Billion Dollar Benefit

JUNE 2024

Technical Appendix

The economic impact of unlocking the skills potential of migrants in Australia

Contents

Acknowledgement of Country

We acknowledge the Aboriginal and Torres Strait Islander peoples as the First and Traditional Custodians of the lands where we live, learn and work. We pay respect to Elders past and present and recognise their continuous connection to Country. We remain committed to reconciliation and to working with First Nations peoples to realise "Makarrata" – a Yolngu word meaning the coming together after a struggle.

About this report

This Technical Appendix is part of the Billion Dollar Benefit: "The economic impact of unlocking the skills potential of migrants in Australia report".

In an Australian-first, this research quantifies the economy-wide impact if migrant professionals worked in jobs that match their skills at a similar rate to Australian-born workers. This research was commissioned by SSI, conducted by Deloitte Access Economics, and jointly supported by SSI, Allianz Australia, Business NSW, Business Western Sydney, and LinkedIn. We also acknowledge the independent advice provided by the Committee for Economic Development of Australia (CEDA).

This report is part of the Billion Dollar Benefit, a cross-sector advocacy coalition convened by SSI to reduce employment barriers so more migrants in Australia can work in their fields of expertise and, in doing so, contribute billions to Australia's economy.

Section A.1. Overview of the approach and data sources

This report uses Computable General Equilibrium (CGE) modelling to demonstrate the economic activity which could be generated from a scenario in which a greater share of recent migrants – those already in Australia – were employed in occupations which better uses their skills.

This modelling approach involves analysing the difference in a forecast economic growth pathway under a 'base case' scenario, and a scenario where there is a change to employment outcomes for recent migrants in the economy (Figure A.1). This Appendix sets out the approach to defining that scenario, which is modelled as a 'shock' to the economy. The $70 billion in economic benefit described in this report represents the difference in economic activity between the scenario and the base case.

This analysis is developed through the steps outlined over the page, which are numbered and visually presented in Figure A.2, below.

Figure A.1: Stylised representation of the CGE modelling framework

1. The economy continues on its current trajectory, whereby migrants continue to be under-utilised.

2. The stylised representation of the employment and productivity effects of closing the skills gap are introduced to the model.

3. As a result of introducing the shock to the economy, the economy moves to a new growth trajectory.

4. The difference between the current and new growth trajectories estimates the size of the economic impact of the shock.

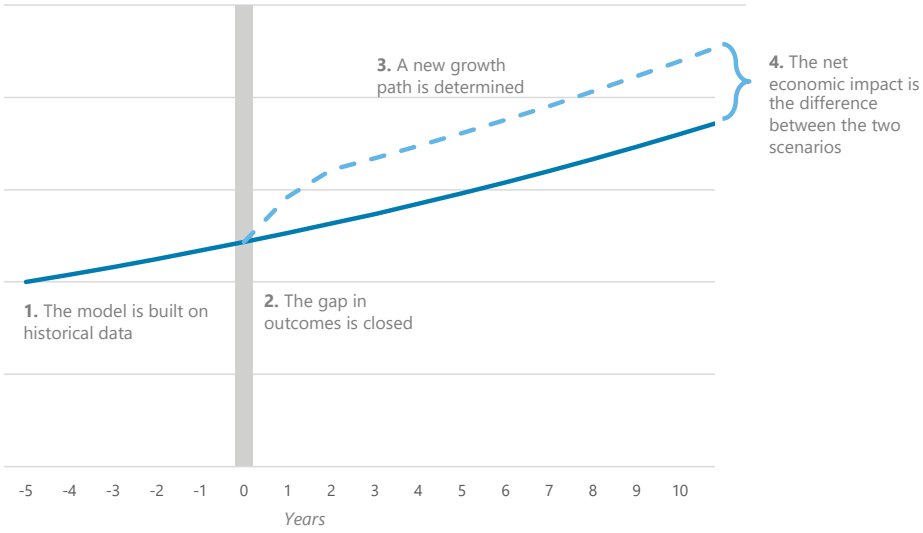
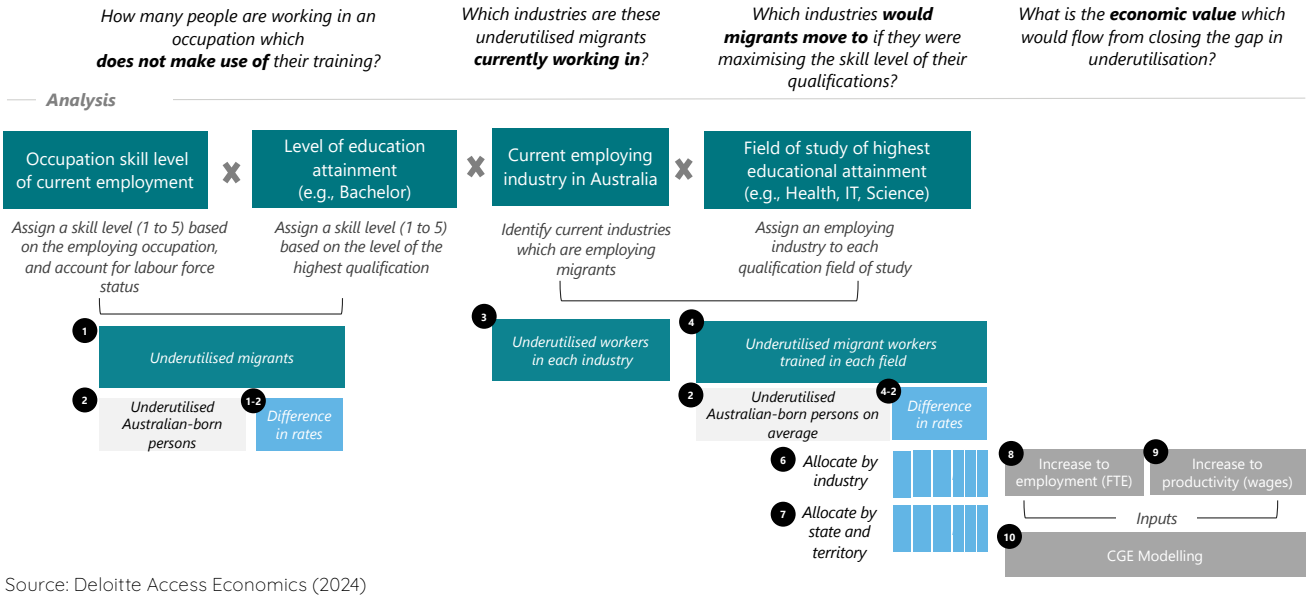


Figure A.2: Overview of the modelling approach



Source: Deloitte Access Economics (2024)

1. **Estimate the extent of qualification utilisation** among recent migrants, by comparing the difference between migrants' current occupations of employment, and their educational attainment (see Section A.2). Both occupations and educational qualifications are assigned a skill level. This analysis uses data from the Australian Census Migrant Integrated Dataset (ACMID), published by the ABS, and looks at the profile of migrants with a year of arrival from 2006 onwards (see Section A.3).
2. **Compare migrant qualification underutilisation with the rates seem among those born in Australia, to calculate the gap in recent migrants' labour market outcomes.** To recognise that there is likely to be some base level of underutilisation across the labour market separate from the migrant experience, this step estimated the *difference* between underutilisation rates for recent migrants and the Australian born population, across industries. It is the difference in utilisation by industry level that drives the CGE estimates in this report.
3. **Analyse the industries currently employing underutilised recent migrants.** Assessing the extent of underutilisation by industry informs the modelling parameters around the reallocation of workers across industries, by defining the 'base case' employment outcomes, and identifying the industries which some recent migrants may leave should their skills be better utilised.
4. **Understand the qualifications held by underutilised recent migrant workers.** The modelling assumes that as some recent migrants become employed at higher skill levels, these individuals are also likely to move to industries which are more relevant to their fields of study (for example, for an individual with a higher education qualification as a health professional to be working to their skill level, they are likely to be employed in the healthcare sector). The modelling uses recent migrants' field of study to understand the likely flow of labour to different industries based on the qualifications these individuals hold.
5. **Understand the qualifications held by underutilised Australian-born workers.** As with step 3, this analysis accounts for the *difference* between underutilisation rates for recent migrants and the Australian born population.
6. **Model the likely flows of labour across industries as underutilised migrants move up skill levels.** Many qualifications prepare workers for employment in many industries (e.g., management and commerce degrees). To incorporate this versatility of skilled labour across industries in the analysis, the number of migrants with an underutilised qualification in each field were allocated 'ideal employing industries'. This was done based on the qualification profile of utilised Australian-born workers as a benchmark benchmark (see Section A.4.3).
7. **Develop state-and territory -level estimations of labour mobility by skill level and industry**, using ABS data on employment by industry and place of usual residence to apportion national estimates.
8. **Understand the employment impacts of closing the gap in recent migrants' employment outcomes and hours worked.** This step involves converting the estimate movement by headcount of workers (Step 6) into full time equivalent (FTE) employment terms. This was done by estimating the average hours worked per week by industry for workers at different skills levels – assuming a consistent trend in hours worked by skill level over a 12-month period.
9. **Understand the employment impacts of closing the gap in recent migrants' outcomes on average wage levels across the economy.** This analysis uses ABS Census data on average weekly wages by industry for each occupational skill level to estimate the increase in wages associated with the increase in employment across skill levels and industries. Estimates account for state-level variation in wage levels. This change to the average wage across industries, by location, is used as a proxy for productivity growth.
10. **Undertaking the CGE modelling**, which considers the economic activity associated with employment levels and productivity under the 'base case' and the difference in outcomes associated with an increase in employment and wages across industries.

The analysis in this report uses data collected by the Australian Bureau of Statistics, predominately via the national census, last undertaken in 2021.

The following sections of this Appendix details components of this approach:

- Section A.2 provides more detail on how underutilisation is defined and estimated (noting there are various approaches used across the literature in different contexts).
- Section A.3 describes the approach to defining the 'recent migrant' cohort in this report and notes some variation in the recent migrant cohort in terms of labour market outcomes.
- Section A.4 describes the approach to estimating mobility across industries based on changes to employment by skill level (steps 4 to 6 in the summary above).
- Section A.5 outlines assumptions used to estimate state and territory level inputs.
- Section A.6 describes how the uplift in employment and wages associated with closing the gap in outcomes is estimated (Step 7, above)
- Section A.7 outlines the components of the scenario represented in the CGE modelling, which informs how the analysis of employment outcomes, wages and productivity (Steps 8 and 9, above) are used to estimate a change in economic activity.
- Section A.8 provides guidance on interpreting results by industry given differences in definitions across datasets.
- Section A.9 provides further detail on the Deloitte Access Economics' Regional General Equilibrium Model and its key assumptions.

Data sources

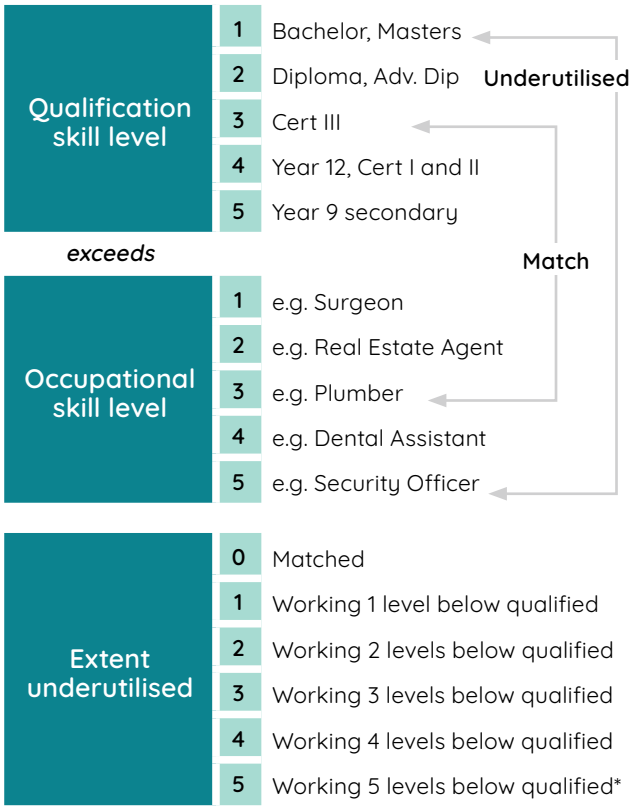
The analysis in this report uses data collected by the Australian Bureau of Statistics, predominately via the national census, last undertaken in 2021. The details on employment patterns, educational attainment levels, field of study and personal characteristics uses the ABS Australian Census Migrant-Integrated Data (ACMID), which matches census data to migrant indicators. The 2021 census data are used to understand the labour market outcomes for recent permanent migrants and in come cases, for the comparison group of Australian-born labour force participants. While some of this data are available more recently for the Australian-born cohort, the 2021 outcomes data to estimate the gap in outcomes for migrants at the same point in time.

Data on wage levels and hours worked use 2021 census data to inform assumptions – noting that the wage uplift is used as a proxy for industry level productivity, That is, the results presented in this report are in 2023 dollar terms.

Section A.2. Estimating the extent of underutilisation

In this report, **underutilisation is defined as a mismatch between a migrant's occupation skill level and their educational attainment**. That is, a migrant is underutilised when they are employed in an occupation with a lower skill level classification than their qualification.

Figure A.3: Measurement of underutilisation



* Only occurs when individuals have qualification level 5 and are unemployed.
Source: Deloitte Access Economics (2024)

The **occupational skill level** (from level 1 to 5) is a measure of the range and complexity of the tasks performed in given job. Skill levels are assigned to occupations based on the typical (1) formal qualification required (2) experience required (3) on-the-job training that is '*typically required for competent performance*' of that job. Skill level is assigned to an occupation rather than to an individual. For example, surgeon is a skill level 1 occupation, *real estate agent* is a skill level 2 occupation.

The **qualification skill level** is an individual measure which reflects the skill level associated with the highest qualification a migrant holds. Also a 1-5 measure, this spectrum varies from a Masters degree (level 1), Certificate III (level 3), or completion of secondary schooling (level 5).

The Australian Bureau of Statistics (ABS) assigns a commensurate occupation skill level to each level in the Australian Qualifications Framework (AQF) (Table A.1). That is, occupations at skill level 1 (the highest skilled jobs) are commensurate with a bachelor degree or higher qualification, and *in some instances*, 5 years' work experience may substitute for the qualification. It is important to note that international work experience is not observable at the individual level, meaning that there may be even greater underutilisation than included in the estimates because commensurate work experience is not counted. This also leads to some estimated 'overutilisation', which picks up workers who are employed above their qualification skill level, likely because they have (unobserved) equivalent work experience.

The extent of underutilisation is estimated by taking the difference in the occupation and qualification skill level. That is underutilisation occurs when **qualification level *exceeds* occupational skill level** (a positive value), while a negative outcome suggests some overutilisation or unobserved work experience. Where the difference is zero, the individual is understood to be appropriately utilised – there is a match between occupational skill level and qualification.

Underutilisation can also be understood as a time-based measure - when an individual works fewer hours than they are willing to work, due to underemployment and unemployment. While this analysis specifies underutilisation in skill-level terms, the scenario analysis accounts for an increase in hours worked among those who are moving to higher-skilled level roles and who are entering the labour market from unemployment.

The Australian labour market is dynamic. As workers upskill, reskill, make transitions across employers or industries, and navigate changes to their life circumstances, there are many reasons that workers (not only migrants) might not be employed at a skill level commensurate with their highest educational attainment. To recognise that there is likely to be some base level of underutilisation across the labour market separate from the migrant experience, comparison is made between underutilisation of migrants and others working in Australia when considering what level of underutilisation is feasible to change for migrants. This estimation repeats the steps described in above for Australian-born working age population.

Table A.1: ANZSCO skill level and commensurate qualification levels

Skill level	Commensurate qualification and/or work experience
Skill level 1	Occupations at Skill Level 1 have a level of skill commensurate with a bachelor degree or higher qualification. At least five years of relevant experience may substitute for the formal qualification. In some instances, relevant experience and/or on-the-job training may be required in addition to the formal qualification.
Skill level 2	Occupations at Skill Level 2 have a level of skill commensurate with an Associate Degree, Advanced Diploma or Diploma. At least three years of relevant experience may substitute for the formal qualifications listed above. In some instances relevant experience and/or on the job training may be required in addition to the formal qualification.
Skill level 3	Occupations at Skill Level 3 have a level of skill commensurate with a Certificate IV or Certificate III including at least two years of on-the-job training.
Skill level 4	Occupations at Skill Level 4 have a level of skill commensurate with a Certificate II or III.
Skill level 5	Occupations at Skill Level 5 have a level of skill commensurate with a Certificate I or compulsory secondary education.

Source: Australian Bureau of Statistics, Australian and New Zealand Standard Classification of Occupations, First Edition.[1]

1 Australian Bureau of Statistics, Australian and New Zealand Standard Classification of Occupations, https://www.abs.gov.au/ausstats/abs@.nsf/0/598C2E23628BB8FDCA2575DF002DA6B8?opendocument

Section A.3. Defining the migrant cohort

This report looks at the rates of underutilisation experienced by permanent visa holders in Australia who arrived in Australia (on any visa) from 2006 to 2021.

Australia's permanent migration program is highly focused on attracting skilled international talent. This report focuses on permanent residents (as opposed to all overseas born residents, or all visa holders) to understand the untapped potential of those who are settling in Australia to make a life and career. The economic opportunity associated with underutilisation of these migrants demonstrates the value for industries when skilled labour is accessible, though it also includes the economic benefits to individuals, families and communities associated with higher earnings and improved employment outcomes.

In this analysis, migrant was defined as being 'born overseas'. There are other definitions that could have been used, such as classification by source countries and / or English language proficiency which might be more tailored to the causes of differences in labour market outcomes between migrants and Australian born workers. To explore this, analysis was undertaken based on definitions of migrants that adjusted for English proficiency, to include second generation migrants, and separating out OECD and developed countries. This sensitivity analysis revealed that the extent of underutilisation experienced by migrants is fairly robust to these definitional variations. As such, the basic definition of 'born overseas' was retained.

Importantly, this work sought to understand the difference in outcomes for different migrant cohorts rather than to decompose the drivers of skills underutilisation. Academic and anecdotal evidence points to a complex picture of these drivers, including the intersection of migrant experience with differences in language background, employer and workforce networks, racial discrimination, and qualification recognition.

This report focuses on permanent residents (as opposed to all overseas born residents, or all visa holders) to understand the untapped potential of those who are settling in Australia to make a life and career.

Section A.4. Modelling mobility across skill levels and industries

To determine the impact of closing the migrant skills gap, it is necessary to understand the number of skilled individuals employed in each industry currently, and how this might change should skills and experience be better utilised through relevant employment. This analysis involves four steps:

A.4.1. Estimating underutilisation by current employing industry:

The number of migrants experiencing underutilisation is determined by comparing migrants' current occupation of employment relative to their highest educational attainment. This analysis is undertaken at an industry level, to estimate the difference between the rate of underutilisation for Australian born and migrant cohorts in each sector. This gives an indication of the industries which migrants might depart should their qualification be recognised (noting that many remain in the same industries, employed at higher skill levels).

A.4.2. Estimating the number of underutilised people holding qualifications in each field of study:

Using the same approach as defined above for industry, this analysis estimates the field of study in which underutilised migrants hold qualifications. The occupation-level information acts as a source of truth for the number of underutilised migrants – this reflects the decision to define underutilisation based on the extent to which skills are being used rather than the relevance of the qualification to the industry, given many qualifications can lead to meaningful work across disciplines.

A.4.3. Allocating underutilised labour by qualification to industry:

There is not necessarily a direct match between an individual's field of study and the employing industry which could utilise that skill. Many qualifications prepare workers for multiple industries (e.g., management and commerce degrees). To ensure incorporate this versatility of skilled labour across industries in the analysis, the number of migrants with an underutilised qualification in each field were allocated 'ideal employing industries'. This was done based on the qualification profile of utilised Australian-born workers as a benchmark. The allocation is shown in Table A.2 and should be read by columns as the share of workers with each qualification working in a given industry (e.g., 83% of people with a qualification in the education field are employed in the *education and training industry*, while the remainder are utilised across other industries). This analysis gives an indication of the industries which migrants would move to should in the event they are able to utilise their qualifications, which may not directly align to their field of study.

Table A.2: Matching qualified profession to industry

Employing industry	Qualifications held by Australian workers										
	Agriculture, Environmental and Related Studies	Architecture and Building	Creative Arts	Education	Engineering and Related Technologies	Food, Hospitality and Personal Services	Health	Information Technology	Management and Commerce	Natural and Physical Sciences	Society and Culture
Accommodation and Food Services	2%	1%	2%	0%	1%	29%	0%	1%	3%	1%	1%
Administrative and Support Services	6%	1%	2%	1%	1%	2%	1%	2%	4%	1%	2%
Agriculture, Forestry and Fishing	27%	1%	1%	1%	2%	1%	1%	0%	1%	2%	1%
Arts and Recreation Services	5%	0%	8%	1%	1%	2%	0%	1%	1%	1%	2%
Construction	11%	69%	2%	1%	19%	4%	1%	2%	5%	1%	2%
Education and Training	6%	1%	16%	83%	2%	3%	4%	7%	6%	21%	13%
Electricity, Gas, Water and Waste Services	2%	1%	1%	0%	4%	0%	0%	2%	2%	1%	1%
Financial and Insurance Services	1%	0%	3%	1%	2%	2%	1%	12%	13%	4%	4%
Health Care and Social Assistance	3%	1%	4%	6%	1%	7%	79%	4%	8%	15%	24%
Information Media and Telecommunications	0%	0%	12%	0%	2%	1%	0%	6%	2%	1%	2%
Manufacturing	4%	4%	5%	1%	15%	6%	1%	3%	5%	8%	1%
Mining	2%	1%	0%	0%	8%	1%	0%	1%	2%	5%	1%
Professional, Scientific and Technical Services	9%	11%	21%	1%	13%	2%	4%	39%	20%	21%	19%
Public Administration and Safety	14%	5%	7%	3%	6%	3%	3%	9%	9%	10%	19%
Rental, Hiring and Real Estate Services	1%	1%	1%	0%	1%	1%	0%	1%	4%	0%	1%
Retail Trade	2%	1%	7%	1%	3%	10%	3%	4%	5%	2%	2%
Transport, Postal and Warehousing	1%	1%	1%	0%	5%	2%	0%	2%	3%	1%	1%
Wholesale Trade	3%	1%	2%	0%	4%	2%	1%	3%	4%	3%	1%
Other Services	2%	1%	2%	1%	10%	24%	1%	1%	2%	1%	4%

Section A.5. Estimating employment level by state and territory

The CGE modelling demonstrates the economic impact of an increase in available skilled labour across industries – which is a mechanism to boost productivity across industries. The modelling of underutilisation by skill level and field of study is undertaken at a national level. The share of additional labour that will become employed in each industry is estimated based on the size of each industry in each state. That is, the increase in the number of skilled migrants transitioning to higher-skilled employment in the mining industry is apportioned across states and territories based on the current share of national mining employment in each jurisdiction.

By allocating future skilled employment by industry size, rather than at the industry size by skill level, the modelling scenario assumes that industries in some states will absorb a greater share of highly skilled labour (that is, those industries will become more productive). The modelling by state is sensitive to this assumption – that is, if the allocation of labour takes employment by industry and skill level, a greater share of the benefit is felt by states with higher-skilled labour. The choice of allocation method also makes some implicit assumptions about labour mobility – that is, the approach assumes fewer migrants relocate to industries in other states and territories to use their qualifications. This approach reflects the relatively low rate of geographic mobility in skilled migrant labour – partly reflecting the restrictions associated with some state-sponsored visas.

Section A.6. Quantifying the uplift in employment and wages associated with underutilisation

The analysis of migrant skill underutilisation is estimated based on individuals' qualifications and occupations of employment. Converting these outcomes to a productivity uplift involved understanding the implications for individuals' hours worked in each industry and their relative wages at each skill level.

A.6.1. Estimating the uplift in total employment

To estimate the economic impact of these individual workers being employed in more relevant industries, headcount were converted to full time equivalent employment rates. Analysis of average weekly hours of employment by skill level show a correlation between qualification underutilisation and time based underutilisation. That is, the higher the skill level, the more hours an individual is likely to be employed – an individual employed at skill level 5 works 29 hours a week on average (0.8 FTE) while an individual at skill level 1 works 37 hours a week, on average (1 FTE). In allocating skilled labour across industries, the modelling also applied an increase in the hours worked, using a ratio of headcount to full time equivalent (FTE) hours.

A.6.2. Estimating growth in wages by industry

To estimate the productivity impact of workers moving to occupations and industries which better utilise their skills, this analysis uses wages to infer the productivity uplift across sectors. This analysis uses data on average weekly wages by occupational skill level (by industry) to estimate the increase in wages associated with these transitions. The average uplift by skill level across industries is presented in Table A.3 for reference. The greater the extent of underutilisation (the difference in employed skill level before and after matching), the greater the wage and productivity benefit for migrants across industries. To estimate state-level wage results, the modelling uses the relative wage levels by skill level and industries.

Table A.3: Average wage by skill level and indicative uplift

Occupational skill level (OSCKP)	**Average annual wage**		
	Average Wage	Uplift relative to prior skill level	Wage as a share of skill level 5
Skill level 1	$95,600	$15,100	195%
Skill level 2	$80,500	$14,700	164%
Skill level 3	$65,800	$6,000	134%
Skill level 4	$59,800	$10,900	122%
Skill level 5	$49,000	$49,000	100%
Unemployed	$0	-	-

Source: Deloitte Access Economics using Australian Census Migrant-Integrated Data (ACMID) and Australian Census of Population and Housing (2021).

Section A.7. Approach to scenario design

This report uses Computable General Equilibrium (CGE) modelling to demonstrate the economic activity which could be generated from a scenario in which a greater share of recent migrants – those already in Australia – were employed in occupations which better uses their skills. This modelling approach involves analysing the difference in a forecast economic growth pathway under a 'base case' scenario, and a scenario where there is a change to employment outcomes for recent migrants in the economy.

The CGE modelling simulates a scenario in which the 146,700 underutilised migrants transition to employment at a skill level commensurate with their skill levels. This scenario assumes that all 146,700 recent migrants that are underutilised transition to suitable jobs in 2024, and that over the next ten years modelled, employment across industries adjusts to account for changes to productivity and skills demand. That is, the modelling captures how closing the gap in migrant skills underutilisation generates a lasting impact on Australia's economic growth trajectory.

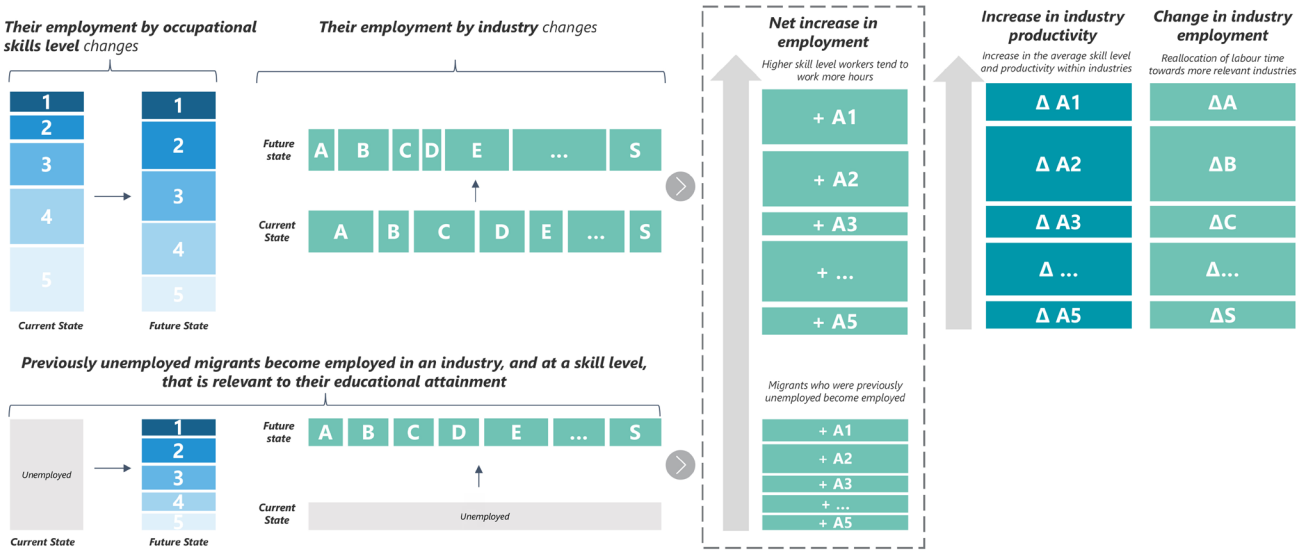
The mechanism for modelling this scenario is threefold. A better match between employment outcomes and skills would result in:

1. **A net increase in employment**, reflecting that more utilised workers also work more hours, and that a previously unemployed group of migrants would become employed at their skill level.
2. **An increase in industry productivity** reflecting that skilled migrants would be working to their qualified potential in relevant industries.
3. **A change in industry employment** reflecting the reallocation of skilled migrant labour towards more relevant industries as those skills are utilised.

These outcomes are illustrated in Figure A.3.

The economic impact demonstrated in the CGE modelling results from an allocation of the migrant labour underutilised at a rate above that seen in the Australian born population Charts A.1, A.2 and A.3 demonstrate how the employment patterns of those 146,700 underutilised migrants change as a result of the modelled scenario – noting that in practice, the modelling is undertaken at an industry level and is best understood as driving a 'productivity shock' across key industries. In the modelled scenario, the equivalent of 21,230 employees (FTEs) join the economy due to the impact of 6,000 migrants becoming utilised from unemployment and 140,000 employed migrants working more hours as they move into higher-skilled occupations.

Figure A.4: The key impacts on employed people who move to employment which is relevant to their skill level



A.7.1. A net increase in employment

There are two drivers of change to migrant employment which have been estimated to occur as a result of closing the gap between the underutilisation of migrants and Australian-born workers:

- Recent permanent migrants face a higher rate of unemployment than Australian-born labour force participant. This analysis assumes that closing the migrant skills underutilisation gap will also close the gap in the unemployment rate.
- For those recent permanent migrants already in employment, it is found that moving to a job at a higher occupational skill level is associated with increased hours of work – thus increasing FTE across the economy

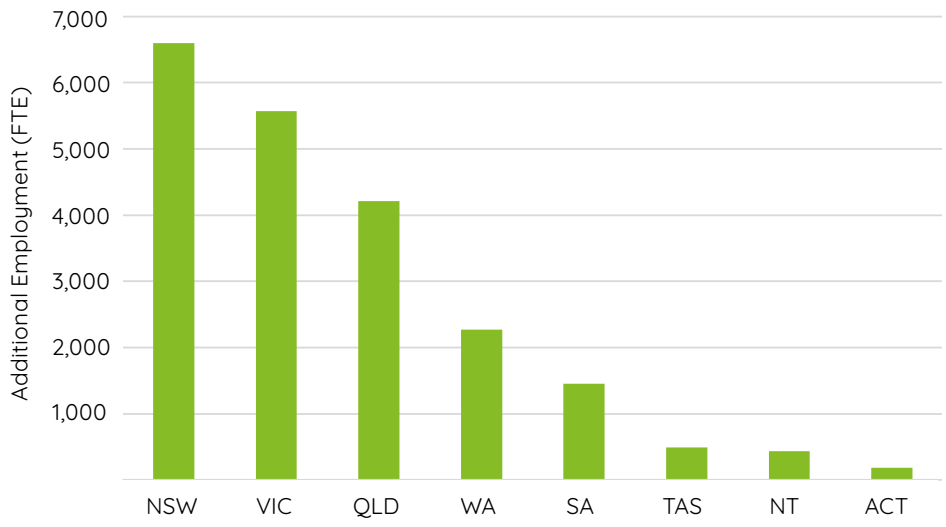
A.7.2. Changes to industry employment

In the modelled scenario, migrants move into jobs which matches their qualifications. For many migrants, moving to a job more suitable to their qualifications is often reflected in a move to a job in another industry (as shown in Chart A.2).

A.7.3. Changes to industry productivity

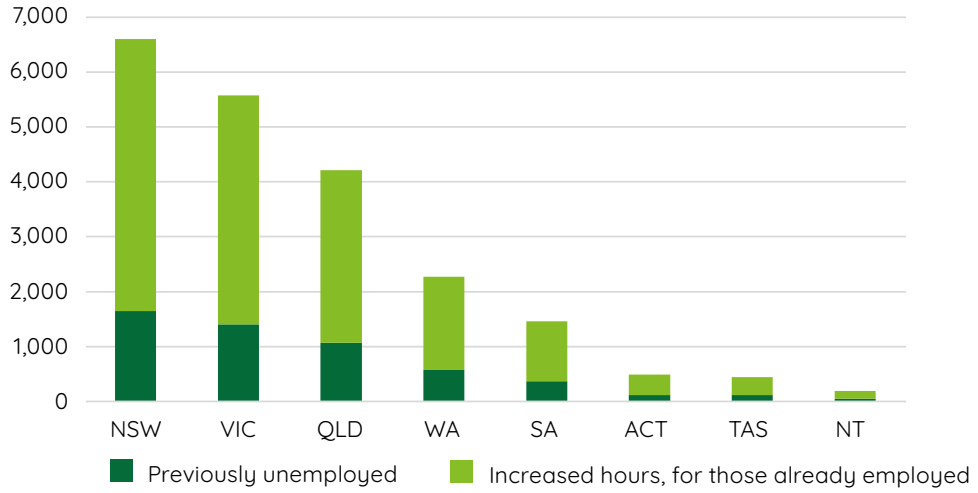
The modelled scenario sees many migrants moving to jobs with higher occupational skills— whether in a new industry, or reflective of a more suitable, higher skilled, role in their current sector of employment. The average productivity increased by industry are shown in Chart A.3, noting that in practice, the uplift was modelled at an industry by state/territory level.

Chart A.1: Net increase in employment (FTE) in the modelled scenario



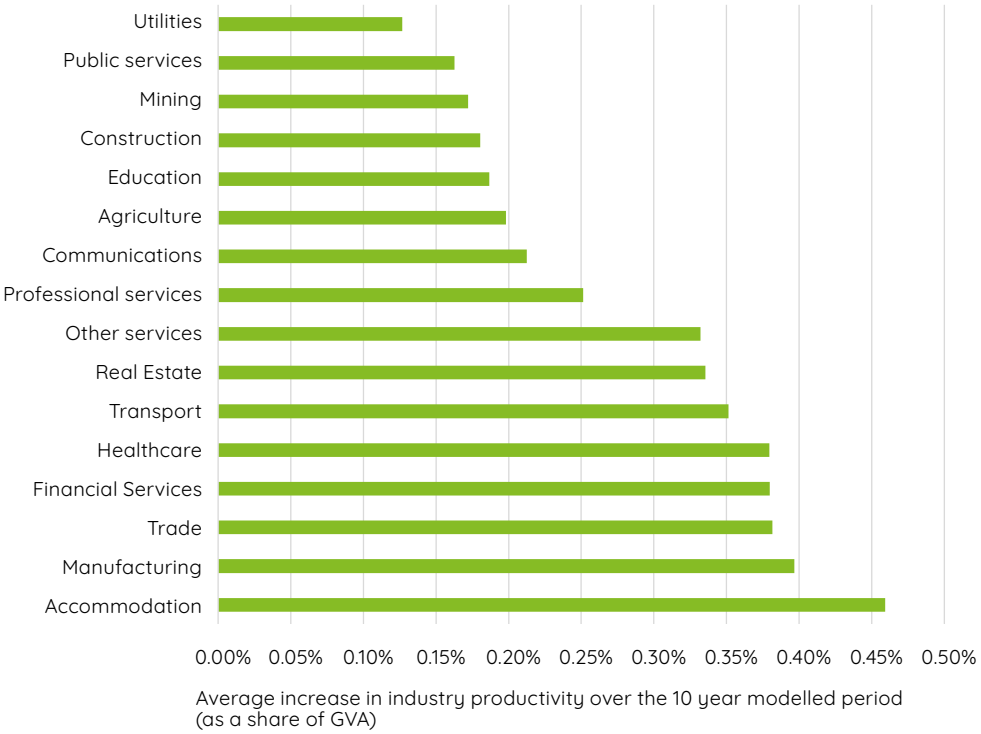
Source: Deloitte Access Economics using Australian Census Migrants Integrated Dataset (ACMID), 2021.

Chart A.2: Changes to employment levels across industries



Source: Deloitte Access Economics using Australian Census Migrants Integrated Dataset (ACMID), 2021.

Chart A.3: Changes to industry productivity



Source: Deloitte Access Economics using Australian Census Migrants Integrated Dataset (ACMID), 2021.

Section A.8. Interpreting industry level results

CGE modelling utilises sector structures and databases from the Global Trade Analysis Project (GTAP). For this analysis, the underlying database has utilised a GTAP sector aggregation to align as closely to Australia and New Zealand Industry classification. This concordance is set out below.

Table A.4: GTAP sector aggregation used in this analysis

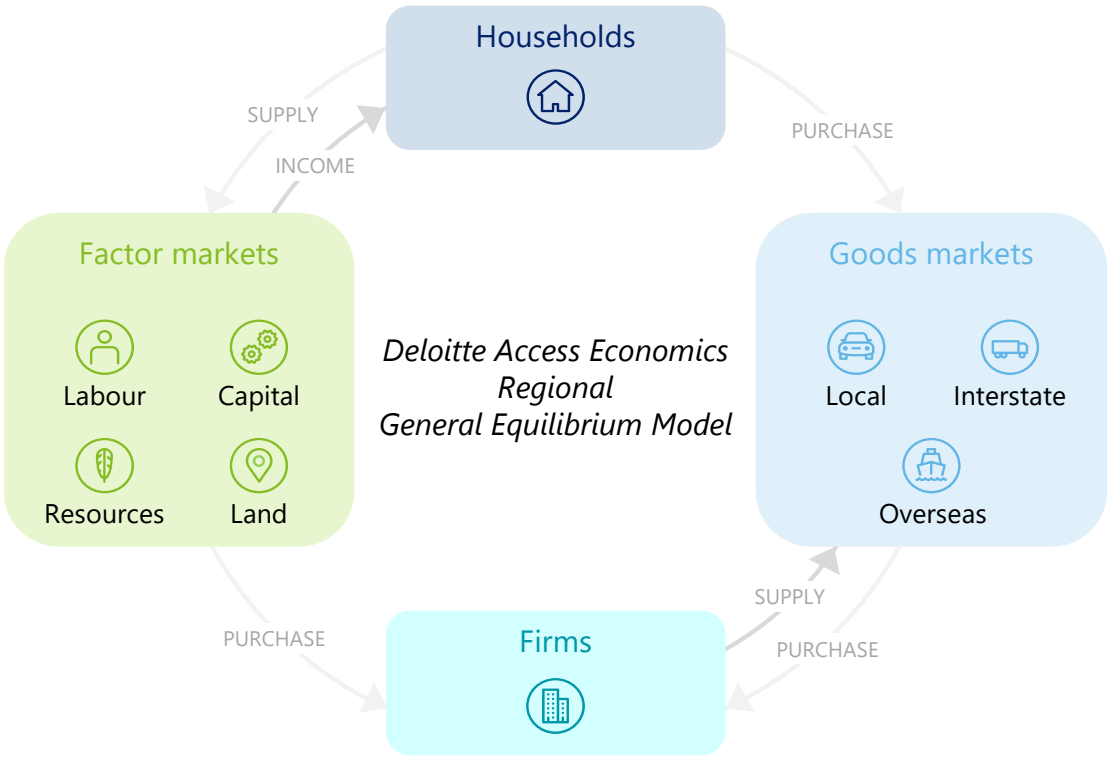
ANZIC Division	Results Category
Agriculture, forestry and fishing	Agriculture
Mining	Mining
Manufacturing	Manufacturing
Electricity, gas, water and waste services	Utilities
Construction	Construction
Wholesale trade	Trade
Retail trade	
Accommodation and food services	Accommodation
Transport, postal and warehousing	Transport
Information, media and telecommunications	Communications
Financial and insurance services	Financial services
Rental, hiring and real estate services	Real estate
Professional, scientific and technical services	Professional services
Administrative and support services	
Public administration and safety	Public services
Education and training	Education
Health care and social assistance	Healthcare
Arts and recreation services	Other services
Other services	

Section A.9. Application of the Deloitte Access Economics' Regional General Equilibrium Model

The Deloitte Access Economics' Regional General Equilibrium Model (DAE RGEM) is a large scale, dynamic, multi-region, multi-commodity CGE model of the world economy with bottom-up modelling of Australian regions. DAE-RGEM encompasses all economic activity in an economy – including production, consumption, employment, taxes and trade – and the inter-linkages between them. For this project, the model has captured the broader economic impacts of an increase in effective labour supply in Australia. At the sectoral level, detailed results such as economic activity employment, sectoral output by industry are also produced.

Figure A.5 gives a stylised representation of DAE-RGEM, specifically a system of interconnected markets with appropriate specifications of demand, supply and the market clearing conditions determine the equilibrium prices and quantity produced, consumed and traded.

Figure A.5: The components of DAE-RGEM and their relationships



Source: Deloitte Access Economics (2024).

The model rests on the following key assumptions:

- All markets are competitive, and all agents are price takers
- All markets clear, regardless of the size of the shock, within the year.
- It takes one year to build the capital stock from investment and investors take future prices to be the same as present ones as they cannot see the future perfectly
- Supply of land and skills are exogenous. In the business as usual case, supply of natural resource adjusts to keep its price unchanged; productivity of land adjusts to keep the land rental constant at the base year level.
- All factors sluggishly move across sectors. Land moves within agricultural sectors; natural resource is specific to the resource using sector. Labour and capital move imperfectly across sectors in response to the differences in factor returns. Inter-sectoral factor movement is controlled by overall return maximizing behaviour subject to a CET function. By raising the size of the elasticity of transformation to a large number we can mimic the perfect mobility of a factor across sectors and by setting the number close to zero we can make the factor sector specific. This formulation allows the model to acknowledge the sector specificity of part of the capital stock used by each sector and also the sector specific skills acquired by labour while remaining in the industry for a long time. Any movement of such labour to another sector will mean a reduction in the efficiency of labour as a part of the skills embodied that will not be used in the new industry of employment.

DAE-RGEM is based on a substantial body of accepted microeconomic theory. Key features of the model are:

- The model contains a 'regional household' that receives all income from factor ownerships (labour, capital, land and natural resources), tax revenues and net income from foreign asset holdings. In other words, the regional household receives the gross national income (GNI) as its income.
- The regional household allocates its income across private consumption, government consumption and savings so as to maximise a Cobb-Douglas utility function. This optimisation process determines national savings, private and government consumption expenditure levels.
- Given the budget levels, household demand for a source-generic composite goods are determined by minimising a CDE (Constant Differences of Elasticities) expenditure function. For most regions, households can source consumption goods only from domestic and foreign sources. In the Australian regions, however, households can also source goods from interstate. In all cases, the choice of sources of each commodity is determined by minimising the cost using a CRESH (Constant Ratios of Elasticities Substitution, Homothetic) utility function defined over the sources of the commodity (using the Armington assumption).
- Government demand for source-generic composite goods, and goods from different sources (domestic, imported and interstate), is determined by maximising utility via Cobb-Douglas utility functions in two stages.
- All savings generated in each region are used to purchase bonds from the global market whose price movements reflect movements in the price of creating capital across all regions.
- Financial investments across the world follow higher rates of return with some allowance for country specific risk differences, captured by the differences in rates of return in the base year data. A conceptual global financial market (or a global bank) facilitates the sale of the bond and finance investments in all countries/regions. The global saving-investment market is cleared by a flexible interest rate.
- Once aggregate investment level is determined in each region, the demand for the capital good is met by a dedicated regional capital goods sector that constructs capital goods by combining intermediate inputs in fixed proportions, and minimises costs by choosing between domestic, imported, and interstate sources for these intermediate inputs subject to a CRESH aggregation function.
- Producers supply goods by combining aggregate intermediate inputs and primary factors in fixed proportions (the Leontief assumption). Source-generic composite intermediate inputs are also combined in fixed proportions (or with a very small elasticity of substitution under a CES function), whereas individual primary factors are chosen to minimise the total primary factor input costs subject to a CES (production) aggregating function.