May 2017
Volume: 14, **No**: 2, pp. 285 – 299
ISSN: 1741-8984
e-ISSN: 1741-8992
www.migrationletters.com

Article history: Received 17 June 2016; accepted 15 December 2016

Can international migration forecasting be improved? The case of Australia

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Abstract

In the first decade of the current century Australia experienced a huge increase in net international (overseas) migration. All demographic forecasts failed to predict this change. The aim of this paper is to assess past net overseas migration forecasts for Australia to quantify the extent of the forecasting challenge, and suggest ways in which improvements might be made. Official net overseas migration forecasts for the past four decades were assessed against subsequently published migration estimates. Mostly they proved highly inaccurate, both for individual years and cumulatively over longer periods. It is suggested that: (1) greater use be made of a detailed migration data source which provides migration estimates by visa/citizenship category, and (2) a combined migration forecasting approach, which draws strength from several complementary methods, is developed. Progress in these two areas offers the potential to improve the accuracy and utility of Australia's overseas migration forecasts.

Keywords: Net overseas migration; forecast error; migration forecasts; combining methods; Australia.

Introduction

In the first decade of the current century net international migration (net overseas migration[1]) to Australia more than doubled in just four years. From 142,000 in the financial year 2004-05 it rose to 300,000 by 2008-09, before falling again but remaining high in historical terms at annual levels of 170,000-230,000 since then (ABS, 2013a, 2016a). Relative to a population which has totalled only 22 – 24 million over the last few years, these net overseas migration (NOM) figures give a rate of net migration which is high compared to most other countries (UN Population Division, 2015). Previously NOM had been more modest, though still fairly high in international terms. Over the period from the end of World War II up to the mid-2000s NOM in Australia averaged about 90,000 per year, albeit with large fluctuations ranging from a minimum of 12,000 to a maximum of 172,000 (ABS,

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[1] Commonly the demographic literature refers to 'international migration'. The Australian Bureau of Statistics instead uses the term 'overseas migration', a convention followed in this paper.

2014). Nonetheless, the pattern seemed to be set, with cyclical swings above and below the long-run average occurring every few years.

The proximate cause of the vast NOM increase was primarily the huge rise in temporary migration, especially from overseas students, working holidaymakers, and business visa holders, rather than substantial changes to the net migration gains of permanent settlers (Birrell and Healy, 2010). The NOM increases were precipitated by migration policy changes which made it easier to obtain temporary visas and offered pathways to transfer to other types of temporary visa and permanent residence, especially for overseas students (Birrell and Healy, 2010; Spinks, 2016). Notably, demographic forecasts produced by the Australian Bureau of Statistics (ABS), other Australian government agencies, State and Territory governments, academics, and others all failed to anticipate the huge rise in NOM.

But even before the recent surge in NOM, demographic forecasts were not predicting the cyclical and annual changes in NOM. They did not even attempt to forecast them, aiming instead for the slightly less challenging task of predicting the long-run average value, and assuming it would not be too different from observations from the last year or two. The evaluation section of this paper reveals whether or not that goal was achieved.

The international literature is broadly in agreement that migration forecasting is challenging and difficult, and that many current approaches are unsatisfactory (e.g. Bongaarts and Bulatao, 2000; Howe and Jackson, 2006; Kupiszewski et al., 2013; Disney et al., 2015; Cappelen et al., 2015). Although a wide array of forecasting methods has been proposed, there is no predominant method with demonstrated reliable forecasting performance. Migration data, methods and theory all have their shortcomings and seem to be less developed than their equivalents for fertility and mortality. Studies assessing past demographic forecasts in many countries reveal large migration errors to be the norm, with limited success achieved in forecasting both the long-run level of migration and short-term fluctuations (e.g. de Beer, 1997; Lowell, 2014; Mulder, 2002; ONS, 2015; Statistics New Zealand, 2008). Earlier work assessing past official Australian population forecasts identified NOM as the largest component of population forecast error (Wilson, 2007, 2012). More importantly, the higher levels of NOM now being experienced by Australia, together with large annual variations, make the need for less erroneous forecasts more pressing than ever before. Unfortunately, there is limited scope to improve the accuracy of Australian population forecasts without making progress in the overseas migration component.

The aim of this paper is two-fold. First, it seeks to quantify the extent of the NOM forecasting challenge in Australia. It evaluates past NOM forecasts prepared as part of regular sets of population projections by the Australian Bureau of Statistics. In doing so it updates and extends an earlier assessment (Wilson, 2007). The focus on these forecasts is not to highlight ABS forecasting inaccuracy in particular. It is just that the ABS forecasts are the longest-established in Australia and the most influential, and are illustrative of Australian overseas migration forecasts generally because many other forecasters in Australia take their lead from the ABS. Second, the paper discusses some avenues for research which might improve the accuracy of Australia's NOM forecasts. It draws on the international literature to propose a combined migration forecasting approach, and promotes the use of a valuable, but underused, migration data source.

Following this introduction, the NOM data and forecast error measures are described. This is followed by a presentation of NOM forecast errors, and then a discussion about how research seeking to improve the forecasts might proceed. Some brief concluding remarks form the final section of the paper.

Data and methods

ABS NOM forecasts

The ABS produces a new set of population forecasts for Australia every 2 to 5 years in the publication *Population Projections, Australia* (e.g. ABS, 2013b). It emphasises that its figures are actually "projections" – the hypothetical outcome of certain projection assumptions – and not forecasts (ABS, 2013b). NOM assumptions typically consist of a fixed long-run net overseas migration number, sometimes preceded by a short run-in period over the first few years. There is limited justification of the chosen migration assumptions, though as a migration *projection* it could be argued that explanation is unnecessary. But users and the media invariably interpret ABS figures as forecasts so they will be described as such here. The ABS numbers are widely publicised and influence the population forecasts prepared by State and Territory governments and others. Thirteen sets of population projections, from the 1978-based set to the most recent 2012-based projections, were evaluated for this paper. Generally, 2 or 3 NOM variants were published in each set, giving a total of 30 NOM projections. Only NOM totals were evaluated in this study due to the lack of published age-sex-specific NOM figures across all sets of projections.

ABS NOM estimates

The ABS publishes estimates of actual NOM in its annual publication *Migration, Australia* (e.g. ABS 2016b), the quarterly publication *Australian Demographic Statistics* (e.g. ABS 2016a) as well as in its online *Historical Population Statistics* (ABS 2014). The data used here were obtained from the March quarter 2016 issue of *Australian Demographic Statistics* (ABS, 2016a) for the most recent years' data, the December quarter 2012 issue which contained revised statistics from 1991 to 2011 (ABS, 2013a), as well as *Historical Population Statistics* for earlier years.

Overseas migration statistics in Australia are based on information obtained from passports and Incoming or Outgoing Passenger Cards which have to be completed by everyone arriving in or leaving Australia. The data are collected by the Department of Immigration and Border Protection (DIBP) and supplied to the ABS, who determines which travellers are migrants and which are visitors. NOM estimates are based on the United Nations recommendation that people are counted as international migrants if they arrive and stay in Australia for a year or more, or leave and remain away from Australia for a year or more. The period of time that individuals spend in Australia, or outside the country, can be calculated because passenger card information supplied on arrival and departure is linked.

One complicating factor in this analysis arises from the change of method for estimating migration which ABS introduced in 2007, and which affects data from the 2006-07 financial year onwards (ABS, 2007). Previously, ABS counted people as migrants if they were in, or out of, Australia for a *continuous* period of 12 months or more. This gave a misleading impression of overseas migration, however, whenever people living in or out of the country for a few years undertook short overseas trips. For example, an overseas student undertaking a 3 year degree course who visited their home country for a month each year would be in Australia for successive 11 month periods, but never be counted as an international migrant or part of the resident Australian population. The new system counts individuals as migrants if they are in or out of Australia for a total of 12 months out of a 16 month period. It therefore counts overseas students (and others) who make short trips out of Australia as international migrants. A shortcoming of this new approach, however, is that an individual's migration status cannot be determined until at least 16 months after a border crossing. In the short-term ABS publishes preliminary NOM values based on expected movements, but these figures are later updated once the actual information is known. Sometimes the revisions are substantial. Unofficial NOM estimates for 2004-05 using the new approach suggest that the empirical impact of the switch was around a 15% increase in estimated NOM (ABS 2007 p. 17). In this paper the previous NOM figures are labelled the 'old NOM estimates' and the current data the 'new NOM estimates'.

<u>Error measures</u>

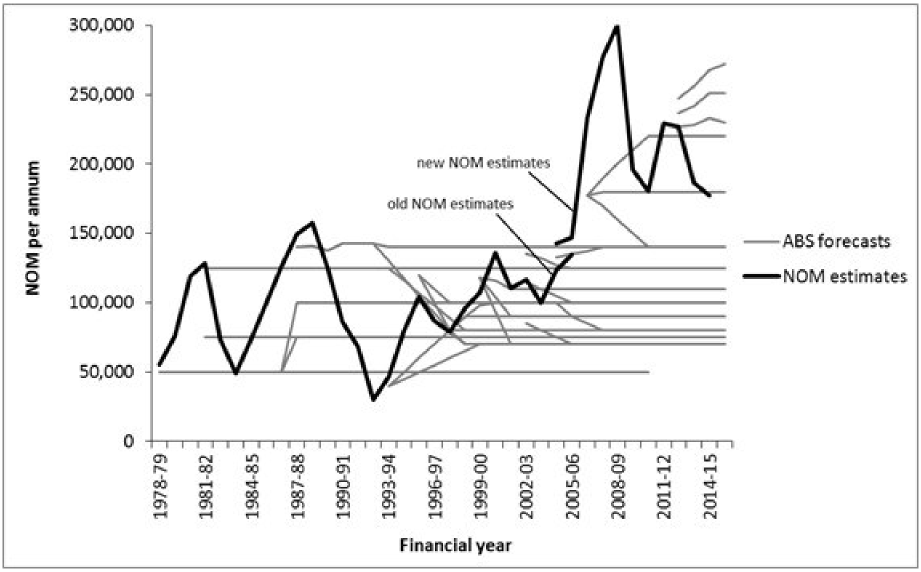
The error of NOM forecasts was calculated using Percentage Error, defined as (Forecast – Estimated) / Estimated × 100%. The 'Estimated' part comprised the old NOM estimates up to 2005-06 and the new NOM estimates from 2006-07 onwards. No adjustments were made for the switch in estimates series, and this needs to borne in mind when interpreting the figures. However, as will become clear in the next section, differences between the old and new NOM estimates are small relative to the size of forecast errors. Median Absolute Percentage Error (MedAPE), the middle value of a set of ranked absolute Percentage Error values, is used as an indication of average error.

Percentage Errors were calculated for NOM over single year projection intervals as well as the cumulative amount of NOM over periods of several years. Because migration forecasts often attempt to forecast long-run levels of NOM, calculating the Percentage Errors of NOM cumulated over longer periods reveals the extent to which this was successful. These cumulative NOM forecasts are the crucial values for forecasting population several years into the future. For example, the population forecast for ten years into the future depends largely on the total amount of NOM forecast over that ten year period, and less on the NOM for individual years.

Evaluation of past NOM forecasts

ABS NOM forecasts for Australia alongside NOM estimates published later are presented in Figure 1. Generally, the forecasts assume that recently recorded NOM values will continue into the future. But, as the graph shows, the defining characteristic of Australia's NOM is volatility, which in combination with these constant forecasts, results in large forecast errors. Until the early 2000s most migration assumptions had NOM at between 70,000 and 100,000 per year. When the rising trend became obvious from the mid-2000s onwards the medium NOM assumption was increased in successive forecasts, starting with a long-run value of 110,000 per annum in the 2005-released projections, rising to 180,000 in 2008, and then 240,000 in 2013 (ABS, 2005, 2008b, 2013b).

Figure 1: ABS forecasts and estimates of net overseas migration



Source: ABS

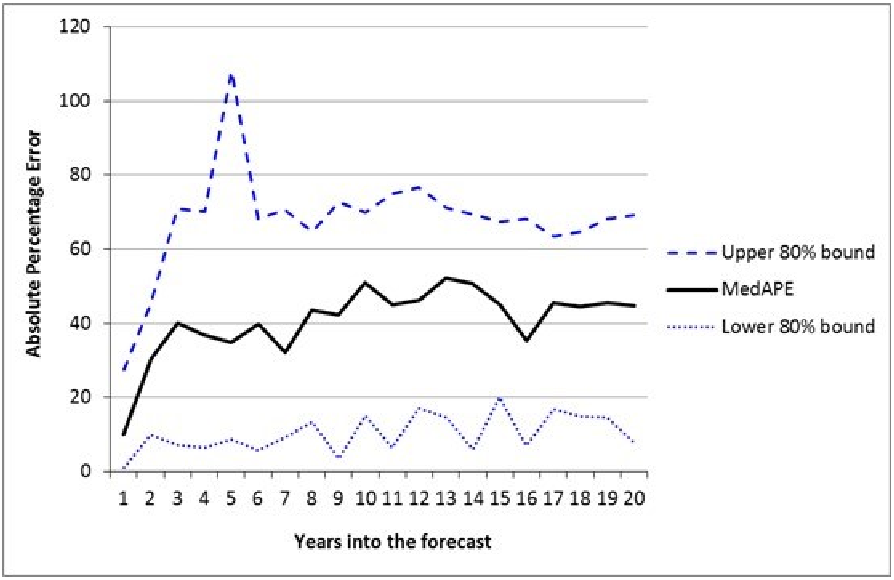
Note. Differences between NOM estimates and the start of forecasts are often due to later revisions to the NOM estimates. For example, all three 2006-based series assumed 177,600 as the NOM value for 2006-07 based on preliminary NOM data for that year; it was subsequently revised to 233,000.

Figure 2 summarises the distribution of absolute Percentage Errors for all NOM forecasts by years into the forecast horizon. It shows the median absolute

Percentage Error (MedAPE) as well as the bounds covering 80% of Absolute Percentage Errors. As would be expected, given the wildly fluctuating NOM trends and largely linear forecasts, the error distribution opens up rapidly. By the third one year interval of the forecasts, the MedAPE is already 40%, while 10% of forecasts exceed 70% error! These are large errors by any standards, and indicate that demographers' abilities to forecast NOM are disappointingly poor. Fortunately, the error distribution does not become much wider with longer forecast horizons.

Figure 3 shows the equivalent error distribution when absolute Percentage Errors are calculated on forecast NOM cumulated over several years. For example, the MedAPE for the total value of NOM summed over the first 3 years of the forecast

Figure 2: Errors of ABS NOM forecasts over the first 20 years of the forecasts

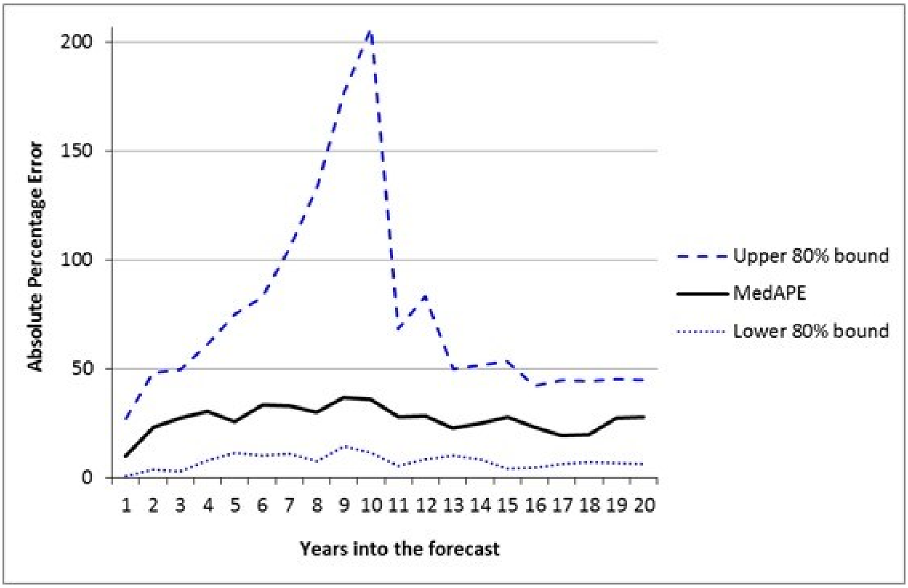


Source: Calculated from ABS data

is 28%. There is a slight increase in error for longer periods, but after about 10 years the median errors of cumulated NOM decline a little. However, as the graph shows, the range of error values is huge! Overall, there is slightly more success in forecasting NOM over periods of several years rather than individual years, but in the context of actual NOM fluctuating either side of linear forecasts, it was to be expected that annual errors would cancel out to some degree. The impact on forecast *population* numbers therefore is that the NOM contribution to population forecast error is a little lower over periods of several years than individual years.

Nonetheless, these remain large errors, demonstrating that forecasts of long-run average NOM values were not particularly successful.

Figure 3: Cumulative errors of ABS NOM forecasts over the first 20 years of the forecasts



Source: Calculated from ABS data

Can NOM forecasting be improved?

Is it possible to improve NOM forecasts, or should we just accept that migration is largely unforecastable? Some researchers view migration as almost impossible to forecast and that efforts should instead be directed at quantifying uncertainty (e.g. Wiśniowski et al., 2012), while others take a more positive view about the forecastability of migration (e.g. van Wissen, 2012). A major challenge complicating the task is the poor quality of migration data for many countries. For Australia, however, migration data have been comprehensive, good quality, and quite detailed in terms of migrant characteristics since the introduction of the 12 months out of 16 measuring system in the mid-2000s (ABS 2008a).

This paper argues for research attention to be directed towards (i) making greater use of the detailed, but underused, Australian overseas migration data, and (ii) re-thinking international migration forecasting approaches. Progress on these two fronts offers the potential to improve the accuracy and utility of Australia's overseas migration forecasts. At the same time, it would also be beneficial to warn users of the likely magnitude of error by ensuring that prediction intervals accompany any demographic forecast.

Data

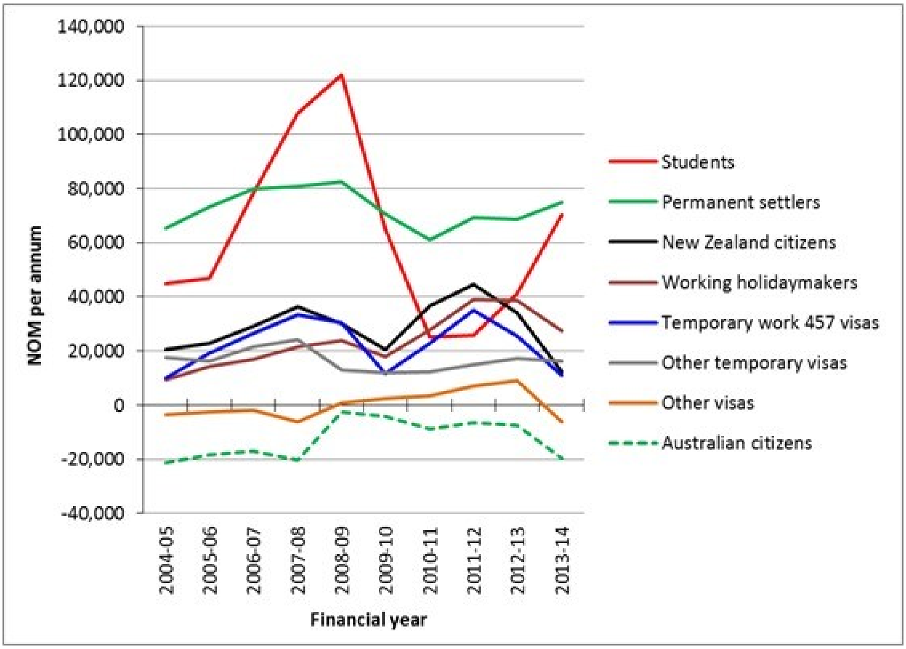
The valuable and underused migration data source in Australia consists of immigration, emigration and NOM estimates by visa or citizenship category which accompany the annual ABS publication *Migration, Australia* (ABS 2016). Although the data are only available from financial year 2004-05 onwards, giving a relatively short time series, they are nonetheless helpful in understanding why Australia's overseas migration levels have varied so much in recent years. The data are also available by sex and age group, and by state and territory. Summary categories of NOM for Australia are shown in Figure 4 below. The dominant role of student migration in pushing Australia's overall NOM up to 300,000 in 2008-09 can be clearly seen. An ability to forecast this particular NOM stream – even approximately and for just a few years ahead – would represent significant progress.

As their labels might suggest, the various categories have different immigration and emigration drivers. The net migration gain of *permanent* settlers is largely influenced by the number of places in the Migration and Humanitarian Programmes which are set in advance by the Australian Government each year (DIBP, 2016). The Migration Programme comprises several streams, with the two main ones being the Skill stream for highly skilled workers and the Family stream for family members of Australian citizens and primary visa holders. Although the number of places is set annually by the Government, they are influenced to some extent by labour market factors (Markus et al., 2009). The Humanitarian Programme accepts 10,000-20,000 refugees each year. Generally, the trend in permanent settlers is less variable over time than that of the temporary migration streams (Figure 4). These temporary migration streams fall outside the control of the Migration and Humanitarian Programmes and are influenced by a variety of Australia and international political, economic and social factors (Hugo, 2006; 2008).

Overseas student migration is affected by factors such as the perceived quality of Australian universities, perceptions of life in Australia, information from expatriate social networks, the cost of living and studying in Australia, and Australian government policies affecting student visas (Rafi and Lewis 2013). The increase in the student component of NOM was caused by the introduction of pathways for students to transfer to other types of visas, including permanent residence, after the completion of their studies. The rules were tightened when the common perception became one of further education colleges effectively offering permanent residence through short cooking courses (Birrell and Healy 2010).

The net migration balance of New Zealand citizens is influenced by the level of economic activity and labour market conditions in Australian and New Zealand (Poot, 2009; Gorbey et al., 1999). Most recently the New Zealand economy has experienced strong growth whilst Australia's has been sluggish. Not surprisingly, the migration data show a marked decline in New Zealand citizens migrating to Australia and an increase in their movement back to New Zealand, resulting in a sharp decline in NOM for this category. The net migration of people on temporary 457 visas, which allow for stays of up to 4 years, and working holidaymaker visas, are also dependent on the state of the Australian economy. NOM declined a little for these categories in 2009-10 as the Australian economy slowed in the Global Financial Crisis.

Figure 4: Australia's Net Overseas Migration by visa/citizenship category, 2004-05 to 2013-14



Source: ABS

Note: 'Permanent settlers' includes Migration Programme and Humanitarian Programme migrants

<u>Forecasting approaches</u>

The literature offers a fairly limited number of general approaches and specific techniques for international migration forecasting, in contrast to mortality and fertility forecasting. The broad approaches include:

no-change assumptions, in which recent migration levels or rates are assumed to hold for the entire projection horizon.

long-run trends, in which recent migration levels or rates are assumed to return quickly towards long-run historical values.

scenarios, in which migration is not really forecast but assumed to follow a hypothetical trajectory, sometimes based on theory, a desirable vision of the future, or government policies (e.g. van der Gaag and van Wissen, 1999).

judgemental approaches, which are heavily informed by recent migration levels and qualitative assessments about factors which might affect possible future trends. These approaches are implemented by many national statistical offices (e.g. ABS, 2013).

extrapolation, such as simple linear extrapolation of immigration and emigration trends.

time series models, in which past trends influence projections, with more recent observations given more weight (e.g. de Beer, 1997).

'explanatory' models based on predictor variables such as GDP, immigrant stock and unemployment rates (e.g. Cappelen at al., 2015).

expert surveys and panels, in which migration experts are asked for their views on the future of migration (e.g. ONS, 2015).

expert argument-based approaches, extended and more structured versions of the surveys and panels approach, primarily associated with Lutz (2009).

the use of *leading indicators* in the short-run. For countries with highly controlled immigration, projections can be informed by visa application numbers, and visa quotas set in advance by governments (e.g. DIBP, 2015).

probabilistic approaches, which focus primarily on quantifying the uncertainty of migration in the future, and often incorporate expert opinions, time series models and Bayesian methods (e.g. Dunstan, 2011).

No individual migration forecasting approach or technique is regarded as clearly superior in the literature. The suggestion here for re-thinking the approach to forecasting Australian international migration is summarised as follows. Rather than trying to select the best individual approach or technique, it could be fruitful to combine several approaches, drawing strength from each of them, such as expert argument-based approaches, long-run trends, explanatory models, and leading indicators. In the general forecasting literature, the benefits of combining methods have been appreciated for some time (e.g. Armstrong, 2001; Bates & Granger, 1969; Clemen, 1989; Goodwin, 2009); in the population sciences combination methods are still rare (but exceptions can be found in Rayer and Smith, 2010, Reinhold and Thomsen, 2015, and Wilson, 2016).

It is essential to consider the migration visa/citizenship categories shown in Figure 4 separately because of their different influences, and also because they possess different age-sex profiles. Examining these categories separately should provide a better chance of dealing with the sensitivity of temporary migration flows such as student migration to policy settings. Explanatory models could be created for, and experts asked about, immigration and emigration flows by category. Separating out migration into different streams for forecasting purposes is nothing new, but doing so with this migration dataset will be.

It may also prove useful to create models and ask experts about migration at various levels of aggregation, so as well as focusing on directional migration flows by category, flows by broad category (e.g. permanent and temporary migrants) could also be considered, as well as net migration levels. There is a long-standing debate in demography about whether more detailed or more aggregate projection approaches are better (e.g. Rogers, 1995; Smith, 1997). It might be useful to draw on the strengths of both.

Table 1: Elements of a combined migration forecasting approach

Approach	Short-term	Medium-term	Long-term
Expert, argument-based survey & discussion Opinions about directional and net flows by visa/citizenship category and broad category	✓	✓	✓
Explanatory models Models of directional and net flows by category and broad category	✓	?	?
Leading indicators Indicators of directional flows by category and broad category	✓	×	×
Long-run trends Immigration, emigration and NOM	?	✓	✓

Notes: ✓ = useful; ? = maybe useful; × = not applicable/not useful

Furthermore, it is suggested that separating out the short-term (up to 5 years ahead, for example) where explanatory models and leading indicators will be of most use, the medium-term (perhaps 5-15 years ahead), and the long-run (15 or more years) will be beneficial. In the short-term, it would be hoped that annual variations in migration could be forecast, even if only approximately. Beyond that, the forecasting approaches could aim to forecast just the approximate level of migration.

This is, of course, only a very brief sketch of what might be termed a combined migration forecasting approach. Table 1 provides an outline. It requires much more work to flesh out the details and decide how the combining of methods would be operationalised. But the principle of drawing strength from complementary methods is one which has rarely been applied in international migration forecasting and, given the positive results from other demographic forecasts based on combining methods, it may well pay dividends.

Conclusions

This paper has assessed past NOM forecasts for Australia and suggested an approach to future migration forecasting which combines several methods. The evaluation of past forecasts reveals that the variable trend in Australian NOM is very hard to forecast. Average errors increase rapidly over the first 3 or 4 years and change more gradually thereafter, and the range of error values was shown to be huge (Figures 2 and 3). Neither annual NOM nor NOM cumulated over many years has been particularly well forecast unfortunately.

The suggested approach for forecasting Australian overseas migration in the future combines different projection methods, suggests splitting the forecasting into short-, medium- and long-term horizons, and makes use of an extremely valuable but underused data source on migration by visa/citizenship category. Being able to anticipate the new few years of student migration alone would go a long way towards improving total NOM forecasts. Existing work on international migration forecasting suggests that a combined approach is feasible and practical. Expert panels and expert argument-based approaches have been implemented in a number of forecasts (e.g. ONS, 2015; Wilson et al., 2011). Good examples of explanatory models have been produced in recent years (e.g. Cappelen at al. 2015). And short-term leading indicators are available in the form of visa numbers in Australia's Migration and Humanitarian Programmes which are announced in advance, together with visa applications, can be used in short-term forecasts (e.g. DIBP 2015). An approach which combines several methods and takes into account different categories of migration flow may well yield better forecasts than the commonly used no-change or judgemental approaches.

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