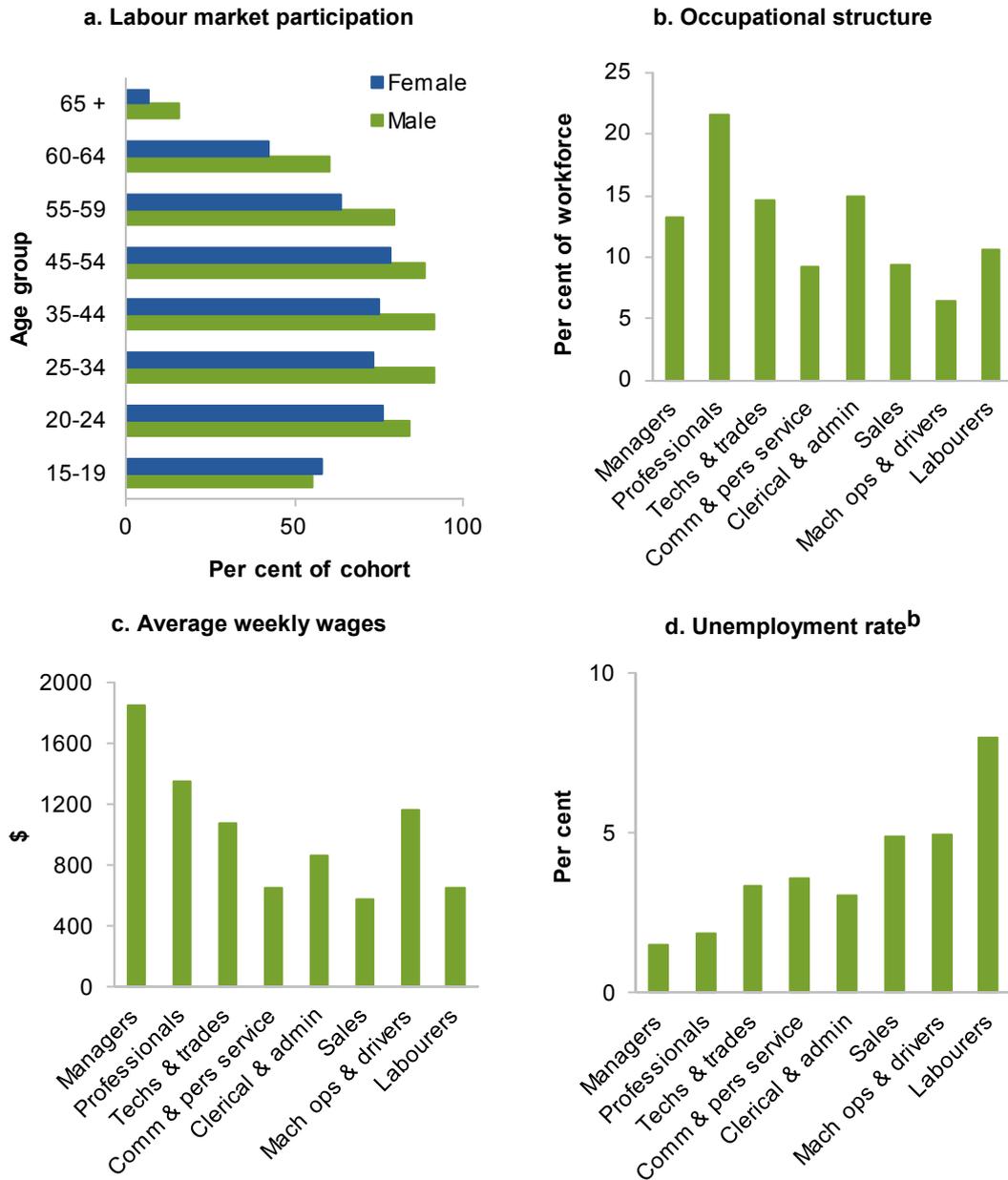
na: not applicable ^a National average.

Sources: Productivity Commission estimates based on ABS (*Australian Historical Population Statistics, 2014*, Cat. no. 3105.0.65.001); ABS (*Australian Demographic Statistics, December 2014*, Cat. no. 3101.0).

The demographic modelling in VURM is based on the framework and assumptions initially developed by the Productivity Commission over the past decade (Cuxson et al. 2008; Lattimore and Pobke 2008; PC 2005, 2006b, 2013). For more detail, see the Commission's documentation of its reference case (PC forthcoming, 2012).

Working age to population ratios, participation rates and employment rates link population to economic activity. Participation rates are highest for males and females aged between 20 and 55 years, tapering off thereafter (figure B.3, panel a). A large proportion of the labour force is engaged in higher-skilled, higher wage occupations (figure B.3, panels b and c). However, not all labour force participants are employed at any one time, with higher unemployment rates experienced by the lower income occupations and lower unemployment rates experienced by the higher income occupations (figure B.3, panel d).

Figure B.3 Labour market characteristics of the Australian labour force, 2010^a



^a 2010 is the initial year in the VURM database. ^b The figure is based on the distribution of persons unemployed who identify their occupations. This group accounted for 64 per cent of the unemployed in 2010. The remaining 36 per cent of the unemployment are recorded as 'unallocated' and are not used to derive this distribution.

Sources: Productivity Commission estimates based on ABS (*Labour Force, Australia, May 2015*, cat. no. 6202.0) and ABS (*Labour Force, Australia, Detailed, Quarterly, February 2015*, cat. no. 6291.0.55.003).

Population and cohort effect of NOM

The business-as-usual scenario projects the Australian population and economy based on a NOM rate at the long-term historical average rate of 0.6 per cent of the population. NOM is assumed to converge from the current high levels to the annual historical average of 0.6 per cent of the population by 2025. It is also assumed that future migrants (modelled as NOM) have the same age, gender and occupational profile as the current migrant intake.

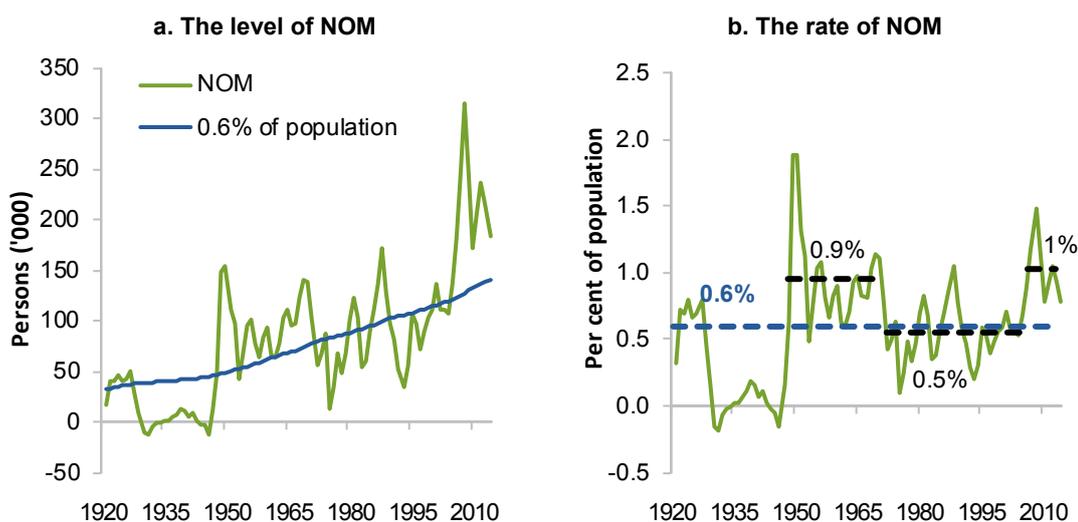
This scenario is used as a reference against which to report on the economywide impacts of zero NOM and of alternative migration scenarios.

Over time, continuing historical trends, labour force participation is assumed to increase fractionally (mainly through increased participation by older people and females). Workers move between occupations based on changes in after-tax real wages. The unemployment rate in each occupation by state is assumed to be fixed at 2014 levels over the projection period.

The demographic projection

NOM has varied substantially over time both in absolute terms and as a share of the population (figure B.4, panel a). From 1921 to the present, NOM has averaged close to 0.6 per cent of the population, varying substantially around this rate in sub-periods (figure B.4, panel b), including over the past decade when NOM averaged around 1 per cent annually.

Figure B.4 **NOM has increased over time**



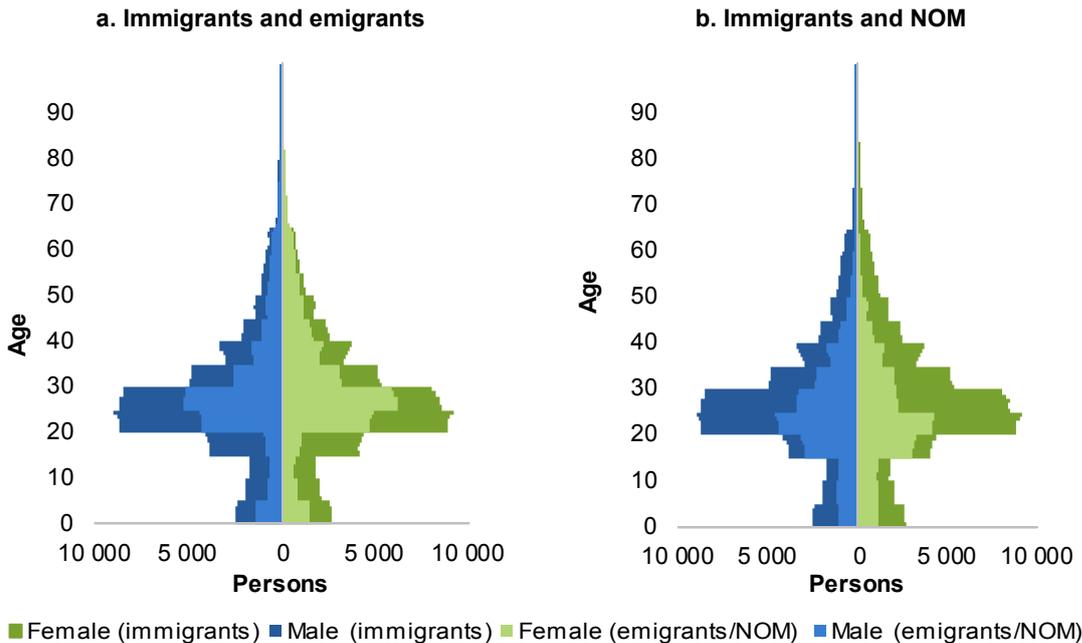
Sources: Productivity Commission estimates based on ABS (*Australian Historical Population Statistics, 2014*, Cat. no. 3105.0.65.001); ABS (*Australian Demographic Statistics, December 2014*, Cat. no. 3101.0); Phillips, Klappdor and Simon-Davies (2010).

The demographic projections for the business-as-usual scenario are based on the assumption that NOM as a share of the population converges from current historically high levels to the annual historical average of 0.6 per cent of the population by 2025. From 2026 onwards, NOM is assumed to continue at a rate of 0.6 per cent of the population to 2060.⁶

In the business-as-usual scenario, it is assumed that over the projection period, the migrant intake has the same demographic characteristics as the current intake. As a result, modelling of the future intake is heavily weighted towards the 20 to 40 year old age groups.

Figure B.5 shows that the age and gender structure of immigrants aligns closely with the age and gender structure of NOM. The Commission has projected the economywide impacts of Australia’s migrant intake by modelling changes in NOM rather than immigrants.

Figure B.5 Immigrants, emigrants and NOM have similar age and gender profiles,^a 2013



^a Five yearly NOM age group data from ABS are allocated to one year age cohorts on the basis of information about the age distribution of the population as a whole.

Sources: Productivity Commission estimates based on ABS (*Migration, Australia, 2012-13*, Cat. no. 3412.0).

⁶ NOM as a percentage share of population is represented by the model variable C_NOM2POP. This variable took the value of 0.9 per cent in 2014 based on actual migrant flows and a projected value of 0.6 per cent from the years 2025 to 2060. The share is assumed to transition linearly from 2014 to 2025.

The demographic modelling assumes that once immigrants have joined the population, they have the same age-specific fertility and mortality rates as the wider population. In this way, the modelling assumes that second-generation immigrants take on the characteristics of the wider population.

The variables shocked and the associated endogenous variable used in the dynamic modelling of NOM are shown in table B.2.

Table B.2 Modelling of NOM in the business-as-usual scenario

<i>Description</i>	<i>VURM-MI exogenous variable</i>	<i>VURM-MI endogenous variable</i>
NOM by age, gender and region of entry is introduced as a source of population change.	Percentage point change in NOM as a percentage share of the Australian population	National NOM in projection period (000) (projectnom)
The direct effect of NOM (model shock) is introduced as an increment in persons by age, gender and region.	(d_nom2pop)	
For this scenario, NOM projections transition from current levels to 0.6% of the population in 2 025 (and later years).		
Use age and gender profiles of current migrant intake for NOM.	Switches on the use of the age and gender profiles of current migrant intake for NOM when it is exogenous (f_om1)	Switches on the use of the age and gender profiles of the current Australian population for NOM when it is exogenous (f_om2)
Represent occupational profile of current migrant intake for NOM.	Modifies the occupational mix of the labour force (occtwist)	National labour supply by occupation (natlab)

Labour force participation

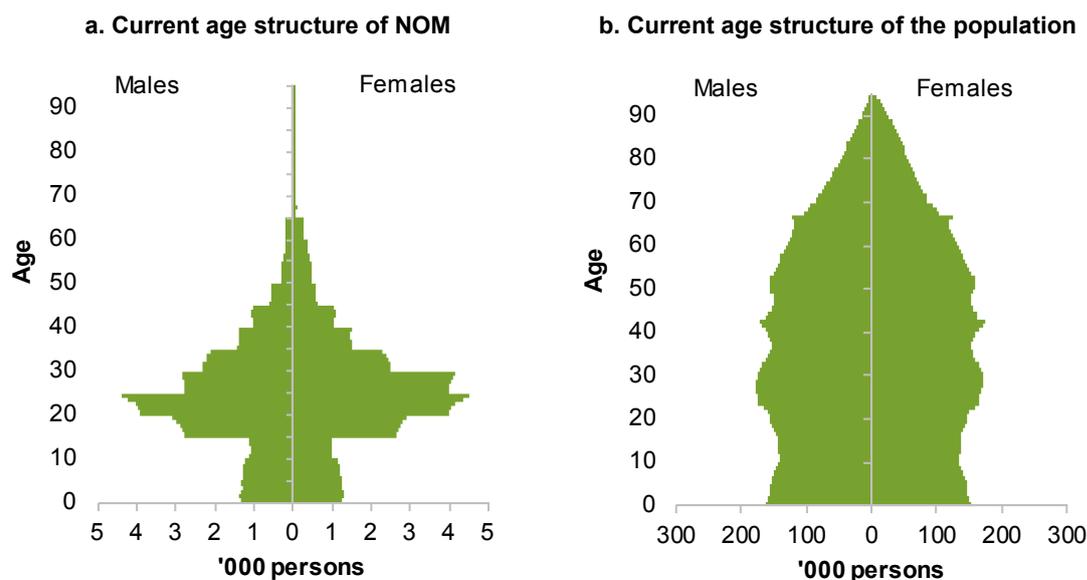
NOM is concentrated in the 20 to 40 year old age groups, with the majority of NOM in those age groups (figure B.6, panel a). However, the Australian population as a whole is older (figure B.6, panel b). Because migrants are on average younger than the Australian population, NOM is likely to boost the proportion of the population in the workforce and, thereby, reduce the impact of population ageing.

Limited information on the labour force participation of permanent and temporary migrants indicates that migrants have similar participation rates to the labour force in the region of employment.⁷ The modelling is based on the assumption that labour force

⁷ Comparative information on migrant participation is not available from a single source. Participation by permanent migrants by visa category (skilled, family and humanitarian migrants) by region of residence was derived from the ABS Australian Census and Migrants Integrated Dataset (ACMID). Participation for temporary migrants by visa category (student and other temporary visa holders) was derived from the ABS Characteristics of Recent Migrants Survey (CORMS) data by region of residence for the two years

participation rates of the Australian population by age and gender are representative of the participation rates of NOM.

Figure B.6 Immigrants have a younger age distribution compared to the Australian population
2014



Source: ABS (*Migration, Australia, 2013-14*, Cat. no. 3412.0).

NOM labour market participants are introduced into the labour force by occupation and region in VURM-MI. The allocation of migrants to a particular region is based on the recorded entry point of the migrant intake in 2014. The process used to derive the estimates of labour force participation by occupation and state is described in box B.2.

The occupational composition of NOM entrants and the Australian labour force appear to both be concentrated in professional occupations (figure B.7). Beyond that, NOM tends to be more concentrated in the community service and labouring occupations and less concentrated in the occupations of managers, clerical and administrative and machinery operators and drivers compared with the Australian labour force more broadly.

2010 and 2013. Aggregating data across visa categories indicates that participation rates for NOM by region were comparable to that of the Australian population more broadly.

Box B.2 Estimating the occupational group of NOM labour force participants by region

Estimation of the occupational composition of NOM labour force participants is undertaken in two steps.

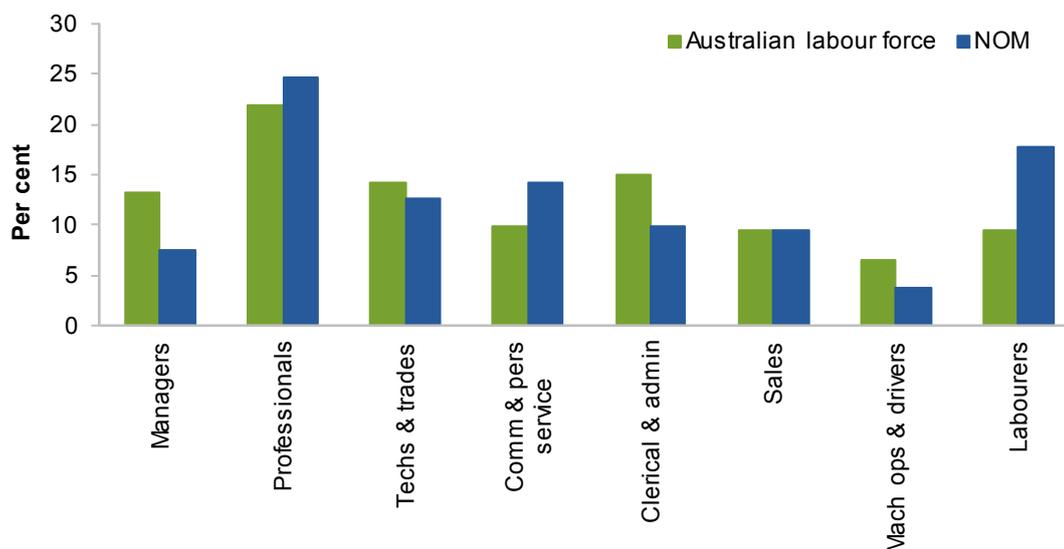
First, a matrix of the distribution of immigrants by occupation and region is compiled.

- Permanent migrants are distributed across four visa categories (skilled, family, humanitarian and other), region of arrival and occupation categories according to three years (2009–2011) of data from the ACMID.
- Temporary migrants are distributed across region of arrival and occupation categories according to three years (2010 to 2013) of data from the (CORMS).
 - Due to this limited sample size, CORMS data does not support a characterisation of the category ‘other’. The occupational distribution of the labour force for the Australian population in 2014 is used as a proxy for this category.

Second, under the assumption that the occupational structure of immigrants by visa category is reflective of the occupations structure of emigrants for the same category, the distribution of immigrants by occupation and region is scaled to the level of NOM for 2014 by visa category as reported by Department of Immigration and Border Protection (DIBP) (2014). The information is aggregated across visa categories to provide a measure of migrants’ labour force participation by occupation and region.

Sources: ABS ACMID, unpublished; ABS CORMS, unpublished data; DIBP (2014).

Figure B.7 The occupational profile of the Australian and NOM labour force, 2014^a



^a Estimates reported for the Australian labour force are for the year 2014. Estimates of occupational distribution are based on average data between 2009 and 2011 for permanent NOM workers and average data for 2010 and 2013 for temporary NOM workers. The occupational distributions were then adjusted to the level of NOM for 2014 (box B.2).

Sources: Productivity Commission estimates based on ABS (*Labour Force, Australia, May 2015*, Cat. no. 6202.0); ABS (*Labour Force, Australia, Detailed, Quarterly, February 2015*, Cat. no. 6291.0.55.003); ABS ACMID, unpublished data and, for the temporary migrants, from the ABS CORMS, unpublished data; DIBP (2014).

B.2 Economywide projections

Macroeconomic effects

Immigration (modelled as NOM) has a number of impacts on economic outcomes, including the economywide level of activity measured as real GDP. Immigration contributes to national production and income through labour supply and productivity.

The increase in Australia's labour supply from NOM is largely driven by the fact that a larger population augments the supply of labour (a *population* or scale effect). As the age profile of NOM is relatively concentrated in prime working age groups, NOM also increases the overall employment to population ratio (a *participation* effect).

Beyond *population* and *participation* effects, NOM may also affect activity levels in the economy through *productivity* effects. That is, to the extent that immigrants have a different level of *labour productivity* compared to the Australian labour force more generally, immigrants affect the average labour productivity.⁸

The magnitudes of the effects depend on the magnitudes of the shocks and their interactions with the structure of the model and values of the parameters assumed. This is explored in the remainder of this technical supplement.

The modelling results presented in this supplement for the alternative NOM scenarios are compared to the business-as-usual scenario. This is a common way to explain how a policy will influence the economy in isolation from other events.

Table B.3 presents a summary of the projections of key macroeconomic variables for the period from 2014 to 2060 under the four main scenarios considered in this technical supplement. Table B.4 presents percentage deviations of the alternative scenarios from the hypothetical business-as-usual scenario.

⁸ Labour productivity is the ratio of the real value of output to the quantity of labour input — measured as real gross value added per hour worked in this technical supplement. Labour productivity depends on the efficiency with which labour and other inputs (such as capital and land) are combined to produce goods and services and on the availability of capital and other factors for each unit of labour.

Table B.3 Projections of national effects of NOM in 2060

Index (2014 = 100)^a

<i>Variable</i>	<i>Zero NOM</i>	<i>0.3% NOM to population</i>	<i>0.6% NOM to population (business- as-usual)</i>	<i>1.0% NOM to population</i>
Population	117	148	173	215
Labour supply (persons)	99	133	160	204
Employment (hours)	88	118	144	185
Labour productivity ^b	189	187	186	184
Real GDP	165	219	264	337
Real GNE	153	202	242	308
<i>of which</i>				
Real household consumption	158	212	257	328
Real government consumption	201	251	291	355
Real investment	89	126	161	218
Export volumes	242	329	401	515
Import volumes	172	224	266	330
Real consumer wage	322	297	280	261
Real producer wage (unit labour costs)	257	249	241	233
GDP per person	141	148	152	157
Household consumption per person	135	143	148	152
GNE per person	131	136	140	143

^a The index numbers represent growth from 2014 to 2060. For example, an index of 117 for population in the zero NOM scenario means population grew by 17 per cent between 2014 and 2060 (117 minus 100).

^b Real gross value added (GVA) per hour worked.

Source: Productivity Commission projections based on VURM-MI.

The broader economic picture under the business-as-usual scenario

Economic growth can be considered in terms of population growth, participation of the population in employment and the productivity of employed persons (box B.3). Under the business-as-usual scenario (0.6% NOM), national population is projected to increase by 73 per cent from 2014 to 2060 (that is, from an index of 100 in 2014 to 173 in 2060, table B.3). In other words, Australia's population is projected to increase on average by 1.2 per cent per year (figure B.8).

Box B.3 **The population-participation-productivity decomposition of the growth in real GDP**

The growth in real gross domestic product (GDP) can be decomposed into population growth, the growth in the participation of the population in employment and the growth in the productivity of employed persons.

The growth in the participation of the population in employment is comprised of:

- the adult share of the population — the proportion of the population who are at least fifteen years old.
- the labour market participation rate — the proportion of the adult population who are able and willing to participate in the labour market.
- the employment rate — the proportion of those in the labour market who are in employment.
- average hours worked per employed person — this allows the change in labour inputs to be expressed in terms of hours worked.

Labour productivity is measured as real gross value added per hour worked.

Combining the growth of population, participation in employment and productivity gives growth in real gross value added. This is equivalent to growth in real GDP after allowing for any changes in taxes less subsidies on products.

Further, the growth in real GDP per person is given by combining the growth of participation in employment and of labour productivity. Therefore, a change in NOM or in migration policy will only improve real GDP per person to the extent that it raises the participation of the population in employment and labour productivity.

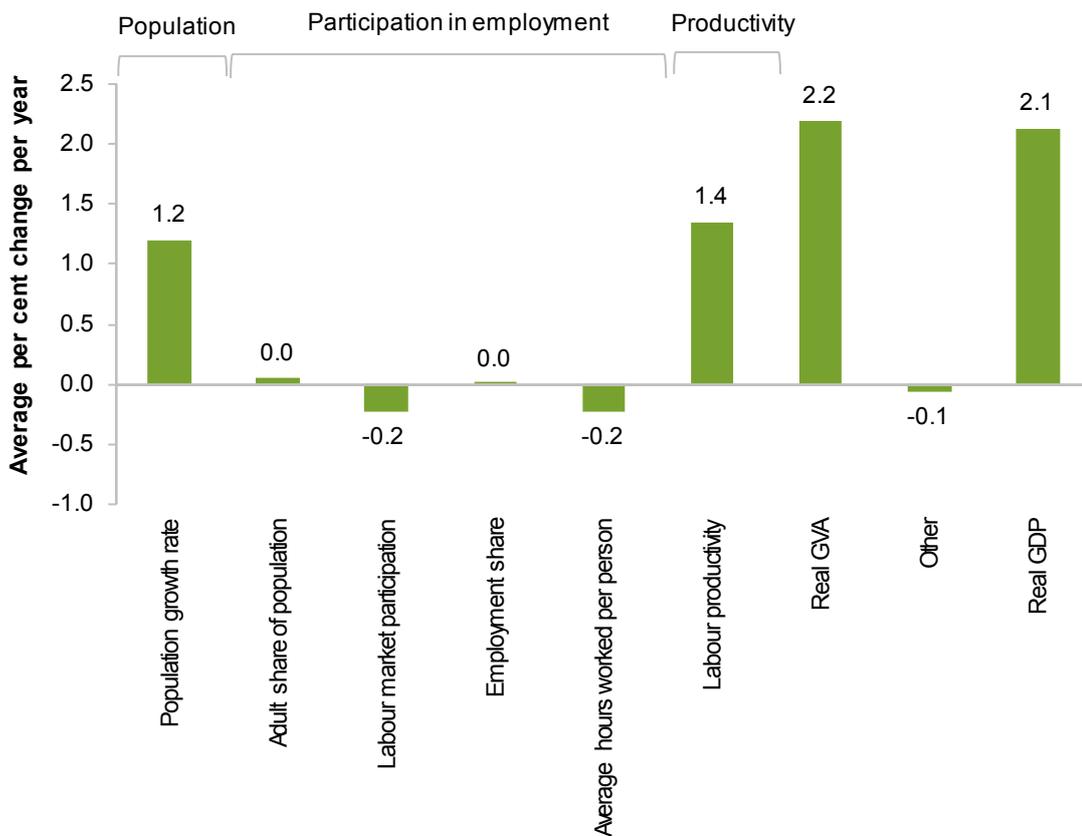
Labour supply grows by less than national population because of a projected decline in participation associated with ageing. Over the projection period, the average age of the Australian population increases from 38 years in 2014 to 43 years by 2060 and the age dependency ratio (measured as the population aged over 65 years as a percentage of the population aged between 15 and 65 years) is projected to almost double from 20 per cent in 2014 to 39 per cent by 2060. An older population is assumed to be less fertile. Ageing is therefore projected to result in the proportion of children declining as reflected in the slight rise in the adult share of the population between 2014 and 2060 (figure B.8). An older population is also assumed to participate less in the labour market. Ageing is therefore projected to result in a decline in the labour market participation rate. The net effect of ageing is that national labour supply grows by less than population. Labour supply is projected to grow by 60 per cent from 2014 to 2060 (table B.3).

It is assumed that the employment rate is fixed over the projection period and that average hours worked declines by 0.2 per cent a year. Consequentially, employment (measured in hours worked) is projected to increase by an average of 0.8 per cent a year.⁹ This is equivalent to a 44 per cent increase in employment between 2014 and 2060 (table B.3).

⁹ Employment measured in hours worked is the sum of the contributions made by the population, the adult share of the population, labour market participation, employment share and average hours worked per person. See box B.3 for more detail.

The growth in national labour productivity averages 1.4 per cent a year between 2014 and 2060 (figure B.8), reflecting the industry specific labour productivity assumptions outlined earlier in the supplement. Over the entire projection period to 2060, labour productivity grows by 86 per cent (table B.3).

Figure B.8 Contributions to the growth in real GDP in the business-as-usual scenario, 2014 to 2060^a



^a 'Other' consists of changes in taxes less subsidies on products.

Source: Productivity Commission projections based on VURM-MI.

As a result, the size of the economy (as measured by real GDP) is projected to grow on average by 2.1 per cent a year (figure B.8). This amounts to an increase of 164 per cent from 2014 levels by 2060 (table B.3). Accounting for population growth, real GDP in per person terms is projected to be around 52 per cent above 2014 levels by 2060, implying growth in real GDP per person of 0.9 per cent per year on average over the projection period.

With a larger economy, real consumption of both the household and government sectors is projected to increase by 157 and 191 per cent respectively by 2060 (table B.3). Household consumption is projected to increase with the growth in real household disposable incomes. The average propensity to consume (and save) is assumed to remain constant. A

net lump sum tax on households is assumed to adjust to hold the government budget deficit fixed as a share of GDP (or GSP for state budgets). The lump sum tax on households is projected to rise as a share of GDP over the projection period as a result of the growing share of public expenditure on health and aged care services associated with an ageing population. Household consumption therefore increases at a slower rate than GDP. For the same reason, government real consumption is projected to increase ahead of household consumption.

Real investment expenditure expands with the economy, at a rate comparable to that of the expansion in the labour force. The ageing of the population and low growth in labour productivity in the non-tradable, labour-intensive sector of the economy contributes to higher wage growth, constraining the rate of return and thereby limiting investment growth. At the same time, the extent to which wage growth exceeds the cost of capital contributes to industries substituting towards the use of capital and away from labour, resulting in investment growth being projected to be somewhat higher than employment growth.

Exports and imports are projected to increase at different rates — rising between 2014 and 2060 by 301 and 166 per cent, respectively. The difference reflects the assumed unwinding of the terms of trade and the associated mining investment boom. The terms of trade is assumed to return to its historical average levels by 2018. It is otherwise assumed that the mining industry progressively deploys previous investment to increase output, mainly directed to exporting. With the declining terms of trade, the costs of imports are projected to rise relative to the prices of local goods and services, slowing the growth of imports relative to that of domestic activity. After a period of adjustment, and without further terms of trade changes, import and export volumes are projected to increase broadly in line with national activity levels.

By 2060, the real wage (an index of the purchasing power of consumers) is projected to be 180 per cent above 2014 levels in the business-as-usual scenario, while the real labour cost (an index of the labour costs faced by producers) is projected to be 141 per cent above 2014 levels (table B.3).¹⁰ The main source of difference between the two wage measures is the composition of the goods and services purchased by consumers and producers, as reflected in the respective price deflators. In particular, the goods and services for producers include inputs associated with capital investment and government expenditures. With the prices of inputs to production being projected to rise faster than consumer product prices, growth in the real purchasing power of producers is expected to be lower than that of consumers.

¹⁰ The real wage indicates the purchasing power of consumers and is the wage deflated by consumer prices. The real producer wage indicates the cost of labour to producers and is the wage and payroll tax paid by producers deflated by the GDP price deflator.

The economywide impact of alternative NOM scenarios

Alternative NOM scenarios have implications for economic growth through their impact on population growth, participation and labour productivity. Table B.4 presents deviations of the alternative NOM scenarios from the business-as-usual scenario.

Table B.4 Marginal effects of alternative scenarios compared with the business-as-usual scenario in 2060

Per cent deviation from business-as-usual scenario

<i>Variable</i>	<i>Zero NOM</i>	<i>0.3% NOM to population</i>	<i>1% NOM to population</i>
Population	-33	-15	24
Labour supply (persons)	-38	-17	28
Labour productivity ^a	2	1	-1
Real GDP	-37	-17	28
Real GNE	-37	-17	27
<i>of which</i>			
Real household consumption	-39	-17	28
Real government consumption	-31	-14	22
Real investment	-45	-22	36
Export volumes	-40	-18	28
Import volumes	-35	-16	24
Real consumer wage	15	6	-7
Real producer wage (unit labour costs)	7	3	-4
GDP per person	-7	-3	3
Household consumption per person	-9	-3	3
GNE per person	-6	-2	2

^a Real gross value added per hour worked.

Source: Productivity Commission projections based on VURM-MI.

With zero NOM, the size of the Australian population is projected to be 33 per cent lower than in the business-as-usual scenario. Furthermore, the average age is projected to be higher. In the zero NOM scenario, the average age is 47 by 2060, compared with 43 in the business-as-usual scenario (figure B.9, panel a). The higher average age results in lower participation in employment than in the business-as-usual scenario (figure B.9, panel b). Therefore, with zero NOM, labour supply is projected to be 38 per cent lower than in the business-as-usual scenario both because of the lower population and because of less participation.

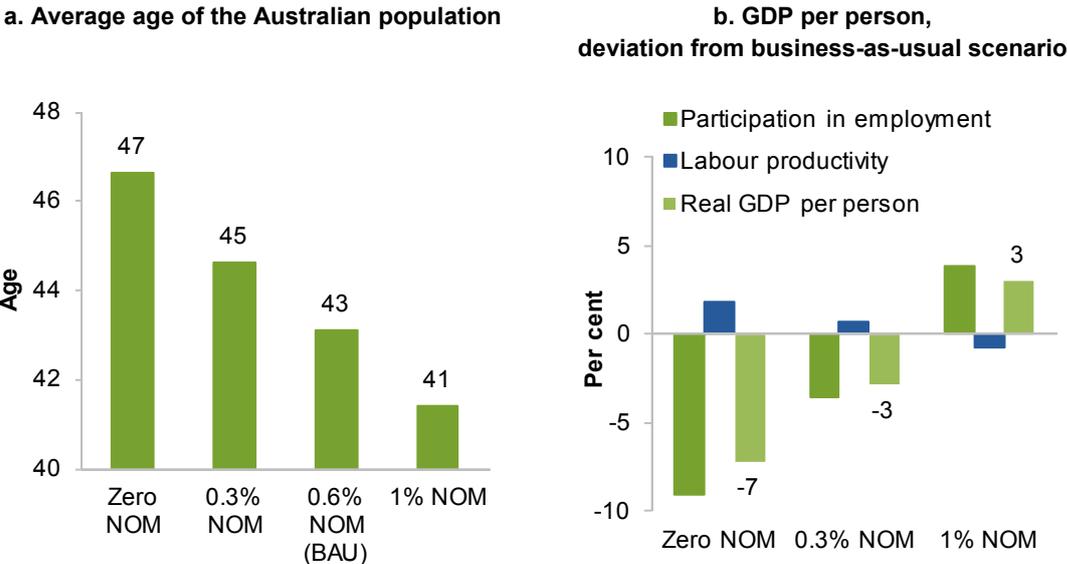
Labour productivity in the zero NOM scenario is projected to be 2 per cent higher than in the business-as-usual scenario. This is a short- to medium-term effect of NOM that dissipates as capital markets adjust. The annual addition of labour supply through NOM ultimately results in a proportionate expansion in capital. But while capital markets adjust

to the assumed migrant intake, there is a temporary increase in labour relative to capital which contributes to lower labour productivity growth. This takes place each year in which there is a non-zero NOM, including in 2060. This effect is present in the business-as-usual, 0.3 and 1 per cent scenarios, but not in the zero NOM scenario. Therefore, the measured labour productivity is marginally higher in the zero NOM scenario than in the business-as-usual and other NOM scenarios.

The net effect of lower participation and modestly higher productivity is that real GDP per person in the zero NOM scenario is 7 per cent lower than in the business-as-usual scenario (table B.4; figure B.9, panel b).

The net effect of lower population growth, less participation in employment and modestly higher productivity in the zero NOM scenario also results in real GDP being 37 per cent lower than in the business-as-usual scenario (table B.4).

Figure B.9 NOM is projected to offset ageing and to increase GDP per person, 2060^a



^a 'BAU' is an abbreviation for the business-as-usual scenario.

Source: Productivity Commission projections based on VURM-MI.

The scale of impact on other macroeconomic aggregates reflects the impact on GDP and the implications of ageing.

Because the population in the zero NOM scenario is older than in the business-as-usual scenario, growth in expenditure on government health and aged care (discussed below) is higher. Therefore, while real government consumption in the zero NOM scenario is 31 per cent lower than in the business-as-usual scenario by 2060, the magnitude is less than for GDP. However, the higher government expenditure associated with ageing is assumed

to be funded by a lump sum tax on households, and therefore, household consumption is projected to contract by more than GDP. Household consumption is 39 per cent lower than in the business-as-usual scenario by 2060.

In the zero NOM scenario, lower domestic demand arising from a smaller population is projected to decrease the demand for imports relative to the business-as-usual scenario. Further, with the decrease in domestic productive capacity exceeding the decrease in domestic absorption, exports are projected to decrease by more than imports compared to business-as-usual.

In the zero NOM scenario, the scarcity of labour supply relative to the population size results in real wages being projected to be higher than in the business-as-usual scenario (wage effects are considered below).

Varying the rate of NOM from that of the business-as-usual scenario to either 0.3 per cent or 1 per cent of the population gives rise to a smaller or larger impact respectively on the size of the economy and on GDP per person (figure B.10). Furthermore, as the modelling broadly assumes that there are constant returns to scale in production, the growth in GDP per person over the projection period to 2060 is broadly linear for a range of population growth outcomes.¹¹ However, in practice there are limits on Australia's environmental capacity, among other things, that mean the impacts are likely to become increasingly nonlinear for larger population growth outcomes, particularly those outside the range considered in this supplement.

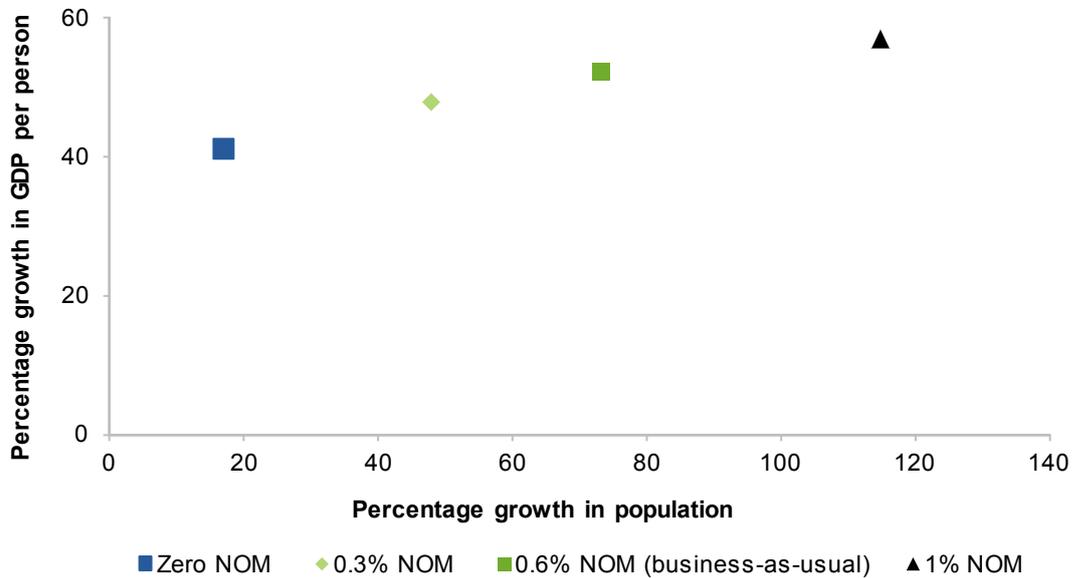
The rate of population growth contributes directly to the rate of growth in GDP. By 2060, GDP is projected to be 17 per cent lower in the 0.3 per cent NOM scenario and 28 per cent larger in the 1 per cent scenario than in the business-as-usual scenario (table B.4).

GDP per person is affected by the rate of NOM through the impact of changing NOM on the age profile of the labour force. Under the assumption that NOM is 0.3 per cent of the population, the average age is 45 by 2060, marginally higher than in the business-as-usual scenario of 43 (figure B.9). As a result, the participation of the population in employment is lower than in the business-as-usual scenario, leading to GDP per person being 3 per cent lower than in the business-as-usual scenario.

Under the assumption that NOM is 1 per cent of the population, the average age of the population is 41 by 2060, lower than in the business-as-usual scenario (figure B.9). Reflecting the younger age profile, the participation of the population in employment is greater than in the business-as-usual scenario. This leads to GDP per person being 3 per cent higher than in the business-as-usual scenario.

¹¹ There is limited substitution between factors, some of which are a fixed resource. For example, agricultural land is a fixed resource which in effect means increases in labour and capital results in a less than proportionate increase in output.

Figure B.10 **A comparison of growth in GDP per person and population, 2014 to 2060**



Source: Productivity Commission projections based on VUMR-MI.

Regional effects

NOM is projected to have varying demographic and economic effects across states and territories over the projected period. Figure B.10 compares the growth in labour supply, employment (measured in persons), GSP and GSP per person under the business-as-usual scenario and the zero NOM scenario.

Between 2014 and 2060, labour supply in the business-as-usual scenario is projected to increase at different rates across states and territories. Labour supply in the more diversified states of New South Wales, Victoria and Queensland are projected to expand at roughly the national average rate (figure B.11, panel a). However, the size of the labour force in the Northern Territory and the Australian Capital Territory is influenced by the relative expansion of government service activities.¹² Conversely, net migration out of Tasmania into other states in response to relative labour market conditions contributes to lower growth in Tasmania.

¹² Some Australian Government expenditure, including on parts of defence and government administration, is allocated to the ACT even though the expenditure may occur in another state or territory. To the extent that the statistics underlying the VURM-MI database do not reflect accurately the location of the government expenditure, specifically in terms of the amount of government related activities in the ACT, projections for activity and employment in the ACT are overstated, and projections in other states and territories are understated.

Under the zero NOM scenario, labour supply in New South Wales is projected to increase slightly from 2014 levels by 2060 (figure B.10, panel a). Populations in the territories which are more dependent on government (including health) service activities, are projected to increase proportionately more than other jurisdictions — by 5 and 110 per cent for the Northern Territory and the Australian Capital Territory, respectively. Growth in the labour force in other jurisdictions is projected to decline between 2014 and 2060 on account of the projected ageing of the population under zero NOM.

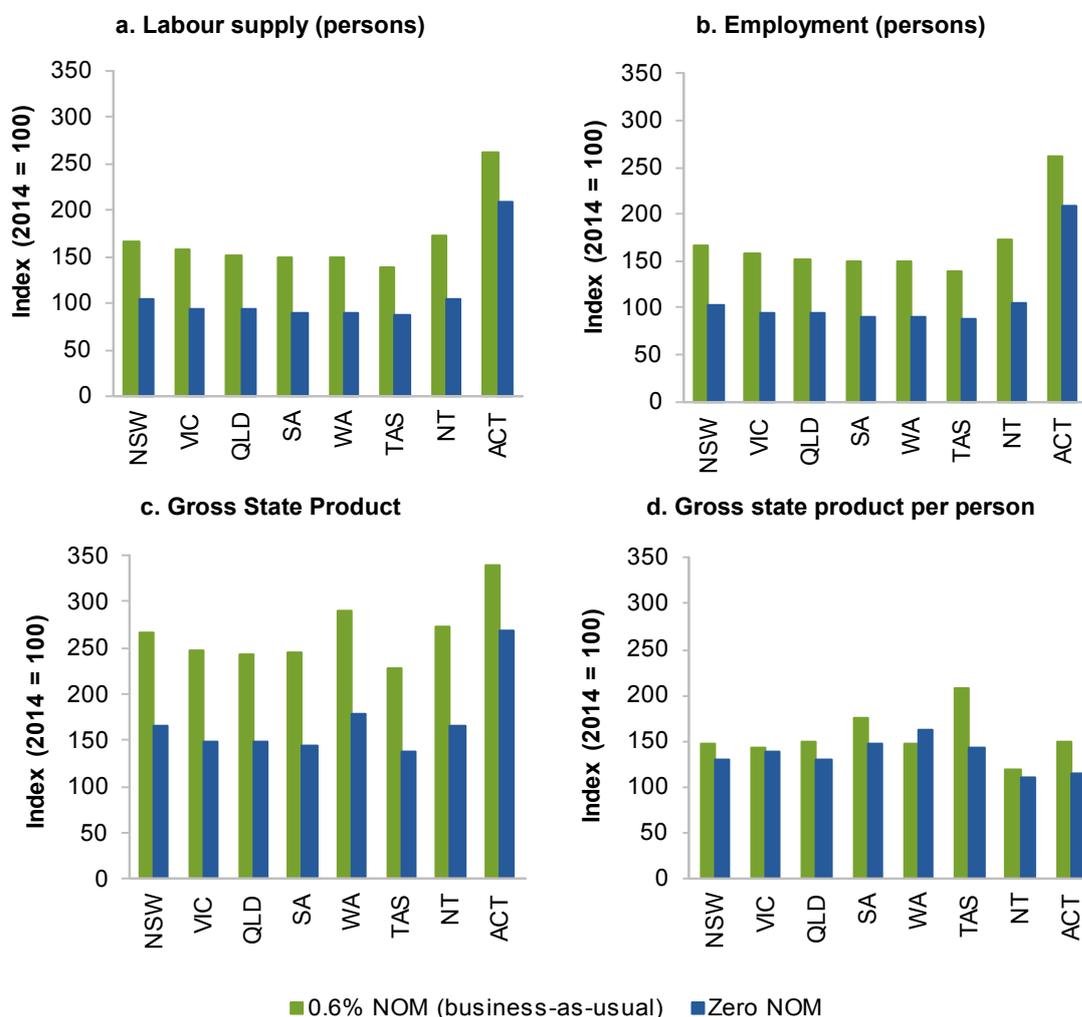
Growth in employment in each jurisdiction is projected to increase with labour supply growth (figure B.11, panel b).

GSP increases with employment, investment and multifactor productivity. Reflecting the combined effect of each of these sources of output growth, GSP is projected to expand in each jurisdiction by more than indicated by the expansion of state and territory employment in both scenarios (figure B.11, panel c).

Growth of real GSP per person is projected to differ between regions (figure B.11, panel d). In the business-as-usual scenario, per person GSP growth is projected to be close to the national average for the more populous and industrially diversified states of New South Wales, Victoria and Queensland. It is otherwise projected to be lowest for the Northern Territory and highest for Tasmania, which reflects the growth in labour supply in these states. As labour supply expands (contracts) relative to the availability of other factors, the marginal product of labour declines (improves).

The impact of NOM on changes in the level of real GSP per person is projected to vary considerably between regions and is ultimately sensitive to the economic structure of the states and territories as well as the occupational composition and region of settlement of NOM. Broadly, other things being equal, the smaller the projected NOM as a share of the regional workforces, the larger the increase in GSP per person. The jurisdictions with low NOM benefit from increased demand for goods and services from jurisdictions where migrants settle and the ability to recruit migrants from other jurisdictions when it is viable to do so. Projections for South Australia and Tasmania are most affected by this effect (figure B.11, panel d).

Figure B.11 Impacts of NOM differ across states and territories, 2060



Source: Productivity Commission projections based on VURM-MI.

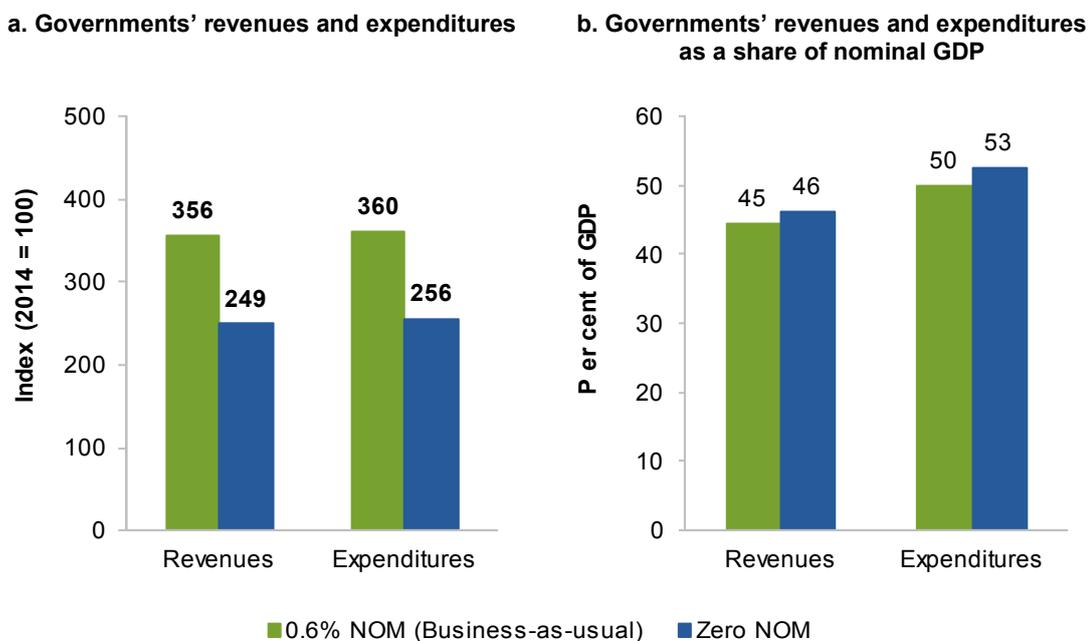
Government revenue and expenditure implications

A larger population and associated changes in its demographic structure will have fiscal implications for Australian governments.

In line with increases in economic activity, Australia’s net migrant intake is projected to increase the level of revenues and expenditures of the Australian, state and territory governments to 2060 over the levels in the zero NOM scenario (figure B.12, panel a).

Figure B.12 With NOM, governments' revenues and expenditures are projected to increase in level, but to decline as a share of GDP by 2060^a

Australian, state and territory governments' revenues and expenditures



^a The lump-sum transfer from households to the Australian, state and territory governments is included in the above charts.

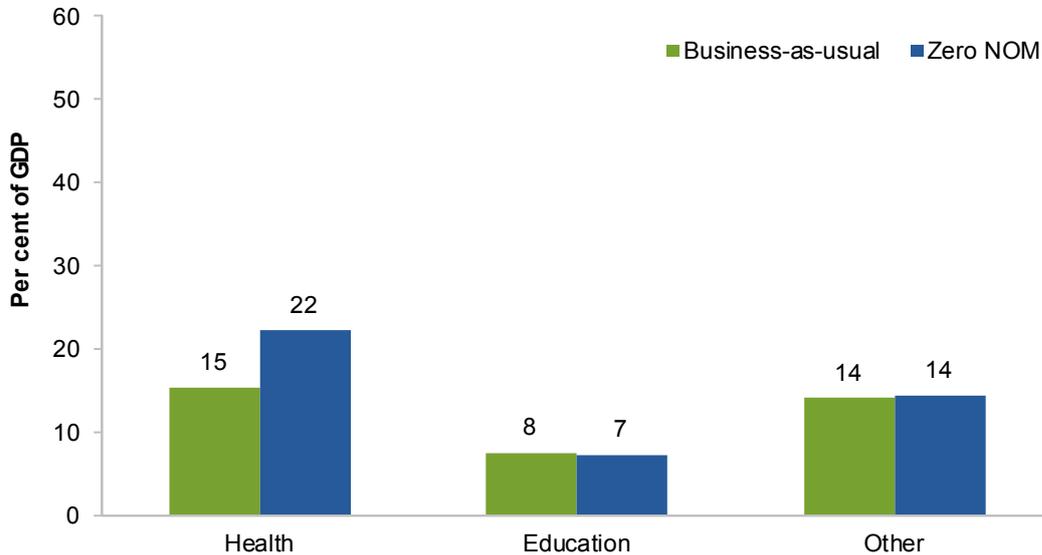
Source: Productivity Commission projections based on VURM-MI.

In the zero NOM scenario, GDP is projected to increase ahead of government revenue over the period 2014 to 2060. The lower revenue growth reflects the slower growth of company taxes as the economy shifts to more labour intensive service activities.

With a lower average age in the business-as-usual scenario, government expenditure (inclusive of health and aged care) as a share of nominal GDP is projected to be lower than in the zero NOM scenario (figure B.12, panel b).

The older age profile associated with zero NOM has two key impacts on governments expenditure on health and related services. First, and of most significance, in 2060 proportionally more of the population consumes health and related services in the zero NOM case compared to the business-as-usual case. Second, relative to the business-as-usual case, zero NOM is projected to have lower employment as a share of the population over the projection period. Growing demand for health and related services results in comparably higher wage growth in professional and community and personal service occupations in 2060. Higher wage growth in these occupations is projected to increase the cost of providing health and related services in the zero NOM case. This contributes to the higher government expenditure on health and related services in the zero NOM case (figure B.13).

Figure B.13 **Governments' expenditure by broad category as a share of nominal GDP**



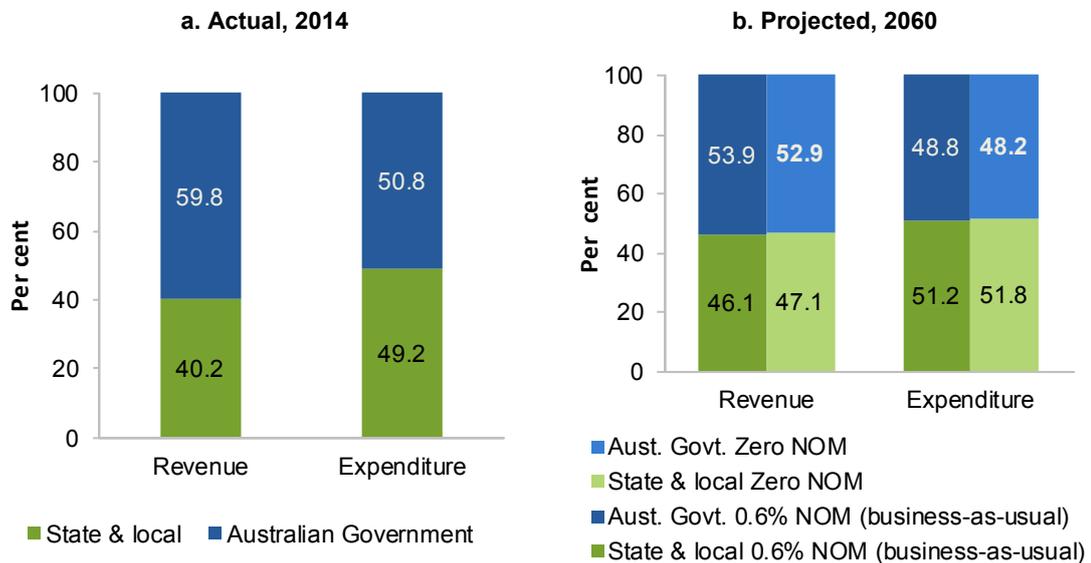
Source: Productivity Commission projections based on VURM-MI.

Under the assumption that governments' financial balances remain fixed as a share of nominal GDP at 2010 levels, any shortfall of projected revenues over expenses are paid for by households as a lump sum to governments. In other words, under current tax and transfer settings governments' deficits are projected to increase. In 2060, the transfer from households is projected to amount to 24 per cent of projected nominal GDP in the zero NOM scenario, compared to 17 per cent of projected nominal GDP in the business-as-usual scenario.

Revenues and expenditures are projected to shift towards the state and territory governments by 2060 (figure B.14). The share of state and territory government revenues is projected to increase by around 6 percentage points (from 40 to 46.1 per cent of GDP) in the business-as-usual scenario, compared to 7 percentage points (from 40 to 47.1 per cent) for the zero NOM scenario.

The shift in revenue towards the state and territory governments is largely due to a projected decline in company income taxation revenue, which accrues to the Australian Government.

Figure B.14 **Projected revenues and expenses shifts towards the State and Territory Governments^{a,b,c}**



^a Australian Government: *Government Finance Statistics (GFS) Revenue*. State, territory & local: *GFS Revenue* less revenue from *Current grants and subsidies*. ^b Australian Government: *GFS Expenses* less revenue from *Current grants and subsidies* received by state, territory and local governments. State, territory & local: *GFS Expenses*. ^c Includes the lump sum payment from households to governments.

Source: Productivity Commission projections based on VURM-MI.

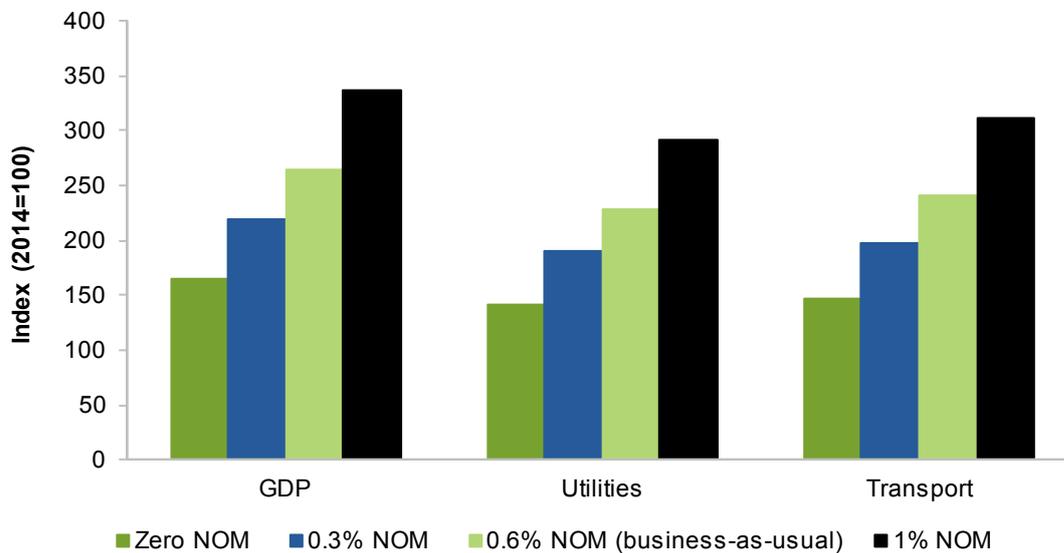
Expenditure also shifts towards state and territory governments. By 2060, state and territory government expenditure shares are projected to increase by around 2 percentage points in both scenarios. This shift in expenditure shares is caused by a projected increase in state and territory governments' gross operating expenses (mainly expenditure on health and aged care).

Increased infrastructure service provision

A larger economy could be expected to be associated with higher levels of activity in infrastructure service provision, such as roads and utility services. Reflecting this, activity in electricity, gas, water and waste services and domestically-oriented transport industries are projected to grow broadly in line with GDP in all scenarios (figure B.15). Specifically, the expansion in labour supply through migration is projected to lead roughly to the same proportional growth in capital and output in most industries including infrastructure industries.

Figure B.15 **Higher levels of GDP are projected to increase activity in infrastructure industries^{a,b}**

Real industry gross value added, 2060



^a Utilities is the electricity supply, gas supply, water and drainage services and waste collection and treatment industries. ^b Transport is the road freight services, road passenger services, rail freight services, rail passenger services, pipeline services, water transport services, air transport services and courier and other transport services industries.

Source: Productivity Commission projections based on VURM-MI.

Real wages and the effects of migration

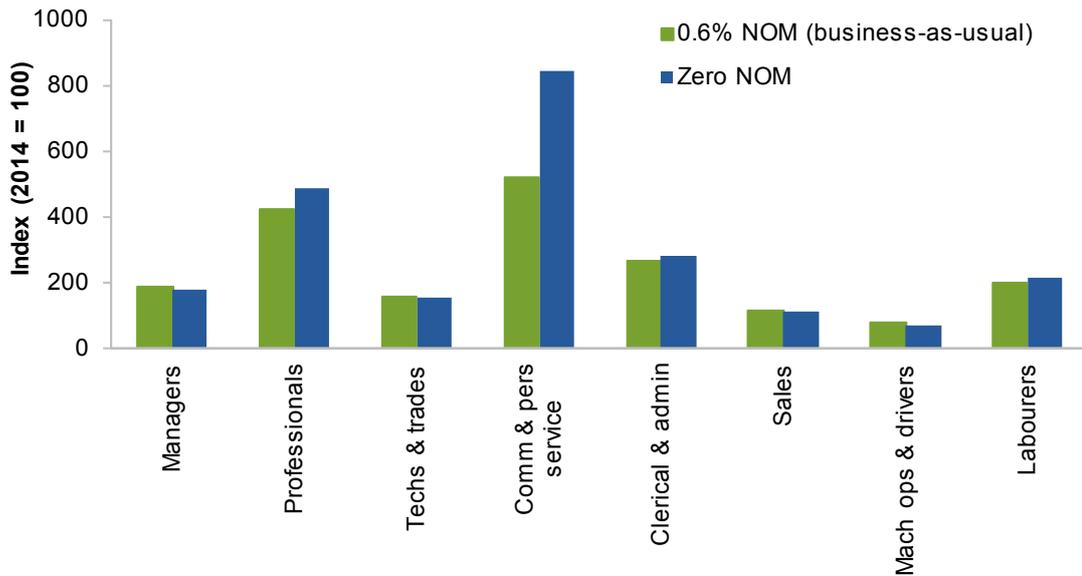
Population ageing is projected to place additional demands on labour, placing upward pressures on real wages, particularly with the expansion of industries servicing older Australians.

Lowering the average age of the population through net migration moderates such pressures — by around 7 per cent by 2060 in the 1 per cent NOM scenario relative to the business-as-usual scenario (table B.4). In contrast, lower net migration raises the average age and results in higher wages. The national real consumer wage is 15 per cent higher under the zero NOM scenario than in the business-as-usual scenario by 2060. While immigration is projected to reduce the extent of real wages growth to 2060, it is important to note that real wages rise substantially over the period in all scenarios (table B.4).¹³

¹³ The Commission's general equilibrium modelling provides an illustrative projection of potential wage differences compared with the business-as-usual scenario over a 45 year period. The general equilibrium analysis differs from the econometric results presented in technical supplement A. Controlling for the influence of experience and education on labour market outcomes, the econometric analysis looks at the relationship between immigration and labour market outcomes between 2001 and 2014.

The higher growth in the service industries is projected to place substantial upward pressure on the professional and community and personal service wages (figure B.16).

Figure B.16 Projected real wages by occupation, 2060
Index (2014 = 100)



Source: Productivity Commission projections based on VURM-MI.

Wage pressures are moderated in the areas where the immigrant labour force is most represented — the professions and community services workers and labourers. These wage effects are mainly influenced by the growth in industries and their labour forces and the movement of people between occupations in response to relative wage differentials.

Real wages are projected to be broadly similar under all scenarios in 2060 for sales workers and machinery operators and drivers. These occupations are concentrated in retail and wholesale trade, and road freight transport. There are relatively limited opportunities for re-employment in the same occupation in other industries. Adding new labour through immigration into these activities, therefore, is projected to lead to a relocation of workers to other occupations and industries in response to real wage differentials.

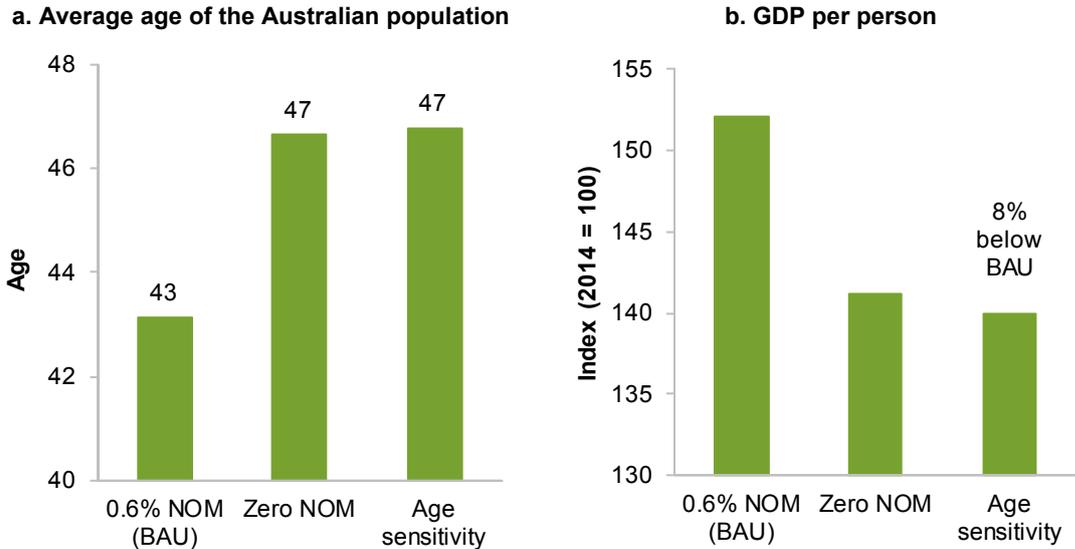
How sensitive are the projections to the assumed age profile of NOM?

The age profile of NOM in the business-as-usual scenario is assumed to be that of the migrant intake of 2014. Sensitivity analysis has been undertaken to illustrate the implications of this assumption for GDP per person. In the sensitivity test, NOM is assumed to have the age profile of the broader Australian population. But the rate of NOM and all other assumptions are identical to that of the business-as-usual scenario.

In the age sensitivity scenario, the participation of the population in employment is lower than in the business-as-usual case where the current (younger) age structure of the migrant intake is modelled. Without the younger migrant intake, GDP per person is projected to be 8 per cent lower than the business-as-usual scenario by 2060 (figure B.17).

Relative to the zero NOM case, population and GDP are projected to be higher in the age sensitivity scenario. However, the average age in the age sensitivity scenario is projected to be the same as in the zero NOM scenario, resulting in a similar rate of participation in employment as in the zero NOM scenario (figure B.17, panel a). On the other hand, there is a lag between the increase in labour supply from migration and the increase in capital required to maintain the same level of labour productivity. This capital shallowing translates to a measured decline in labour productivity as capital markets adjust. The relatively lower levels of labour productivity in the age sensitivity scenario are projected to contribute to lower GDP per person in 2060 compared to the zero NOM scenario (figure B.17, panel b).

Figure B.17 The implications of the age profile for ageing and GDP per person, 2060^a



^a 'BAU' is an abbreviation for the business-as-usual scenario.

Source: Productivity Commission projections based on VURM-MI.

How sensitive are the projections to the assumed occupational profile of NOM?

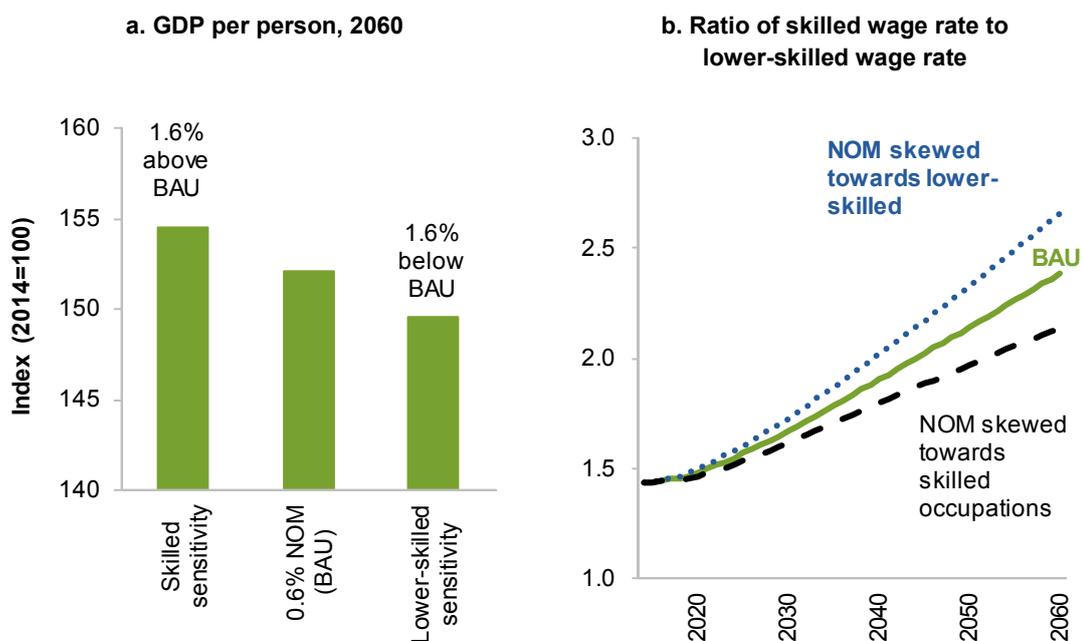
The occupational profile of NOM in the business-as-usual scenario is assumed to be the same as that of the current migrant intake. However there may be scope for varying the occupations targeted by the migration program. Sensitivity analysis has been undertaken to illustrate the implications of varying the occupational profile of NOM.

The ‘skilled scenario’ assumes that the share of the occupations of managers; professionals; technicians and trades workers; and community and personal service workers in NOM is 30 percentage points higher than in the business-as-usual scenario. The ‘lower-skilled scenario’ assumes that the share of clerical and administrative workers; sales workers; machinery operators and drivers; and labourers in NOM is 30 percentage points higher than in the business-as-usual scenario.

The projections show that the skill profile of immigrants affects real GDP per person (figure B.18, panel a). Real GDP per person is projected to be 1.6 per cent higher than the business-as-usual scenario as a result of assuming an additional 30 percentage points of NOM are in more skilled occupations. Conversely, real GDP per person is 1.6 per cent lower than the business-as-usual scenario as a result of assuming an additional 30 percentage points of NOM are in lower-skilled occupations.

Skilled workers have a higher level of productivity than lower-skilled workers. Output per person, as reflected in the wage rate, is around 50 per cent higher for the four skilled occupations than the four lower-skilled occupations in 2014 (figure B.18, panel b). Furthermore, reflecting the rising demand for professionals and community workers, the differential between the output per person of skilled and lower-skilled occupations is projected to increase over time to be 100 per cent greater by 2060 in the business-as-usual scenario.

Figure B.18 **The occupational skills profile of migrants and GDP per person^a**



^a ‘BAU’ is an abbreviation for the business-as-usual scenario.

Source: Productivity Commission projections based on VURM-MI.

For this reason, skewing the migrant intake toward more skilled occupations gives rise to gains in labour productivity and hence in GDP per person relative to the business-as-usual scenario. Furthermore, by ameliorating the rise in labour costs that are associated with rising demand for professionals and community workers, the skilled scenario is projected to improve the rate of return to capital, leading to higher investment and a larger capital base for the economy than in the business-as-usual scenario.

How sensitive are the projections to the assumed level of NOM?

In the scenarios above, NOM is defined in terms of a fixed proportion of the population. Alternatively, NOM can be defined in terms of an absolute number of migrants, which implies the proportion of NOM declines over time. Further modelling was undertaken based on three alternative levels of NOM.

- 100 000 NOM — NOM is assumed to decline to 100 000 persons per year by 2026 and to remain at that level until 2060.
- 200 000 NOM — NOM is assumed to remain at around 200,000 persons per year from 2015 through to 2060. Under this scenario, NOM is 0.8 per cent of the population in 2015 and as the population grows, the NOM to population ratio declines to 0.5 per cent by 2060.
- 250 000 NOM — NOM is assumed to rise to 250 000 persons per year by 2026 and to remain at that level until 2060.

The approach to modelling these alternative scenarios follows that of the business-as-usual scenario, including the assumption that NOM has the same age-gender and occupational profiles as the current migrant intake. The only difference is the assumed number of NOM.

Table B.5 shows key demographic and macroeconomic effects of NOM under the three alternative NOM level scenarios compared with the business-as-usual scenario, the 0.3 per cent NOM scenario and the 1 per cent NOM scenario. The projections illustrate that an increase in NOM would raise projected levels of economic activity. As NOM is assumed in each alternative scenario to be concentrated in the prime working age groups, higher NOM would reduce the average age of the population and raise GDP per person, thereby reducing the demographic impact of ageing.

Table B.5 National effects under five alternative scenarios of NOM, 2060

	Units	NOM as a fixed share of the population			The level of NOM is fixed		
		Business-as-usual scenario	NOM 0.3% of population	NOM 1% of population	NOM 100 000 per year	NOM 200 000 per year	NOM 250 000 per year
Annual NOM	'000 persons	237	102	486	100	200	250
Population	Index, 2014=100	173	148	215	150	175	188
Population	Million persons	40	34	50	35	40	43
NOM share of population	Per cent share	0.6	0.3	1.0	0.3	0.5	0.6
Average age ^a	Years	43	45	41	45	43	43
Age dependency ratio ^b	Per cent share	39	45	33	45	39	37
GDP	Index, 2014=100	264	219	337	223	267	290
GDP per person	Index, 2014=100	152	148	157	148	153	154

^a Average age is weighted by the population share of each age group. ^b Age dependency ratio is the population aged over 65 years as a percentage of the population aged between 15 and 65 years.

Source: Productivity Commission projections based on VURM-MI.

Attachment 1 Key classifications

Table 1.1 Industries in VURM database

	<i>Industry</i>	<i>IOIG number</i>
1	Sheep and beef cattle	0101 (part)
2	Whole milk and dairy cattle	0101 (part)
3	Animals other than cattle and sheep	0101 (part), 0102
4	Crops and grains	0101 (part)
5	Other agriculture	0103
6	Fishing, hunting and aquaculture	0201, 0401
7	Forestry and logging	0301
8	Agriculture, forestry, fishing support services	0501
9	Coal mining	0601
10	Oil mining (includes condensate)	0701 (part)
11	Gas mining	0701 (part)
12	Liquefied natural gas production	0701 (part)
13	Iron ore mining	0801
14	Non-ferrous metal ores	0802
15	Non-metallic mineral mining	0901
16	Exploration and mining support services	1001
17	Meat products	1101
18	Dairy products	1103
19	Other food products	1102, 1104-09
20	Beverages	1201-05
21	Textiles, clothing and footwear	1301-06
22	Sawmill and other wood products	1401, 1402
23	Pulp, paper and paper products	1501, 1502
24	Printing and recorded media	1601
25	Petroleum and coal products	1701
26	Basic chemicals and products	1801-04
27	Polymer and rubber products	1901–2004
28	Non-metallic mineral products	2001–05 (not 03)
29	Cement, lime and concrete	2003
30	Iron and steel	2101
31	Alumina	2102 (part)
32	Aluminium	2102 (part)
33	Other non-ferrous metals	2102 (part)
34	Metal products	2201-04
35	Motor vehicles and parts	2301
36	Other equipment	2302-2405
37	Furniture and other manufactured products	2501, 2502
38	Electricity generation from coal	2601 (part)
39	Electricity generation from gas	2601 (part)
40	Electricity generation from Hydro	2601 (part)
41	Electricity generation from non-hydro renewables	2601 (part)

(Continued next page)

Table 1.1 (continued)

	<i>Industry</i>	<i>IOIG number</i>
42	Electricity generation from nuclear	2601 (part)
43	Electricity supply (retail and wholesale)	2605
44	Gas supply	2701
45	Water and drainage services	2801
46	Waste collection and treatment	2901
47	Residential building construction	3001
48	Non-residential building construction	3002, 3101
49	Construction services	3201
50	Wholesale trade	3301
51	Retail trade	3901
52	Accommodation and food services	4401, 4501
53	Road freight services	4601 (part)
54	Road passenger services	4601 (part)
55	Rail freight services	4602 (part)
56	Rail passenger services	4602 (part)
57	Pipeline services	4801 (part)
58	Water transport services	4801 (part)
59	Air transport services	4901
60	Courier and other transport services	5101, 5201
61	Publishing, information and media	5401-5701, 6001
62	Telecommunication services	5801
63	Banking services	6201 (part)
64	Finance services other than banking	6201 (part)
65	Insurance services	6301 (part)
66	Superannuation fund services	6301 (part)
67	Other financial services	6401
68	Ownership of dwellings	6701, 7310
69	Business services	6601, 6702-7310
70	Public administration and public order and safety	7501, 7701
71	Defence	7601
72	Primary and secondary education	8010
73	Technical, vocational and tertiary education	8110
74	Health care services	8401
75	Residential care and social assistance services	8601
76	Arts and recreation services	8210-9201
77	Automotive repair and maintenance	9401
78	Other repair and maintenance	9402
79	Personal and other services	9501, 9502

Source: CoPS (2015))

Table 1.2 Occupational classification

<i>No.</i>	<i>Major group</i>	<i>Description</i>	<i>Predominant skill levels</i>
1	Managers	Plan, organise, direct, control, coordinate and review the operations of government, commercial, agricultural, industrial, non-profit and other organisations, and departments.	<ul style="list-style-type: none"> • Bachelor of higher qualification; Associate Degree; or • Advanced Diploma or Diploma, or at least three years of relevant experience.
2	Professionals	Perform analytical, conceptual and creative tasks through the application of theoretical knowledge and experience in the fields of the arts, media, business, design, engineering, the physical and life sciences, transport, education, health, information and communication technology, the law, social sciences and social welfare.	<ul style="list-style-type: none"> • Bachelor or higher qualification.
3	Technicians and trades workers	Perform a variety of skilled tasks, applying broad or in-depth technical, trade or industry specific knowledge, often in support of scientific, engineering, building and manufacturing activities.	<ul style="list-style-type: none"> • Associate Degree, Advanced Diploma or Diploma, or at least three years of experience; or • Certificate III including at least two years of on-the-job training; or • Certificate IV or at least three years of relevant experience.
4	Community and personal service workers	Assist Health Professionals in the provision of patient care, provide information and support on a range of social welfare matters, and provide other services in the areas of aged care and childcare, education support, hospitality, defence, policing and emergency services, security, travel and tourism, fitness, sports and personal services.	<ul style="list-style-type: none"> • Associate Degree, Advanced Diploma or Diploma, or at least three years of relevant experience; or • Certificate III including at least two years of on-the-job training; or • Certificate IV, or at least three years of relevant experience; or • Certificate II or III, or at least one year of relevant experience; or • AQF Certificate I, or compulsory secondary education.
5	Clerical and administrative workers	Provide support to Managers, Professionals and organisations by organising, storing, manipulating and retrieving information.	<ul style="list-style-type: none"> • Associate Degree, Advanced Diploma or Diploma, or at least three years of relevant experience; or • Certificate III including at least two years of on-the-job training, or Certificate IV, or at least three years of relevant experience; or • Certificate II or III, or at least one year of relevant experience; or • Certificate I, or compulsory secondary education.

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Table 1.2 (continued)

<i>No.</i>	<i>Major group</i>	<i>Description</i>	<i>Predominant skill levels</i>
6	Sales workers	Sell goods, services and property, and provide sales support in areas such as operating cash registers and displaying and demonstrating goods. ICT and Technical Sales Representatives are excluded from this major group.	<ul style="list-style-type: none"> • Associate Degree, Advanced Diploma or Diploma, or at least three years of relevant experience; or • Certificate III including at least two years of on-the-job training; or • Certificate IV, or at least three years of relevant experience; or • Certificate II or III, or at least one year of relevant experience; or • Certificate I, or compulsory secondary education.
7	Machinery operators and drivers	Operate machines, plant, vehicles and other equipment to perform a range of agricultural, manufacturing and construction functions, move materials, and transport passengers and freight.	<ul style="list-style-type: none"> • Certificate II or III.
8	Labourers	Perform a variety of routine and repetitive physical tasks using hand and power tools, and machines either as an individual or as part of a team assisting more skilled workers such as Trades Workers, and Machinery Operators and Drivers.	<ul style="list-style-type: none"> • Certificate II or III, or at least one year of relevant experience (ANZSCO Skill Level 4); or • Certificate I, or compulsory secondary education.

Source: ABS, *Australian and new Zealand Standard Classification of Occupations, 2013*, cat. no. 1220.0, Version 1.2, June 2013.

Attachment 2 Coding details of VURM-MI extensions

This appendix provides coding changes to the standard VURM to implement extensions for the Migrant Intake inquiry with respect to the modelling of:

- migrant labour force characteristics
- the implications of demographic change on health, aged care and education.

Extension for the modelling of migrant labour force characteristics

The modelling of NOM has been extended to allow the changes in NOM (equations E_om2 in box 2.1) to be based on the share of the Australian population in each age, gender and region cohort. Previously NOM was based on the age, gender and region profile of NOM. Now a scenario can be based on either the NOM profile or on the Australian population profile.

Box 2.1 Coding details for the modelling of the age, gender and state profile of NOM

```
! Allocate projected NOM using existing population shares !  
Equation E_om2 # Net overseas migration on an age at migration basis (000) #  
(all,x,AGE)(all,g,GENDER)(all,q,REGDST)  
om(x,g,q)=(1-PROJECTION)*actualnom(x,g,q)  
+PROJECTION*COHORT@1(x,g,q)/C_NATPOP*projectnom + f_om2(x,g,q);
```

Source: VURM-MI.

A further extension allows the modelling of the occupational profile of NOM. This is represented by altering the occupational mix of the change in the national labour supply (occtwist(o) in equation E_natlab in box 2.2). The shocks to the occupational mix must be calibrated to sum to zero. This is enforced in the model code (by equation E_occtwist). Set definitions are not shown in the box, but ‘occtset’ in equation E_occtwist is defined in the code and database as Labourers and ‘occtset2’ are the seven other occupations.

Box 2.2 Coding details for the modelling of the occupational profile of NOM

```
Equation E_natlab # National supply of Labour by occupation #  
(all,o,OCC)  
natlab(o) = natlab_o + SIGMALABO*[natpwage_i(o) - natpwage_io] + occtwist(o);  
Equation E_occtwist # twist between skill types #  
(all,o,OCCSET)  
occtwist(o) = 0*d_unity - sum{o2,OCCSET2, occtwist(o2)} ;
```

Source: VURM-MI.

Extension for the modelling of the implications of demographic change on health, aged care and education

The modelling of state and territory governments and the Australian Government final consumption expenditure in VURM has been extended to include:

- linking of government expenditure to demographic change over the entire population age structure
- the two VURM education commodities — school and non-school education — and aged care services are added into the set of commodities for which government expenditure is linked to demographic change
- linking changes in the per person government expenditure for aged care by age and gender to improvements in the mortality rate
- per person government expenditures by age and gender for health, aged care and education services are drawn from the Commission's research report on the implications of an ageing population (PC 2013).

To apply this extension, equations E_{x5aB3} and E_{x6aB3} have been implemented in VURM-MI. These equations link state and territory governments and the Australian Government's final consumption expenditure to demographic changes to the age structure of the population, health, aged care and education government spending per person and changes in national aggregate real household final consumption spending per person. Equations E_{x5pc} and E_{x6pc} link per person state and territory governments and the Australian Government's expenditure for aged care to improvements in the mortality rate by age and gender (box 2.3).

Box 2.3 Coding details for the modelling of the implications of demographic change on health, aged care and education

Equation E_x5aB3

Real state government consumption of commodities associated with ageing #
 (all,c,AGECOM)(all,s,ALLSRC)(all,q,REGDST)
 $x5a(c,s,q) = natx3tot - natpop +$
 $1/ID01[\sum\{x,AGE,\sum\{g,GENDER, C_X5PC(c,x,g)*COHORT@1(x,g,q)\}}]*$
 $\sum\{x,AGE,\sum\{g,GENDER, [C_X5PC(c,x,g)*COHORT@1(x,g,q)]*}$
 $[x5pc(c,x,g) + f_x5pc(c,q) + f_natx5pc(c) + f5tot(q) + natf5tot]\}} +$
 $100/ID01[\sum\{x,AGE,\sum\{g,GENDER, C_X5PC(c,x,g)*COHORT@1(x,g,q)\}}]*$
 $\sum\{x,AGE,\sum\{g,GENDER, [C_X5PC(c,x,g)*popchange(x,g,q)]\}} +$
 $f_x5a(c,s,q) ;$

Equation E_x6aB3

Real Federal government consumption of commodities associated with ageing#
 (all,c,AGECOM)(all,s,ALLSRC)(all,q,REGDST)
 $x6a(c,s,q) = natx3tot - natpop +$
 $1/ID01[\sum\{x,AGE,\sum\{g,GENDER, C_X6PC(c,x,g)*COHORT@1(x,g,q)\}}]*$
 $\sum\{x,AGE,\sum\{g,GENDER, [C_X6PC(c,x,g)*COHORT@1(x,g,q)]*}$
 $[x6pc(c,x,g) + f_x6pc(c,q) + f_natx6pc(c) + f6tot(q) + natf6tot]\}} +$
 $100/ID01[\sum\{x,AGE,\sum\{g,GENDER, C_X6PC(c,x,g)*COHORT@1(x,g,q)\}}]*$
 $\sum\{x,AGE,\sum\{g,GENDER, [C_X6PC(c,x,g)*popchange(x,g,q)]\}} +$
 $f_x6a(c,s,q);$

Equation E_x5pc # Percentage change in state aged care activity per person #
 (all,c,AGECARE)(all,x,AGE)(all,g,GENDER)
 $MORT(x,g,"NSW")*x5pc(c,x,g) = 100*d_mort(x,g,"NSW") ;$

Equation E_x6pc # Percentage change in federal aged care activity per person #
 (all,c,AGECARE)(all,x,AGE)(all,g,GENDER)
 $MORT(x,g,"NSW")*x6pc(c,x,g) = 100*d_mort(x,g,"NSW");$

Source: VURM-MI.

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