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**DIAC-TERM: A Multi-regional Model
of the Australian Economy
with Migration Detail**

by

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General Paper No. G-238 July 2012

ISSN 1 031 9034

ISBN 978 1 921654 46 6

The Centre of Policy Studies (COPS) is a research centre at Monash University devoted to economy-wide modelling of economic policy issues.

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JEL classification: C68, D58, R13, F22

Key words: CGE modelling, dynamics, regional economics, migration, labour economics

Acknowledgements

The research described in this paper was undertaken by the Centre of Policy Studies (CoPS) at Monash University, Melbourne, Australia for the Department of Immigration and Citizenship (DIAC) in 2012. We thank Professor Mark Horridge and Dr. Michael Jerie for providing valuable assistance in resolving data processing and computing issues. We thank Dr George Verikios for advice on model design. We thank members of the Migration Forecasting, Modelling and Analysis Division, Department of Immigration and Citizenship, particularly Karen McGuigan, Kasipillai Kandiah, and Fleur Butt for providing us with important migration data, advice on the nature of immigration programs, and advice on simulation design.

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1 INTRODUCTION

The DIAC-TERM model is a dynamic multi-regional computable general equilibrium (CGE) model of Australia with special emphasis on labour market detail relevant to the analysis of Australia's Net Overseas Migration (NOM) program. The model distinguishes 15 regions (the ACT and the capital cities and balance of the remaining states and territories), 36 industries, 8 occupations, 9 visa categories, and 7 ten-year working age groups. In essence, DIAC-TERM is an integration of two models: the multi-regional computable general equilibrium (CGE) model TERM (Horridge 2011) and a labour supply model with immigration detail. In the sections below we briefly describe the characteristics of the model and key results from the illustrative model applications. More detailed discussions of the model's theory, database construction and applications are included in Sections 2 -6 of the paper.

1.1 The TERM model

The starting point for the development of the DIAC-TERM model is TERM, a dynamic bottom-up multi-regional CGE model. A defining feature of TERM is its compact data structure, which allows it to distinguish many sectors and regions while being quickly solved on a high-end personal computer. TERM's computational efficiency, relative to some other detailed bottom-up multi-regional CGE models, like MMRF¹, arises from a number of simplifying assumptions that greatly reduce the size of the model while sacrificing little in terms of the model's usefulness for applied policy work. For example, TERM assumes that all users in a particular region of a particular commodity source their purchases of that commodity from other regions according to common proportions. The data structure is the key to TERM's strengths. It allows the same detailed bottom-up multiregional treatment of economic agents employed in other large-scale regional CGE models to be included in a model with many more regions.

TERM explicitly captures the behaviour of industries, households, investors, government and exporters at the regional level. The theoretical structure of TERM follows the familiar neoclassical pattern common to many applied general equilibrium models. Producers in each region are assumed to minimize production costs subject to a production technology that allows substitution between primary factors (labour, capital and land) and between geographical sources of supply for specific intermediate inputs. An effective input of labour to each regional industry is defined over labour distinguished by occupation. A representative household in each region purchases goods in order to obtain the optimal bundle in accordance with its preferences and disposable income. Investors seek to

¹ The Monash Multi-Regional Forecasting model of the Australian economy, documented in Adams et al. (2010).

maximize their rate of return, while demand by foreigners is modelled via export demand functions that capture the responsiveness of foreigners to changes in export supply prices. TERM's theoretical and data structures are well documented elsewhere, and so we do not expand further on the structure of TERM in this report. For documentation of TERM, we refer the reader to Horridge (2011).

1.2 The labour supply model

The DIAC-TERM model expands on TERM's theoretical structure by developing the supply side of the labour market. In essence, DIAC-TERM's labour market theory imposes a stock/flow dynamic on highly disaggregated labour market groups. These groups are defined by relevant labour market characteristics, such as occupation, region and age. Start-of-year stocks of persons thus classified are based on labour market activities undertaken in the previous year, after taking account of relevant exogenous transitions between labour market categories, such as the gradual transition from younger age categories to older age categories. Having determined start-of-year stocks of persons in each category, labour supplies to various labour market activities in the current year are guided by movements in relative wage rates across those activities. Full details of the labour market theory are provided in Section 2.

1.3 The DIAC-TERM model

A simple way of understanding the DIAC-TERM model is to view the model's TERM component as largely determining labour demand by occupation and region, and view the model's labour supply component as largely determining labour supply by occupation and region. The two components are linked within DIAC-TERM by markets for occupation- and region-specific labour. These labour markets are defined over eight occupations² and fifteen regions³.

Labour supply to the occupation- and region-specific labour markets is defined over categories distinguished by age, qualification, visa status, previous occupation, and previous region.⁴ Movements into these categories are in part determined by new entrants (whether domestic or foreign) and in part determined by last year's labour market activities, mediated by exogenous rates of transition between age categories and visa types. In terms of potential shocks to policy variables of interest to DIAC, the model's labour supply side offers the possibility of investigating alternative net overseas migration scenarios by altering the exogenous paths of variables describing either foreign new entrants, or the rates of

² Managers, Professional, Technicians and trades workers, Community and personal service workers, Clerical and administrative workers, Sales workers, Machinery operators and drivers, and Labourers.

³ Sydney, Melbourne, Brisbane, Perth, Adelaide, Hobart, Darwin, Australian Capital Territory, Balance of New South Wales, Balance of Victoria, Balance of Queensland, Balance of South Australia, Balance of Western Australia, Balance of Tasmania, Balance of Northern Territory.

⁴ See the listing of these categories in Section 2.1.2

transition between alternative visa categories. In Sections 4 – 6 of this report, we discuss three simulations with the model of this nature.

Labour demand for each of the occupation- and region-specific labour markets is defined over region-specific industries⁵. In terms of potential shocks to variables of interest to DIAC, the model's demand side offers the possibility of exploring alternative scenarios relating to: occupational bias in labour-saving technical change; factor-specific bias in primary factor technical change; commodity-specific movements in industry-specific productivity; household tastes; the country's external trading environment expressed in terms of movements in foreign currency import and export prices; indirect tax rates; government consumption spending; investor confidence; and, household savings rates.

1.4 Illustrative applications

Sections 4 – 6 report three illustrative simulations. The first examines a once-off 10% increase in the intake of the long-term temporary business visa subclass 457 in 2012/13. The second simulation is a permanent increase from 2012/13 onwards of permanent skilled visas by 10% both via an increase in gross NOM arrivals and via an increase in the transition into the skilled visa class from other visa categories. The third simulation is a permanent increase in gross NOM arrivals of all visa categories (excluding New Zealanders) from 2012/13 onwards.⁶

The remainder of this report is structured as follows. Section 2 explains in detail the theory of the labour market supply module of DIAC-TERM. Section 3 discusses data sources and the process of compilation of the database for the labour supply module of the DIAC-TERM model. Sections 4-6 discuss the illustrative applications of the model for the analysis of changes in Australia's Net Overseas Migration policy.

⁵ The current version of the model identifies thirty six industries: 1. Agriculture, forestry and fishing; 2. Coal mining; 3. Oil and gas mining; 4. Metal ores mining; 5. Other mining; 6. Mining services; 7. Food, beverages and tobacco; 8. Textiles, clothing and footwear; 9. Wood and paper products; 10. Print and recording media; 11. Petroleum and coal products; 12. Chemical, rubber and plastic products; 13. Non-metallic mineral products; 14. Metal products manufacturing; 15. Transport equipment manufacturing; 16. Machinery and equipment manufacturing; 17. Furniture and other manufacturing; 18. Utilities; 19. Residential building; 20. Other construction; 21. Wholesale trade; 22. Retail trade; 23. Accommodation and restaurants; 24. Transport and storage; 25. Communications; 26. Finance and insurance; 27. Dwelling services; 28. Property services; 29. Professional and technical services; 30. Other business services; 31. Government administration and defence; 32. Education; 33. Medical services; 34. Community services; 35. Cultural and recreational services; 36. Other services.

⁶ For information about different visa programs in Australia, see the website of the Department of Immigration and Citizenship at www.immi.gov.au.

2 THEORY OF THE LABOUR MARKET MODULE

2.1 KEY CONCEPTS

This section defines the key concepts underpinning the modelling of the labour market in DIAC-TERM. These definitions will prove helpful in the setting out of the labour market theory in Section 2.2.

2.1.1 Working age population

The working age population (WAP) includes all persons 15 and older residing in Australia. The WAP is divided into groups based on common characteristics such as labour market activities, region, visa status, skill and age. These characteristics are listed in Section 2.1.2.

2.1.2 Characteristics of the working age population

The WAP is defined according to the following characteristics:

Labour market function	(1) Managers; (2) Professionals; (3) Technicians and Trades Workers; (4) Community and Personal Service Workers; (5) Clerical and Administrative Workers; (6) Sales Workers; (7) Machinery Operators and Drivers; (8) Labourers; (9) Short-run unemployment; (10) Long-run unemployment; (11) Not in the labour force; (12) Overseas.
Region	15 Domestic regions (The ACT plus 7 capital cities and 7 balance of the remaining 7 Australian states and territories); 1 Foreign region (Overseas).
Visa status	(1) Citizen; (2) Skilled; (3) Family; (4) Humanitarian; (5) Other permanent visas; (6) Student; (7) Long-stay business visa 457; (8) Other temporary visas; and (9) New Zealanders.
Skill	One skill element, which is a combination of: (1) University; (2) Certificates and Diploma, and (3) No post-school qualification.
Age	(1) 15-24; (2) 25-34; (3) 35-44; (4) 45-54; (5) 55-64; (6) 65-74; (7) 75 +.

2.1.3 Categories

People are assigned to “categories” at the start of year t . These categories are based on common characteristics, namely: visa status, skill, age, and labour-market activity performed in a domestic region during year $t - 1$. The five labour market categories are:

- employment in occupation o in region r , where o is one of the 8 occupations and r is one of 15 domestic regions;
- short-run unemployed (S) in region r , that is unemployed in year $t - 1$ but employed in year $t - 2$;
- long-run unemployed (L) in region r , that is unemployed in both year $t - 1$ and $t - 2$;
- “not in the labour force” (NILF) in region r , that is people not part of any employment or unemployment activity in year $t - 1$ or $t - 2$; and
- new entrants (N) into the WAP. The new entrant category is not based on any activity performed in year $t - 1$. This category is added exogenously at the start of year t . See Section 2.1.5 for a description of new entrants.

2.1.4 Activities

We begin by noting that the description of the activities and categories matrices is quite similar. Both matrices are defined by labour-market function, region, visa status, skill and age. There are three main differences between the two matrices. First, the matrices relate to different points in time. The *activities* matrix relates to what a person is doing *during* year t , while the *categories* matrix is defined at the *start* of year t on the basis of the previous year’s activities. An adult’s activity during the year depends in part on the category into which they were grouped at the start of year t . Second, it is helpful to view new entrants (N) as an additional category that is added exogenously at the start of each year. The activities matrix does not include new entrants as an activity. Rather, new entrants perform a specific activity (such as being employed as a manager) during their year of entry into the WAP. Third, we include an “overseas” (OS) activity and region to facilitate modelling of gross emigration. In each year of the simulation, we allow people in each category the possibility of a move to the activity “overseas” (OS) taking place in the region “overseas” (OS).

The main activities undertaken during year t are:

- employment in occupation o in domestic region r , where o is one of the 8 occupations and r is one of 15 domestic regions;
- short-run unemployed (S) in domestic region r , that is employed in year $t - 1$ but unemployed in year t ;
- long-run unemployed (L) in domestic region r , that is unemployed in both year $t - 1$ and t ,

- “not in the labour force” (NILF) in domestic region r , and
- moving overseas (that is, moving to activity OS in region OS).

2.1.5 New entrant

“New entrants” are defined as a category at the start of year t . There are two sources that constitute new entrants in the labour supply model. First, new entrants refer to people who are already in Australia and turn 15. These people appear in the age group 15-24. They may hold any visa status. Second, new entrants can include those who are entering Australia from overseas, that is, foreigners or returning citizens who enter Australia at the start of year t . New foreign arrivals may fall into any age group and visa status.

2.1.6 Flows from categories to activities

Once categories have been specified, the people within these categories supply labour to an activity during year t . These supplies are based on category-specific solutions to utility maximisation problems. The flows from categories to activities are sensitive to changes in both occupation-and-region-specific relative wages and personal preferences. While the theory allows for the possibility of a change in labour market activity, most people choose to remain in the same activity in the same region as performed during the previous year. A comparatively small proportion of people will move to a different occupation and region, or move to the unemployment activity in region r , or choose not to be in the labour force in region r , or go overseas. The construction of these flows is based on ABS’s labour mobility and regional mobility data, which are described in Section 3.

2.2 THE FUNCTIONING OF THE LABOUR-MARKET SPECIFICATION

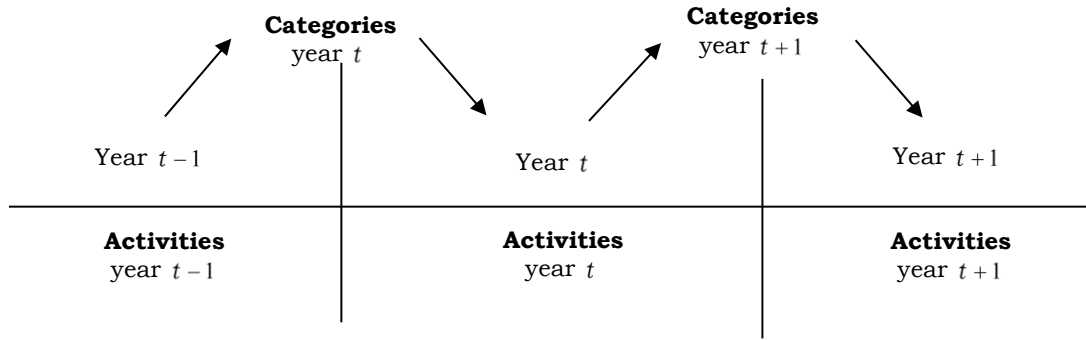
The following key ingredients are specified in the labour-supply model:

- Assignment of the WAP to categories at the start of each year. We define equations linking the number of people in activity a in year $t-1$ to the number of people in category c at the start of year t .
- Identification of workforce activities in all domestic regions during the year.
- Determination of the supply of labour by each category c to each activity a in region r .
- Determination of the demand for labour for each employment activity a in region r .

At the start of year t , people are divided into categories based on common characteristics. These characteristics are visa status, skill, age and labour-market activity performed in a region during year $t-1$. People in categories make labour supplies to activities in different regions. In Figure 2.1, this flow is illustrated by the downward sloping arrow between categories and activities. At the end of year t , people still part of the WAP progress one year

in age and may change their visa status. Some people leave the WAP due to death. This transition is illustrated by the upward sloping arrow in Figure 2.1. After this transition, people are again grouped into categories, based on common characteristics. The process of labour supply from a category to an activity is then repeated. Figure 2.1 abstracts from a large number of labour market flows. This detail is expanded upon in Figure 2.2.

Figure 2.1. Movement of labour-supply from year $t - 1$ to year t



Source: Adapted from Dixon and Rimmer, 2008

2.3 DETERMINING CATEGORIES AT THE START OF YEAR t

(Figure 2.2; flow t)

At the beginning of each year, we allocate people in the WAP to categories according to their recent labour-market activity, region, visa status, skill and age. Every year we allow a small proportion of people to leave the WAP through death. This is implicit in flow (t) in Figure 2.2, in the sense that not every member of the WAP survives into year $t + 1$. Those who do survive are assumed to progress one year in age. Since our age groups comprise ten year spans, this is implemented by moving one tenth of each age group into the higher age category. We also allow people to change their visa status. For example, a person who survives from year $t - 1$ to year t may change their visa status from “Skilled” in year $t - 1$ to “Citizen” in year t . The alternative to this change is to either remain with a “Skilled” visa status, or change to some other visa status to which “Skilled” visa holders are eligible to move. See Section 3.4.4 for our discussion of the initial settings for the transition matrix describing all possible age and visa transitions. A person’s recent labour-market activity refers to what a person did as an activity in year $t - 1$. The activities are specified in Section 2.1.4 and illustrated in Figure 2.2.

Categories at the start of the year are specified in (E2.1):

$$CAT_{(o,r,v,s,a)} = \sum_{vv \in VISA} \sum_{aa \in AGE} ACT_{-L_{(o,rr,v,s,aa)}} * T_{(vv,aa,v,a)} \quad (E2.1)$$

$o \in EUF$; ⁷ $r \in REG$; $v \in VISA$; $s \in SKILL$ and $a \in AGE$.

New entrants, described in Figure 2.2 by flow (u), are determined exogenously:

$$CAT_{(N,r,v,s,a)} = \text{exogenous} \quad (E2.2)$$

$r \in REG$; $v \in VISA$; $s \in SKILL$ and $a \in AGE$.

- where
- $CAT_{(o,r,v,s,a)}$ is the level of the number of people in category o,r with skill s allocated to visa status v and age a at the start of year t ;
 - $ACT_L_{(o,r,vv,s,aa)}$ is the level of the number of people who performed activity o in region r during year $t-1$, given their visa vv , skill s and age aa ;
 - $T_{(vv,aa,v,a)}$ is the proportion of people who were in age aa with visa status vv in year $t-1$, who are allocated to visa status v and age a at the start of year t . The T matrix is uniform across all activities o , region r and skill s . We do not allow people to change their activity, region and skill from the previous year. Only visa status and age can change; and
 - $CAT_{(N,r,v,s,a)}$ is the level of the number of new entrants at the start of year t by region r , visa status v , skill s and age a . New entrants are exogenously added at the start of year t .

The percentage-change form of Equation (E2.1) is:

$$CAT_{(o,r,v,s,a)}^* cat_{(o,r,v,s,a)} = \sum_{vv \in VISA} \sum_{aa \in AGE} \left\{ ACT_L_{(o,r,vv,s,aa)}^* \right. \\ \left. \left(T_{(vv,aa,v,a)}^* act_l_{(o,r,vv,s,aa)} + 100 * d_transit_{(vv,aa,v,a)} \right) \right\} \quad (E2.3)$$

$o \in EUF$; $r \in REG$; $v \in VISA$; $s \in SKILL$ and $a \in AGE$.

- where
- $cat_{(o,r,v,s,a)}$ is the percentage change in the number of people in each category o,r for all visa status v , skill s and age a ;
 - $act_l_{(o,r,vv,s,aa)}$ is the percentage change in the number of people in activity o performed in year $t-1$, in all regions r , for all visa status vv , skill and age aa ; and,
 - $d_transit_{(vv,aa,v,a)}$ is the ordinary change in the transition rate allowing people to change their visa status from vv to v and age from aa to a between years $t-1$

⁷ $EU F$ is the set of all employment, short and long-run unemployment and “not in the labour force” categories.

and t .

2.4 LABOUR SUPPLY FROM CATEGORIES TO ACTIVITIES

Utility maximisation problem

Following Dixon and Rimmer (2008), we assume that people in category c, rr choose their labour supplies across activities a, r by solving a utility maximisation problem. The utility function takes a CES form. The general maximisation problem is defined as an adult choosing $L_{(c,rr,a,r)}$ to:

$$\text{Max } U_{(c,rr)} = \left[\sum_{a \in EUFO} \sum_{r \in REG} \left(B_{(c,rr,a,r)} * ATW_{(a,r)} * L_{(c,rr,a,r)} \right)^{\frac{\eta}{1+\eta}} \right]^{\frac{1+\eta}{\eta}} \quad (\text{E2.4})$$

$$\text{subject to } \sum_{a \in EUFO} \sum_{r \in REG} L_{(c,rr,a,r)} = CAT_{(c,rr)}^{(initial)} \quad (\text{E2.5})$$

- where
- $EUFO$ is the set for all activities describing employment, unemployment, not in the labour force, and movement overseas;
 - $U_{(c,rr)}$ is a category c, rr -specific utility function;
 - $B_{(c,rr,a,r)}$ captures exogenous non-wage factors, such as preferences, that may motivate people from category c, rr to offer their labour to activity a in region r ;
 - $ATW_{(a,r)}$ is the real after-tax wage rate in activity a in region r ;
 - $L_{(c,rr,a,r)}$ is labour supply from category c, rr to activity a in region r ; and,
 - $CAT_{(c,rr)}$ is the number of people in category c, rr at the start of year t .

In specifying utility from labour allocation according to (E2.4), we implicitly assume that people in category (c, rr) treat dollars earned in different activities as imperfect substitutes. By specifying a separate utility function for each category, we ensure that each category supplies labour to activities that are compatible with that category's visa status, skill, age and occupational characteristics. Within the DIAC-TERM framework, the majority of people continue to supply labour to the same activity performed in the same region as in the previous year. However, the theory allows for people to move between occupations within the same region, or to a different occupation in a different region. These movements depend on the labour mobility and regional mobility, which are based on ABS's Census and survey data (see Section 3).

The utility-maximising labour-supply equations that follow from (E2.4) and (E2.5) take the form:

$$L_{(c,rr,a,r)} = CAT_{(c,rr)} * \left[\frac{\left(B_{(c,rr,a,r)} * ATW_{(a,r)} \right)^\eta}{\sum_q \sum_p \left(B_{(c,rr,q,p)} * ATW_{(q,p)} \right)^\eta} \right] \quad (E2.6)$$

In the computer implementation of the model, it is computationally convenient to divide (E2.6) into two parts. The first describes labour supply from all categories to all domestic activities performed in domestic regions. The second describes movements from all domestic categories to an activity “overseas” performed in a region “overseas”.

For the flows to domestic activities in domestic regions, the percentage-change form of (E2.6) is:

$$l_{(oo,rr,v,s,a,o,r)} = cat_{(oo,rr,v,s,a)} + \eta \left[atw_{(o,r)} - ave_atw_{(oo,rr,v,s,a)} + \right. \\ \left. d_pref_{(oo,rr,v,s,a,o,r)} - ave_pref_{(oo,rr,v,s,a)} \right] \quad (E2.7)$$

$oo \in EUFN$ ⁸; $rr \in REG$; $v \in VISA$; $s \in SKILL$; $a \in AGE$; $o \in EUF$ and $r \in REG$.

where $l_{(oo,rr,v,s,a,o,r)}$ is the percentage change in the number of persons of visa status v , skill s and age a , moving from category oo,rr to activity o in region r ;

- $cat_{(oo,rr,v,s,a)}$ is the percentage change in the number of people in category oo,rr with visa status v , skill s and age a ;
- $atw_{(o,r)}$ is the percentage change in the activity-specific real after-tax wage earned in region r ;
- $d_pref_{(oo,rr,v,s,a,o,r)}$ describes the preference of a person of visa status v , skill s and age a , offering their labour supply from category o,rr to activity o in region r ;
- η reflects the ease with which people shift between activities; and
- $ave_atw_{(oo,rr,v,s,a)}$ and $ave_pref_{(oo,rr,v,s,a)}$ are weighted percentage changes in the average after-tax wage and preference variable for adults in category o,rr with visa status v , skill s and age a .

For the flows to an overseas activity, the percentage-change form of (E2.6) is:

⁸ $EUFN$ is a set of all employment, unemployment, “not in the labour force” and new entrant categories.

$$l_{(oo,rr,v,s,a,OS,OS)} = cat_{(oo,rr,v,s,a)} + \eta \left[atw_{(OS,OS)} - atw_{(oo,rr,v,s,a)}^{ave} + e - pref_{(oo,rr,v,s,a,OS,OS)} - ave - pref_{(oo,rr,v,s,a)} \right] \quad (E2.8)$$

where $l_{(oo,rr,v,s,a,OS,OS)}$ is the percentage change in the number of persons of visa status v , skill s and age a , moving from category oo,rr to activity “overseas” (OS) in region “overseas” (OS);

$cat_{(oo,rr,v,s,a)}$ is the percentage change in the number of people in each oo,rr category by visa status v , skill s and age a ;

$atw_{(OS,OS)}$ is the percentage change in the foreign wage earned overseas;

$e - pref_{(oo,rr,v,s,a,OS,OS)}$ is the preference of a person of visa status v , skill s and age a , offering their labour supply from category o,rr to the OS activity in region OS. Movements in this preference variable represent exogenous changes in the preference to move overseas relative to remaining in Australia;

η , $ave - atw_{(oo,rr,v,s,a)}$ and $ave - pref_{(oo,rr,v,s,a)}$ are as defined for (E2.7).

In interpreting Equations (E2.7) and (E2.8), begin by assuming that there are no changes in the after-tax real wage and preference variables. Then, the percentage change in labour supply from oo in region rr to activity o in region r will follow the percentage change in the supply of labour in general from category oo,rr .

In the absence of changes in preferences, people in category oo in region rr will shift their labour supply towards activity o in region r when the real after-tax wage in activity o in region r rises relative to the weighted average of wage rates across all activities in which category (o,rr) people could participate. Generally, we do not expect movements in ATW to have large effects on labour supply from category oo,rr to activity o,r . This is because a large part of labour supplies from category oo,rr to employment activity o,r is from incumbents, reflecting the assumption that the majority of people desire to perform the same occupation within the same region in year t as in year $t-1$. Hence, $LS_{(o,r,o,r)}$ is a large fraction of $LS_{(o,r)}$, and as such, $atw_{(o,r)} - ave_atw_{(oo,rr)}$ will typically be close to zero.

Equations (E2.7) and (E2.8) introduced variables describing average wage rates and average preferences respectively as appropriate share-weighted averages. These variables are calculated by equations (E2.9) and (E2.10) respectively:

$$\begin{aligned}
CAT_{(oo,rr,v,s,a)} * ave_atw_{(oo,rr,v,s,a)} &= \sum_{o \in EUF} \sum_{r \in REG} L_{(oo,rr,v,s,a,o,r)} * atw_{(o,r)} + \\
&L_{(oo,rr,v,s,a,OS,OS)} * atw_{(OS,OS)}
\end{aligned} \tag{E2.9}$$

$oo \in EUFN$; $rr \in REG$; $v \in VISA$; $s \in SKILL$ and $a \in AGE$

$$\begin{aligned}
CAT_{(oo,rr,v,s,a)} * ave_pref_{(oo,rr,v,s,a)} &= \sum_{o \in EUF} \sum_{r \in REG} L_{(oo,rr,v,s,a,o,r)} * d_pref_{(oo,rr,v,s,a,o,r)} + \\
&L_{(oo,rr,v,s,a,OS,OS)} * e_pref_{(oo,rr,v,s,a,OS,OS)}
\end{aligned} \tag{E2.10}$$

$oo \in EUFN$; $rr \in REG$; $v \in VISA$; $s \in SKILL$ and $a \in AGE$

Once the flow from each category of labour supply to each domestic employment activity is determined by Equations (E2.7), labour supply to each employment activity o in region r by visa-, skill- and age-specific labour is the sum of supplies from all categories oo,rr . The levels form of this equation is presented in (E2.11) and the percentage change form in (E2.12):

$$LS_{(v,s,a,o,r)} = \sum_{oo \in EUFN} \sum_{rr \in REG} L_{(oo,rr,v,s,a,o,r)} \tag{E2.11}$$

$o \in EUFO$; $r \in REGO$

$$LS_{(v,s,a,o,r)} * ls_{(v,s,a,o,r)} = \sum_{oo \in EUFN} \sum_{rr \in REG} L_{(oo,rr,v,s,a,o,r)} * l_{(oo,rr,v,s,a,o,r)} \tag{E2.12}$$

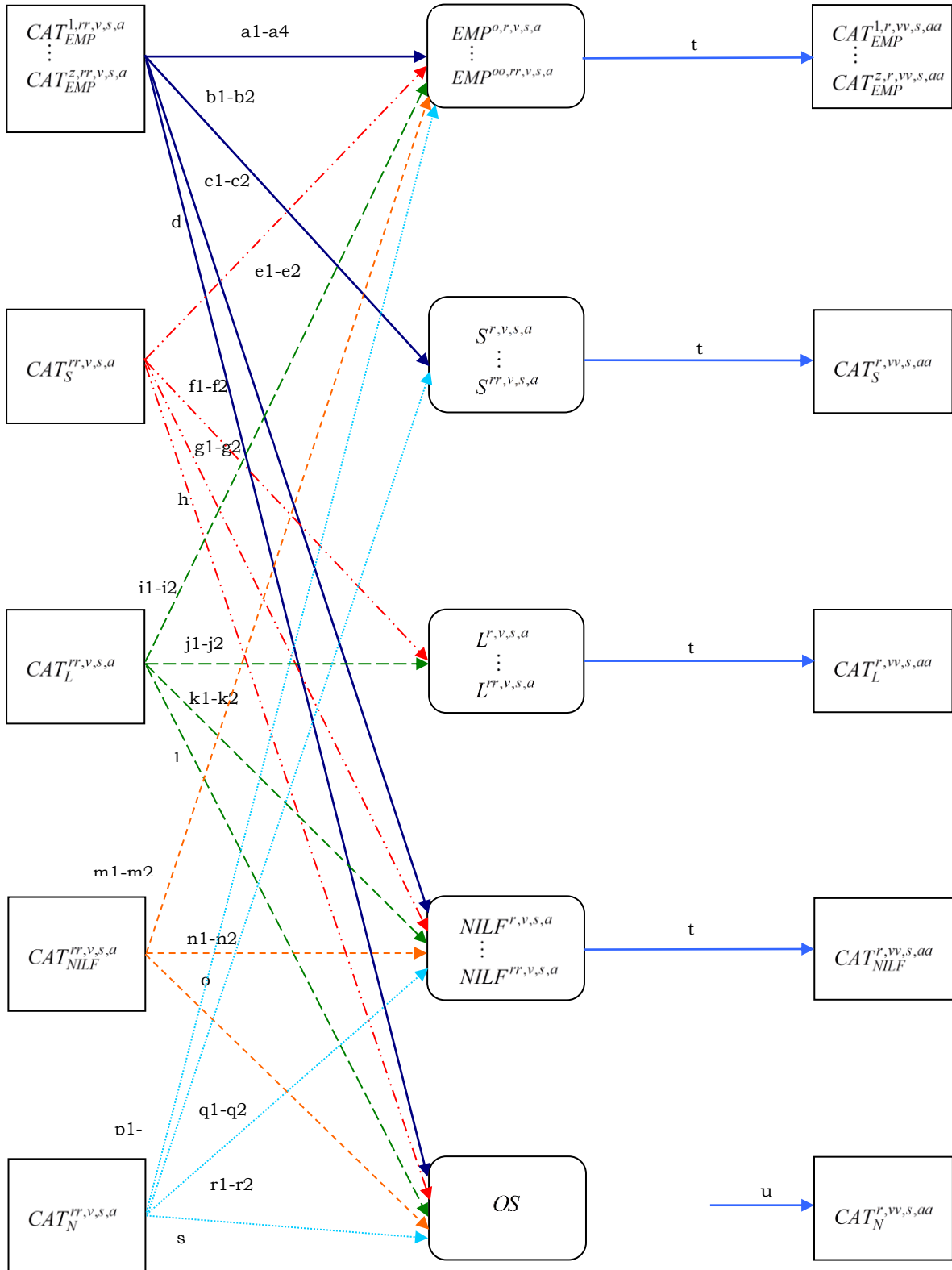
where $L_{(oo,rr,v,s,a,o,r)}$ is the number of people of visa status v , skill s and age a , moving from the category oo,rr to activity o in region r . $l_{(oo,rr,v,s,a,o,r)}$ is the corresponding percentage change variable;
 $LS_{(v,s,a,o,r)}$ is the total number of people in activity o in region r of age a , visa status v and skill s . $ls_{(v,s,a,o,r)}$ is the corresponding percentage change variable.

2.5 DESCRIPTION OF FLOWS FROM CATEGORIES TO ACTIVITIES

Figure 2.2 provides a map of all model flows from categories to activities. In this section, we describe the possible flows from categories to activities which are specified in Figure 2.2:

$CAT_{EMP}^{1,rr,v,s,a}$	This category describes people employed in region rr during year $t-1$ by visa v , status v , skill s and age a . In year t , people in this category can
to	return to the same occupation in the same region (flow a1); move to a different occupation in the same region (flow a2); move to the same occupation in a different region (flow a3); move to a different occupation in a different region (flow a4); move to short-run unemployment in the same region (flow b1); move to short-run unemployment in a different region (flow b2); move to the “not in the labour force” activity in the same region (flow c1); move to the “not in the labour force” activity in a different region (flow c2); or move overseas (flow d).
$CAT_{EMP}^{2,rr,v,s,a}$	
$CAT_S^{rr,v,s,a}$	This category describes people in region rr by visa status v , skill s and age a , who were not employed in year $t-1$, but employed in year $t-2$. In year t , people in this category can: move to employment activity o in region r (flow e1); move to employment activity o in region rr (flow e2); move into the long-run unemployment activity in region r (flow f1); move into the long-run unemployment activity in region rr (flow f2); move to the “not in the labour force” activity in region rr (flow g1); move to the “not in the labour force” activity in a different region (flow g2); or move overseas (flow h).
$CAT_L^{rr,v,s,a}$	This category describes people in region rr by visa status v , skill s and age a , who were not employed in year $t-1$ or in year $t-2$. In year t , people in this category can: move to employment activity o in region r (flow i1); move to employment activity o in region rr (flow i2); move into the long-run unemployment activity in region r (flow j1); move into the long-run unemployment activity in a region rr (flow j2); move to the “not in the labour force” activity in region rr (flow k1); move to the “not in the labour force” activity in a different region (flow k2); or move overseas (flow l).
$CAT_{NILF}^{rr,v,s,a}$	This category describes people in region rr by visa status v , skill s and age a , who were “not in the labour force”. In year t , people in this category can: move to employment activity o in region rr (flow m1); move to employment activity o in region r (flow m2); move to the “not in the labour force” activity in region rr (flow n1); move to the “not in the labour force” activity in a different region (flow n2); or move overseas (flow o).

Figure 2.2. Flows between categories at the start of year t and activities during year t



$CAT_N^{rr,v,s,a}$ The final category describes people in region rr by visa status v , skill s and age a , who enter the WAP for the first time. In year t , people in this category can: move to employment activity o in region r (flow p1); move to employment activity o in region rr (flow p2); move to the short-run unemployment activity in region r (flow ql); move to the short-run unemployment activity in region rr (flow ql); move to the “not in the labour force” activity in region rr (flow r1); move to the “not in the labour force” activity in region r (flow r2); or move overseas (flow s).

2.6 TRANSLATING LABOUR SUPPLY IN PERSONS TO LABOUR SUPPLY IN HOURS

Equation (E2.12) defines $ls_{(v,s,a,o,r)}$, the percentage change in the number of persons of visa type v , skill s , and age a employed in occupation o in region r . The model recognises that annual hours worked per person differ across visa types, skill categories, age groups, occupations and regions. To translate labour supply by persons into labour supply in hours, we begin with equation (E2.13), which defines the percentage change in annual hours worked in occupation (o,r) by persons with characteristics (v,s,a) :

$$lh_{(v,s,a,o,r)} = hpp_{(v,s,a,o,r)} + ls_{(v,s,a,o,r)} \quad (E2.13)$$

where:

- $hpp_{(v,s,a,o,r)}$ is the percentage change in the number of hours worked per person in occupation (o,r) by persons with characteristics (v,s,a) ;
- $lh_{(v,s,a,o,r)}$ is the percentage change in total hours of labour supplied to occupation o in region r by persons with characteristics (v,s,a) .

Equation (2.14) calculates $lht_{(o,r)}$, the percentage change in total labour supply to occupation (o) in region (r) :

$$HT_{(o,r)} lht_{(o,r)} = \sum_v \sum_s \sum_a H_{(v,s,a,o,r)} lh_{(v,s,a,o,r)} \quad (E2.14)$$

where $H_{(v,s,a,o,r)}$ is the total number of hours supplied to (o,r) by persons with characteristics (v,s,a) and $HT_{(o,r)} = \sum_v \sum_s \sum_a H_{(v,s,a,o,r)}$.

2.7 LINKING THE LABOUR SUPPLY MODEL WITH THE TERM MODEL

Equation (E2.14) calculates the percentage change in labour supply by occupation and region. In linking the labour supply model to the TERM model, we equate labour supply and labour demand via endogenous occupation- and region-specific wage rates. Specifically, we assume that:

$$lht_{(o,r)} = xlab_{(o,r)} \quad (E2.15)$$

where $xlab_{(o,r)}$ is the percentage change in labour demand as defined within the TERM model. In TERM, labour demands are defined on an industry-, occupation- and region-specific basis. We refer the reader to Horridge (2011) for details of the TERM model's labour demand side. However, in general functional form, we can represent the labour demand side of the TERM model in the following condensed form:

$$xlab_{(o,r)} = f_{(o,r)}(w_{(o,r)}, z_{(j,r)}, p_{(j,r)}, a_{(o,j,r)}^{(L)}) \quad (E2.16)$$

where $w_{(o,r)}$ is the percentage change in the price faced by industry for occupation o in region r , $z_{(j,r)}$ is the percentage change in the output of industry j in region r , $p_{(j,r)}$ is the percentage change in the basic price of the output of industry j in region r , and $a_{(o,j,r)}^{(L)}$ is occupation-specific bias in labour-using technical change.

This concludes our description of the labour supply module of the DIAC-TERM model. The next section discusses the compilation of the database which serves as an initial solution of the model.

3 DATABASE FOR THE LABOUR-MARKET SPECIFICATION

This section describes the construction of the database underlying the labour market theory described in Section 2. This database has the following characteristics:

- It contains detailed information regarding the structure of the working age population (WAP)⁹ in the base year (2007-2008).
- It is the initial solution to the labour-market specification described in Section 2.
- It includes a transition matrix that allows adults to change their age and visa status between year $t-1$ and year t .
- It includes matrices describing the flow of adults from categories to activities. Categories are created at the beginning of each year. People are grouped into categories based on common characteristics such as age, visa status, skill level, region of residence and most recent labour market activity. They supply their labour to activities performed during the year based on the solution of their utility maximisation problem discussed in Section 2.4.

The remainder of this section is set out as follows. Section 3.1 introduces all coefficients and sets in the database. Section 3.2 describes the data sources used to compile the database. Section 3.3 provides an overview of the database compilation process, and Section 3.4 gives a brief description of each step in that process.

3.1 OVERVIEW OF THE DATABASE

3.1.1 Coefficients

As discussed in Section 2, the model requires a number of coefficients. They are matrices describing: activities undertaken during the base year; categories at the start of the base year; flows between categories and activities; and a transition matrix. The coefficients are listed in Table 3.1. Each matrix is defined by a number of dimensions. The sets in these dimensions are listed in Table 3.2.

⁹ The working age population includes all those aged 15 and over. In the database, WAP is described in terms of labour market activity, age, skill level, visa status, and region of residence.

Table 3.1. Coefficients and parameters¹⁰

Coefficient	Dimension	Description
$LS_{(o,r,v,s,a)}$	EUFO * REGO * VISA * SKILL * AGE	The activity matrix in year t . This matrix refers to the number of adults in each labour market activity o by region r , visa type v , skill level s and age a . (See equation E2.11, Section 2).
$ACT - L_{(o,r,v,s,a)}$	EUFO * REGO * VISA * SKILL * AGE	The <i>lagged activities</i> matrix for year $t - 1$. This matrix is similar in dimensions to $ACT_{(o,r,v,s,a)}$, but is defined for the preceding year. It is used in equation (E2.1), Section 2)
$CAT_{(o,r,v,s,a)}$	EUFN * REG * VISA * SKILL * AGE	The number of adults in <i>category</i> c at the start of year t . This matrix shows the number of adults in each labour market category c by region r who belong to visa type v , skill level s and age group a at the start of year t . An additional category, new entrant (N) is exogenously added at the beginning of each year. This coefficient is used in equations (E2.1), (E2.6), (e2.9), Section 2.
$L_{(c,r,v,s,a,o,r)}$	EUFN * REG * VISA * SKILL * AGE * EUFO * REGO	<i>Labour flow</i> matrix for year t . This matrix shows the flows from category c to activity o , given a set of age a , skill level s , region r , and visa type v characteristics.
$T - RR_{(vv,aa,v,a)}$	VISA * AGE * VISA * AGE	The <i>transition matrix</i> . This matrix shows the probability of a person moving from visa type vv to v and from age aa to a . This matrix determines how adults move from $ACT - L_{(o,r,vv,s,aa)}$ to $CAT_{(o,r,v,s,a)}$ at the end of each year (see equation (E2.1).
$T_{(o,rr,v,s,a,r)}$	EUFN * REG * VISA * SKILL * AGE * REG	The <i>regional transition matrix</i> . This matrix shows the propensity of people in category c , domestic region rr at the beginning of the year to move to labour market

¹⁰ A note on our set index notation: throughout this document, we use double letters (such as oo , rr , vv) to denote the initial position, and the single letter (e.g. o , r , v) to denote the final position of a category or activity. For example, in the coefficient $T_{(vv,aa,v,a)}$ vv and aa denote the visa type and age of a group of people during year $t-1$, and v and a denote their visa and age at the beginning of year t .

		activity o in domestic region r during the year. This coefficient underlies the preference matrix B in equation (E2.6), Section 2.
$T_{OO_{(oo,r,v,s,a,o)}}$	EUFN * REG * VISA * SKILL * AGE* EUF	The <i>occupational transition matrix</i> . This matrix shows the propensity of people in labour market category oo at the beginning of the year to move to labour market activity o during the year. This coefficient underlies the preference matrix B in equation (E2.6), Section 2.
$H_{(v,s,a,o,r)}$	VISA*SKILL*AGE*OCC*REG	The total number of hours supplied to (o,r) by persons with characteristics (v,s,a) . This coefficient is required for equation (E2.14), Section 2).

Table 3.2. Sets

Symbol	Dimension	Description/Elements
OCC	8	Occupations. 8 ANZSCO major groups, namely: (1) Managers; (2) Professionals; (3) Technicians and Trades Workers; (4) Community and Personal Service Workers; (5) Clerical and Administrative Workers; (6) Sales Workers; (7) Machinery Operators and Drivers; (8) Labourers.
UN	2	Unemployed (Short-term S and long-term L).
NEWENT	1	New entrants (N), which includes domestic residents who turn 15 and new overseas arrivals.
NILF	1	Not in the labour force (NILF).
EMIG	1	Emigrants (OS) (People who move overseas).
EU	10	Labour force (OCC + UN).
EUN	11	OCC + S+L +N.
UF	3	Unemployed and Not in the labour force (UN + NILF).
NEMP	4	Not-employed (UF + NEWENT).

EUFN	12	Domestic labour categories (OCC + UN + NILF + NEWENT).
EUF	11	Domestic labour activities (OCC + UN + NILF).
EUFO	12	Activities (Domestic activities plus emigration (OCC + UN + NILF + EMIG).
REG	15	15 Domestic regions (The ACT plus 7 capital cities and 7 balances of the remaining 7 Australian states).
OS	1	Overseas (Rest of the World).
REGO	16	Domestic region plus Overseas (REG + OS).
VISA	9	Visa types. (1) Citizen; (2) Skilled; (3) Family; (4) Humanitarian; (5) Other permanent visas; (6) Student; (7) Long-stay business visa 457; (8) Other temporary visa; and (9) New Zealanders.
SKILL	3	An element representing the aggregation of all non-school qualification levels.
AGE	7	10-year age groups 15+, namely: (1) 15-24; (2) 25-34; (3) 35-44; (4) 45-54; (5) 55-64; (6) 65-74; (7) 75 and over.

3.1.2 Time frame of the initial database

As can be seen from Section 3.2 below, our main data source is Census 2006. This provides us with information on labour market activities for the year 2006-2007. We adopt the year 2006/07 as year $t-1$. With 2006/07 identified as year $t-1$ in the database, the time frames of the matrices in the initial database of the model are as follows:

Coefficient	Coefficient name	Time frame of the initial database
$ACT_{(oo,rr,v,s,a)} - L$	Lagged activity matrix	Financial year 2006/07
$ACT_{(o,r,v,s,a)}$	Activity matrix	Financial year 2007/08
$CAT_{(oo,rr,v,s,a)}$	Categories	Start of financial year 2007/08.
$LS_{(oo,rr,v,s,a,o,r)}$	Labour supply matrix	Financial year 2007/08
$T_{(vv,aa,v,a)}$	Transition matrix	Start of financial year 2007/08.
NEWY	New entrants into the labour market	Financial year 2007/08
EMIG	Emigrants out of Australia	Financial year 2007/08

These matrices are updated via a baseline forecast to the financial year 2010/11 using available observed statistics for key economic and migration variables in the model during the period 2006/07 – 2010/11.

3.2 DATA SOURCES

As can be seen from Section 3.1, our model requires data on the number of people in all activities in the country in a given year, as well as information on how they change their age and visa statuses, economic activities and region of residence from one year to the next. In this section we introduce the data sources that are used to construct this database. More detail on the sources and how they are used are presented in later sections, where we describe the process of constructing each of the coefficients listed in Section 3.1 above.

3.2.1 Census of Population and Housing 2006.

At the time of writing of this report the Census 2006 (ABS, 2006) is the most comprehensive and reliable source of data on the number and key characteristics of people in Australia. It covers all people in Australia on census night, including visitors. Characteristics covered by the Census and relevant to our model include:

1. age,
2. region of residence on Census night,
3. labour force status,
4. occupation of employment,

5. Australian citizenship,
6. non-school qualification level,
7. region of residence one year earlier, and
8. country of birth.

Census data was the main input to creation of the following matrices:

1. The lagged activity matrix $ACT_L_{(o,r,v,s,a)}$, which shows the number of adults in each labour market activity o by region r , visa type v , skill level s and age a for the financial year 2006-2007. Note that the Census provides information on Australian citizenship, but not detailed information on visa types for non-citizens. In order to create the $ACT_L_{(o,r,v,s,a)}$ matrix with all 9 of the model's visa types, we complement the Census data with information from both the Characteristics of Recent Migrants surveys in 2007 and 2010 and from DIAC visa stock data. These sources are discussed in Sections 3.2.3 and 3.2.2 below.
2. The regional mobility matrix $T_RR_{(vv,aa,v,a)}$ (see Table 3.1). This matrix is compiled from the information on the region of residence on Census night and the region of residence one year earlier.
3. The profile of New Zealand born non-residents, by age, region of residence, occupation and skill level. This profile is used as proxy for the profile of New Zealanders in Australia in our compilation of the "New Zealanders" visa type in the $ACT_L_{(o,r,v,s,a)}$ matrix (see discussion in Section 3.2.1).

3.2.2 DIAC data for stock of migrants

DIAC has provided us with stock data for temporary and permanent visa holders (DIAC, 2011a; 2011b) by approximately 400 visa sub-classes. These sub-classes can be mapped into the 9 visa categories required by the model. The data include:

- Stock of temporary visa holders, by visa type and 8 states for the period 2004-2008.
- Stock of temporary visa holders, by visa type, age and 8 states for the period 2008-2011.
- Stock of permanent visa holders, by visa type and age for the period 2006-2011.

These stock data were used to:

1. Compile the non-citizen visa categories in the $ACT_L_{(o,r,v,s,a)}$ matrix for the year 2006.
- Note that for each of the visa types, the DIAC stock data provides information on the total number of visa holders, their age and, in the case of temporary visa holders, state of residence, but not information on occupational, qualification, or capital

cities/balance of state. We use information from the Characteristics of Recent Migrants (CoRM) surveys in 2010 and 2007, and information from Census to create these dimensions (see discussion in Section 3.4.3).

2. Compile the time series for visa stocks for the period 2007-2011. This time series is used (a) in our estimation of the visa transition matrix (discussed in Section 3.4.4) and (b) to calculate the year-on-year growth rate in visa stocks for the period 2008-2011 in order to update the model database from the year 2006/07 to 2010/11 via simulation.

3.2.3 Characteristics of Recent Migrants, November 2010 and November 2007

The main source of our cross-classified data by visa categories, age, region of residence, skill, and labour market activities¹¹ of visa holders is the Expanded Confidentialised Unit Records files (CURF) for the Characteristics of Recent Migrants (CoRM) survey, conducted in November 2010. The CURF provides data for the following 7 visa categories at the survey date: (1) Citizen; (2) Permanent visa – skilled, independent (3) Permanent visa – skilled, other; (4) Permanent visa – other; (5) Temporary visa – student; (6) Temporary visa – other; and (7) “Not applicable” visa type, which include New Zealanders and people who intend to stay less than 12 months.

The CURF does not provide data for more disaggregated visa types required by the model, such as Family, Humanitarian, Permanent-other, or Long-stay business visa subclass 457. Therefore, we complement the CURF with data for CoRM 2010 from ABS (2011a), which contains information on state of residence and labour force status for the Family, Humanitarian, and Permanent-other visa categories. As for the visa subclass 457, we use information on its labour force status from CoRM 2007 as published in ABS (2008a).¹²

The combined data from the CoRM 2010 and 2007 are used to:

- 1) Create the labour market activities, regional and skill dimensions for the DIAC visa stock data discussed in Section 3.2.2.¹³
- 2) Calculate the average number of working hours per person per week, by age, region and visa type. This information is used to calculate the hours matrix $H_{(v,s,a,o,r)}$.

¹¹ Namely: the 8 occupations, unemployment, and not-in-the-labour-force status of visa holders.

¹² The ABS publication for 2010 does not distinguish the 457 visa category.

¹³ We mainly use CoRM 2010 to disaggregate the non-citizen dimension of Census 2006. In this way, we allow the structure of the database to more closely reflect the composition of visa holders closer to the updated database year (year 2010/2011), rather than the composition of visa holders in 2007. CoRM 2007 is only used to disaggregate the labour force status of the 457 visa holders.

- 3) Estimate the initial visa transition matrix for *permanent* visa holders (see Section 3.4.4.2) based on CoRM 2007's and CoRM 2010's information on the visa status of respondents on arrival and at the time of survey. We do not use CoRM to estimate the initial visa transition matrix for *temporary* visa holders. This is because the survey CURFs aggregate the time of arrival into 10-year blocks. This means we do not have accurate information for temporary visa holders, who typically stay in the country less than 10 years. Information for temporary visa holders is obtained from DIAC's NOM data, discussed in Section 3.2.4.

3.2.4 DIAC NOM data

DIAC provided us with two sets of time series data for gross arrivals to, and departures from, Australia:

1. Quarterly arrivals and departures, by visa subclass and age, for the period 2004-2009.
2. Quarterly arrivals and departures for the period 2004-2022, by visa major classes. The major classes include: student, long-term temporary business visa 457, tourist, skilled, family, humanitarian, Australian, New Zealanders, and other.

The two time series differ in the following respects:

- The series for 2004-2022 do not contain age information; that is, it does not distinguish between working age and younger populations.
- The visa subclasses in the series for the period 2004-2009 can be mapped very closely to the 9 model visa types, but the visa major classes in the series for 2004-2022 cannot be mapped uniquely to the model visa types. This is mainly because the visa major class "Other" contains both permanent and temporary visa types. Also, there is no one-to-one concordance between the major visa types and the model visa types, even if they have the same apparent name, such as Family, or Humanitarian. We have found in the "Other" major visa class some visa subclasses which belong to Family, Skill, or Humanitarian under the concordance between visa subclasses and the model's 9 visa types.

To calculate the NOM data for the working age population for the period 2004-2022, we use the information on age and the structure of the "Other" visa category in the series for 2004-2009 to adjust the series for the period 2004-2012. To calculate the working age population for the period 2004-2022, we assume that the proportion of the working age population in the series is the same as the average proportion aged 15 and over for the period 2004-2009. To split the "Other" visa class into P_other and T_other, we assume that the shares of P_other and T_other in the aggregate "Other" visa classes are the same as their average shares over the period 2004-2009.

3.2.5 DIAC NOM panel data

DIAC provided us with NOM panel data for over 900 thousand individuals, mainly temporary visa holders, over the period 2007-2011, by visa sub-class, age, and state. The data also includes information on the occupations of the 457 visa subclass. This data source was used to:

1. Compile the initial visa transition matrix for temporary visa holders. This initial visa transition matrix is later adjusted using DIAC's time series data for visa stocks, gross arrivals and gross departures. This procedure is discussed in Section 3.4.4.2.
2. Calculate the occupational and regional profiles of the 457 visa subclass. This information is used to create the data for 457 visa subclass, as discussed in Section 3.4.3.

3.2.6 Labour mobility 2008 and 2010

In the model, people may stay in the same occupation/labour force status category, or they may move from to another. Their propensity to stay or move is represented by the matrix $T_{OO(o,r,v,s,a,o)}$, which is described in Table 3.2. The matrix is calculated using data from the Labour Mobility surveys conducted in 2008 and 2010 (ABS, 2008b; 2010b). These surveys cover those people aged 15 years and over who have, within the 12 months to the survey time, "either had a change of employer/business in their main job, or had some change in work with their current employer/business, for which they had worked for one year or more".

3.2.7 ABS's labour market statistics

The ABS provides time series data for the labour force status of the working age population, as well as data on employment by occupation and region (ABS, 2012a; 2012b; 2012c; 2012d). We use these data to update the lagged activity matrix ($ACT_{L(o,r,v,s,a)}$) obtained from Census August 2006, so that it reflects ABS's labour market statistics for the financial year 2006/07. These data are also used in our baseline forecast to update the model to the year 2010/11.

3.2.8 ABS's demographic data

The ABS provides time series data for the number of deaths, by 8 states and territories (ABS, 2010c). We use these data to estimate the age-specific death rates that are incorporated into the transition matrix.

We also use ABS's demographic data (ABS, 2011b) to estimate the number of domestic new entrants, *i.e.* people 14-year of age, turning 15 in the following year. For the base data, new entrants are people aged 14 years in 2006, turning 15 in the year 2007/08.

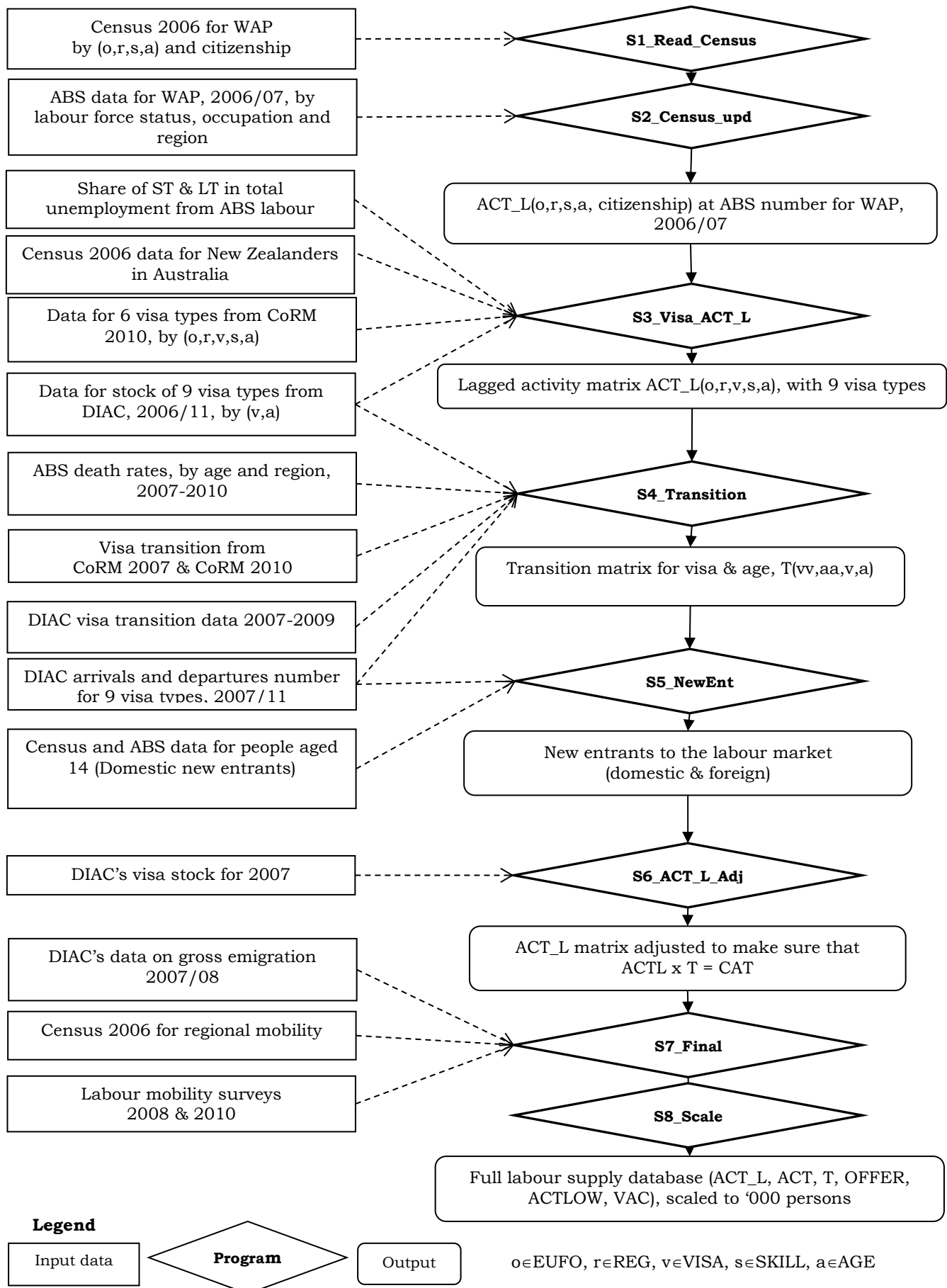
3.3 OVERVIEW OF THE DATABASE CREATION PROCESS

To convert the available data into the database required by the DIAC model, seven main steps are undertaken. These are described in Figure 3.1 below.

To promote transparency and to assist trouble shooting, we have automated the process of generating the database by using GEMPACK (Harrison and Pearson, 1996). Much of our initial input data was provided to us in Excel, CSV or text format. We converted these data into Header Array files using ViewHAR (Horridge, 2003). For each step of the database creation process, we wrote a GEMPACK “TABLO” program to conduct the necessary calculations and manipulations. An important part of each TABLO program at each step is the inclusion of a series of checking statements to ensure that the data meet necessary balance and other conditions. Batch files automate the execution of the series of TABLO-generated programs.

Our approach has a number of advantages, particularly relative to the common alternative of doing large numbers of sequential data manipulations using a spreadsheet program such as Excel. First, it is transparent. TABLO input files are text files written in an easy to master language. As such, each TABLO program represents transparent documentation of the data manipulation processes that we have implemented at each stage of the database creation process. Second, automation enables a more timely generation of an updated database.

Figure 3.1 below provides an overview of the key steps in the database creation process. These steps are complemented by many auxiliary program files, which are not shown in the figure, but are listed in Table 3.4 below. A still more comprehensive flowchart describing the whole database creation process is presented in the Appendix.

Figure 3.1. Key steps in compiling the labour market supply module database

In the sections below we describe each of the main steps in our database compilation process. Column (2) of Table 3.4 provides a navigational aid to the directory structure of the large zip file of data jobs that accompanies this document. Detailed accounts of each data process can be found in the TABLO input programs listed in Column (3), Table 3.4.

3.4 STEPS IN THE DATABASE CREATION PROCESS

3.4.1 Step 1. Processing Census data

In this step, we process the Census 2006 data extracted from the Census website, using Table Builder (ABS, 2006). These data contain information that forms the core database for the model. There are several reasons for the choice of this data source. First, unlike sample surveys which have sampling errors, the Census provides the most comprehensive coverage of the Australian population at a point in time. Second, it is the Census closest to the time period of the input-output data used for the initial database for the TERM model, which was 2005/06. Finally, the Table Builder facility for the Census data allows the extraction of data which are cross-classified for most of the required dimensions. The data that we obtained from the Census have the dimensions of: occupation, labour force status, region, skill, age, and citizenship. Data at this high level of cross-classification are difficult to obtain from other sources.

The processing of Census data includes:

- Reformatting Census data from comma-separated values (CSV) format to header array (HAR) format.
- Handling supplementary categories – categories dealing with unclear responses in the Census – such as “Not stated”, or “Inadequately specified”. In general, persons belonging to these categories are reallocated proportionately to definite categories. For example, the supplementary categories in the occupation dimension are allocated to all 8 one-digit ANZSCO occupations in proportion to the shares of those occupations in the total of categories in the Census.

The outcome of this step is the lagged activity matrix *ACT_L* for the Australian working age population, by age, region, occupation, labour force status, skill, and citizenship, at August 2006. At this stage, the matrix does not contain detailed visa types, or disaggregation between short-term and long-term unemployed. These activities are created in Step 3.

3.4.2 Step 2: Update the lagged activity matrix to ABS labour force data

The Census data reflects the working age population (WAP) at August 2006. Our database is for the whole financial year 2007/08. In this step, we use ABS labour force data (ABS, 2012a; 2012b; 2012c; 2012d) to update the database so as to reflect the WAP for the financial year 2007/08.

3.4.3 Step 3: Creating the complete lagged activity matrix

In this step we create the complete lagged activity coefficient with all required dimensions. This coefficient shows the number of adults in each labour market activity o by region r , visa type v , skill level s and age a [$ACT_L(o,r,v,s,a)$, with $o \in EUFO$, $r \in REGO$, $v \in VISA$, $s \in SKILL$ and $a \in AGE$]. The ACT_L for the Citizen category is available from the updated Census data created in Step 2. In this step we complete the process of compiling the ACT_L coefficient by:

1. Creating the non-citizen component of the coefficient;
2. Splitting the unemployment activity in the Census 2006 data into short-term and long-term unemployment; and
3. Creating the lagged activity “OS” in region “OS”; that is, the flows of people to move overseas.

3.4.3.1 Creating the non-citizen component of the ACT_L coefficient

As discussed in Sections 3.2.2 and 3.2.4, information on visa type is available from the following main sources:

- (1) DIAC’s stock data for about 400 visa sub-classes at June 2006-June 2011, by age.
- (2) The Expanded Confidentialised Unit Record File (Expanded CURF) of the Characteristics of Recent Migrants (CoRM) November 2010. The CURF provides data, cross-classified by occupation, region, skill and age, for 6 visa types (namely citizen, independent permanent skill, other permanent skill, other permanent, student, and other temporary visas).
- (3) ABS’s publications on CoRM 2010 (ABS, 2011a) and CoRM 2007 (ABS, 2008a). These publications provide labour force status and states of residence for the more disaggregated visa types, such as family, humanitarian, other permanent visa, and long-term temporary business visa subclass 457.
- (4) DIAC’s NOM panel data, which includes information on occupations and regions for the T-457 class.

CoRM 2010’s strength is that it provides information on all characteristics required for the model for each of the six visa cohorts. Its disadvantage is that it distinguishes only 5 non-citizen visa types, not the 8 required by the model. The DIAC data, on the other hand, distinguishes all visa types, but has less information on visa holders. We combined the strengths of both databases.

Table 3.5 reports the concordance between CoRM visa categories at November 2010 and DIAC/Model visa types.

Table 3.5. Concordance between Census 2006, CoRM 2010 and model visa types

(A) Census 2006	(B) CoRM categories	(C) Model visa types	(D) Abbreviation
Citizen	1.Citizen	1. Citizen	1.Citizen
Non-citizen	2.Permanent, skilled independent 3.Permanent, skilled, other	2. Permanent, skilled	2.P-Skilled
	4.Permanent, other	3. Permanent, family 4. Permanent, humanitarian 5. Permanent, other	3.P-Family 4.P-Humantrn 5.P-Other
	5.Temporary, student	6. Temporary, student	6.T-Student
	6.Temporary, other	7. Temporary, 457 visa 8. Temporary, other	7.T-457 8.T-other
	7.Not applicable	9. New Zealanders	9.Nzers

The procedure to create the non-citizen component of the *ACT_L* matrix is as follows:

- (1) We start with DIAC's stock data for the year 2006, by visa type and age.
- (2) We then use information from the full matrix by (o,r,s,a) for P-Skilled and T-Student from the Expanded CURF from CoRM 2010 to split DIAC stock data for these visa categories into the full matrix by (o,r,s,a).
- (3) For P-Family, P-Humantrn and P-Other, DIAC stock data already contain information describing their age structure. We describe their labour force status using information from CoRM 2010 (ABS, 2011a). We then create the remaining dimensions (occupation, region, and skill) using relevant shares from the "Permanent, other" category in CoRM 2010 (item 4, Panel B, Table 3.5).
- (4) For T-457 and T-other, DIAC stock data already contains information on their age and regional structure. We describe their labour force status using information from CoRM 2007 (ABS, 2008a). We then split the "employment" element in the labour force status of T-457 into occupations using occupational shares from DIAC's NOM panel data (discussed in Section 3.2.5). The remaining dimensions for T-457 and T-Other are created using relevant shares from the "Temporary, other" visa type in CoRM 2010 (item 6, Panel B, Table 3.5).
- (5) For New Zealanders, DIAC's stock data contains information on their age. We create the remaining dimensions for this visa category using data from Census 2006 for New Zealand-born people.

After creating the matrices for each of the 8 non-citizen visa types, we combine them with the Citizen data from Census to form the full *ACT_L* matrix. These data are scaled to ensure that they sum to ABS's statistics for the working age population in Australia for the financial year 2006/07.

3.4.3.2 Splitting unemployment into short-term and long-term

In this step we expand the occupation dimension to include not only one-digit ANZSCO occupations, but also the categories of short-term unemployment, long-term unemployment, and not-in-the-labour-force (NILF). The Census data already distinguishes between ANZSCO occupations and NILF, but contains one unemployment activity. To split this activity into short-term and long-term unemployment, we use shares in total unemployment by age and region, calculated from ABS (2012a) data for the year 2006/07.

3.4.3.3 Creating emigration flows

To create emigration flows, we use DIAC's data on gross outflows of people from Australia (discussed in Section 3.2.4). DIAC's emigration data only contains information on visa major classes and age. It does not contain information on emigrants' occupation, region, or skill. We impute this information by assuming that all people in Australia have an equal probability of moving overseas.

The output of this step is the ACT_L matrix with all required dimensions.

3.4.4 Step 4: Creating the transition matrix

3.4.4.1 Introduction

This section describes the construction of the transition matrix, $T_{(vv,aa,v,a)}$. This matrix appears in equation (E2.1), Section 2, which calculates the number of people in each category at the start of the year.

The transition matrix is defined as the product of two matrices:

$$T_{(vv,aa,v,a)} = T_age_{(aa,a)} * T_visa_{(vv,v)}, \quad v \in VISA \text{ and } a \in AGE \quad (E3.1)$$

where $T_age_{(aa,a)}$ is the probability of a person moving from age aa to age a between year $t-1$ and year t ;

$T_visa_{(vv,v)}$ is the probability of a person changing their visa type from vv to v between year $t-1$ and year t ; and

$T_{(vv,aa,v,a)}$ is the proportion of people changing their visa type from vv to v and moving from age aa to age a between year $t-1$ and year t .

The transition matrix $T_{(vv,aa,v,a)}$ allows people, given a set of o,r,s characteristics to do one of the following:

- remain in age aa and remain in visa status vv ;

- move from age aa to age a and change visa status from vv to v ;
- remain in age aa and change visa status from vv to v ;
- move from age aa to age a and remain in visa status vv ; or
- leave the working age population due to death.

Note that the transition matrix does not relate to changes in labour market activity or region. We assume that the (v,a) transition probabilities are uniform across (o,r) . Changes in o and r are determined by the utility maximisation problem discussed in Section 2.4.

The remainder of this section describes the development of the transition matrix by describing the setting of the $T_{age_{(aa,a)}}$ and $T_{visa_{(vv,v)}}$ matrices. Once these matrices are determined, the final transition matrix can be calculated.

3.4.4.2 Visa transition ($T_{visa_{(vv,v)}}$)

The visa transition matrix shows the probability of a person of age aa changing their visa type from vv to v between year $t-1$ and year t . For any given visa category in year $t-1$, the sum of probabilities to remain within the same visa category or move to a different visa category in year t is 1.

The visa transition matrix was calculated using the following data sources (discussed in Sections 3.2.2 and 3.2.4):

1. ABS's CoRM 2007 and CoRM 2010 survey data in Expanded CURFs (ABS, 2007; 2010a). In this survey, people were asked their visa status at the survey time and their visa status on arrival, which could be any year up to the survey year. With data on the number of people who arrived since 2001, their visa status in 2007, and their visa status in 2010, we calculated the probabilities of visa transitions implied in the data.
2. DIAC panel data for over 900,000 people and their visa status during the period 2007-2009.
3. DIAC expert opinion on the plausibility of the estimates of visa transition probability derived from the above two sources.
4. DIAC's stock and NOM data for 9 visa types.
5. Based on visa stock data, we assume that people aged 65 and over cannot transfer from other visa categories into the following visa categories: Skilled, Student, and 457.

We used the data items (1) and (2) above to estimate an initial visa transition matrix. We then refined these initial estimates by fitting them to DIAC's time series for visa stock and NOM during the period 2006-2011, using an iterative process. The final visa transition matrix allows us to closely track the visa stock accumulation process.

3.4.4.3 Age transition ($T_{age_{(aa,a)}}$)

The age transition matrix shows the combined probabilities of people moving from one age group to another. Thus, it is a product of the pure age transition and the death rate.

(a) Pure age transition ($PAGE_{(aa,a)}$)

Our model contains 10-year age groups. Therefore, we assume that 90 per cent of each age cohort stays in the same age group, while 10 per cent progress to the next age cohort. An exception is the age group 75 and over, where people within this group are assumed to stay until they die. We further assume that this setting is uniform over skill level, region and visa type.

(b) Death rate ($DRATE_{(aa)}$)

Age-specific death rates were calculated by dividing the number of deaths for 2007 (ABS, 2010c), into the total WAP in the ACT_L matrix created in the previous steps. We assume that the death rates are uniform across regions, occupations and skill levels. The annual death rate increases with age: it is lowest for the 15-24 age group, at 0.045%, and highest for the age group 75 and over, at 8.27%.

(c) Final age transition matrix

The final age transition matrix is calculated as a product of the pure age transition matrix and the death rate. That is:

$$T_{age_{(aa,a)}} = PAGE_{(aa,a)} * [1 - DRATE_{(aa)}] \quad (E3.2)$$

3.4.4.4 Final transition matrix ($T_{(vv,aa,v,a)}$)

The final transition matrix shows the proportion of people moving from age aa to age a and visa status vv to v . This matrix is calculated as:

$$T_{vv,aa,v} = T_{age_{(aa,a)}} * T_{visa_{(vv,aa,v)}} \quad (E3.3)$$

3.4.5 Step 5: Creating matrices for new entrants

As can be seen from Figure 3.1, we use ABS demographic data (ABS, 2011b) and DIAC net overseas migration (NOM) data to create the matrices for new entrants into the labour market for the base year 2007/08.

3.4.5.1 Domestic new entrants

We define domestic new entrants as people who were 14 in 2006/07 and turned 15 in 2007/08. This data is provided by the ABS (2011b). People in this group have the “Citizen” visa category, and are assigned the characteristics of the age group 15-24. Therefore, we allocate the new entrants to occupations, region and skill categories based on the occupational, regional and skill composition of the citizen group aged 15-24.

3.4.5.2 New entrants from overseas

In addition to domestic new entrants to the labour market, there are also new arrivals from overseas. We use the arrivals number by age groups and visa types in DIAC’s NOM data (DIAC, 2012a) for the year 2007 to create this category. Unlike domestic new entrants, new entrants from overseas belong to all age groups. DIAC’s NOM data for 2007 do not contain information on region, skill or occupation. We allocate new entrants from overseas to region, skill and occupation based on the assumption that they have the same regional, skill and occupational compositions as those of current visa holders in Australia.

Together, domestic and foreign new entrants comprise the new entrant category in the category matrix CAT.

3.4.6 Step 6: Adjustment of the ACT_L matrix

The model requires values of visa stock holders at the beginning of the simulation year, *i.e.* end of June 2007. Stocks at June 2007 should equal stocks at June 2006, plus new arrivals during the financial year 2006/07, less new departures during the same year. This stock-flow relationship is modelled in DIAC-TERM. However, for the initial database, the visa stock at June 2007 is created with the equation:

$$CAT_{(o,r,v,s,a)} = \sum_{aa \in AGE} \sum_{vv \in VISA} ACT_{-L_{(oo,r,vv,s,a)}} * T_{(vv,aa,v,a)} \quad (E3.4)$$

$o \in EUF$; $a \in AGE$; $r \in REG$; $s \in SKILL$ and $v \in VISA$.

Equation (E3.4) shows that the right-hand-side of the equation must embody both the stock at June 2006, transformed during the year 2006/07, and the gross inflows and outflows during the year. Because there is no straight-forward way to calculate the ACT_L matrix so as to satisfy (E3.4) with a given T matrix, we use an iterative process to adjust the ACT_L matrix to achieve this aim.

3.4.7 Step 7: Creating all other coefficients

In previous steps we have created the lagged activities matrix $ACT_L_{(o,r,v,s,a)}$ and the transition matrix $T_{(vv,aa,v,a)}$. In the final step of the database creation process, we compile all the remaining coefficients required for the initial solution of the model, namely:

- The categories at the start of the year $CAT_{(o,r,v,s,a)}$
- The flows from categories to activities $L_{(c,r,v,s,a,o,r)}$
- The activities during the year $LS_{(o,r,v,s,a)}$
- The total number of hours supplied to (o,r) by persons with characteristics (v,s,a) $H_{(v,s,a,o,r)}$.

3.4.7.1 Categories

The $CAT_{(o,r,v,s,a)}$ matrix is calculated from the lagged activities matrix $ACT_L_{(o,r,v,s,a)}$ and the transition matrix $T_{(vv,aa,v,a)}$ using equation (E2.1). That is,

$$CAT_{(o,r,v,s,a)} = \sum_{vv \in VISA} \sum_{aa \in AGE} ACT_L_{(o,rr,v,s,aa)} * T_{(vv,aa,v,a)}$$

$o \in EUF$; ¹⁴ $r \in REG$; $v \in VISA$; $s \in SKILL$ and $a \in AGE$.

3.4.7.2 Flows from categories to activities

As discussed in Section 2.4, people in category c , region rr choose their labour supplies across activities a in region r by solving a utility maximisation problem specified in (E2.4) and (E2.5). The resulting solution is the labour supply equation (E2.6). Figure 2.2, Section 2, provides a schematic representation of the flows between categories at the start of year t and activities during year t . We describe below our compilation of these flows, using notations in Figure 2.2.

- Flows from all categories to OS are calculated based on DIAC's emigration data, and an assumption that all categories have the same propensity to go overseas. These flows are then deducted from the categories to derive the number of people who stay in the economy and participate in the domestic flows described below.
- Domestic flows from categories $CAT_{EMP}^{1,rr,v,s,a}$, $CAT_S^{rr,v,s,a}$, $CAT_L^{rr,v,s,a}$ and $CAT_{NILF}^{rr,v,s,a}$ to $EMP^{o,r,v,s,a}$, $S^{r,v,s,a}$, $L^{r,v,s,a}$ and $NILF^{r,v,s,a}$ are calculated based on the labour mobility matrix and regional mobility probabilities $T_{OO}_{(oo,r,v,s,a,o)}$ and $T_{RR}_{(vv,aa,v,a)}$ (see their

¹⁴ EUF is the set of all employment, short and long-run unemployment and "not in the labour force" categories.

description in Table 3.1). These probability matrices have been calculated based on the ABS's labour mobility surveys and the Census 2006 (see Sections 3.2.6 and 3.2.1).

- Flows from the new entrant category ($CAT_N^{rr,v,s,a}$) to all activities are compiled based on the assumption that the propensity of new entrants to work, or to go to S, L or NILF, or to move between regions, is the same as that of the incumbents with the same (rr,v,s,a) characteristics. That is, if the CAT matrix shows that 35% of incumbent temporary student visa holders aged 15-24 in Sydney are not in the labour force, then we assume that 35% of new temporary student visa holders aged 15-24 who arrive in Sydney at the beginning of 2007/08 will also be not in the labour force.

3.4.7.3 The activities matrix

The activity (or labour supply) matrix $LS_{(o,r,v,s,a)}$ is calculated from the flow matrix based on equation (E2.11), which is reproduced below.

$$LS_{(v,s,a,o,r)} = \sum_{oo \in EUFN} \sum_{rr \in REG} L_{(oo,rr,v,s,a,o,r)} \quad , \quad o \in EUFO ; r \in REGO$$

3.4.7.4 The hours matrix

As discussed in Section 2.6, the model recognises that annual hours worked differs across visa types, skill categories, age groups, occupations and regions. The hours matrix $H_{(v,s,a,o,r)}$ is required in equation (E2.14), and is important in the translation of labour supply by persons into labour supply in hours. The matrix is calculated as follows:

1. We first start with the calculation of average hours worked per person per week for each of the dimensions: occupation, region, age and visa type, based on CoRM 2010 (ABS, 2010a). The visa types in CoRM 2010 are the 7 types listed in Panel B, Table 3.5.
2. We then calculate the target total number of working hours per person per week based on average working hours per person per week and the total number of persons by each of the dimensions: occupation, region, and age.
3. The average number of working hours per person per week for the 9 visa types required by the model is adjusted based on (a) the average hours by occupation, state and age; (b) the occupational, regional and age structure of visa holders in each of the visa types in CoRM 2010; and (c) information on the number of working hours per person per week for Working Holiday Makers from Tan *et al.* (2009).
4. Finally, we use an iterative bi-proportional scaling procedure to estimate an hours matrix per person per week, cross-classified by all of the model dimensions, that is consistent with all the targets by each of the dimensions (namely occupation, region, age, and visa category).

This concludes our discussion of the compilation of the initial database for the DIAC-TERM model. Readers wishing to follow this process in more detail are referred to our TABLO input programs listed in Column (3), Table 3.4.

The remaining sections of this report discuss three applications of the DIAC-TERM model.

4 ANALYSIS OF A ONCE-OFF INCREASE IN THE INTAKE OF TEMPORARY SKILL MIGRATION PROGRAM IN 2012/13

4.1 Introduction

For many decades, migration has been an important policy to address labour and skill shortage in Australia. Among the different migration programs, the long-term skilled temporary migration (visa subclass 457, hereafter T-457) program has become increasingly important. T-457 is a demand-driven program which allows employers to bringing in skilled workers from overseas for up to four years to fill vacancies for which they cannot fill with local residents. The program is aimed at addressing short-term skill shortages, especially shortages in regional Australia.¹⁵

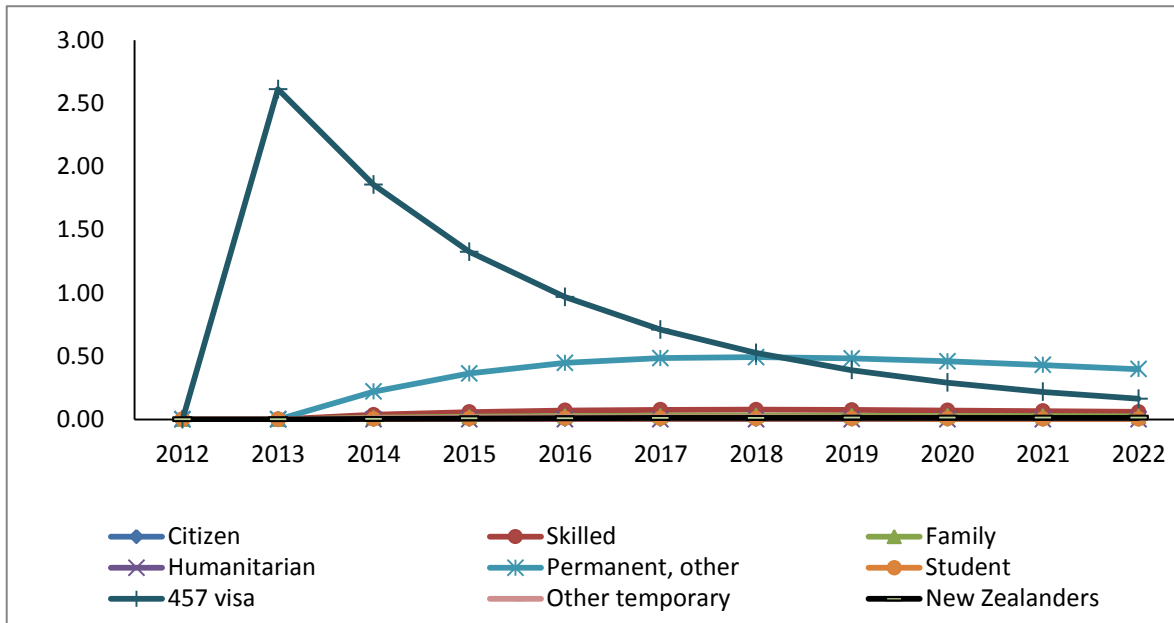
In this section we examine the macro, industry and regional effects of an increase in the intake of the T-457 visa program. In 2012/13 we increase gross inflows of T-457 visa holders by approximately 3.4 thousand persons relative to baseline.¹⁶ From 2013/14 onwards we restore the T-457 inflow to its baseline value.

Figure 1 plots the deviation paths for numbers of persons classified by visa. The 2012/13 stock of T-457 visa holders in the baseline is approximately 139 thousand. Hence our shock to the T-457 inflow represents an approximately 2.5% increase in the 2012/13 T-457 stock (see Figure 1).

¹⁵ In the seven years from 2004/05, the size of Australia's annual T-457 visa intake grew almost threefold, rising from 17 thousand to more than 48 thousand. The program makes up 47.3% of gross skilled migrant intake in the financial year 2011/12, and is projected to make up just under 60% of the gross skilled migrant intake for the period up to 2021/22 (DIAC, 2012a). For policy statements relating to the T-457 program and regional development, see Bowen (2012). For the description of the program, see DIAC (2012b).

¹⁶ 3.4 thousand persons represents 10% of the forecast 2011/12 gross inflow of T-457 visa holders. Our baseline forecasts for yearly gross inflows and outflows of persons by visa category between 2011/12 and 2021/22 were supplied by DIAC. These forecast inflows and outflows form part of the shocks that define out baseline.

Figure 1. Persons, by visa type (percentage deviation from baseline)



In Figure 1 we see that the increase in the 2012/13 T-457 inflow generates a temporary increase in the stock of T-457 visa holders. Two forces gradually return the T-457 visa stock to its baseline value. First, approximately 16% of T-457 visa holders return overseas each year.¹⁷ Second, the model's visa transition matrix shows that approximately 10% of T-457 visa holders move to a different visa category each year.¹⁸ It is these movements out of the T-457 visa category that accounts for the steady decline in the T-457 visa stock in Figure 1. For T-457 visa holders, the main visa destinations for those changing visa type are P-Other and P-Skilled. This accounts for the positive deviations in the stock of these visa categories in Figure 1.¹⁹

4.2 Macro results

Figure 2 reports deviations in employment, capital stock and real GDP. The positive deviation in T-457 visa holders generates a positive deviation in labour supply and employment. The employment deviation peaks in the first year of the simulation. Thereafter

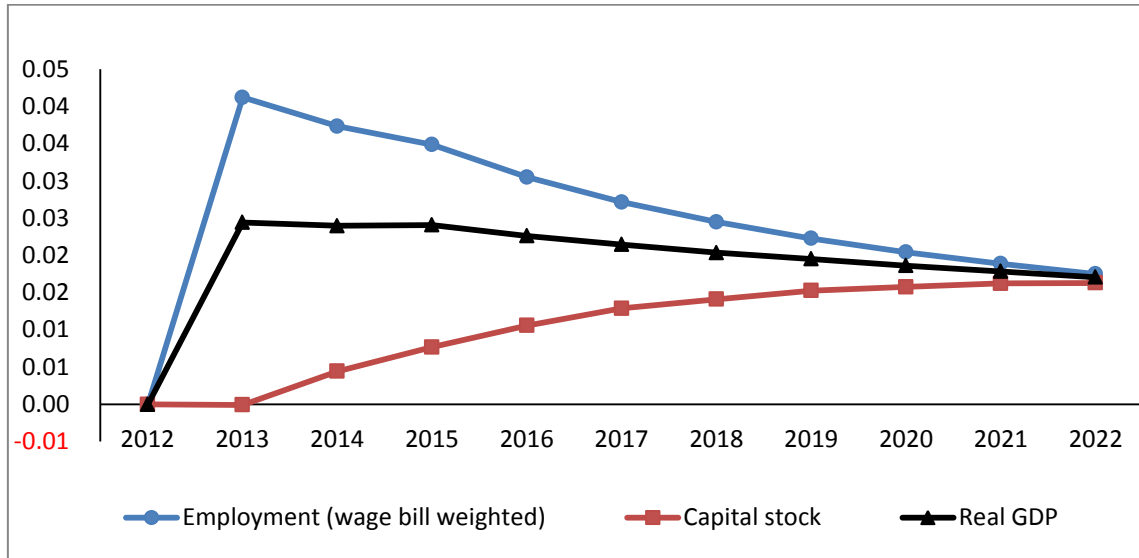
¹⁷ The model's database contains DIAC data on both the annual stock of persons by visa category and gross emigration numbers by visa category. Dividing the latter by the former yields gross emigration rates by visa category. For the T-457 category, this rate is approximately 16%.

¹⁸ The visa transition matrix describes, for each visa category, the annual probability of a person remaining within the same visa class or moving to a new visa class. The visa transition matrix is constructed from a number of official data sources. We begin with a 2007/08 transition matrix constructed from Characteristics of Recent Migrants Surveys 2007 and 2010 (ABS, 2007, 2010) for permanent visa holders, and DIAC's NOM data (DIAC, 2011c) for temporary visa holders. To generate transition matrices for subsequent years, we use DIAC values for annual stocks of persons by visa category (DIAC, 2011a, 2011b) together with DIAC values for gross foreign inflows and foreign outflows (DIAC, 2012a) to calculate changes in stock numbers due to people moving between visa categories. The latter is used to dynamically adjust the initial transition matrix.

¹⁹ The reader will see that the deviation in P-Other exceeds the deviation in P-Skilled. This reflects the relative sizes of the underlying stocks of persons in these categories, rather than differences in the rate at which T-457 visa holders move into these categories. On average, the stock of P-Other is only about 13.5% of the size of the stock of P-Skilled over the baseline forecast.

it gradually declines as the T-457 visa holders emigrate or transition to other visa categories. Since the visa categories to which the T-457 visa holders transition have lower emigration rates than the T-457 category, the increase in 2012/13 T-457 inflows generates a long-run permanent increase in employment (Figure 2).

Figure 2. Employment, real GDP and capital stock (percentage deviation from baseline)



Capital stocks are sticky in the short run, since they can only deviate from baseline if investment deviates from baseline. With the capital stock responding only gradually to the positive employment deviation, in the short run the labour/capital ratio rises relative to baseline (Figure 2). The short-run increase in the labour/capital ratio causes the marginal product of capital, and with it, the rate of return on capital, to rise relative to baseline. Our model assumes a positive relationship between investment and rates of return. Hence, investment rises relative to baseline in the short run (Figure 3). Over time, the positive deviation in real investment causes the capital stock to rise relative to baseline (Figure 2). By the end of the simulation period the employment and capital deviations are of a similar magnitude, signalling a return of the labour/capital ratio to close to its baseline value (Figure 2). With the capital stock above baseline at the end of the simulation period, so too must be the investment deviation so as to maintain the new higher level of the capital stock (Figure 3). By the end of the simulation period, with both employment and the capital stock above baseline, the real GDP deviation must be positive (Figure 2).

Figure 4 plots deviation paths for real GDP, and the components of domestic absorption. In our policy simulation, we assume that the national propensity to consume out of GNP follows its baseline value. We note that the difference between GDP and GNP is net income on the country's net foreign assets. Recall that Figure 3 reports a growing positive capital deviation. This capital deviation is partly financed by foreign borrowing. Interest payments on these borrowings gradually damp the real GNP deviation relative to the real GDP deviation. In Figure 4, this partly explains why the real consumption and real GDP deviations track closely in the early years of the simulation, but over time, the real

consumption deviation comes to track below the real GDP deviation. A second factor damping the real consumption deviation relative to the real GDP deviation is a decline in the terms of trade relative to baseline.

Figure 3. Investment and capital stock *(percentage deviation from baseline)*

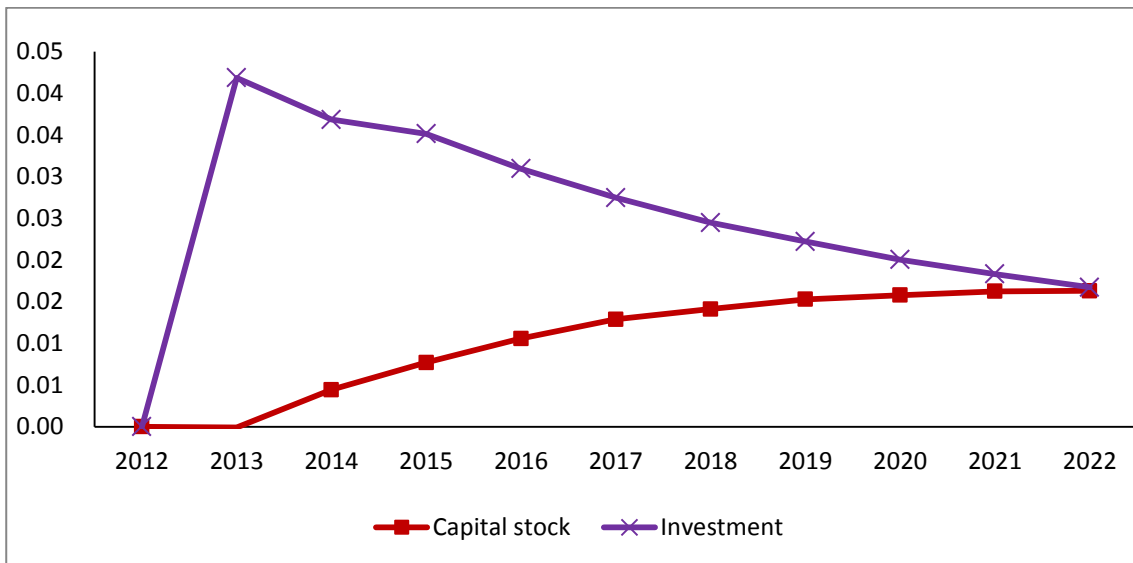
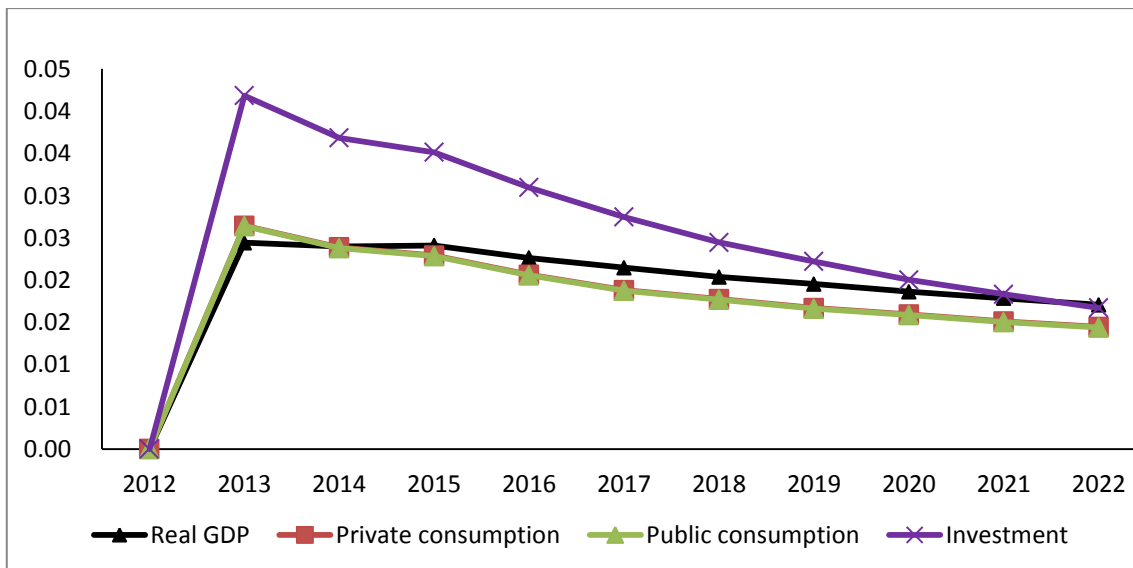


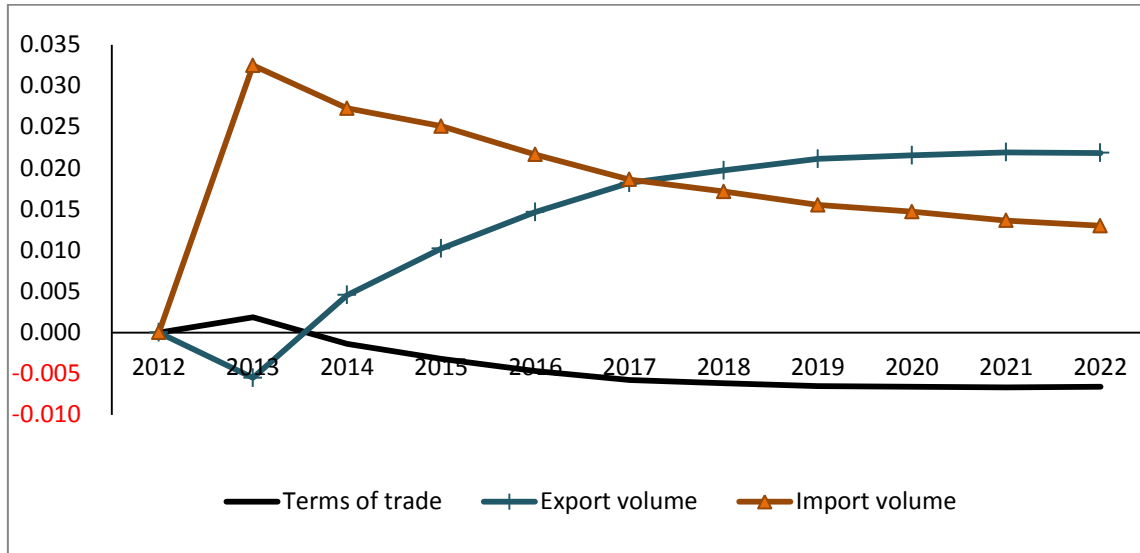
Figure 4. Real GDP and components of real domestic absorption *(percentage deviation from baseline)*



The real investment deviation peaks in the simulation's first year. Together, the short-run deviations in real consumption spending and real investment spending generate a deviation in real GNE that exceeds the deviation in real GDP. This requires the short-run real balance of trade to move towards deficit (Figure 5). Over time, we see the real investment and real GDP deviations converging. At the same time, we see the long-run real consumption deviation lying below the real GDP deviation. Together, these long-run movements in real investment and real consumption relative to real GDP generate a deviation in real GNE that

lies below the deviation in real GDP (Figure 4). This accounts for the long-run movement towards real balance of trade surplus described in Figure 5. We also see in Figure 5 that the import deviation is positive in the long run. This reflects an activity effect: with real GDP higher in the long run, so too are import volumes.

Figure 5. Export, import and the terms of trade (percentage deviation from baseline)



4.3 Sectoral results

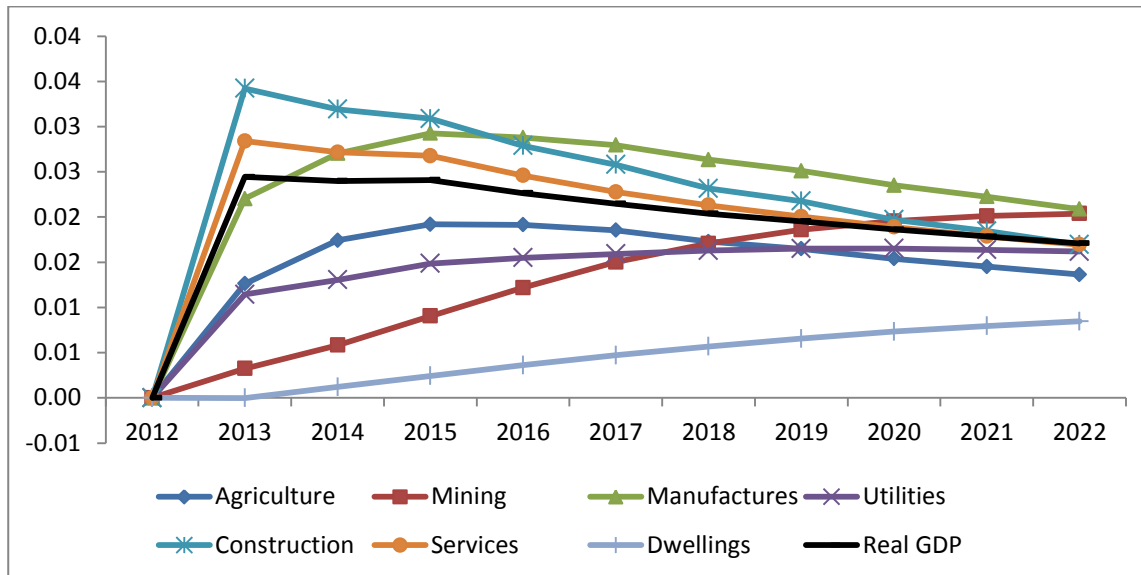
The model contains 36 industries. To facilitate reporting and discussion of results, we aggregate the outcomes for the 36 industries to outcomes for 7 broad sectors. Figure 6 reports percentage deviations in output by sector at the national level. In the first year of the simulation the construction sector experiences the largest deviation in output. This reflects the strong positive deviation in short-run aggregate investment (see Figure 3). As discussed earlier, the aggregate investment deviation declines throughout the simulation period. This accounts for the steady attenuation of the construction output deviation in Figure 6.

The second-ranked sector in terms of short-run output deviation is services. This is so for two reasons. First, the services sector is labour intensive. As such, it gains from the expansion in labour supply generated by the policy. Second, the services sector sells the bulk of its output to private and public consumption spending. With real consumption rising strongly in the short run (see Figure 4), so too does output of the services sector. In Figure 4 we see the real consumption deviation declining over time. This accounts for the gradual decline in the services output deviation in Figure 6.

The short-run deviation in output of manufactures is close to the short-run deviation in real GDP. In the long run, the output deviation for manufactures lies above the real GDP deviation. This is so for two reasons. First, manufactures is relatively labour intensive. Hence it benefits from the increase in labour supply generated by the policy. Second,

manufactures is import-competing. In Figure 5 we see the real balance of trade moving towards surplus in the long run. This requires the real exchange rate to depreciate relative to the baseline, which assists trade-exposed sectors like manufacturing.

Figure 6. Sectoral output (*percentage deviation from baseline*)



In the short run, utilities is the fourth-ranked sector in terms of output deviation. Throughout the simulation the output deviation for utilities lies below the real GDP deviation. The relatively small output deviation for utilities can be traced to two main factors. First, the sector is relatively capital intensive, and as such does not gain to the same degree as other sectors from the expansion in labour supply. Second, consumer demand for utilities is income-inelastic, hence we expect the deviation in utility output to lie below the deviation in real consumption.

The deviation in agricultural output is relatively steady throughout the simulation period. In the short run the scope for deviation in agricultural output is somewhat constrained by the fixity of both capital and land supply. In the long run, as a trade-exposed sector, agriculture benefits from real depreciation.

Like agriculture, the scope for short run deviation in the output of mining is constrained by both its capital intensity and the fixity of short-run capital stocks. In the long run, as a trade-exposed sector, mining benefits from real depreciation. This accounts for the growing positive deviation in mining output in Figure 6.

The sector with the smallest short run output deviation is dwellings. In the short run, this reflects the fixity of the dwelling capital stock. However, output of dwellings gradually rises relative to baseline as dwellings investment responds to the increase in demand for dwelling services which arises from the increase in private consumption.

4.4 Regional results

Our model contains 15 regions: the ACT and capital cities and state balances for the remaining seven states and territories. To facilitate reporting and discussion of results, in Figures 7 and 8 we report employment and real GDP outcomes at the state level.

In the first year of the simulation, the largest employment deviations are experienced by WA, NSW, QLD, and VIC. This reflects the database destination for new T-457 arrivals, which are weighted towards these regions. The distribution of real GDP outcomes in the simulation's first year closely reflects the distribution of employment outcomes: the four regions experiencing the largest short run deviations in real GDP are NSW, VIC, QLD, and WA.

Consistent with the steady attenuation of the national employment deviation in Figure 1, in Figure 7 we see steady declines in the state level employment deviations. This reflects the same phenomenon underlying the steady attenuation of the national employment deviation, namely, the gradual departure overseas of those of the additional 2012/13 T-457 visa holders who have not transitioned to other visa categories with low emigration rates. Consistent with the long-run attenuation of state employment deviation in Figure 7, Figure 8 shows long-run attenuation of the state real GDP deviations.

Figure 7. Employment, by state (percentage deviation from baseline)

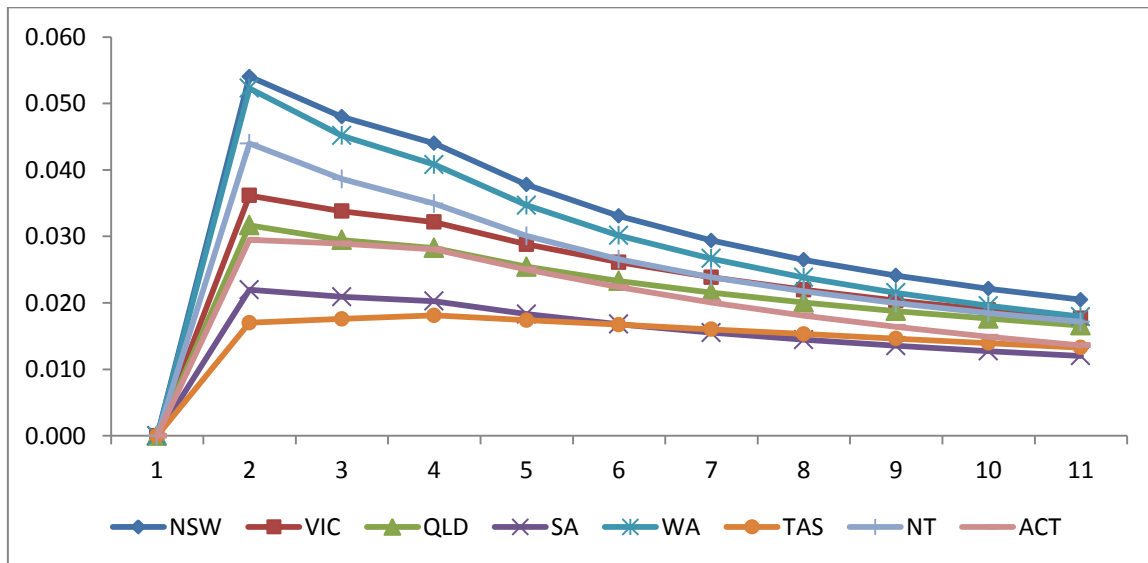
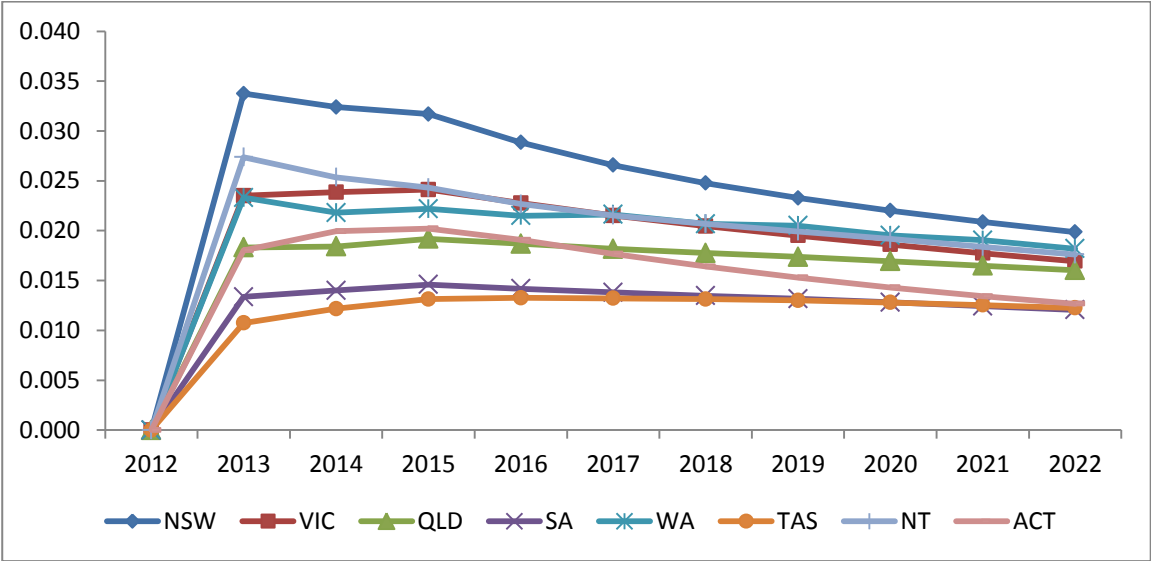


Figure 8. State real GDP *(percentage deviation from baseline)*



5 ANALYSIS OF A PERMANENT 10% INCREASE IN THE INFLOWS TO THE P-SKILLED VISA CATEGORY

5.1 Introduction

We examine the effects of a permanent increase in the permanent skilled (hereafter P-Skilled) visa grants. In 2012/13 we increase by 10% relative to baseline two sources of inflows to the stock of P-Skilled visa holders: (1) gross NOM arrivals, (2) transitions into P-Skilled from other visa types. To increase the first inflow, we increase directly the number of NOM arrivals by 10% relative to baseline. To increase the second inflow, we increase the transition probabilities into P-Skilled by 10%. Figure 1 reports the percentage deviations in the number of inflows into the P-Skilled visa stock for these sources. In the first year, the deviation for both sources is 10%. Thereafter, the deviation in gross annual arrivals remains at 10%. However, the deviation in transition inflows declines slightly because of declines in the stocks of those on-shore visa holders that transition into P-Skilled. As discussed in reference to Figure 2, the stocks of visa types that transition into P-Skilled decline relative to baseline because, as discussed above, the second of our two shocks involves a rise in transition probabilities into P-Skilled.

Figure 1. Inflows to P-Skilled by source *(percentage deviation from baseline)*

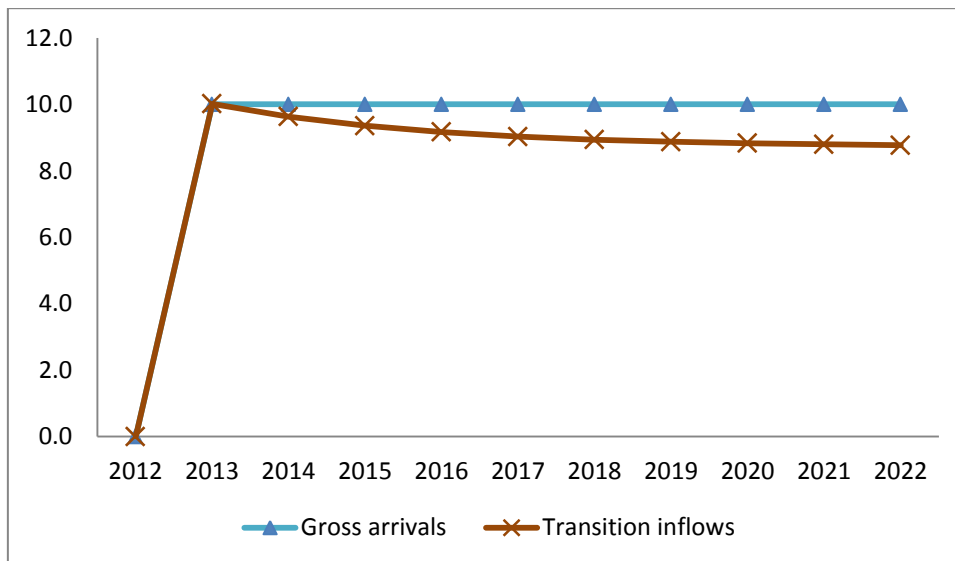
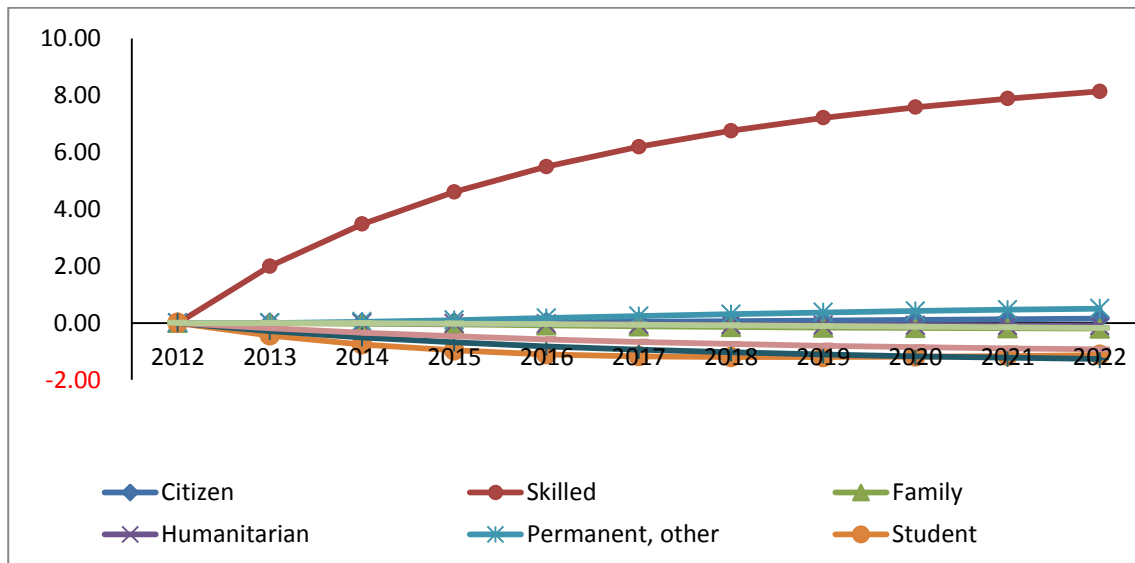


Figure 2 plots the deviation paths for numbers of persons classified by visa. Consistent with our permanent increase in the annual inflow of P-Skilled, we see in Figure 2 that the stock of P-Skilled visa holders grows steadily, but at a declining rate. By the end of the simulation period, the stock of P-Skilled visa holders has begun to plateau at a level approximately 8.5% above baseline. The plateauing of the deviation in P-Skilled visa holders reflects the fact that any given year's addition to the stock of P-Skilled does not represent a permanent addition to the stock. Over time, people move out of the P-Skilled category by either

becoming citizens, transitioning to another visa category, or emigrating overseas. By 2022, outflows via these routes almost match the new higher level of inflows, generating the plateauing of the P-Skilled visa stock evident in Figure 2.

Figure 2. Persons, by visa type *(percentage deviation from baseline)*



Recall that one source of the expanded inflows into P-Skilled are higher transition probabilities for P-Skilled's pathway visas. The transition matrix shows that the following four visas are pathways to P-Skilled: T-Student, T-457, T-Other and New Zealanders. We increase the transition probabilities into P-Skilled for these visa categories by 10%. To maintain baseline row sums across transition probabilities for these visa categories, we reduce diagonal transition probabilities. That is, we reduce the probability of remaining in the same visa category by the same amount as the increase in the probability of moving to P-Skilled. This accounts for the reduction in stocks of T-Student, T-457, T-Other and New Zealanders reported in Figure 2. Figure 2 also reports small reductions in the stocks of P-Family and P-Humanitarian. This is due to the negative deviations in the stocks of T-Student, T-457 and T-Other. Our transition matrix records small transition probabilities for T-Student and T-Other into P-Humanitarian. Together with T-Other, all three visa categories record small transition probabilities into P-Family.

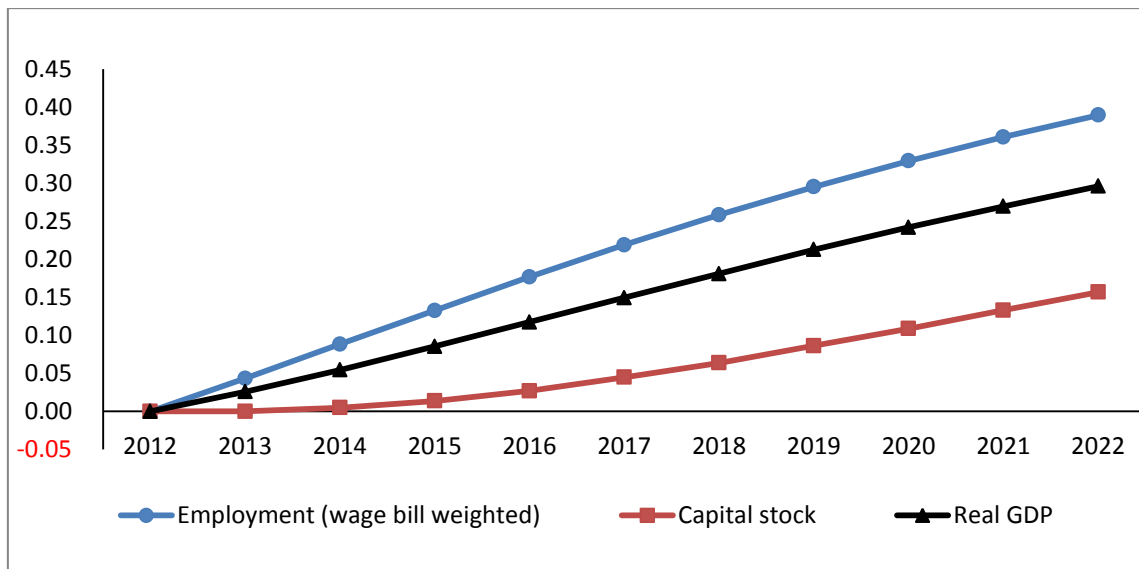
Figure 2 also records small positive deviations in the P-Other and Citizen categories. Our transition matrix shows P-Skilled to be an important pathway to the Citizen category. Hence the positive deviation in P-Skilled generates a positive deviation in Citizen. Similarly, the transition matrix records a small probability for P-Skilled to transition to P-Other. As such, the positive deviation in P-Skilled also generates a positive deviation in P-Other.

5.2 Macro results

Figure 3 reports deviations in employment, capital stock and real GDP. The deviations in employment and capital stock grow throughout the simulation period. This accounts for the growing positive real GDP deviation in Figure 3.

The positive deviation in P-Skilled visa holders generates a positive deviation in labour supply and employment. Note that in Figure 2, while the rate of increase in the employment deviation declines over time, this decline is not as rapid as that exhibited by the P-Skilled deviation in Figure 2. As discussed in Section 1, the P-Skilled deviation plateaus chiefly because P-Skilled visa holders become citizens or emigrate. Outflows from the Citizen category arise from deaths and emigration. Rates of outflow via these routes have not yet matched the inflows from the increase in P-Skilled by the end of the simulation period. This explains why the employment deviation has not yet reached a plateau by the end of the simulation period.

Figure 3. Employment, real GDP and capital stock (percentage deviation from baseline)



Capital stocks are sticky in the short run, since they can only deviate from baseline if investment deviates from baseline. With the capital stock responding gradually to the positive employment deviation, in the short run the labour/capital ratio rises relative to baseline (Figure 3). The short-run increase in the labour/capital ratio causes the marginal product of capital, and with it, the rate of return on capital, to rise relative to baseline. Our model assumes a positive relationship between investment and rates of return. Hence, investment rises relative to baseline in the short run (Figure 4). Over time, the positive deviation in real investment causes the capital stock to rise relative to baseline (Figure 3). In Figure 4 we see that the investment deviation remains above the capital deviation at the end of the simulation period. This reflects a lagged response to the growth in employment. Unlike simulation 1, a once-off boost to T-457 numbers, the present simulation results in growing additions to employment relative to baseline in every year of the simulation. By the

end of the simulation period, investors are still responding to this growing employment deviation.

Figure 4. Investment and capital stock *(percentage deviation from baseline)*

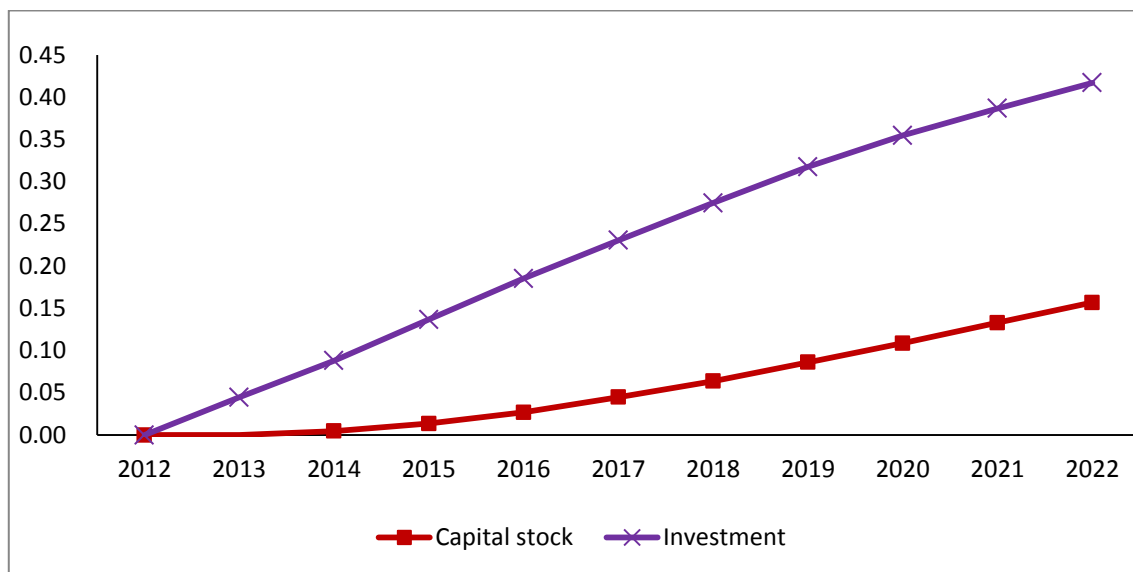


Figure 5 plots deviation paths for real GDP, and the components of domestic absorption. In our policy simulation, we assume that the national propensity to consume out of GNP follows its baseline value. We note that the difference between GDP and GNP is net income on the country's net foreign assets. Recall that capital stock experiences a growing positive deviation. This capital deviation is partly financed by foreign borrowing. Interest payments on these borrowings gradually damp the real GNP deviation relative to the real GDP deviation. In Figure 5, this partly explains why the real consumption and real GDP deviations track closely in the early years of the simulation, but over time, the real consumption deviation comes to track below the real GDP deviation. A second factor damping the real consumption deviation relative to the real GDP deviation is a decline in the terms of trade relative to baseline (Figure 6).

The real investment deviation lies above the real GDP deviation throughout the simulation period. In the first half of the simulation period the real consumption and real GDP deviations track closely together. Hence, with the real investment deviation lying above the real GDP deviation, in the first half of the simulation period, the real GNE deviation lies above the real GDP deviation. This requires the short-run real balance of trade to move towards deficit (Figure 6). In the latter half of the simulation period, we see the long-run real consumption deviation lying below the real GDP deviation (Figure 5). This accounts for the gradual attenuation of the movement towards balance of trade deficit evident in Figure 6.

Figure 5. Real GDP and components of real domestic absorption (percentage deviation from baseline)

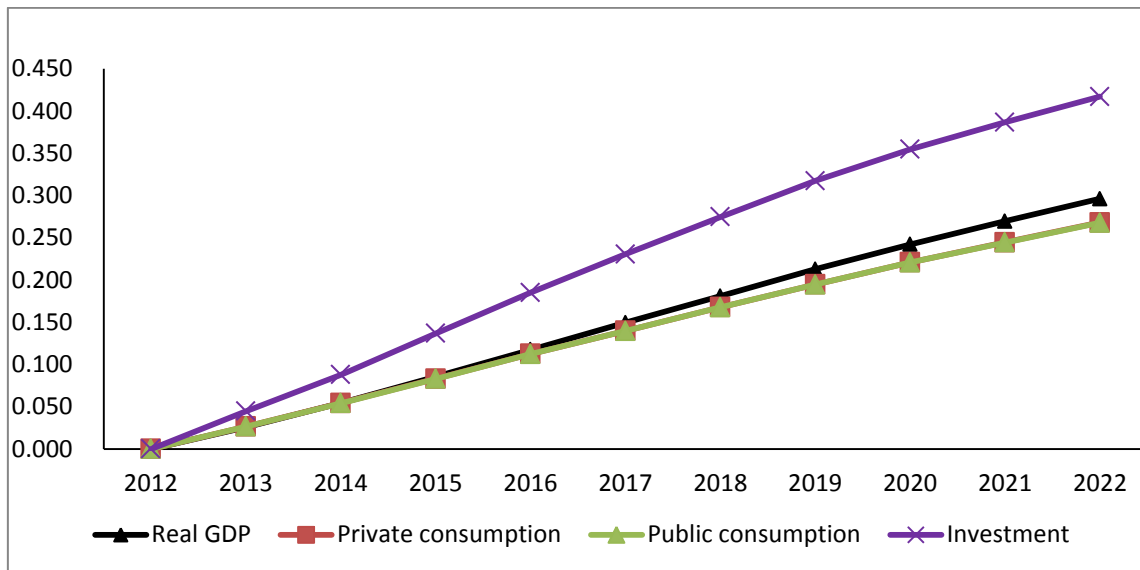


Figure 6. Export, import and the terms of trade (percentage deviation from baseline)

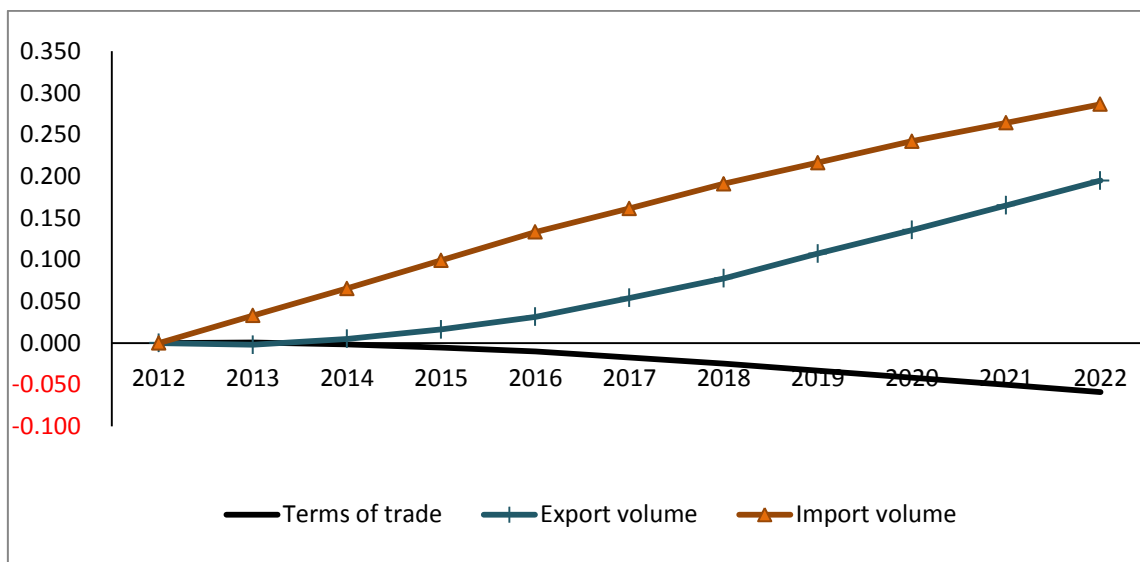


Figure 6 shows a growing positive deviation in import volumes. This reflects an activity effect: the growing positive real GDP deviation generates a growing positive deviation in import volumes.

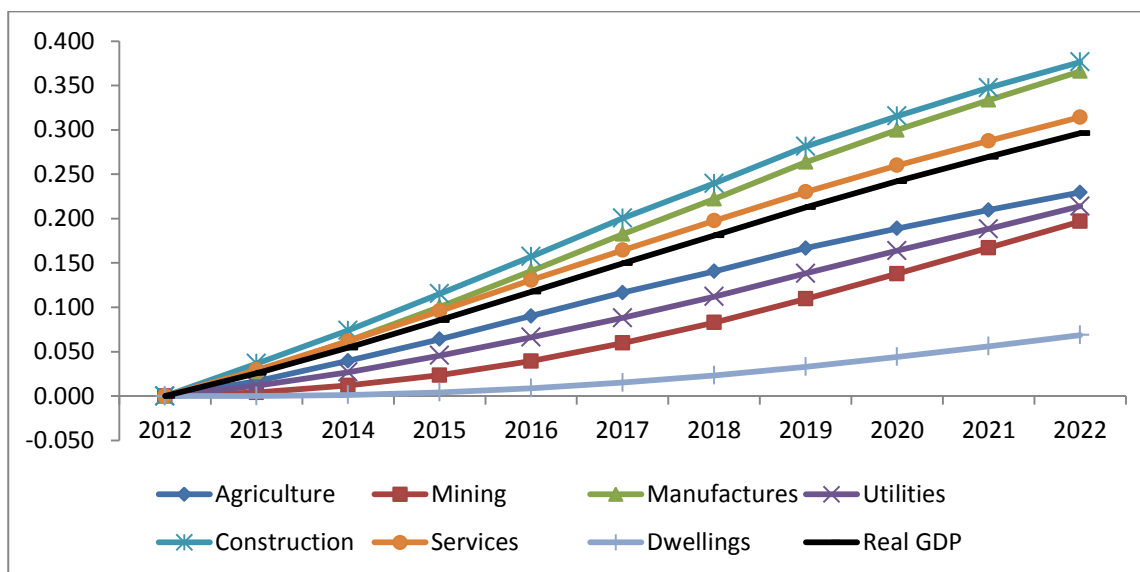
5.3 Sectoral results

The model contains 36 industries. To facilitate reporting and discussion of results, we aggregate the outcomes for the 36 industries to outcomes for 7 broad sectors. Figure 7 reports percentage deviations in output by sector at the national level. Consistent with the growing positive deviation in aggregate activity reported in Figure 3, all sectors experience growing positive output deviations throughout the simulation period. Note in Figure 3 that the deviation in employment exceeds the deviation in the capital stock. Broadly, we shall see

this macro outcome also reflected in the sectoral results, with deviations in the output of labour-intensive sectors tending to exceed deviations in the output of capital-intensive sectors.

The construction sector experiences the largest deviation in output. This reflects the strong positive deviation in aggregate investment (see Figure 4). The manufacturing and services sectors also experience strong positive output deviations. For manufacturing, this outcome reflects its relative labour intensity. In the case of services, its strong output deviation reflects two factors. First, it sells a high proportion of its outputs to public and private consumption. As a result, there is a tendency for the sector to closely track the output deviation for aggregate real consumption. As discussed in reference to Figure 5, the real consumption deviation closely tracks the real GDP deviation. Second, the sector benefits from an improvement in its relative cost position because it is intensive the use of the occupation professionals. The visa category P-Skilled supplies relatively heavily to this occupation.

Figure 7. Sectoral output (percentage deviation from baseline)

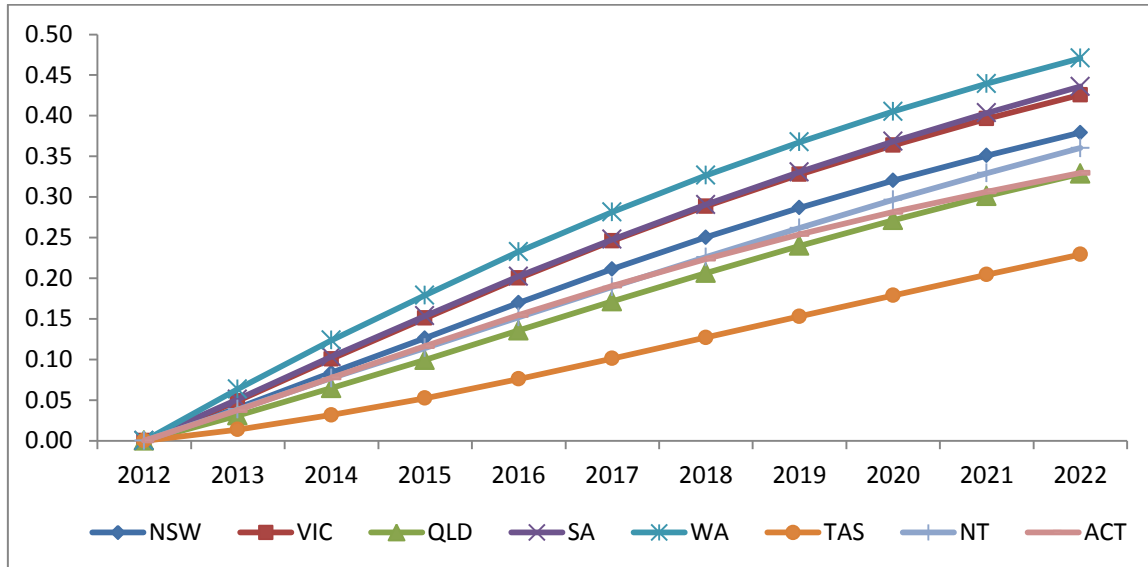


The deviation in utilities output lies below the real GDP deviation. This reflects the relative capital intensity of this sector. Like the utilities sector, mining is also capital intensive. In addition, both mining and agriculture sell high shares of their output to the export sector. As discussed in reference to Figures 5 and 6, the export volume deviation lies below the real GDP deviation. With prospects for agriculture and mining largely governed by prospects for aggregate export volumes, in Figure 7 we see the output deviations for these sectors lying below the real GDP deviation. As the most capital-intensive sector, the dwellings sector experiences the lowest output deviation.

5.4 Regional results

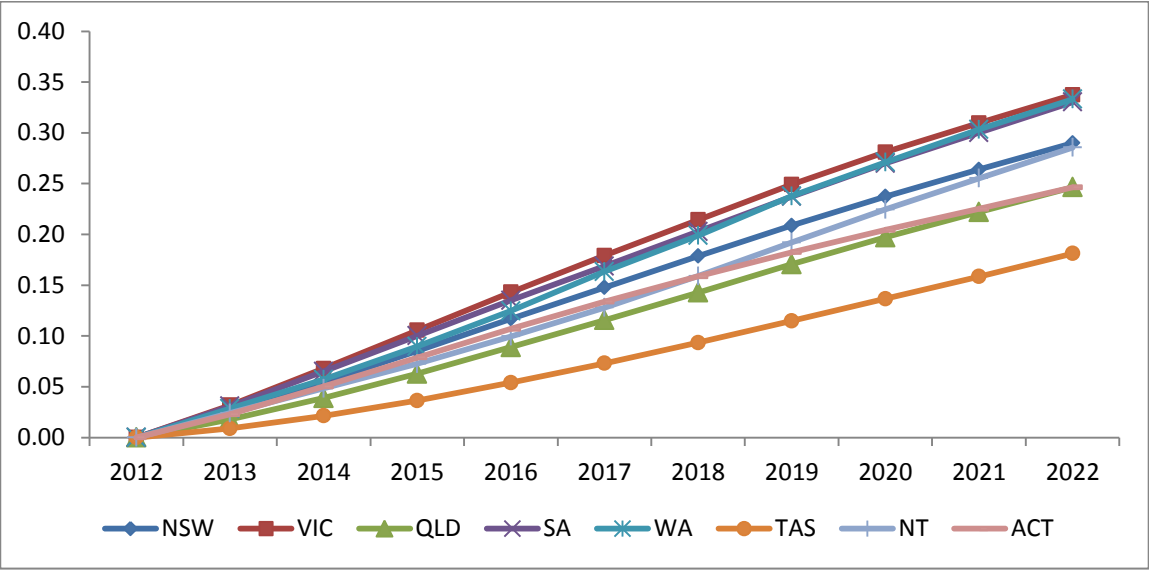
Our model contains 15 regions: the ACT and capital cities and state balances for the remaining seven states and territories. To facilitate reporting and discussion of results, in Figures 8 and 9 we report employment and real GDP outcomes at the state level.

Figure 8. Employment, by state (percentage deviation from baseline)



The largest employment deviations are experienced by WA, SA and VIC. The lowest employment deviations are experienced by TAS, NT and QLD. This largely reflects the destinations for new P-Skilled arrivals, which are more heavily weighted towards the former regions. The distribution of real GDP outcomes closely reflects the distribution of employment outcomes. Two exceptions are VIC and WA, with VIC's real GDP rank being higher than its employment deviation rank, and with WA's GDP deviation rank being lower than its employment deviation rank. This reflects sectoral outcomes. VIC is relatively intensive in manufacturing, which, as we saw in Figure 7, is relatively highly ranked in terms of output deviation. WA is relatively intensive in mining. In Figure 7, we see mining is relatively low ranked in terms of output deviation.

Figure 9. State real GDP *(percentage deviation from baseline)*

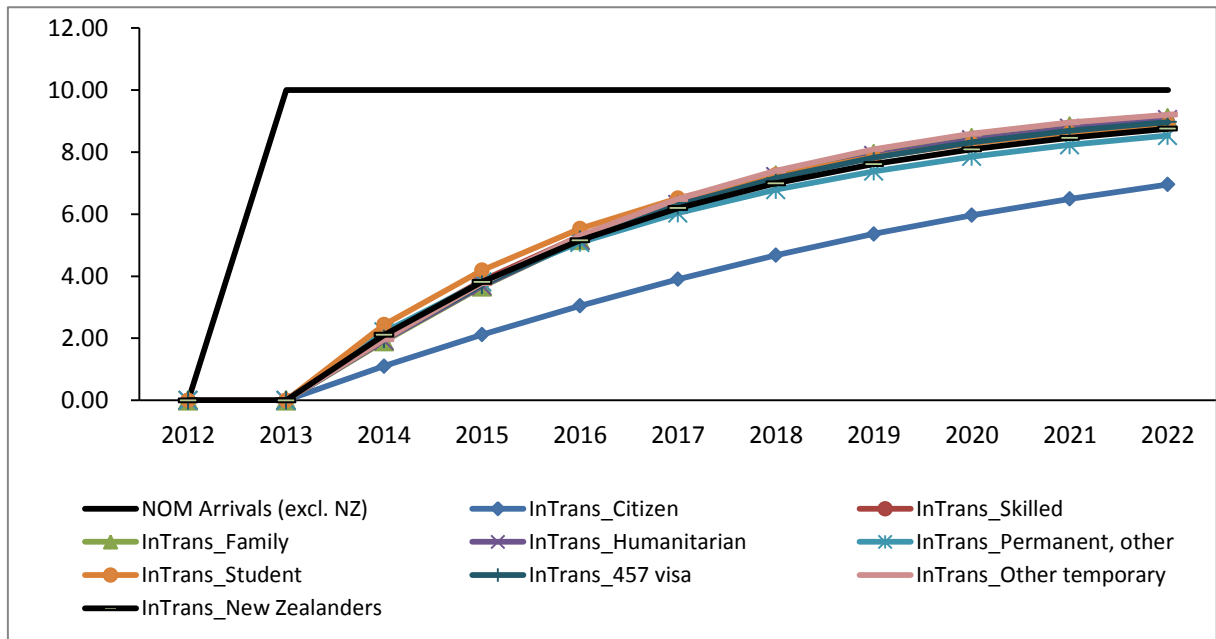


6 ANALYSIS OF A PERMANENT 10% INCREASE IN GROSS ARRIVALS OF NON-NZ VISA CATEGORIES

6.1 Introduction

We examine the effects of a 10% permanent increase in gross arrivals of all visa categories, excluding New Zealanders, from 2012/13 onwards.²⁰ Over time, this increases visa stocks via two routes (see Figure 1). First, NOM arrivals for all visa categories (excluding New Zealanders) rise by 10% relative to baseline from 2013 onwards. Second, higher NOM arrivals, by increasing visa stocks, increase intra-visa inflows via the transition matrix. Figure 1 reports the percentage deviations in inflows into each visa category via these two sources.

Figure 1. Inflows to all visa types by source (percentage deviation from baseline)



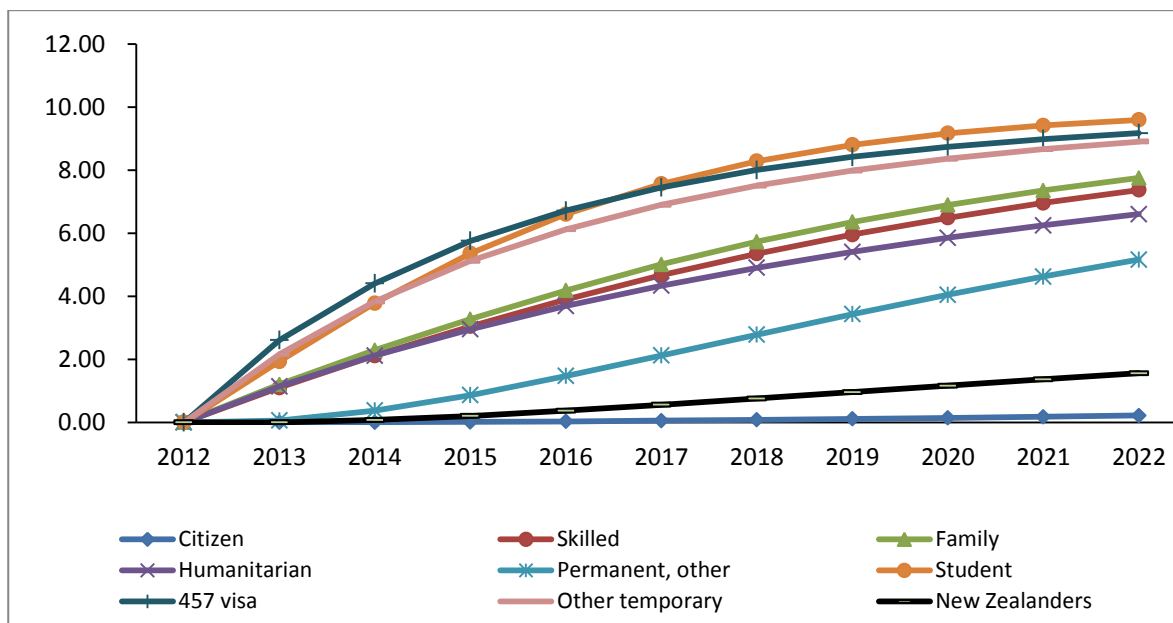
The increase in 2012/13 NOM arrivals reported in Figure 1 generates growing positive deviations in visa stock from 2012/13 onwards. It is these growing visa stocks that accounts for the growing positive deviations in transition inflows evident in Figure 1.²¹

²⁰ Our model distinguishes Australian citizens and holders of eight visa categories, namely: New Zealanders, permanent skilled (P-Skilled), permanent family (P-Family), permanent humanitarian (P-Humanitarian), other permanent visas (P-Other), temporary student (T-Student), temporary long-term business visa subclass 457 (T-457), and other temporary visas (T-Other). Our simulation involves a permanent 10% increase in arrivals of the latter seven visa categories.

²¹ In Figure 1 we see that deviations in transition inflows begin with a one year lag. Our model calculates visa transition at the start of each year by applying transition probabilities to values of visa stocks at the end of the previous year. This accounts for the one-year lag in Figure 1. The reader might note that in Simulation 2 the deviations in transition inflows begin in the first year. This reflects the shocks in simulation 2. Simulation 2 simulates a policy of increasing both NOM arrival of P-Skilled visa holders, and grants of P-Skilled visas for on-shore visa holders. It is the latter shock that accounts for the immediate deviation in transition inflows in Simulation 2.

Eventually, the 10% positive deviation in NOM arrivals will generate 10% positive deviation in visa stocks. This point is reached when outflows (via transition, emigration and death) by visa category match the new higher level of inflows. Hence in Figure 2, by the end of the simulation period, we see the deviations in stocks by visa class at various stages of approach to a 10% asymptote. In Figure 2, we can discern three bands of visa category distinguished by the relative sizes of their stock deviation. The three temporary visa categories are approaching the 10% asymptote at the fastest rate, followed by the four permanent visa categories. The low deviation in New Zealand visa stocks simply reflects the fact that we have excluded New Zealanders from our otherwise general expansion in NOM arrivals. That there is any deviation in New Zealanders visa stocks at all simply reflects the fact that our transition matrix records small positive transition probabilities into this category.

Figure 2. Persons, by visa type (percentage deviation from baseline)



In Figure 2, the gap between the deviations in stocks of temporary visa holders and stocks of permanent visa holders reflects baseline differences in ratios of NOM arrivals to visa stocks across these visa categories. In general, for temporary visa holders, NOM arrivals represent a greater share of visa stocks than is the case for permanent visa holders.²² Hence, a 10% rise in NOM arrivals for temporary visa holders has a larger immediate impact on stocks of temporary visa holders relative to the impact on the stock of permanent visa holders of a 10% rise in permanent visa NOM arrivals.

In Figure 1 we see that the deviation in transitions into the Citizen category lags the deviation in transitions into other categories. This reflects the lower deviations in permanent

²² In the first year of the policy simulation, for example, the 10% increase in NOM arrivals constitutes 2.4%, 3.5% and 2.8% of stocks for T-Student, T-457 and T-Other respectively. In comparison, the 10% increase in NOM arrivals constitutes approximately 1.3 – 1.5% of permanent visa stocks.

visa categories in Figure 2. Permanent visa categories are the only sources of transition into the Citizen category.

6.2 Macro results

Figure 3 reports deviations in employment, capital stock and real GDP. The deviations in employment and capital stock grow throughout the simulation.

The positive deviation in the stock of all visa holders generates a positive deviation in labour supply and employment. Note that in Figure 3, while the rate of increase in the employment deviation declines over time, this decline is not as rapid as that exhibited by the visa stock deviations in Figure 2. As discussed in Section 1, the visa stock deviations plateau chiefly because visa holders become citizens or emigrate. Outflows from the Citizen category arise from deaths and emigration. Rates of outflow via these routes have not yet matched the inflows from the increase in NOM arrivals by the end of the simulation period. This explains why the employment deviation has not yet reached a plateau by the end of the simulation period.

Figure 3. Employment, real GDP and capital stock (percentage deviation from baseline)

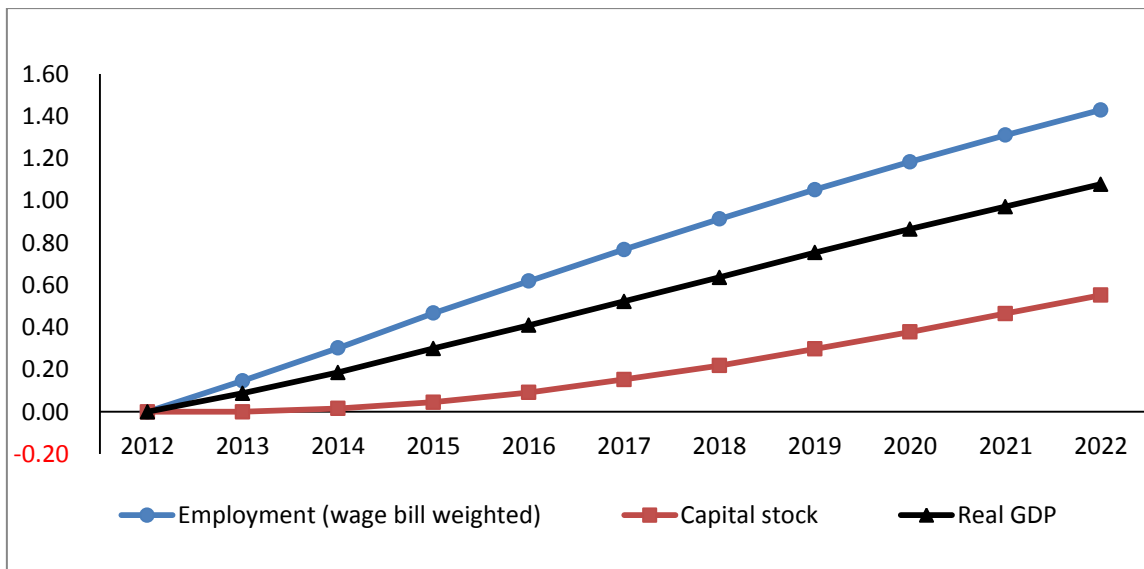
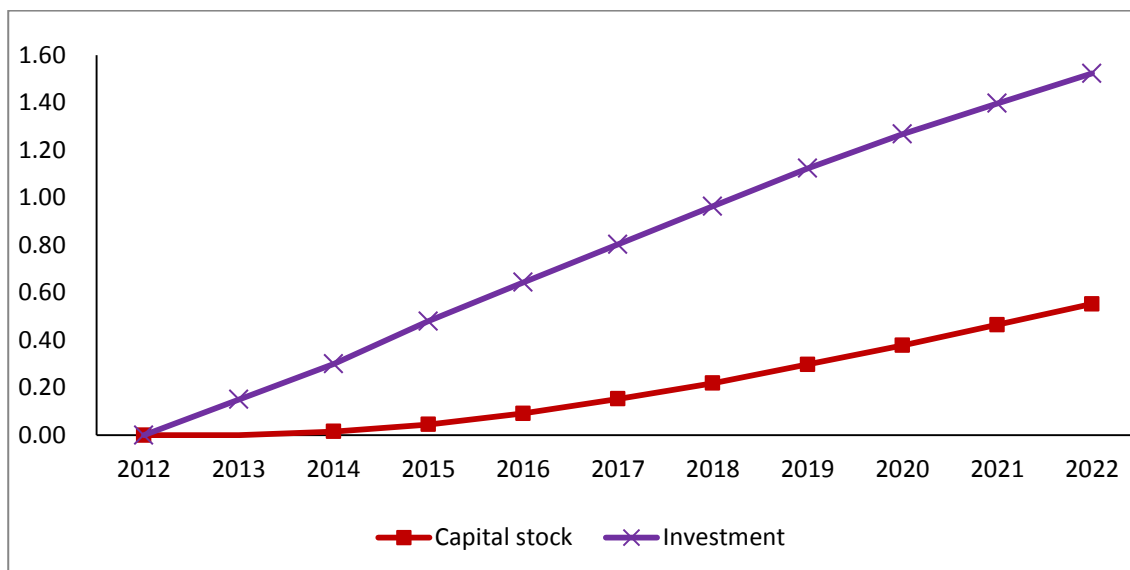


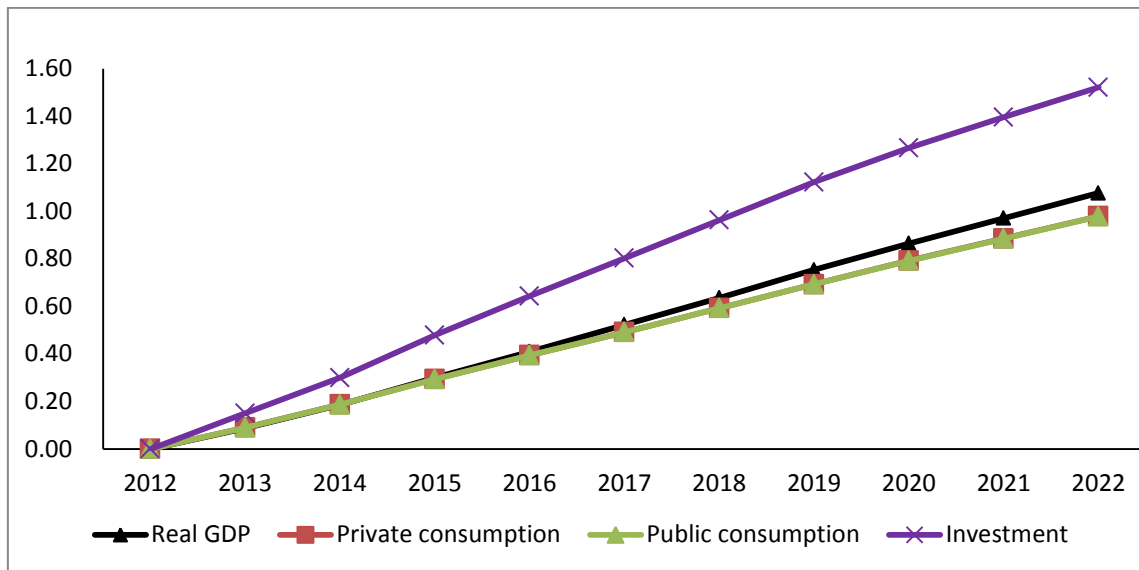
Figure 4. Investment and capital stock (percentage deviation from baseline)



Capital stocks are sticky in the short run, since they can only deviate from baseline if investment deviates from baseline. With the capital stock responding gradually to the positive employment deviation, in the short run the labour/capital ratio rises relative to baseline (Figure 3). The short-run increase in the labour/capital ratio causes the marginal product of capital, and with it, the rate of return on capital, to rise relative to baseline. Our model assumes a positive relationship between investment and rates of return. Hence, investment rises relative to baseline in the short run (Figure 4). Over time, the positive deviation in real investment causes the capital stock to rise relative to baseline (Figure 3). In Figure 4 we see that the investment deviation remains above the capital deviation at the end of the simulation period. This reflects a lagged response to the growth in employment.

Because the growth in employment continues throughout the simulation period, by the end of the simulation period, investors are still responding to the growing employment deviation. Figure 5 plots deviation paths for real GDP, and the components of domestic absorption. In our policy simulation, we assume that the national propensity to consume out of GNP follows its baseline value. We note that differences in GDP and GNP arise from movement in both net income on the country's net foreign assets and the terms of trade. Recall that the capital stock experiences a growing positive deviation. This capital deviation is partly financed by foreign borrowing. Interest payments on these borrowings gradually damp the real GNP deviation relative to the real GDP deviation. In Figure 5, this partly explains why the real consumption and real GDP deviations track closely in the early years of the simulation, but over time, the real consumption deviation comes to track slightly below the real GDP deviation. A second factor damping the real consumption deviation relative to the real GDP deviation is a decline in the terms of trade relative to baseline (Figure 6).

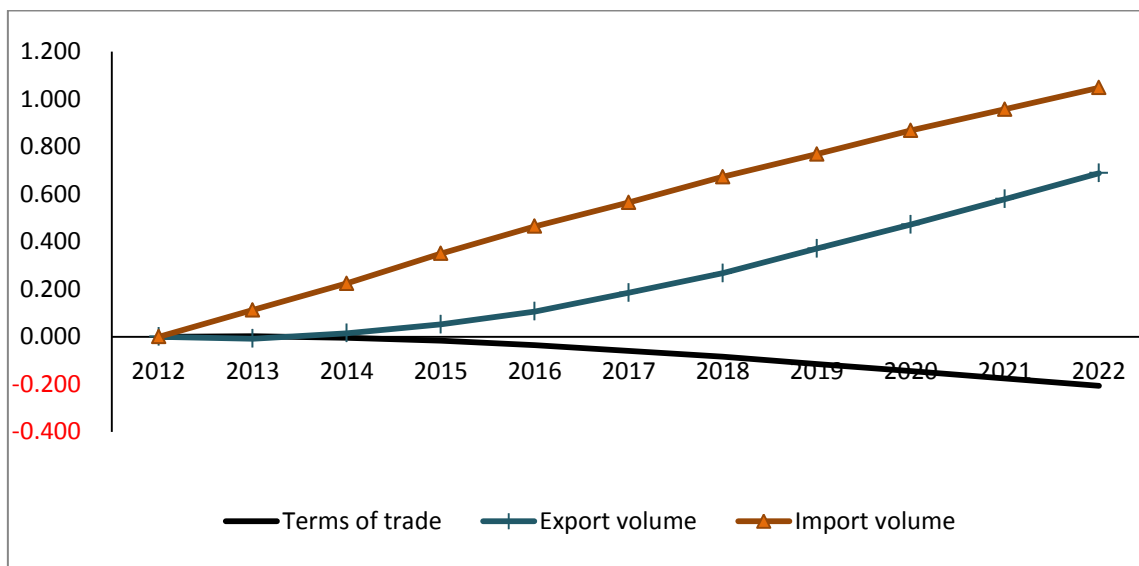
Figure 5. Real GDP and components of real domestic absorption (percentage deviation from baseline)



The real investment deviation lies above the real GDP deviation throughout the simulation period. In the first half of the simulation period the real consumption and real GDP deviations track closely together. Hence, with the real investment deviation lying above the real GDP deviation, in the first half of the simulation period, the real GNE deviation lies above the real GDP deviation. This requires the short-run real balance of trade to move towards deficit (Figure 6). In the latter half of the simulation period, we see the long-run real consumption deviation lying below the real GDP deviation (Figure 5). This accounts for the gradual attenuation of the movement towards balance of trade deficit evident in Figure 6.

Figure 6 shows a growing positive deviation in import volumes. This reflects an activity effect: the growing positive real GDP deviation generates a growing positive deviation in import volumes.

Figure 6. Export, import and the terms of trade (percentage deviation from baseline)

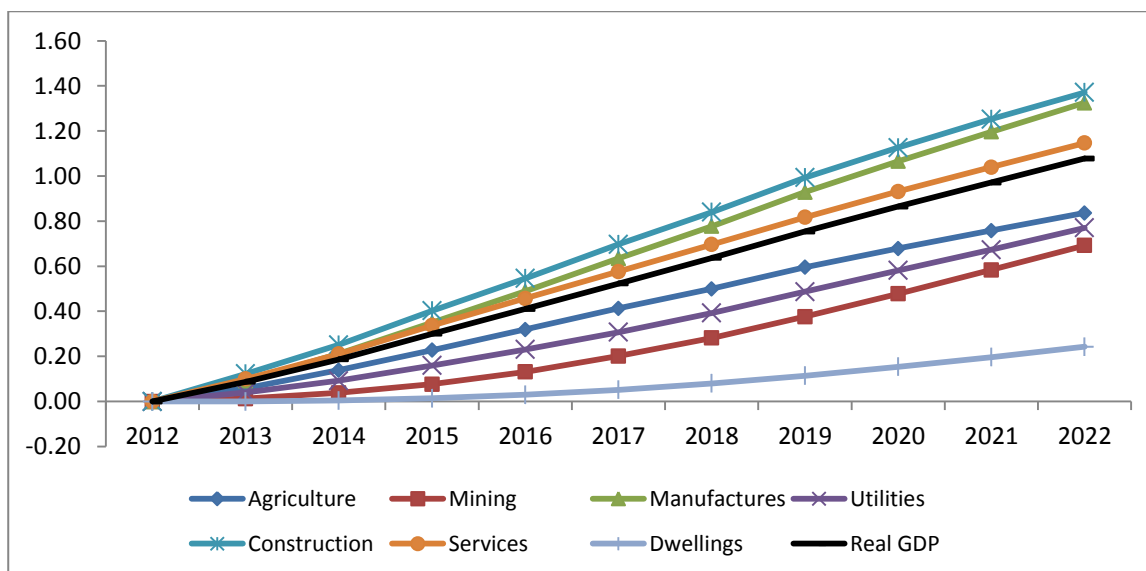


6.3 Sectoral results

The model contains 36 industries. To facilitate reporting and discussion of results, we aggregate the outcomes for the 36 industries to outcomes for 7 broad sectors. Figure 7 reports percentage deviations in output by sector at the national level. Consistent with the growing positive deviation in aggregate activity reported in Figure 3, all sectors experience growing positive output deviations throughout the simulation period. Note in Figure 3 that the deviation in employment exceeds the deviation in the capital stock. Broadly, we shall see this macro outcome also reflected in the sectoral results, with deviations in the output of labour-intensive sectors tending to exceed deviations in the output of capital-intensive sectors.

The construction sector experiences the largest deviation in output. This reflects the strong positive deviation in aggregate investment (see Figure 4). The manufacturing and services sectors also experience strong positive output deviations. For manufacturing, this outcome reflects its relative labour intensity. In the case of services, its strong output deviation reflects two factors. First, it sells a high proportion of its output to public and private consumption. As a result, there is a tendency for the sector to closely track the output deviation for aggregate real consumption. As discussed in reference to Figure 5, the real consumption deviation closely tracks the real GDP deviation. Second, the sector benefits from an improvement in its relative cost position because it is relatively labour intensive.

Figure 7. Sectoral output (*percentage deviation from baseline*)



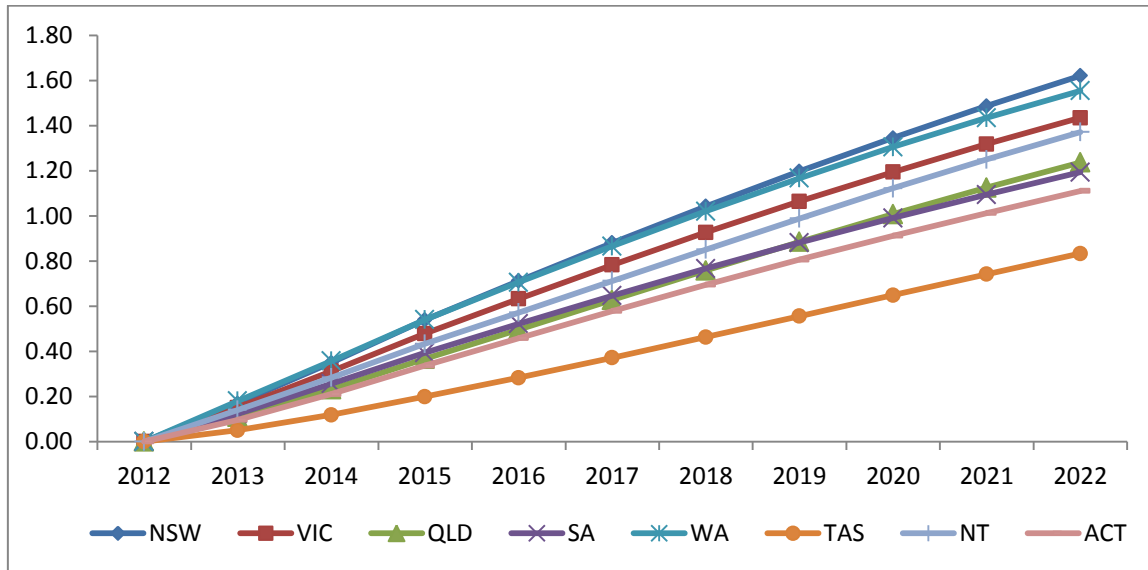
The deviation in utilities output lies below the real GDP deviation. This reflects the relative capital intensity of this sector. Like the utilities sector, mining is also capital intensive. In addition, both mining and agriculture sell high shares of their output to the export sector. As discussed in reference to Figures 5 and 6, the export volume deviation lies below the real GDP deviation. With prospects for agriculture and mining largely governed by prospects for aggregate export volumes, in Figure 7 we see the output deviations for these sectors lying

below the real GDP deviation. As the most capital-intensive sector, the dwellings sector experiences the lowest output deviation.

6.4 Regional results

Our model contains 15 regions: the ACT, and capital cities and state balances for the remaining seven states and territories. To facilitate reporting and discussion of results, in Figures 8 and 9 we report employment and real GDP outcomes at the state level.

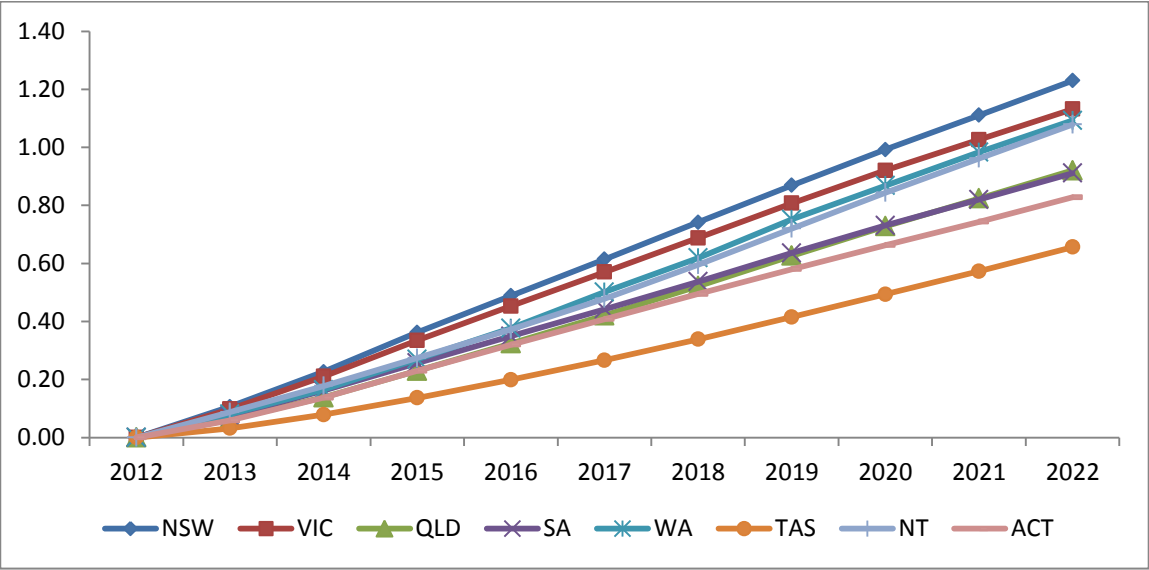
Figure 8. Employment, by state (percentage deviation from baseline)



The largest employment deviations are experienced by NSW, WA and VIC. The lowest employment deviations are experienced by TAS and the ACT. This distribution of regional employment outcomes largely reflects the destination shares of new arrivals. Relative to the regional distribution of employment, new arrivals have higher propensities to arrive in NSW, WA and VIC. Similarly, TAS and the ACT are low ranked destinations for new arrivals.

The distribution of real regional GDP outcomes closely reflects the distribution of employment outcomes. Two exceptions are VIC and WA, with VIC's real GDP rank being higher than its employment deviation rank, and with WA's GDP deviation rank being lower than its employment deviation rank. This reflects sectoral outcomes. VIC is relatively intensive in manufacturing, which, as we saw in Figure 7, is relatively highly ranked in terms of output deviation. WA is relatively intensive in mining. In Figure 7, we see mining is relatively low ranked in terms of output deviation.

Figure 9. State real GDP *(percentage deviation from baseline)*



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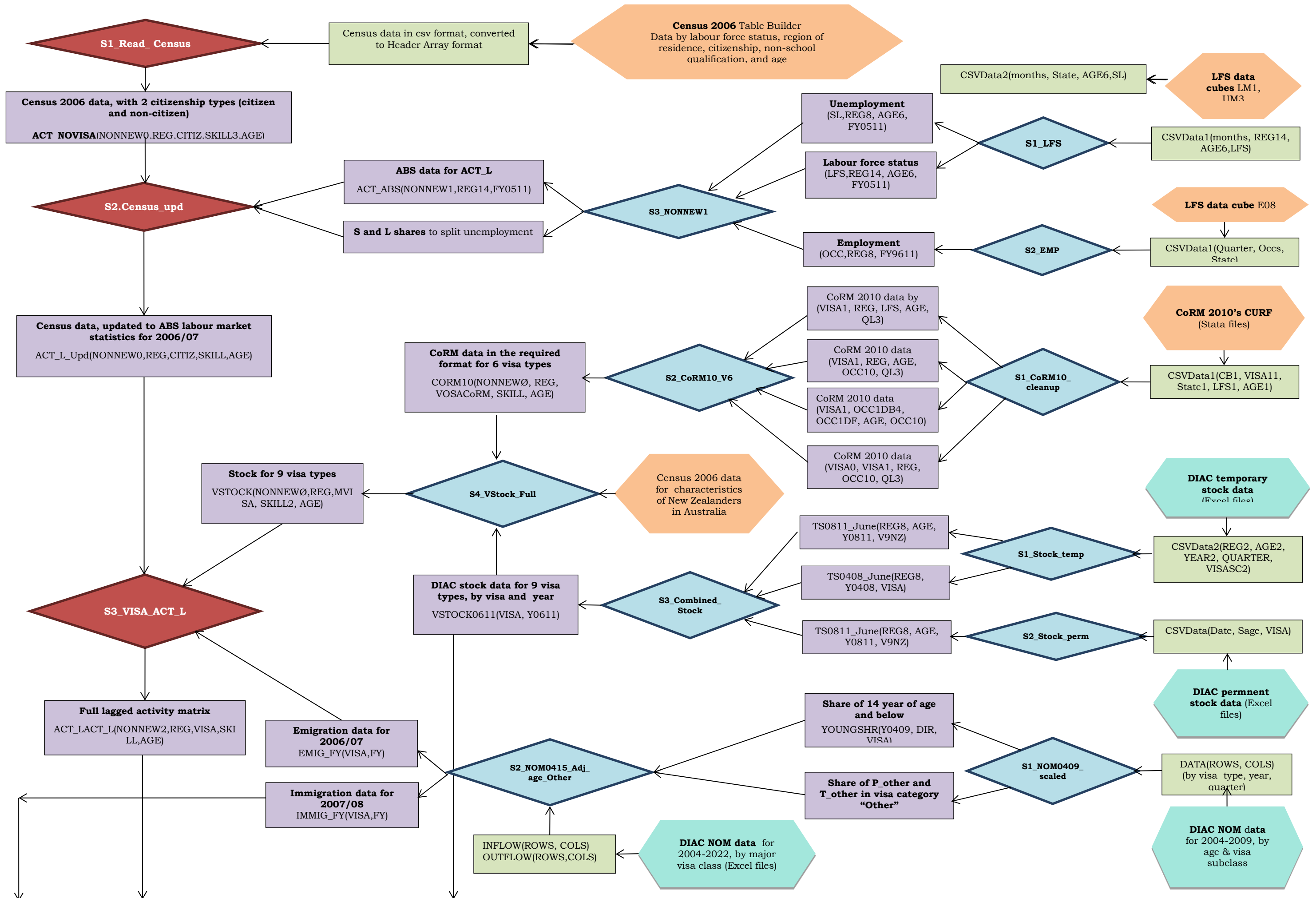
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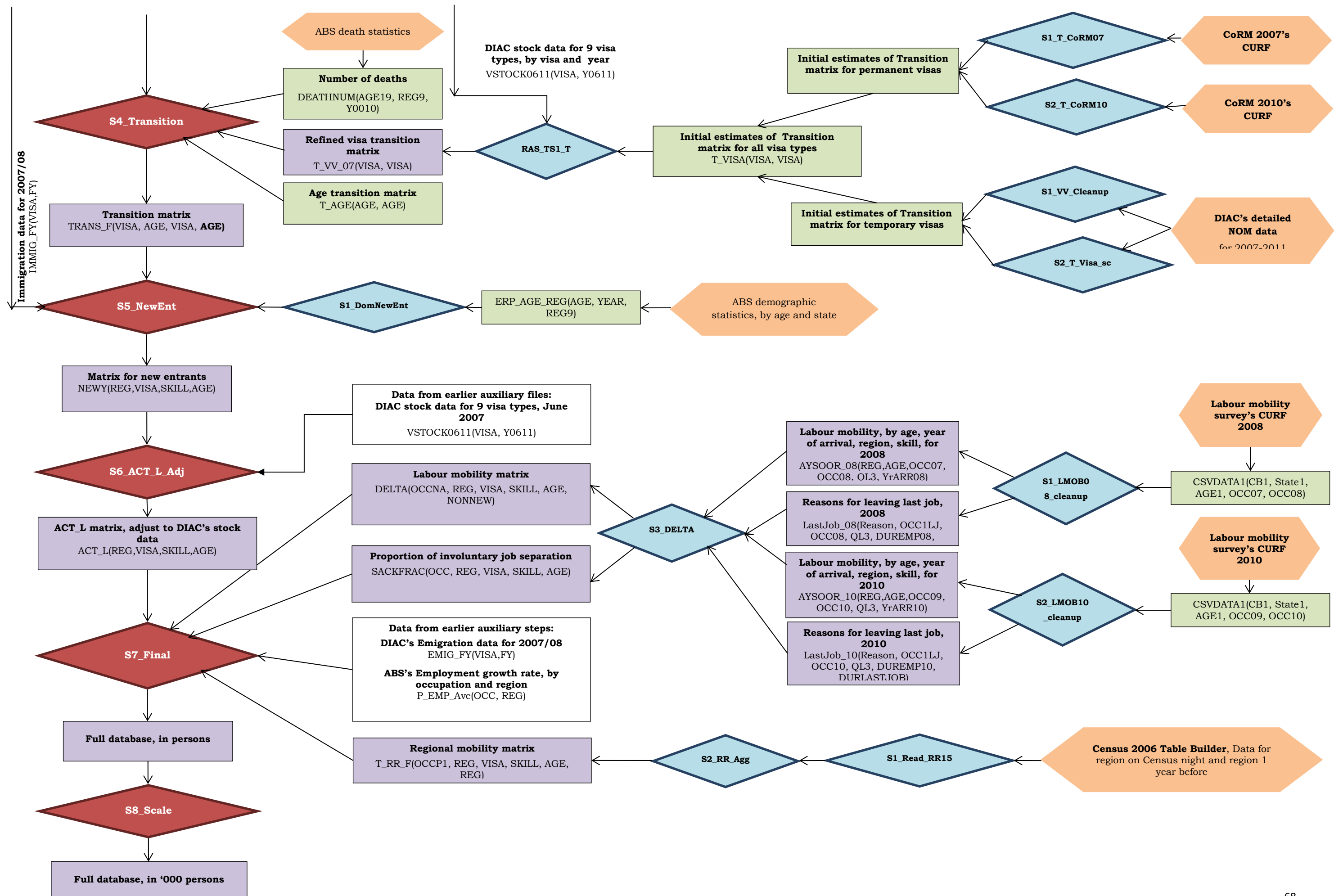
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APPENDIX: DATA PROCESSING FRAMEWORK FOR THE DIAC-TERM MODEL





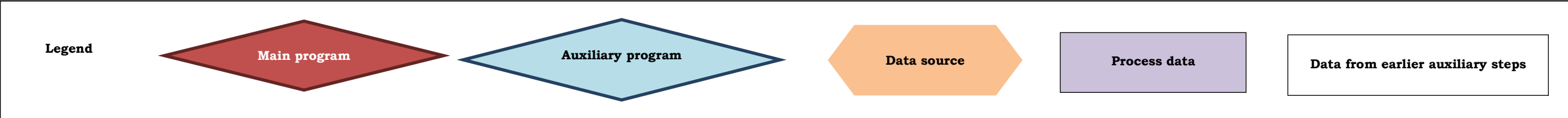


TABLE A1. Sets used in the database compilation process

Set in data compilation process	Corresponding set in the theory Section	Dimension	Description/Elements
OCC	OCC	8	Occupations. 8 ANZSCO major groups, namely: (1) Managers; (2) Professionals; (3) Technicians and Trades Workers; (4) Community and Personal Service Workers; (5) Clerical and Administrative Workers; (6) Sales Workers; (7) Machinery Operators and Drivers; (8) Labourers.
Occs		13	Occ + survey's supplementary categories, namely "Not stated" and "Inadequately described"
SL	UN	2	Unemployed (Short-term S and long-term L)
NEWENT	NEWENT	1	New entrants (N), which includes domestic residents who turn 15 and new overseas arrivals
NILF	NILF	1	Not in the labour force (NILF)
EMIG	EMIG	1	Emigrants (OS) (People who move overseas)
OCCP1	EUFN	12	Domestic labour categories (OCC + UN + NILF + NEWENT)
NONNEW1	EUF	11	Domestic labour activities (OCC + UN + NILF)
NONNEW2	EUFO	12	Activities (Domestic activities plus emigration (OCC + UN + NILF + EMIG)
REG	REG	15	15 Domestic regions (The ACT plus 7 capital cities and 7 balance of the remaining 7 Australian states and territories)
OS	OS	1	Overseas (Rest of the World)
REG2	REGO	16	Domestic region plus Overseas (REG + OS)
VISA	VISA	9	Visa types. (1) Citizen; (2) Skilled; (3) Family; (4) Humanitarian; (5) Other permanent visas; (6) Student; (7) Long-stay business visa 457; (8) Other temporary visa; and (9) New Zealanders.
SKILL3	SKILL	3	Non-school qualification levels, namely: (1) University; (2) Certificates and Diploma, and (3) No-non-school qualification.
AGE	AGE	7	10-year age groups 15+, namely: (1) 15-24; (2) 25-34; (3) 35-44; (4) 45-54; (5) 55-64; (6) 65-74; (7) 75 and over.
NONNEW0		10	8 OCC + Unemployed + NILF
CITIZ		2	Citizenship type: (1) Citizen, (2) NonCitizen
REG8		8	8 states and territories
REG14		14	14 capital cities and balance of state in ABS Labour market data cube LM1 data: Sydney, RoNSW, Melbourne, RoVIC, Brisbane, RoQLD, Adelaide, RoSA, Perth, RoWA, Hobart, RoTAS, NT, ACT);
FY			Financial year. For example, FY0511 means financial years 2005/06 to 2010/11
AGE6		6	Six 10-year age groups, namely: 15-24, 25-34, 35-44, 45-54, 55-64, 65 and over