



Australian Government
Productivity Commission

The economywide impacts
of migration – general
equilibrium modelling

Migrant Intake into Australia
Draft Report
Technical Supplement A

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Draft

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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.

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The economywide impacts of migration — general equilibrium modelling

Chapter 8 of the Migrant Intake into Australia inquiry draft report presents some preliminary analysis of the economywide impact of Australia's migrant intake. This technical supplement provides details of that modelling.

The modelling adopts a scenarios approach to quantify the likely impacts of net overseas migration (NOM) on the Australian population and economy against the case without NOM (that is, assuming zero NOM from 2015 onwards). These scenarios do not represent policy options — they are simply illustrative of the potential economywide impacts of NOM. Four scenarios are considered.

- Scenario 1: Without NOM. This scenario is used to illustrate the implications of natural population increases alone with current fertility, life expectancy and labour market (including occupational) characteristics.
- Scenario 2: Population scale and cohort effect of NOM. This is based on scenario 1 with the addition of NOM which is assumed to converge to the historical average of the ratio of net migration to population (0.6 per cent) by 2024-25. These migrants are assumed to have the same demographic characteristics as the current migrant intake and the same labour market characteristics (including occupation profile) as the incumbent labour force. This scenario illustrates the possible effects of net migration on the size and age composition of the population and the effects of net migration on demography and changing labour force participation.
- Scenario 3: Labour force occupational effect. This is based on scenario 2 with the addition of the assumption that future migrants have the same occupational characteristics as the current migrant intake rather than the incumbent labour force.
- Scenario 4: Spillover effects. This is based on scenario 2 with a conjectured 1 per cent increase in national labour productivity growth on account of migration. This is highly speculative as there is insufficient empirical evidence to determine the magnitude of any generalised productivity improvement that might be associated with migration in Australia.

Section A.1 describes the modelling approach adopted and A.2 the derivation of the modelling scenarios. Section A.3 provides additional detail on model projections.

A.1 Modelling approach

The modelling framework

The Commission has used the integrated multi-regional economic-demographic model — known as the Victoria University Multi-Regional (VUMR) model — to illustrate the potential impacts of NOM on Australia's demography and economy, relative to a hypothetical scenario without further NOM from 2015. For this inquiry, the VUMR model has been augmented to include additional detail on the modelling of NOM and the consequences of demographic change on government expenditure on health, aged care and education by age group. The version incorporating the additional detail and applied in this inquiry is termed the VUMR-MI (Migrant Intake) model.

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

The Commission has made extensive use of computable general equilibrium (CGE) models to assess the economywide impacts of economic change and policy reforms.

- 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 migration (PC 2006).
- In 2012, the Commission used a CGE modelling framework to assess the impacts of Council of Australian Government's (COAG) policy reforms (PC 2012a).
- In 2013, the Commission adapted the same framework to assess the impacts of prospective changes Australia's automotive industry (PC 2013).

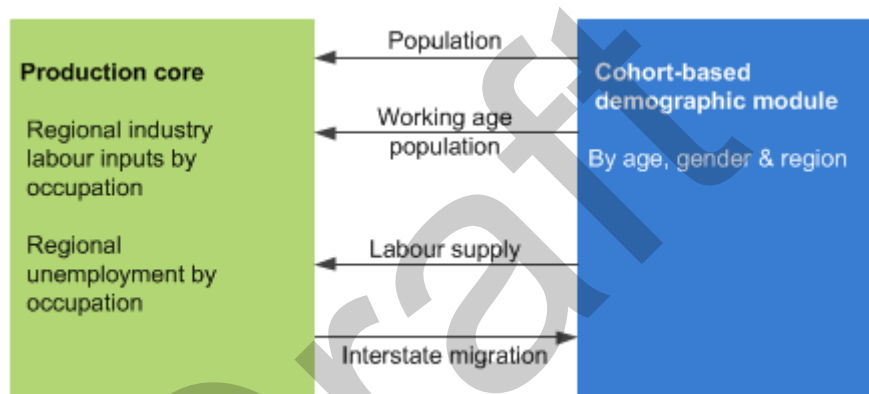
The particular model adopted in the 2012 and 2013 studies, and a number of earlier studies, was an earlier version of the VUMR model (known as the Monash Multi-Regional Forecasting (MMRF) model). The VUMR (and the MMRF) models differ from the MONASH model in that VUMR models each state and territory as a separate economy while the MONASH model is a national CGE model.

The version of the VUMR model being used in this inquiry broadly follows that used in the Commission's 2012 study on the impacts of COAG reforms and later used to assess automotive industry changes (PC 2012, 2013). As noted, it treats each state and territory as a separate economy linked by inter-regional trade and movement of labour force. Production in each jurisdiction is disaggregated into 79 industries and the labour force into 8 occupational groups. The VUMR model also includes a cohort-based demographic model which is integrated with the production core of the model, as well as detailed accounting of government finances for each state and territory government and the Australian Government (box A.1).

The VUMR-MI model is applied in its *dynamic* mode to explore the evolution of the population through natural increase and NOM as well as growth in the economy through changes in labour force participation and labour productivity over time. Under the dynamic approach, the modelling scenarios focus on the path of the economy with alternative assumptions with and without NOM over the 45-year period from 2014-15 to 2059-60, inclusive.

The assumed path 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 model (figure A.1).

Figure A.1 **Stylised representation of the VUMR-MI model**



A detailed description of the theoretical structure of the model is provided in *A Dynamic Multi-Regional Applied General Equilibrium Model of the Australian Economy* (CoPS 2014).

The modelling in context

No model can fully replicate the economy, and all of the complex interactions within and between the domestic and global economic systems. The model also does not fully take account of social and environmental conditions that can have feedback effects on Australia's demography, consumption choices, labour supply, and production and trade. There are also some real world processes that are not included. For example, the model does not directly capture the emergence of new activities and products, or global population and economic changes.

The modelling approach adopted in this inquiry, nevertheless, seeks to capture the direct relationships relevant to economywide impacts of migration. In model simulations, the direct effects of NOM are imposed on the model as exogenous population shocks (scenario 2), labour force occupation shocks (scenario 3) and productivity shocks

(scenario 4) and the flow-on economic effects on production and consumption, and government revenue and expenditure are projected.

As the scenarios modelled reflect migrant movements imposed on the model, they should *not* be interpreted as a quantification of the effects of future policy decisions of government. Rather they are reflective of the historical average levels of migration and the current characteristics of migrants and how these may evolve over time.

The dynamic modelling undertaken is based on a framework of ‘adaptive’ expectations where industry adjusts gradually to economic change. Under this approach, capital progressively depreciates and accumulates to equilibrate actual return on capital with the expected rate, based on the historical average. Investment decisions of businesses are modelled as responding to higher population and labour force levels. There is, therefore, a lag between new arrivals of migrants and new capital investment. More broadly, to the extent that firms anticipate changes in the economy and adjust investment, output and employment decisions, the modelling results may not accurately reflect likely outcomes.

The behavioural parameters included in the VUMR-MI model determine the responsiveness of producers and consumers to changes in relative prices (including wages) and are based on benchmark model values. The accuracy of the model projections depends, in part, on whether the actual behavioural responses by producers and consumers differ from those implied by parameter values in the model (such as in purchasing local and imported supplies, the substitution between labour and capital in production or the relocation of labour between regions). This version uses the standard parameters values included in previous versions of the model.

Similarly, the compilation of the model database is based on many simplifying assumptions needed to translate and calibrate available statistical information into a database representing the complex interactions in the economy. Deviations in the model data from actual economic flows could contribute to some deviation of aggregate results from likely outcomes, or variation in the distributional effects.

Extensions to the VUMR model for this inquiry

Modelling of net overseas migration

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 labour force.

In the VUMR framework, NOM is introduced to the model as a source of population change based on the state and age-gender of migrants. This process is outlined in box A.1.

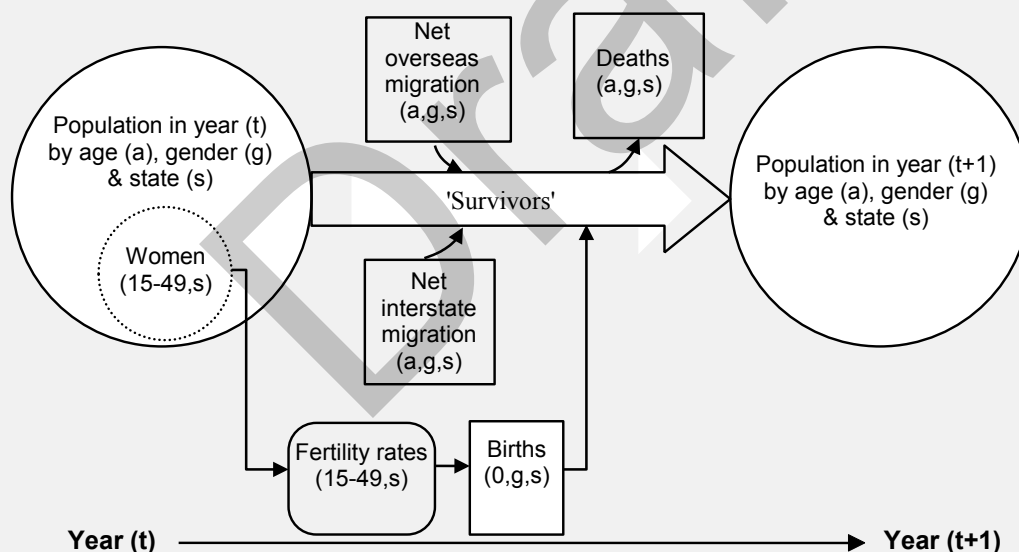
Box A.1 Operation of the demographic module

The demographic module models the effect of demographic change 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 2013-14 database consists of the estimated resident population (ERP) for 1616 cohorts as at 30 June 2013. Each cohort represents a unique combination 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 age, gender and region cohort data that underpin the database for the new demographic module is sourced from the ABS (2014a; 2014b).

In each simulation year, the number of people in each age, gender and region cohort changes according to: the net inflow through NOM (i.e., immigration less emigration); the net inflow through interstate migration (i.e., interstate arrivals less departures); and deaths and births for the group aged '0 year olds'.



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 is linked into the model core to determine population, working-age population and labour supply. The module is expressed in level terms and adopts the practice in VUMR of reporting all population and labour market variables in thousands of persons.

On joining the Australian population, migrants are conventionally modelled as assuming the average characteristics of the population with respect to age-specific fertility and labour force participation rates. In the standard model, migrants are also assumed to initially

reside in and join the labour force of the state of disembarkation and have the state average occupational characteristics at the time of arrival, and the same state by occupation unemployment rates.

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

- age-gender specific labour force participation rates
- state by occupation employment characteristics compared to the characteristics of incumbents.

Scenario 3 (the labour force occupation effect) employs this modification to project the economic impact of a continuation in the current occupational structure of NOM. Key model relationships and model code changes are listed in appendix B.

Modelling of government finances

The terms of reference direct the Commission to consider the Australian and state and territory governments finance implications of migration. In addition to migration-specific expenditures, an important means by which NOM affects governments finances is through its effects on expenditures directly related to demography including health, aged care and education, in addition to the Age Pension.

In the benchmark VUMR model, the value of Age Pension payments is indexed to the population over 65 years and the model index of consumer prices (CPI). Under this setup, Age Pension payments are responsive to the effect of NOM on the demographic structure of the population.

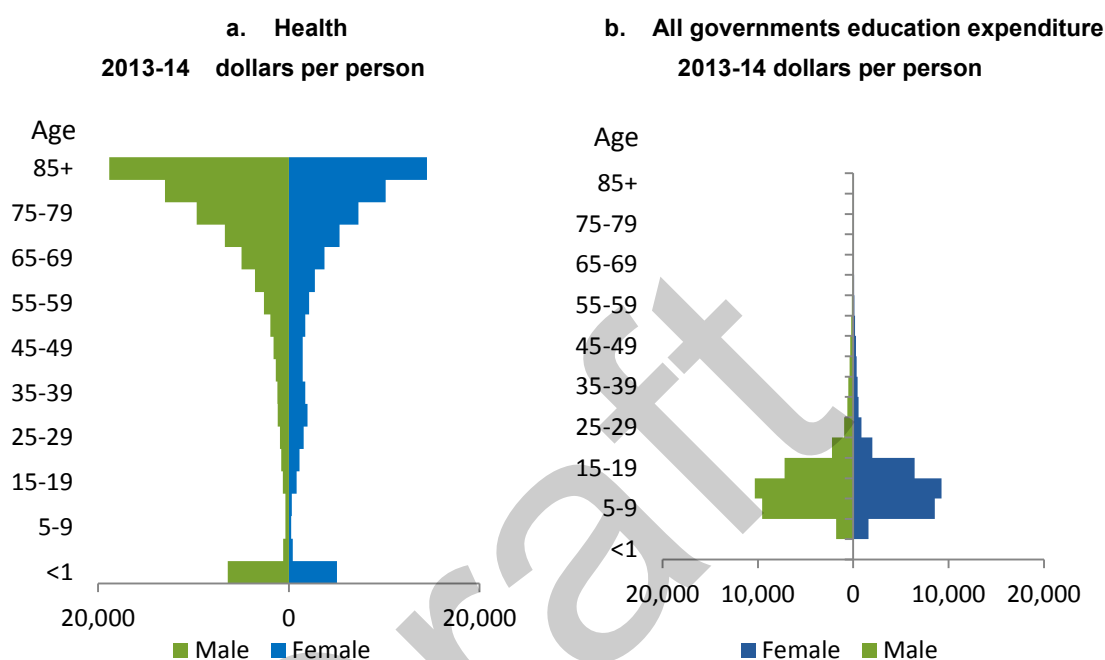
The benchmark model also varies real government final consumption expenditure¹ on health and aged care services in response to changes in national aggregate real household final consumption spending and the proportion of the population aged 65 years and over. The price of those services is indexed to the output price of health and aged care service provision. In the benchmark model, real government final consumption expenditure on education services varies with household final consumption spending.

The per person government expenditure pyramids for each of health and education (adjusted to 2013-14 prices) are shown in figure A.2. The pyramids show that the level of government expenditures on these services is sensitive to the population age structure, with

¹ 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 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 those charged to capital works, etc.), 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.)

the profiles for health being weighted towards the older age groups and education towards the younger in terms of level of per person government expenditure.

Figure A.2 Health and education costs to governments by age and gender vary^a



^a Productivity Commission estimates based on aged-related government spending for all governments per person taken from *Economic Impacts of Migration and Population Growth* PC (2013), adjusted to 2013-14 prices.

Source: Based on PC (2013).

Based on these expenditure profiles, the VUMR model has been augmented for this inquiry to take account of differences in age-specific expenditure on education and charges in the demographic structure of the population. Under the revised treatment, real government final consumption expenditure on health and education services varies in response to changes in national aggregate final consumption spending (as in the standard model) and changes in the age-gender structure of the population. The standard treatment of aged care services has been maintained, that is, real government final consumption expenditure on aged care services changes with national aggregate real household final consumption spending and the proportion of the population aged 65 years and over.

The main additional equations included in the VUMR model implementing this theory are listed in appendix B.

The economic environment (model closure)

The inquiry examines the question of ‘How might the Australian economy might differ as a result of NOM or varying migrant characteristics?’. Addressing this question involves running the model through time in a series of one-year recursive-dynamic modelling steps. As noted, each step involves gradual adjustment in capital and labour markets to changes in the economic conditions. The projected model database is updated automatically at each annual iteration.

The modelling undertaken for this inquiry is based on a number of 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 pre-determined state-specific assumptions about fertility, life expectancy and NOM.
- The aggregate supply of labour is determined by the state-specific working age population and labour force participation rates, as well as the unemployment rate by state and occupation. Labour enters each state labour force by occupation. The occupation of new labour force entrants is based on the occupational structure of incumbents, or a separate assumption about the occupational composition of new entrants.
- Employment by state, 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), and 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 gradually responds to differences between the expected and actual rates of return on capital. The reference expected rates of return are determined by values in the VUMR database. Real regional government investment is assumed to move in line with real regional investment.
- Nominal aggregate household consumption is determined by post-tax household disposable income, while the balance of trade as a ratio of GDP in local currency prices is allowed to vary. Household consumption by state is determined by state post-tax household disposable income. Expenditure on individual products varies according the relative purchasers’ prices of consumption items 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).
- Government 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 GDP or Gross State Product (GSP) through the use of lump-sum transfers to, or from, households.

- The aggregate terms of trade in Australian dollars is assumed to decline to its long-run trend by 2017-18 and then remain fixed thereafter, while the price of individual exported products in domestic and foreign currency prices can vary with changes in the competitiveness of exporting industries. Import prices are assumed to be fixed in foreign currency prices.
- 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.

In this inquiry, the projection period is the 45 years from 2014-15 to 2059-60 (inclusive). Given the considerable uncertainty about future size and make-up of the economy, it is necessary to make assumptions about possible future directions of change in economic conditions. For this study, the following assumptions have been made.

- Growth in labour productivity for each industry returns from its current 2013-14 growth rate to its longer-term average by 2017-18, and is applied to the same industry in each region.
- The national terms of trade in Australian dollars is assumed to return from current high levels to the historical average level as represented by the 2005-06 level, and by 2016-17 to broadly align with the duration of previous terms of trade cycles.
- NOM is assumed to return from current high levels as a proportion of the population to the longer term average of 0.6 per cent by 2024-25, and to broadly align with previous NOM cycles.

As far as practicable, the modelling assumptions are aligned with historical experience in Australia. However, the economic conditions that will actual apply over the projection period are inherently uncertain, and the results must be treated as conditional projections for the purposes of estimating the effect of a variation in NOM and not as a forecast.

Model parameters

In CGE models such as VUMR, the key parameters driving the adjustment to an external shock are the responsiveness of trade volumes to changes in the competitiveness of local industry, and the use of labour and capital between activities and across regions. Model parameters include:

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

The standard benchmark VUMR parameter values have been used in the year-to-year dynamic modelling undertaken for the Migrant Intake Into Australia inquiry.

Export demand elasticities

Export demand elasticities govern the extent to which greater export volumes respond to changes in export price — the larger the elasticities, the smaller the price declines required 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 into 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.

The year-to-year export demand elasticity value of -5 was adopted by the Commission in its assessment of the impacts of COAG reforms (PC 2012b) and in the assessment of the impacts of closure of passenger motor vehicle manufacturers (PC 2014).

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:

- domestic demand for imports to changes in the price of imports (relative to the price of domestic production)
- domestic demand for domestic production to changes in the price of domestic products (relative to price of imports).

The values adopted in this study are the standard values incorporated by the CoPS in the VUMR model. The values range between 0 (for products with little or no imports) and 10 (for products with a high degree of flexibility).

Primary factor substitution and occupational mobility parameters

On the demand side, substitution elasticities determine the degree to which labour and capital inputs can be substituted for each other in production. The benchmark values for year-to-year simulations in the VUMR model are 0.5 for all industries and regions.²

² The VUMR parameter SIGMA1FAC for all industries and regions.

VUMR also includes elasticities governing the degree of substitutability in the use of labour in the eight different occupations in production. The benchmark values for year-to-year simulations are 0.35. The selection of these values reflects an assumption that employers have limited flexibility to alter the occupational mix used in production on a year-to-year basis.³

On the supply side, transformation elasticities determine the extent to which the supply of labour, including immigrant labour, can move between the eight occupational groups. The benchmark 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.⁴

Model database

The database used for this inquiry was created from the standard VUMR model database, which aligns with the 2009-10 ABS *Input-Output Tables*. The database has been updated to 2013-14 based on population, terms of trade and other changes over the period 2009-10 to 2013-14.

A.2 Modelling scenarios

This section outlines key aspects of each of the four preliminary scenarios modelled in the draft report.

The key demographic assumptions of the projections compared to data for 2013-14 (the benchmark year used in each scenario modelled) are reported in table A.1. The demographic projections are based on current age, state- and gender-specific fertility and life expectancy projections. These assumptions accord with those generally applied in demographic modelling.

The working age population contributes to productive activity through participation in the labour force and employment in various occupations. Males and females aged between 20 and 60 years have the highest rate of labour force participation, with participation rates tapering off thereafter (figure A.3, panel a). A higher portion of the labour force participation is engaged in higher-skilled, higher income occupations (figure A.3, panels b and c) than other occupations. However, not all labour force participants are employed at any one time, with the higher unemployment rates experienced by the lower income occupations and the lower unemployment rates experienced by the higher income occupations (figure A.3, panel d).

³ The VUMR parameter SIGMA1LAB for all industries and regions.

⁴ The VUMR parameter SIGMALABO.

Table A.1 Key demographic assumptions

	<i>VUMR variable</i>	<i>2013-14</i>	<i>2059-60</i>
Starting population (million)	natpop	23	na
Total fertility rate (average of states) (births per woman)	LRT_TFR	1.86	1.86
Male births per 100 female births	POPALPHA	105.6	105.6
Average life expectancy at birth	EXTB		
Males		79	88
Females		84	95
NOM ('000)	Projectnom	206	0.6 per cent of the population

na not applicable.

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

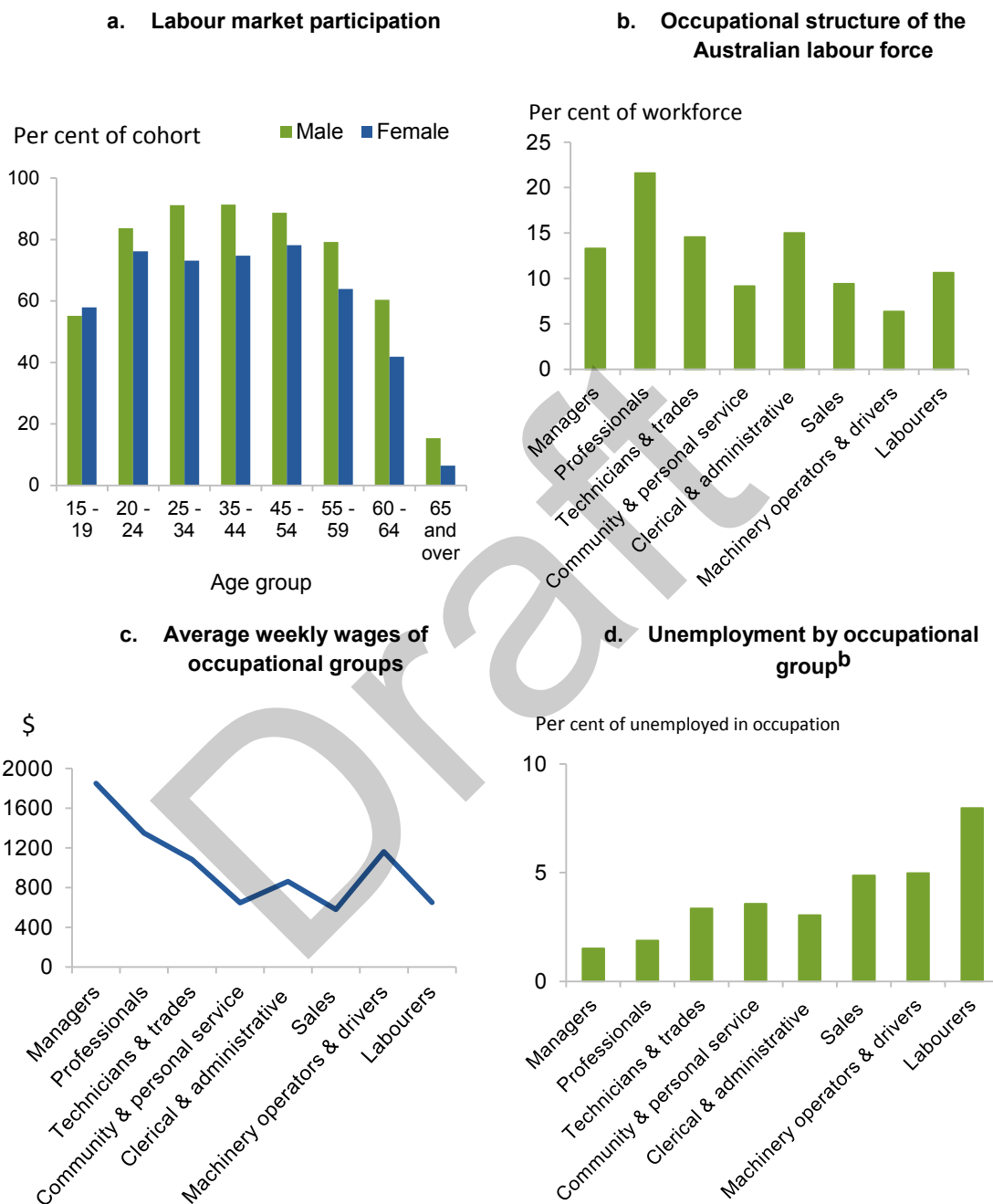
Scenario 1 — Without NOM

Scenario 1 illustrates the implications for the evolution of the Australian population and economy as a result of natural population increases alone — that is, assuming zero NOM from 2014-15 onwards. This scenario is used as a reference against which to report on the economywide impacts of NOM.

These labour market characteristics presented in Table A.1 are applied in scenario 1. Over time, consistent with historical trends, it is assumed that labour force participation will increase fractionally (mainly through increased participation by older people and females) while workers will move between occupations based on changes in after-tax real wage and real unit labour costs of occupations. The unemployment rate in each occupation by state is assumed to be exogenous and fixed at current 2013-14 levels by state and occupation over the projection period.

The variables shocked and the associated endogenous variable used in the dynamic modelling of the without NOM scenario (that is, zero NOM) are shown in table A.2.

Figure A.3 Labour market characteristics of the Australian labour force, 2009-10^a



^a 2009-10 is the first year in the VUMR database used in the modelling. Projection period for this inquiry is from 2013-14 to 2059-60. ^b The figure is based on the distribution of persons unemployed who are able to identify their own occupations. This group accounted for 64 per cent of the unemployed in 2009-10. The remaining 36 per cent of the unemployment are recorded as 'unallocated'.

Source: 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).

Table A.2 Modelling of the zero NOM scenario (scenario 1)

<i>Rationale</i>	<i>VUMR exogenous variable</i>	<i>VUMR endogenous variable</i>
<p>NOM by age, gender and state of entry is introduced as a source of population change. Population by region changes through natural increase, NOM and interstate migration.</p> <p>The direct effect of NOM (model shock) is introduced as an increment in persons by age, gender and state.</p> <p>For this scenario, NOM is set at zero.</p>	National net overseas migration in projection period (000) (projectnom)	National net overseas migration shift term (000) (f_natnom)

Scenario 2 — Population and cohort effect of NOM

Scenario 2 introduces a positive (long-term average) NOM into the growth of the Australian population. It illustrates the possible effects of NOM on the size of the population and its effects on demography and changing labour force participation.

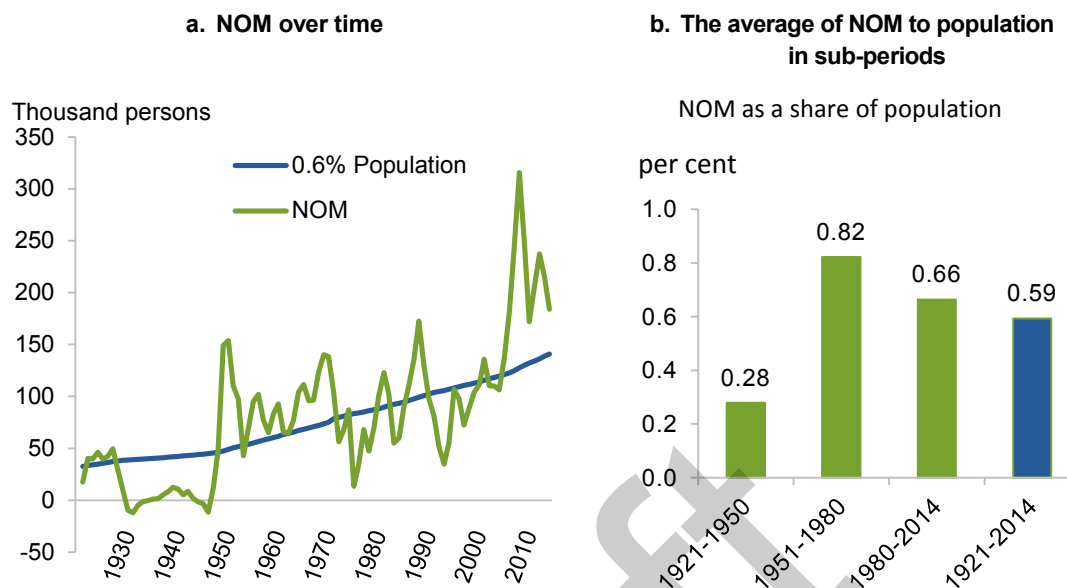
The demographic projection

NOM has varied substantially over time both in absolute terms and as a share of the population (figure A.4, panel a). Over the period from the 1920s to the present, NOM has averaged close to 0.6 per cent of the population since 1921, although in sub-periods it has varied substantially around this rate (figure A.4, panel b), including over recent years.⁵

Against this background, the demographic projections have assumed 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 2024-25. From 2025-26 onwards, NOM is assumed to continue at a rate of 0.6 per cent of the population to 2059-60. The period of convergence is based on the amplitude of past migration cycles.

Scenario 2 assumes that over the projected period, each annual migrant intake has the same demographic characteristics as the current migrant intake (figure A.5, panel a). As a result, modelling of the future migrant intake is heavily weighted towards the 20 to 40 year old age groups.

⁵ NOM as a share of population (per cent) is represented by the model variable C_NOM2POP. This variable took the value of 0.8 in 2013-14 based on actual migrant flows and a projected value of 0.6 from the years 2024-25 to 2059-60. The share is assumed to transition in equal steps from 2013-14 to 2024-25.

Figure A.4 Net overseas migration has been highly variable

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

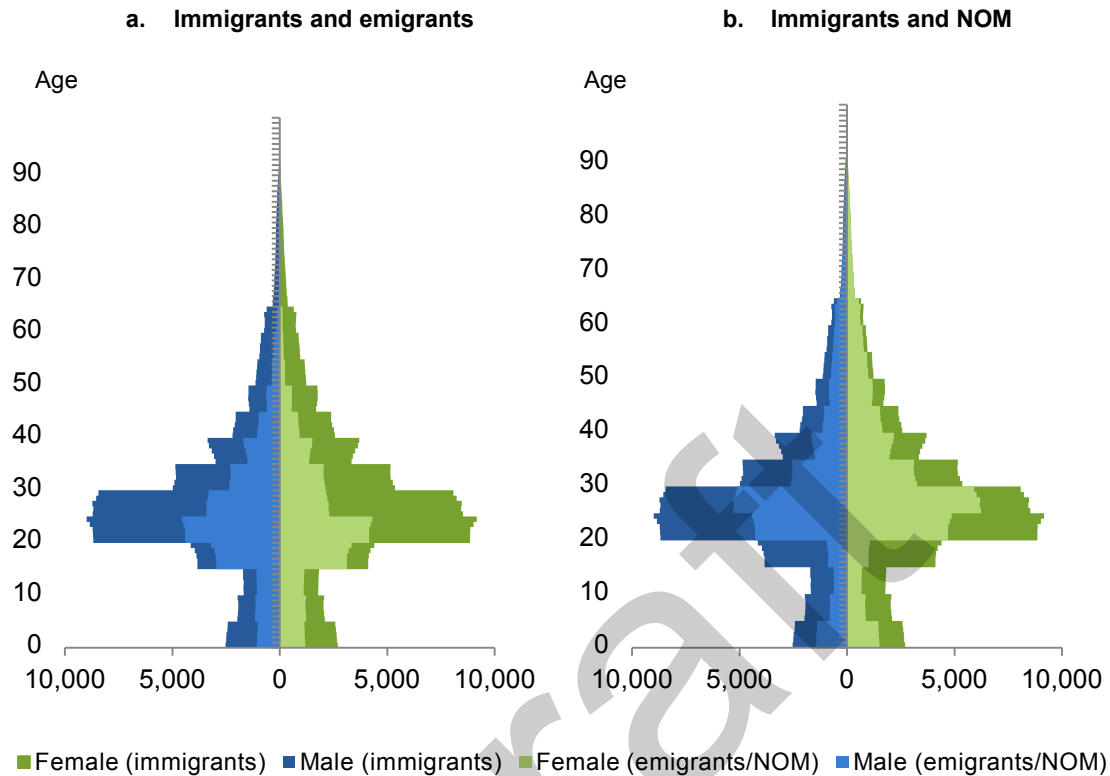
Panel b of figure A.5 shows that the age and gender structure of immigrants closely aligns with the age and gender structure of NOM, that is, the age and gender profile of emigrants is similar to that of immigrants. Given this, the Commission has projected the economywide impacts of Australia's migrant intake by modelling changes in NOM.

The demographic modelling also accounts for second-generation migrants. In this regard, the modelling assumes that migrants once having joined the population, have the same age-specific fertility and mortality rates as the incumbent population.

Because migrants are on average younger than the incumbent population, NOM is projected to shift the age structure of the Australian population and delay the ageing of the population.

The variables shocked and the associated endogenous variable used in the dynamic modelling of NOM are shown in table A.3.

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



^a Estimated from 2013-14 information drawn from ABS (*Migration, Australia, 2012-13*, Cat. no. 3412.0) classified by 5 yearly NOM age groups. The age group information is prorated to age cohorts on the basis of information about the age distribution of the population as a whole.

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

Table A.3 Modelling of NOM at the long-term average (scenario 2)

<i>Description</i>	<i>VUMR exogenous variable</i>	<i>VUMR endogenous variable</i>
<p>NOM by age, gender and state of entry is introduced as a source of population change. Population by region changes through natural increase, NOM and interstate migration.</p> <p>The direct effect of NOM (model shock) is introduced as an increment in persons by age, gender and state.</p> <p>For this scenario, NOM projections transition from current levels to 0.6 per cent of the population in 2024-25 (and later years).</p>	National net overseas migration in projection period (000) (projectnom)	National net overseas migration shift term (000) (f_natnom)

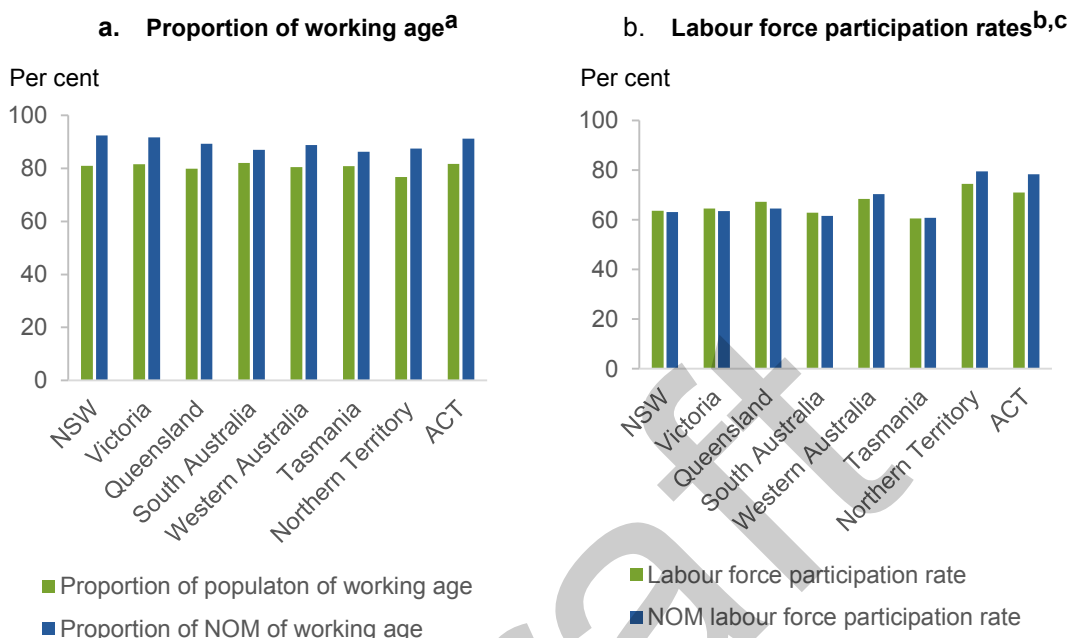
Labour force participation

As noted, NOM is concentrated in the 20 to 40 year old age groups, while the population as a whole is more dispersed toward older age groups. This results in a higher proportion of NOM in working age than in the population in each state (figure A.6, panel a). Available information on labour force participation of permanent and temporary migrants indicates that migrants have similar participation rates to the labour force in the state of employment (figure A.6, panel b).

The modelled scenario is based on the assumption that labour force participation rates of the population by age and gender are representative of the participation rates of migrants (both migrants on arrival and emigrants at departure).

Figure A.6 While a higher proportion of NOM is of working age, working-aged migrants have similar labour force participation rates to the incumbent labour force

Per cent, 2013-14



^a The working age NOM is defined as the number of persons who are 15 years and older. The NOM age-gender cohort data for 2013-14 from ABS (Migration, Australia, 2013-14, Cat. no. 3412.0) were adopted. The original data classified by 5-yearly age groups was prorated to age cohorts on the basis of information about the age distribution of the population. ^b Labour force participants are people who are either employed or actively looking for work. Participation rates are defined as the proportion of the labour market participants in the working aged population. Information on participation by age and gender by state for the labour force are derived from ABS Labour Force Survey. ^c Comparative information on labour force participation of migrants is not available from a single source. To fill this information gap, labour market participation by permanent migrants by visa category (skilled, family and humanitarian migrants) by state of residence was derived from the ABS ACMID data for the migrants arriving in Australia over the years 2009 to 2011, inclusive. Information on labour market participation for temporary migrants by visa category (student and other temporary visa holders) was derived from the ABS CORMS data by state of residence for the two years 2010 and 2013. This derived information was applied to NOM data by visa category by state for 2013-14 to estimate labour force participation by visa category by state. Participation rates for NOM by state were estimated by aggregating data across visa categories. This methodology assumes that participation rates estimated from the survey data are representative of NOM participation rates in 2013-14.

Sources: Productivity Commission estimates based on ABS (*Labour Force, Australia, Detailed, Quarterly, February 2015*, Cat. no. 6291.0.55.003). Estimates for permanent migrants based on ABS 2011 *Australian Census and Migrants Integrated Dataset* (ACMID), unpublished data and, for the temporary migrants, from the ABS *Characteristics of Recent Migrants Survey* (CORMS), unpublished data.

Scenario 3 — Labour force occupational effect

Scenario 3 introduces the additional assumption that future migrants (modelled as NOM) have the same occupational profile as the current migrant intake.

For this scenario, NOM labour market participants are introduced into the labour force by occupation and state in the VUMR model. The allocation of migrants to a particular state is based on the recorded entry point by state of the migrant intake in 2013-14. The process used to derive the estimates of labour force participation by occupation and state is described in box A.2.

Box A.2 Estimating the occupational group of NOM labour force participants by state

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 state for each of the five visa categories — skilled, family, humanitarian, temporary and other — was compiled.

- For permanent migrants, visa categories by state and occupation are derived from ABS 2011 Australian Census and Migrants Integrated Dataset (ACMID) data. the distribution is based on the average of data of migrants arriving in Australia over the years 2009 to 2011, inclusive (the latest period for which data are available).
- For temporary migrants, visa categories by state and occupation are derived from the ABS Characteristics of Recent Migrants Dataset Survey (CORMS). The distribution is based on the average of data across the samples for 2010 and 2013.
 - Due to this limited sample size, CORMS data does not support identification and estimation of the 'other' migrants by occupation and state. To fill this information gap, the occupational distribution of the labour force for the Australian population in 2013-14 is used as a 'proxy' for migrants in this category.

Second, under the assumption that the occupational structure of immigrants by visa category is reflective of the occupational structure of emigrants for the same category, the distribution of immigrants by occupation and state is scaled to the level of NOM for 2013-14 by visa category (as reported in *Australia's Migration Trends 2013* published by the Department of Immigration and Border Protection (DIBP)). For the modelling, the information is aggregated across visa categories to provide a measure of labour force participation by occupation and state.

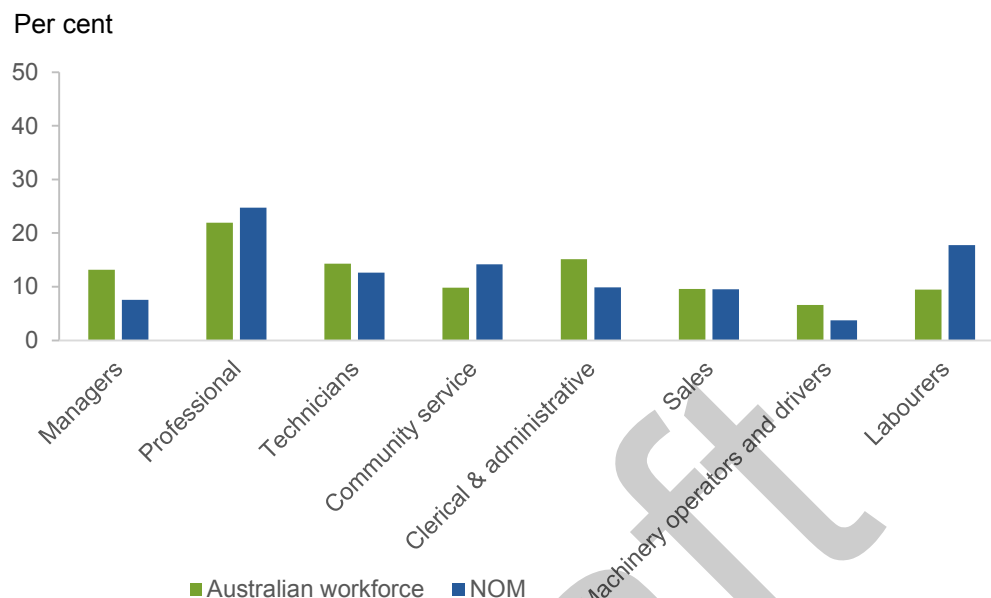
The occupational distribution of NOM by state is applied in the modelling over the projection period.

Sources: ABS Australian Census and Migrants Integrated Dataset (ACMID), unpublished; ABS Characteristics of Recent Migrants Survey (CORMS), unpublished data, Australia's Migration Trends 2013 published by the Department of Immigration and Border Protection (DIBP).

Available information about the occupational composition of NOM entrants and the Australian labour force suggests that both are concentrated in professional occupations (figure A.7). Beyond the professional occupations, NOM labour force participants tend 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.

The variables shocked and the associated endogenous variable used in the dynamic modelling of the occupational effect of NOM, are shown in table A.4.

Figure A.7 The Australian labour force and NOM visa entrants are more concentrated in professional and labourers occupations^a



^a Estimates reported for the Australian labour force are for the year 2013-14. 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 2013-14 (See box A.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 2011 *Australian Census and Migrants Integrated Dataset* (ACMID), unpublished data and, for the temporary migrants, from the ABS *Characteristics of Recent Migrants Survey* (CORMS), unpublished data; *Australia's Migration Trends 2013* (Tables 6.1 and 6.2) published by the Department of Immigration and Border Protection (DIBP).

Table A.4 Modelling of the occupational effects of NOM (scenario 3)

Description	VUMR exogenous variable	VUMR endogenous variable
The occupational composition of NOM by region can differ from the occupational composition of the incumbent labour force in each region.	Distribute NOM using NOM profiles (f_om1)	Distribute NOM using incumbent profiles f_om2
The direct effect occupational effect of NOM (model shock) is introduced by using the migrants profile by age, gender and state.		
The occupational profile of NOM is assumed unchanged during the projection period.		

Scenario 4 — Spillover productivity effects

Scenario 4 examines the impact of positive spillover benefits from migration to national labour productivity.

International evidence suggests that immigration (particularly skilled immigration) has generally been found to have a small, positive effect on aggregate productivity growth through its positive spillover effects⁶. A number of spillover channels have been identified through the migrant intake that can raise the aggregate productivity above levels that would otherwise be achieved, including through:

- increased innovative activity and innovation enabled by the acquisition of additional research and development skills;
- more rapid adoption of technological and organisational changes through increased knowledge and access to international best practice (for example, knowledge spillovers or increased task specialisation); and
- exposure to increased opportunities and competitive pressures through the take up of new foreign trade and investment opportunities and entrepreneurship.

There is, however, limited empirical evidence in the Australian context of what the impact of such spillover channels may be. To give an indication of the economywide impact of potential productivity spillover effects, a small across the board labour productivity growth of 1 per cent has been modelled.

The variables shocked and the associated endogenous variable used in the dynamic modelling of the spillover effects of NOM, are shown in table A.5.

Table A.5 Modelling of the potential productivity spillover effects of NOM (scenario 4)

<i>Description</i>	<i>VUMR exogenous variable</i>	<i>VUMR endogenous variable</i>
NOM can lead to improvements in labour productivity though a number of channels not included in the theory of the model. The direct effect labour productivity effect (model shock) of spillovers is introduced through an exogenous increase of 1 per cent in the rate of growth of labour productivity from rates that would otherwise prevail.	Labour productivity (using GVA as output) (x1labprod) Across industries	All primary factor technical change (a1prim) Across industries

⁶ Details are provided in Chapter 5 of the Draft Report.

A.3 Preliminary economywide projections

Macroeconomic effects

Table A.6 presents a summary of the preliminary projections of key macroeconomic variables for the period from 2013-14 to 2059-60 under the four scenarios considered in the draft report for this inquiry. Table A.7 presents percentage deviations of scenarios 2 to 4 modelled from the hypothetical without NOM case (scenario 1).

As noted in the introduction to this supplement, the projections reported are conditional on the assumptions underpinning the modelling and are intended to illustrate the economic implications of alternative scenarios relating to the migrant intake into Australia. They are not forecasts of the future.

The broader economic picture under the reference case

Under scenario 1 (the case of zero NOM), the size of the economy, measured by real GDP, is projected to increase by 63 per cent from 2013-14 levels (that is, from an index of 100 in 2013-14 to 163 in 2059-60, table A.6). With a larger economy, real consumption of both the household and government sectors is also expected to increase by 64 and 86 per cent, respectively. 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. Government real consumption is projected to increase ahead of household consumption on account of additional public expenditure on health and aged care services associated with an ageing population.

Under this scenario, the capital-labour ratio is projected to increase above current levels by 2059-60 as, with the ageing of the population, employment is projected to decline relative to capital stocks. The growth in output above changes in labour and capital inputs is assumed to be supported by higher productivity of labour and capital (that is multifactor productivity).

In per capita terms, GDP is projected to be around 42 per cent above current levels.

Exports and imports are projected to increase in substantially different proportions — rising from current levels to 2059-60 by 124 and 47 per cent, respectively. The difference reflects projected changes following the unwinding of the terms of trade and associated mining investment boom. For the modelling, it has been assumed that the terms of trade returns to historical average levels by 2017-18 and that the mining industry progressively deploys previous investment to increase output, mainly directed to exporting. With the declining terms of trade, the cost of imports are projected to rise relative to the prices of local goods and services slowing the projected growth of imports relative to overall activity levels. 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. Although the assumed changes in the terms of trade and associated adjustments are

not directly affected by Australia's migrant intake, they do represent part of the broader economic environment in which future migration is assumed to occur.

Table A.6 Preliminary projections of national effects of NOM in 2059-60
Index 2013-14 = 100

<i>Variable</i>	<i>Without NOM (Scenario 1)</i>	<i>With NOM (Scenario 2)</i>	<i>Occupational effect (Scenario 3)^a</i>	<i>Spillover effect (Scenario 4)</i>
Population	115	172	172	172
Labour force (persons)	102	164	164	164
Real GDP	163	258	259	259
Real GNE	150	243	254	244
<i>of which</i>				
Real household consumption	164	253	257	254
Real government consumption	186	277	282	279
Real investment	83	185	219	184
Export volumes	224	333	264	336
Import volumes	147	250	252	256
Real consumer wage	300	260	255	263
Real producer wage (unit labour costs)	245	228	223	229
Labour productivity ^b	186	181	176	181
GDP per capita	142	150	151	150
Household consumption per capita	143	147	149	148
GNE per capita	130	141	147	141

^a This scenario embodies assumptions that constrains adjustment of exports in response to assumed longer term movements in the terms of trade relative to the modelling of scenarios 1, 2 and 4. This constrains projected export changes and inflates projected investment changes. There are some lesser flow-on effects to other aggregate variables. ^b Real Gross Value Added (GVA) per hour worked.

Source: Productivity Commission preliminary projections.

The modelling suggests that, by 2059-60, the real consumer wage is projected to be 200 per cent (increasing from an index value of 100 to 300) above current levels in the without NOM scenario, while the real producer wage is projected to be 145 per cent (increasing from 100 to 245) above current levels. The real consumer wage reflects purchasing power with reference to the goods and services for consumers, while the real producer wage reflects the purchasing power of producers. The main source of difference between the two wage measures is in the composition of the goods and services for consumers and producers and the consequential difference in price deflators. In particular, the goods and services for producers include inputs associated with capital investment and, also importantly, 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 (in all scenarios modelled).

The projected economywide impact of NOM

Table A.7 presents deviations of the 3 NOM alternative scenarios from the reference case without NOM (scenario 1). The projected increases in NOM would increase the size and lower the average age of the Australian population. This would lead to a larger labour force and typically raise GDP and most other macroeconomic variables above levels that would otherwise prevail.

Table A.7 Marginal effects of alternative scenarios compared with the base case (scenario 1) in 2059-60

Alternative scenarios expressed as per cent deviation from scenario 1^a

<i>Variable</i>	<i>With NOM (Scenario 2)</i>	<i>Occupational effect (Scenario 3)^a</i>	<i>Spillover effect (Scenario 4)</i>
Population	50	50	50
Labour supply (persons)	60	60	60
Real GDP	58	59	59
Real GNE	62	69	63
<i>of which</i>			
Real household consumption	55	57	55
Real government consumption	49	52	50
Real investment	124	166	123
Export volumes	49	18	50
Import volumes	70	71	74
Real consumer wage	-13	-15	-13
Real producer wage (unit labour costs)	-7	-9	-7
Labour productivity ^b	-3	-5	-3
GDP per capita	5	6	6
Household consumption per capita	3	5	4
GNE per capita	8	13	8

^a This scenario embodies assumptions that constrains adjustment of exports in response to assumed longer term movements in the terms of trade relative to the modelling of scenarios 1, 2 and 4. This constrains projected export changes and inflates projected investment changes. There are some lesser flow-on effects to other aggregate variables. ^b Real Gross Value Added (GVA) per hour worked.

Source: Productivity Commission preliminary projections.

In scenario 2, GDP is projected to be 58 per cent higher in 2059-60 relative to scenario 1. Similarly, real gross national expenditure (GNE) and its three components (real household consumption, government consumption and investment), as well as exports and imports are projected to be higher under scenario 2. Because the average age of the population in scenario 2 is lower than scenario 1, growth in government health and aged care expenditure (discussed below) is attenuated relative to growth in overall real government consumption expenditure (which is indexed to real household consumption). Real government consumption in scenario 2 is accordingly projected to increase by less than

household consumption. Higher domestic demand arising from a higher population is projected to increase the demand for imports but, with the increase in domestic absorption, exports are projected to increase less than imports.

While GDP is projected to be substantially higher with NOM compared to the case without NOM, total GDP is shared among a larger population. For this reason, GDP per capita is projected to be only 5 per cent higher compared with scenario 1.

In scenario 2, the real consumption and producer wages are projected to increase over time, but at a slower rate compared to scenario 1. Over the period, the real consumer wage is projected to be lower by 13 per cent and real producer wage by 7 per cent compared with scenario 1. This difference mainly reflects the effect of a larger labour force relative to the size of the population, as well as lags between demand for and installation of new investment to meet the needs of a larger population and the relative effect of these changes in prices faced by consumers and producers.⁷

The impact of occupational and spillover benefits to labour productivity

Scenario 3 adopts the current occupational profile for NOM rather than the profile of the incumbent labour force. As described above, the NOM occupational profile, although broadly similar to that of the current labour force, is more heavily weighted towards professionals, community service workers and labourers. While the adoption of the alternative occupational profile has little effect on the projections of GDP between scenarios 2 and 3, it is projected to have some distributional effects that favour industries employing the more heavily represented workers, including less trade exposed service activities. As a consequence, real GNE on goods and services is projected to be higher and exports projected to be lower than scenario 2 relative to scenario 1.

The projected downward pressure on real wages relative to scenarios 1 and 2 reflects the relatively high concentration of NOM (compared to the general labour force) in more labour intensive activities.

Scenario 4 models the impacts of a 1 per cent increase in the annual growth of labour productivity over the projection period arising from prospective productivity spillover benefits of migration. In line with the assumed relatively small direct effect, the projected change to GDP relative to the other scenarios is modest. Similarly, because the productivity increase improves the trade competitiveness of the economy, it is projected to have distributional effects favouring trade exposed activities. Because of the relatively small direct effect (that is, a 1 per cent increase in the rate of growth) the deviation in projections of economic aggregates from scenario 2 is small.

⁷ As noted, the VUMR adopts an adaptive expectations approach to the modelling of investment behaviour. Under this approach, there is some stickiness in investors reactions and new investment tends to lag the increase in labour and new demands.

Regional effects

According to the modelling, NOM will have varying demographic and economic effects across states and territories over the projected period. Figure A.8 compares the growth in population, employment (measured in persons), GSP and GSP per person under the scenario without NOM (scenario 1) and with NOM (scenario 2).

Between 2013-14 and 2059-60, with only natural increase (scenario 1), the populations of New South Wales, Victoria, Queensland, South Australia, Western Australia and Tasmania are projected to increase by up to 16 per cent from current levels (figure A.8, 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 57 and 86 per cent for the Northern Territory and the Australian Capital Territory, respectively. Growth in the labour force in each jurisdiction is projected to lag the growth in population on account of the projected ageing of the population (figure A.8, panel b).

With NOM (scenario 2), the population is projected to increase across states and territories, but at different rates. Continued NOM to attract a relatively high concentration of working aged migrants would increase the supply of labour in the Australian economy and lower the age dependency ratio. This labour would find employment in existing centres and also support the expansion of new activities, projected to include more trade exposed-capital intensive activities, including those associated with mining and minerals processes across Australia. With the relative concentration of these activities in the economies of Western Australia and Northern Territory, populations are projected to expand in these states relative to other states (figure A.8, panel a). The population in the Northern Territory and the Australian Capital Territory is also influenced by the above average projected expansion of government service activities. The populations of the more diversified states of New South Wales, Victoria and Queensland are projected to expand at roughly the national average rate.

GSP will increase with the employment of people as well as with increases in capital through investment and the productivity of labour and capital through 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 the without NOM and with NOM scenarios (figure A.8, panel c).

Growth of GSP per person is projected to differ between regions, however (figure A.8, panel d). In the hypothetical without NOM case (scenario 1), per capita 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 and lowest for the Northern Territory and the Australian Capital Territory, which includes a concentration of government service activities with low (or zero) assumed multifactor productivity growth. Northern Territory also has relatively low projected employment per capita lowering the productivity capacity of that region relative to other regions.

Figure A.8 Impacts of NOM differ between states and territories

2059-60



Source: Productivity Commission preliminary projections.

The impact of NOM on changes in the level of GSP per person is likely to vary considerably between regions and ultimately would be sensitive to the economic structure of regions as well as the occupational composition of NOM and state of settlement. Broadly, other things being equal, the smaller the projected NOM arrivals are as a share of the regional workforces, the larger is the GSP per person increase. The jurisdictions with lower NOM would benefit from increased demand for goods and services from other jurisdictions and the ability to recruit through interstate migration workers from other jurisdictions when it is competitive to do so. Projections for South Australia, Queensland and Tasmania are most affected by this effect, with New South Wales also affected (figure A.8 panel d).

The larger NOM is relative to the incumbent population, the smaller the increase in GSP per capita. This effect is most evident in the projections for Western Australia. This region has a relatively large projected population increase while changes in GSP are projected to broadly align with changes projected for other regions (figure A.8, panels c and a).

Government revenue and expenditure implications

Australia's net migrant intake (scenario 2 and beyond) is projected to increase the level of revenues and expenditures of the Australian, state and territory governments to 2059-60 over the levels in the without NOM scenario (figure A.9 panel a).

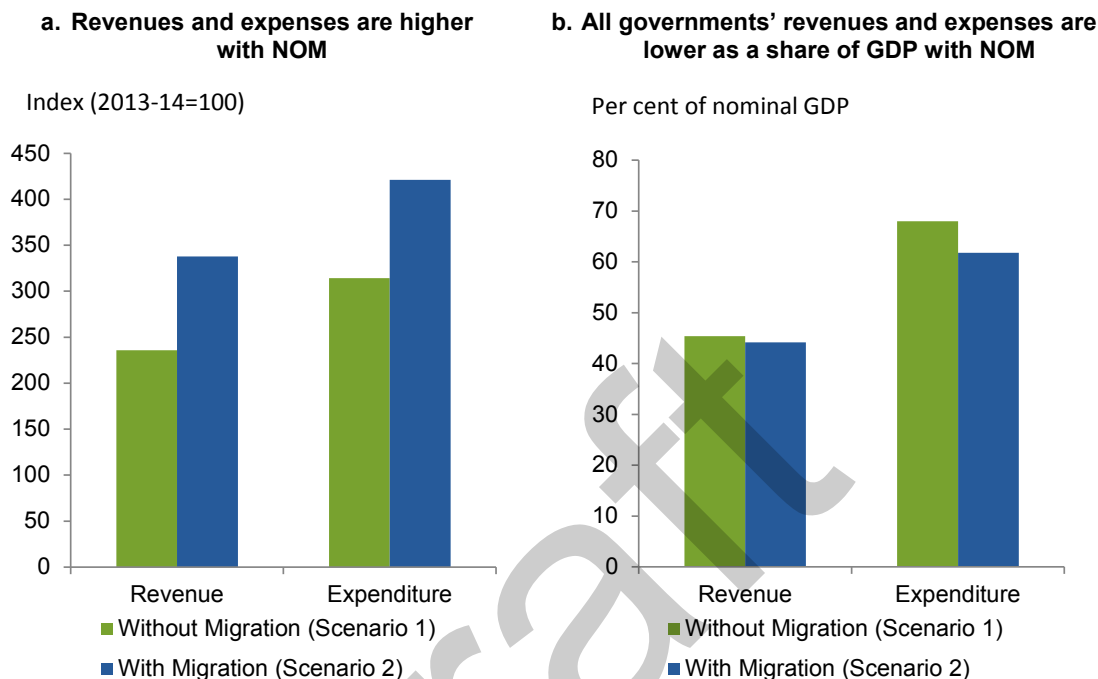
As GDP is projected to increase ahead of government revenue, government revenue as a share of GDP is projected to decline. The lower revenue growth reflects the slower growth of company taxes as the economy shifts to more labour intensive service activities. With a lower age-dependency ratio in the with NOM case, government expenses (inclusive of health and aged care) as a share of GDP is projected to be lower in the zero NOM case relative to the with migration case (figure A.9, panel b).

Under the modelling assumption that government financial balances remains constant as a share of nominal GDP (at 2009-10 levels), any shortfall of projected revenues over expenses are transferred from households as a lump sum transfer to governments. In 2059-60, the transfer from households is projected to amount to 16 per cent of projected nominal GDP in the zero NOM case, compared to only 12 per cent of projected nominal GDP with migration. This highlights the sensitivity of government balances to small changes in aggregate revenues and expenses.

Over the projection period to 2059-60, the balance of Australian and state and territory government revenues and expenditures is projected to shift towards the state and territory governments (figure A.10). In 2059-60, the share of state and territory government revenues are projected to increase by around 6 percentage points (from 40.2 to 46.1 per cent of GDP) in the zero migration case, compared to 5 percentage points (from 40.2 to 45.6 per cent) for the with NOM scenarios.

Figure A.9 The level of government revenues and expenditures are projected to increase, but decline as a share of GDP with migration^a

2059-60



^a The lump-sum transfer from households to the Australian and state and territory governments is excluded from the above charts. Figure 8.6 in the draft report includes the lump sum transfer.

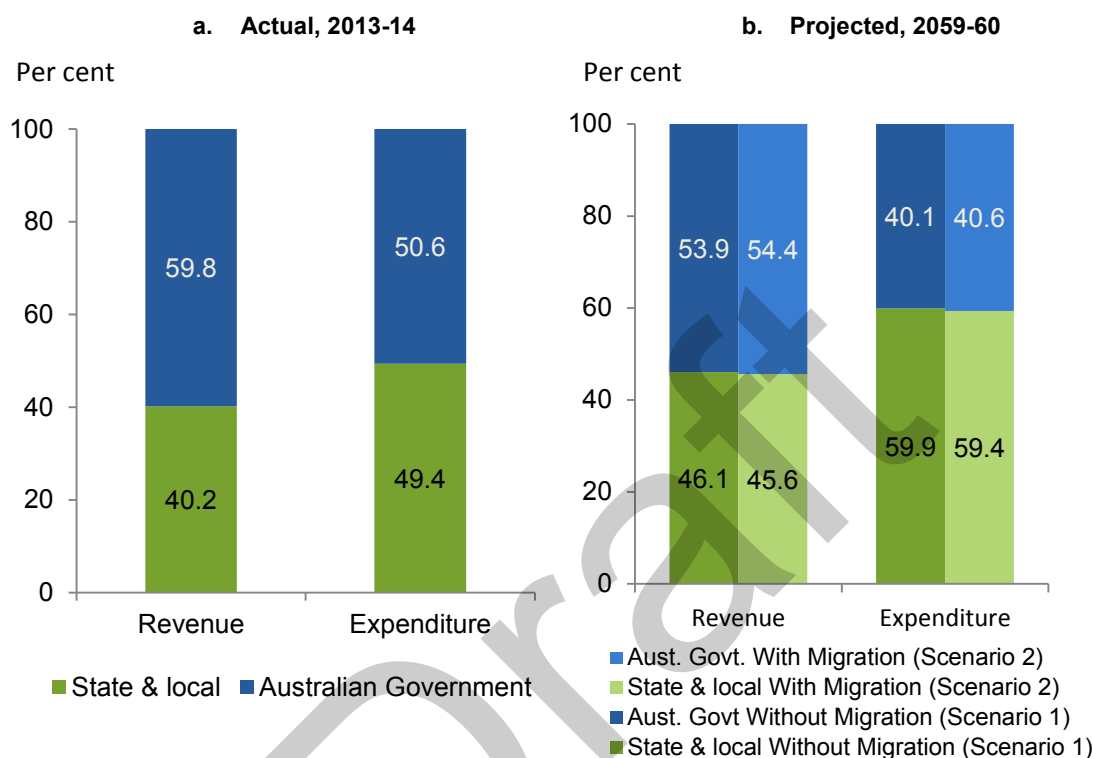
Source: Productivity Commission preliminary projections.

The shift in revenue from the Australian Government towards the state and territory governments is caused by a projected increase in the sales of goods and services for the state and territory governments. Contributing to this shift in revenue towards the state and territory governments is a projected decline in the share of Australian Government taxation revenue from company income taxation as a proportion of total Australian Government revenue.

The projected expenditure shares between the Australian Government and the state and territory governments' also shift towards the state and territory governments. By 2059-60, there is a projected shift in expenditure shares towards the state and territory governments of around 10 percentage points both with and without NOM. This shift in expenditure shares is caused by a projected increase in the share of state and territory governments' gross operating expenses (namely expenditure on health) as a proportion of the state and territory governments' total expenditure.

Figure A.10 The balance of projected revenues and expenses shifts towards the state and territory governments^{a,b,c}

Actual and projected fiscal shares,^{a,b,c}



^a Australian Government: *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 & local governments. State, territory & local: *GFS Expenses*.

^c Excludes the lump sum payment from the household to the governments.

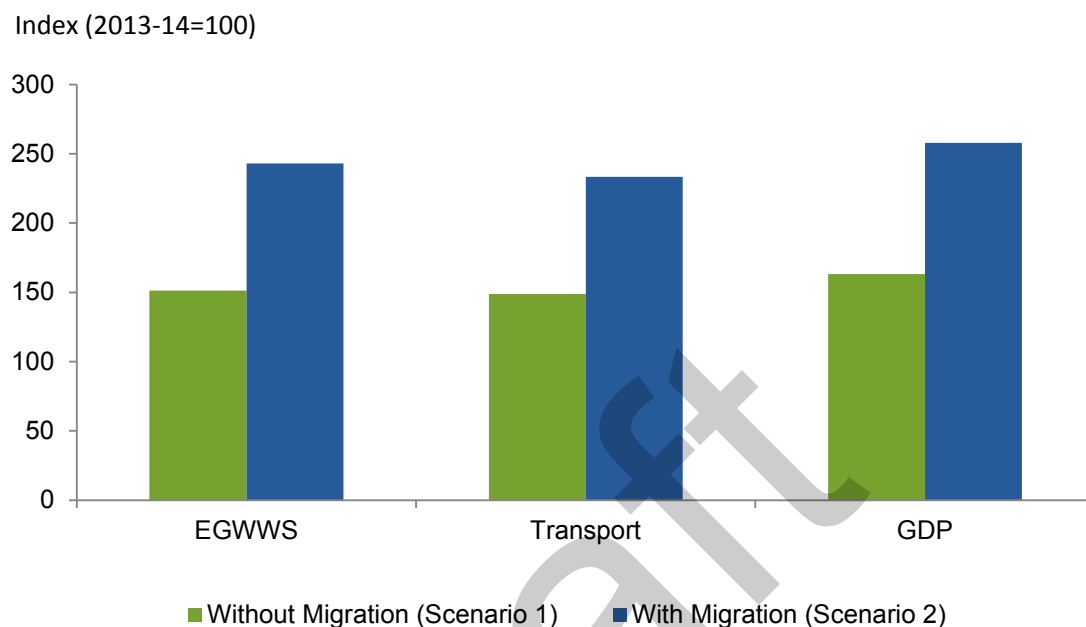
Source: Productivity Commission preliminary projections.

Increased infrastructure service provision

A larger population and economy could be expected to be associated with higher levels of activity in infrastructure service provision, such as roads and utility services. Reflecting this likelihood, economic activity in the electricity, gas, water and waste services (EGWWS) and domestically oriented transport industries are projected to grow broadly in line with GDP in both the hypothetical without and with NOM scenarios (figure A.11).

Figure A.11 The level of activity in infrastructure industries is expected to increase with migration to 2059-60

Industry gross value added (GVA)



^a EGWWS is the Electricity, Gas, Water and Waste Services industry.

Source: Productivity Commission preliminary projections.

Real wages and the effects of migration

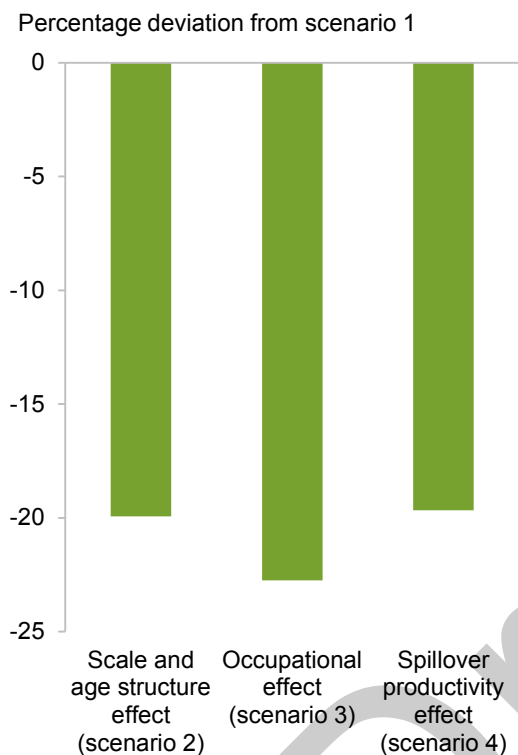
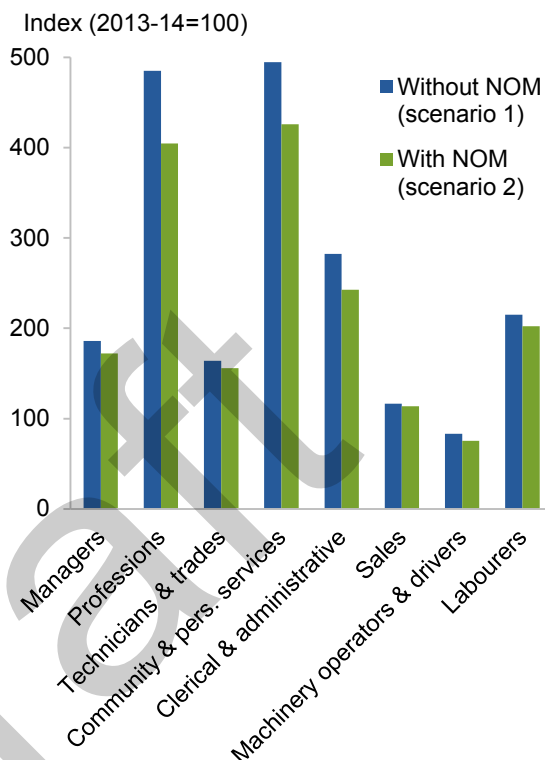
Population ageing is projected to place additional demands on available labour, placing upward pressures on real (after-tax) wages, particularly in industries servicing older Australians.

A lowering of the age dependency ratio through net migration would moderate such pressures — by around 20 per cent economywide by 2059-60 (scenario 2) (figure A.12, panel a). While immigration is projected to reduce the extent of real wages growth to 2059-60, it is important to note that real wages are projected to rise substantially over the period from prevailing levels reflecting ongoing improvements labour productivity (table A.6).⁸

⁸ The Commission's general equilibrium modelling provides an illustrative projection of potential wage differences compared to the hypothetical counterfactual of no-migration over the next 45 years. The general equilibrium analysis differs from the econometric results presented in technical supplement C. 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.

Figure A.12 Real wage changes

Projected changes in real after-tax consumer wages

a. Percentage deviation in total wages from the without NOM projection in 2059-60**b. Cumulative change in real wages by occupation percentage change from 2013-14 to 2059-60**

Source: Productivity Commission preliminary projections.

The higher growth in the service industries is projected to place substantial upward pressure on the professional and community and personal service wages (figure A.12, panel b).

Moderation of wage pressures is projected to be highest in the areas where the immigrant labour force is most represented — the professions and community services workers and labourers — and pressure for wage growth is high. This takes account of both the growth in industries, 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 the with and without NOM scenarios in 2059-60 for sales workers and machinery operators and drivers. These occupations are concentrated in retail and wholesale trade, and road freight transport. As such, 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 level of NOM?

The modelling results presented so far are based on the assumption that, in the long term, Australia's intake of NOM will transition from the current level to 0.6 per cent of the population in 2024-25 and remain at that proportion of the population at least until 2059-60 — that is, at about the average proportion over the period between 1921-22 and 2013-14. Under this assumption NOM could reach 350 000 persons by 2059-60.

However, the actual level of NOM has historically varied substantially from period to period and any projection is uncertain (figure A.4, panel a). If the growth in NOM was to differ from the levels used in the modelling, the projected Australian economy would also differ from what is presented under the four scenarios modelled for the draft report.

In order to illustrate some of the broad economic implications of different levels of NOM, further modelling was undertaken based on five alternative assumptions about the future level of NOM over the 45 years to 2059-60.

- Scenario 2.B — NOM is assumed to be 0.8 per cent of the population in 2014-15 and remain at that share of the population until at least 2059-60.
- Scenario 2.C — NOM is assumed to be 1.2 per cent of the population in 2014-15 and remain at that share of the population until 2059-60.
- Scenario 2.D — The number of NOM is assumed to be fixed at 100,000 persons per year over the period 2014-15 to 2059-60.
- Scenario 2.E — The number of NOM is assumed to be fixed at 205,000 persons per year over the period 2014-15 to 2059-60. This would be roughly equivalent to NOM in 2013-14. Under this scenario, NOM would have been 0.97 per cent of the population in 2013-14 and as the population grows decline to 0.51 per cent by 2059-60.
- Scenario 2.F — The number of NOM is assumed to be fixed at 250,000 persons per year over the period 2014-15 to 2059-60. Under this scenario, NOM would have been 1.2 per cent of the population in 2013-14 terms, and it would progressively decline as a proportion of the population to 0.6 per cent of the population in 2059-60.

Apart from differing levels of projected NOM, modelling of the alternative NOM scenarios follows that of scenario 2 updated above, including the assumption that NOM hold the same age-gender profile of the current migrant intake.

Table A.8 shows key demographic and macroeconomic effects of NOM under scenario 2 (reported above) and the five alternative scenarios. 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 age dependency ratio and raise GDP per person, thereby reducing the demographic impact of ageing. This effect is greater in the scenarios where NOM is modelled as a share of the population as immigrants too age, so a growing intake is required to have long term demographic effects.

Comparison of the scenarios where NOM is assumed to continue as a fixed proportion of the population (scenarios 2, 2.B and 2.C) with scenarios in which NOM is assumed to continue at a fixed level (scenarios 2.D to 2.F), also illustrate that as the overall size population increases, the economic impact of NOM diminishes in the fixed-migration number cases relative to the fixed proportion cases. (The Commission proposes to explore the projection of the population and economy beyond 2059-60 to assess the implications of alternative migration scenarios on the age-dependency ratio.)

Table A.8 National effects under five alternative scenarios of NOM, 2059-60

Index (2013-14 = 100), Persons '000

Variable	NOM as a share of the population assumed fixed			The level of NOM is assumed fixed		
	Scenario 2	Scenario 2.B	Scenario 2.C	Scenario 2.D	Scenario 2.E	Scenario 2.F
	NOM 0.6% of pop. from 2013-14	NOM 0.8% of pop. from 2013-14	NOM 1.2% of pop. from 2013-14	NOM 100,000 per year	NOM 205 000 per year	NOM 250 000 per year
NOM (Persons '000)	8,963	12,156	19,444	5,235	9,468	11,235
Population (Index)	172	192	236	150	176	187
Population (Persons '000)	39,799	44,323	54,544	34,571	40,737	43,316
GDP	258	290	364	220	266	285
GDP per capita	150	151	154	147	151	152
Age dependency ratio	0.42	0.38	0.32	0.48	0.41	0.39

Source: Productivity Commission preliminary projections.

Appendix A Key classifications

Table A1 Industries in the VUMR model data base

	<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

(Continued next page)

Table A1 (continued)

	<i>Industry</i>	<i>IOIG number</i>
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)
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, 'Construction of the 2009-10 Database for the Victoria University Multi-Regional Model', database prepared by Glyn Wittwer, Philip Adams, Janine Dixon and Nhi Tran, Centre of Policy Studies, Victoria University, with contributions from staff at the Productivity Commission, 27 August 2015 (Version 1.0).

Table A2 Occupational classification

	<i>Major group</i>	<i>Description</i>	<i>Predominant skill levels</i>
1	Managers	MANAGERS plan, organise, direct, control, coordinate and review the operations of government, commercial, agricultural, industrial, non-profit and other organisations, and departments.	Bachelor of higher qualification; Associate Degree; or Advanced Diploma or Diploma, or at least three years of relevant experience.
2	Professionals	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.	Bachelor or higher qualification.
3	Technicians and trades workers	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.	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	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.	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	CLERICAL AND ADMINISTRATIVE WORKERS provide support to Managers, Professionals and organisations by organising, storing, manipulating and retrieving information.	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.

(Continued next page)

Table A2 (continued)

	<i>Major group</i>	<i>Description</i>	<i>Predominant skill levels</i>
6	Sales workers	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.	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	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.	Certificate II or III.
8	Labourers	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.	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.

Appendix B Coding details of VUMR model extensions

This appendix provides coding changes to the standard VUMR model to implement extensions for the Migrant Intake Inquiry with respect to:

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

Extension for the modelling of migrant labour force characteristics

The changes in the number of NOM (equations E_om1 in box B1) is updated by the projected national level of NOM (projectnom) weighted by the share of NOM in each age, gender and state cohort (OMSHARE (x,g,q)). The projected national level of NOM (projectnom) is designated as a share of the population (C_NOM2POP). In scenario 2, this proportion is assumed to be 0.6 per cent.

Box B1

Coding details for the modelling of impact of NOM (scenario 2)

! Link changes in net overseas migration to population in projection period !

Equation E_projectnom

Projection of net overseas migration on an age at migration basis (000)

projectnom = [C_NOM2POP@1/100]*C_NATPOP@1*d_unity + f_natnom;

! Allocate projected NOM using actual migration shares !

Equation E_om1 *# 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*OMSHARE(x,g,q)*projectnom + f_om1(x,g,q);

Source: Productivity Commission preliminary modelling.

Changes in the state labour force supply that accounts for the occupation characteristics of NOM (E_d_lab_rd_n) is updated by the changes in the persons of NOM (d_pop_nom(y,g,q), their participation rates (prate_nom) and occupational share (d_occshr_n(q,o)) in each state. These three components in change form are presented in box B2.

Box B2

Coding details for the modelling of NOM labour force occupation characteristics (scenario 3)**Equation E_d_lab_rd_n**

Change in state labour supply - NOM (persons)

(all,q,REGDST)(all,o,OCC)

d_lab_rd_n(q,o) =

$$\text{sum}\{y, \text{WORKINGAGE}, \text{sum}\{g, \text{GENDER},$$

$$[\text{OCCSHR_NOM}(q,o)/100] * [\text{PR_NOM}(y,g,q)/100] * d_pop_nom(y,g,q) +$$

$$[\text{OCCSHR_NOM}(q,o)/100] * [\text{PR_NOM}(y,g,q)/100] * [\text{COHORT@1_NOM}(y,g,q)/100] * prate_nom(y,g,q) +$$

$$[\text{PR_NOM}(y,g,q)/100] * \text{COHORT@1_NOM}(y,g,q) * d_occshr_n(q,o)\}\};$$

Source: Productivity Commission preliminary modelling

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

The preliminary modelling of state and territory governments and the Australian Government final consumption expenditure in the VUMR-MI model has been extended to include:

- linking of government expenditure to demographic change over the entire population age structure
- the two VUMR education commodities — school and non-school education — are added into the set of commodities for which government expenditure is linked to demographic change
- per capita government expenditure by age and gender for health and education services are drawn from the Commission's research report on the implications of an ageing population (PC 2013).

The standard treatment of aged care services has been maintained in VUMR-MI, that is, real government final consumption expenditure on aged care services changes in with national aggregate real household final consumption spending and the proportion of the population aged 65 and over.

To apply this extension, equations *E_x5aB3* and *E_x6aB3* have been implemented in the VUMR-MI model. 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 and education government spending per person and changes in national aggregate real household final consumption spending per capita (box B3).

Box B3

Coding details for the modelling of the implications of demographic change on health 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)

 $x6a(c,s,q) = natx3tot - natpop +$ $1/ID01[\sum\{x,AGE,\sum\{g,GENDER, C_X6PC(c,x,g)*COHORT@1(x,g,q)\}}]*$ $\sum\{x,AGE,\sum\{g,GENDER, [C_X6PC(c,x,g)*COHORT@1(x,g,q)]*$ $[x6pc(c,x,g) + f_x6pc(c,q) + f_natx6pc(c) + f6tot(q) + natf6tot]\}} +$ $100/ID01[\sum\{x,AGE,\sum\{g,GENDER, C_X6PC(c,x,g)*COHORT@1(x,g,q)\}}]*$ $\sum\{x,AGE,\sum\{g,GENDER, [C_X6PC(c,x,g)*popchange(x,g,q)]\}} +$ $f_x6a(c,s,q);$

Source: Productivity Commission preliminary modelling.

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