4

The Demography of the Five Intergenerational Reports

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Key points

- Relative to the first intergenerational report (IGR) (2002), rises in older-age labour force participation rates, driven mainly by favourable economic conditions and, to a lesser extent, changes in policy, have helped reduce the projected fiscal deficit in subsequent IGRs.
- The projected fiscal deficit has been reduced even more by increases in net overseas migration following the 2002 IGR.
- The projected trend of falling fertility in the 2002 IGR also led to enhancements of family support policy aimed partly at sustaining the level of fertility.
- The disturbing results of the 2002 IGR elevated population policy in Australia to a level reminiscent of the period of postwar reconstruction following the Second World War.
- As explained in the chapter, the rationale for the setting of the migration assumption for the 2021 IGR is flawed.
- Future IGRs should include more sensitivity analysis based on a wider range of assumptions about demography and labour force participation.

Introduction

The intergenerational report (IGR) is based upon a 'three Ps' model: productivity, participation and population. The IGR assumption about the growth rate of labour productivity is the most important of these three components regarding the future fiscal deficit. However, concern about the future ageing of the Australian population drove the decision to produce the first IGR. That the impact of population is significant is indicated by the observation that the first IGR in 2002 (IGR1) assumed that the growth rate of labour productivity would be 1.75 per cent per annum, a higher level than was assumed for the 2021 IGR (IGR5). Despite this, the fiscal deficit in IGR1 in 2041–42 was 5 per cent of GDP, a much larger deficit than that projected for the same year by IGR5, at 1.1 per cent. Clearly, between 2002 and 2021, the other inputs to the model must have changed substantially. As this is the demographic chapter, the focus here will be upon changes to the demographic inputs, but changes in labour force participation relative to the IGR1 projections are also important and are considered first. Then, the chapter examines changes in the assumptions across the five IGRs in relation to the three demographic components: fertility, mortality and international migration. The chapter shows that variations in these assumptions across the five IGRs have been substantial. This is partly because the results of previous IGRs, especially IGR1, led to changes in policy, especially policy relating to the level of international migration.

Changes in labour force participation rates

The projections of labour force participation rates that were used in IGR1 and the 2007 IGR (IGR2) were well below the levels that eventuated, especially at older ages. Dowrick and McDonald (2002) were critical of the pessimistic assumptions of future labour force participation rates that were made in IGR1. However, as late as 2005, the Productivity Commission was still projecting somewhat pessimistic labour force participation rates at older ages (McDonald 2012). As a striking example, IGR1 projected that the labour force participation rate for women aged 60–64 in 2021 would be 26 per cent and the Productivity Commission (2005) projected a rate of just under 40 per cent, both well below the level of 55 per cent that eventuated. These higher older-age labour force participation rates had a large impact on the fiscal position of the government (Temple et al. 2017).

Increased labour force participation at older ages is one of the major policy strategies to mitigate population ageing. From July 1995, the age for pension eligibility for women was increased by six months every two years from age 60 until it reached age 65, the level that had applied to men from 1909. An analysis by Ryan and Whelan (2013) concluded that the increase in the pension age for women from 60 to 65 increased the likelihood that a woman was working at age 62 by a significant 15 percentage points. The fact that this policy was in place from 1995 makes it even more surprising that IGR1 and IGR2 had relatively pessimistic assumptions about labour force participation for women aged 60–64 years.

Then, in 2009, the Labor government introduced measures to increase the pension age to 67 for both men and women through gradual increases during the period July 2017 to July 2023. Next, a proposal was made in the 2014–15 budget to continue to increase the pension age by six months every two years from 1 July 2025 until it reached 70 years, but this change was abandoned by the then coalition government in 2018. Changes were also made to superannuation to encourage longer labour force participation. This included the right to draw an income stream from superannuation while continuing to work—an incentive for part-time employment—as well as superannuation being tax free if accessed after age 60, no tax on lump sums and no tax on superannuation pensions. However, acting as an incentive to retire, the age pension in 1997 was fixed at 25 per cent of male average ordinary time weekly earnings. This was considered a level at which most people could live a comfortable life if they owned their own house (Swoboda 2014).

Despite all these changes, the rapid increases in labour force participation that applied during the first decade of the twenty-first century slowed considerably in the second decade (Chomik and Khan 2021). Analysing Australian Bureau of Statistics (ABS) Labour Force Survey data, McDonald and Moyle (2020) have shown that the historic increases in labour force participation at older ages were driven by favourable economic conditions, which saw people both re-enter work in mid-life (under age 55) and, in the following decades, delay their retirement with high retention rates. Entry to the labour force at ages 55 and over was very uncommon. This was particularly the case for women. Thus, policies for older people had little to no impact on labour force entry but may have had strong effects on labour force retention.

The methodology for the age- and sex-specific labour force projections used in IGR5 is based sensibly on an age and cohort econometric model (Gustaffson 2021). The results show only modest increases in labour force participation at older ages across the 40 years from 2020 to 2060, suggesting that the current policy regime has run its course in stimulating higher older-age participation.

Changes in the demographic assumptions, IGR1 to IGR5

Policy change

The most striking of the changes in the IGR assumptions across time are in the demography of the model. IGR1 projected that Australia's population would rise to 25.3 million by 2042. In fact, it took only 17 years, not 40 years, for Australia's population to reach 25.3 million. From IGR1 to IGR4, each successive IGR projected increasingly higher population numbers in the future (Figure 4.1). Assumed lower fertility and the short-term effects of COVID-19 on immigration produced a somewhat lower projection in IGR5. Changes in the trajectory of the demographic components in the IGR model were to a large extent the result of policy changes. Indeed, it could be said that the results of IGR1 elevated population policy in Australia to a level reminiscent of the period of postwar reconstruction following the Second World War.

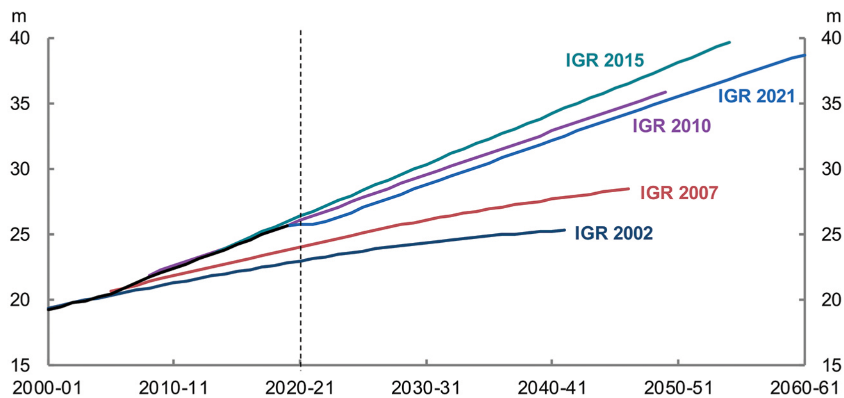

Figure 4.1: Population projections across IGRs.

Source: Reproduced from Commonwealth of Australia (2021:15).

IGR1 showed a large fiscal deficit by 2042 of 5 per cent of GDP, a result primarily of population ageing. The report suggested that this deficit could be addressed through control over expenditure, particularly the growth of government expenditure on health but also through increases in labour force participation and increased labour productivity. IGR1 did not recommend a population response. Even a careful reader of the first three IGRs would not draw the conclusion that the population P was important (McDonald 2012).

Despite this, starting slowly from 2000 but rapidly from 2004 following IGR1, the Howard government moved to moderate population ageing using demographic approaches. It substantially increased its migration program and introduced a family policy package aimed, at least partially, at increasing the birth rate. Enlargement of the migration program represented a major turning point in Howard's policy approach. Abul Rizvi (2020), who was the leading migration policy adviser in the Department of Immigration at that time, concluded that there were three main factors that led to the change in approach of the Howard government to immigration policy:

- Research highlighting the improved labour market performance of skill stream migrants, which was incorporated into the Liberal Party's 2001 election policy platform.
- Decline in fertility through the 1990s and the impact of this on population ageing that was highlighted in a number of articles and reports, including by Professor Peter McDonald and Dr Rebecca Kippen (1999, commissioned by the Department of Immigration), Withers (1999), and the Productivity Commission (1998), and picked up in then treasurer Peter Costello's first Intergenerational Report (2002).
- Ongoing complaints from industry and employer bodies about increasing skill shortages, including in regional Australia, and reinforced through criticism by the Australian Labor Party (Rizvi 2020:Chapter 5).

In 2004, the Howard government also introduced a comprehensive family policy package, which included a universal maternity allowance (later termed the Baby Bonus), a childcare tax rebate and substantial increases in the per child family allowance (Family Tax Benefit Part 1). This package had the dual policy objectives of supporting families with children while at the same time stimulating the birth rate (McDonald 2009).

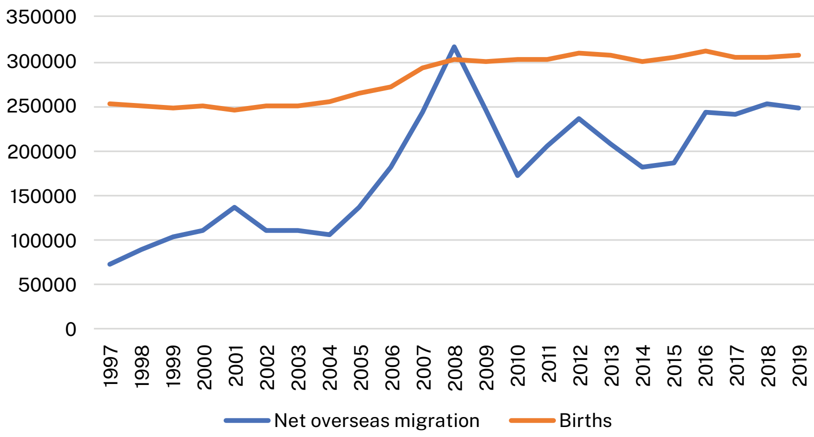

Figure 4.2: Births and net overseas migration (numbers), 1997–2019, Australia.

Source: Author, using published ABS data.

Subsequent to 2004, net overseas migration (NOM) more than doubled from 100,000 per annum to 220,000 per annum (2005–19 average) and the number of births increased from around 250,000 per annum to 300,000 per annum (Figure 4.2). Each successive IGR to IGR4 projected a larger and relatively younger population than the previous IGR and these demographic shifts were associated with a continual fall in the fiscal deficit as a proportion of GDP 40 years later (McDonald 2012, 2016). By IGR4, a fiscal surplus was projected 40 years out due to many factors, but primarily to the demographic mitigation of population ageing (the projection was based on the then government's proposed policies, not existing legislated policy).

IGR fertility assumptions

The number of births occurring in any one year is determined primarily by the number of women in the childbearing ages and the rate of birth that they experience. The appropriate rate of birth is the total fertility rate (TFR). TFR is the sum of the birth rates at each age in a given year. It is equivalent to the average number of births a woman would have if she were to experience these annual birth rates at every age across her lifetime. While it is a hypothetical measure in respect of the lifetimes of any real group of women, on an annual basis it does represent what might be called the force of fertility in that year.

The TFR, however, has one substantial problem. It is heavily affected by changes in the timing of births, especially changes in the timing of the first birth (McDonald and Kippen 2011). When births are delayed to some future point in time, the TFR falls in the short term but may rise in subsequent years when the delayed births take place.[1] This is exactly what happened in the years before and after IGR1. In the decade leading up to IGR1, first births were delayed year after year so that the TFR showed a continuous declining trend. The statistical modelling done by Treasury for IGR1 projected this decline to continue uniformly across the 40 years of the projection from 1.75 births per woman in 2002 to 1.6 births per woman in 2042 (see Figure 4.3). With the assistance of an economic boom in the first decade of the new century and the Howard government support package in 2004, those who had delayed their births were encouraged to have them. Instead of continuing to fall, the TFR rose to a 35-year high of 2.0 births per woman in 2007–08 (Figure 4.4).

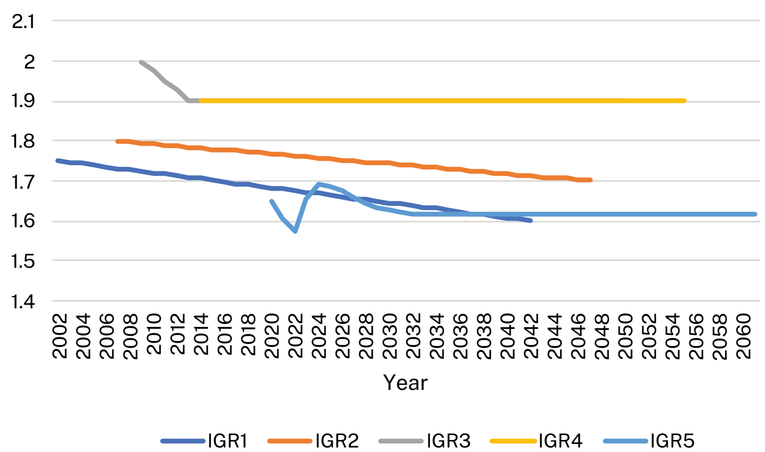

Figure 4.3: Total fertility rate assumptions in successive IGRs.
Source: Author, using information published in the five IGRs.

For IGR2 in 2007, consistent with the most recently observed value, Treasury moved the initial rate up to 1.8 but then assumed the continuous decline that had been assumed for IGR1. Just three years later in 2010, the initial fertility rate in IGR3 was taken as 2.0, again consistent with the most

1 Not all delayed births take place and so the delay of first births to older ages that has continued year after year in Australia since the mid-1970s has led to increasingly lower completed family sizes when women reach the end of their reproductive years (McDonald 2020).

recently observed value, but the rate was pushed down rapidly to a long-run constant level of 1.9. In 2015, IGR4 maintained the long-run assumption of 1.9 (Figure 4.3). However, instead of remaining constant at the high level of 1.9, the Australian TFR then fell rapidly, reaching 1.61 by 2019–20. This was not simply an Australian trend, as rapid declines between 2013 and 2019 were observed in all the English-speaking countries (Figure 4.5) and in most of the Nordic countries. Accordingly, IGR5 with its fertility assumption based on McDonald (2020), after some initial fluctuations related to COVID-19, projected a long run TFR of 1.62, ironically very similar to the level projected in IGR1.

In projecting the level of TFR in 40 years' time, we are projecting the fertility of women who are not yet born themselves, a very hypothetical exercise. It is also important to remember that the annual number of births is affected not just by the fertility rate; it is also affected by the number of women in the childbearing ages. This number is in turn affected by the level of NOM. Thus, in IGR5, while the TFR remains constant in the long run, the number of births rises year upon year to 2060. For perspective, the projected number of births in 2060 is 81 per cent higher using the IGR5 migration assumption compared with a projection assuming net zero migration between 2020 and 2060. This means that 45 per cent of all births in 2060 will be due to people who were not living in Australia in 2020.

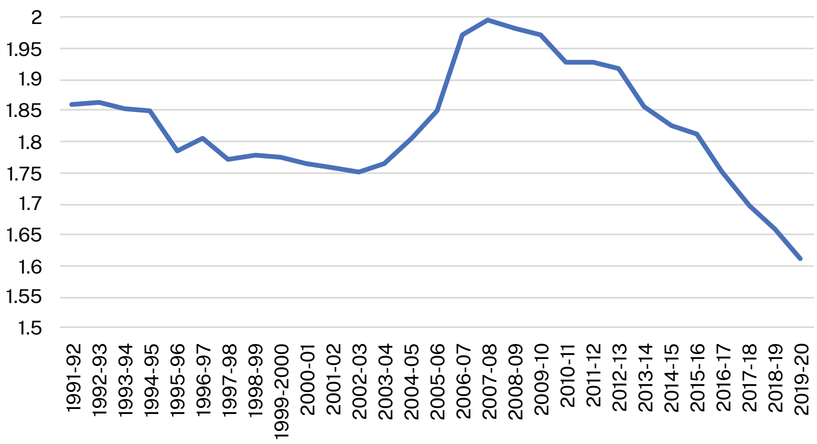

Figure 4.4: The TFR, Australia, 1991–92 to 2019–20.

Source: McDonald (2020) and ABS (2022a).

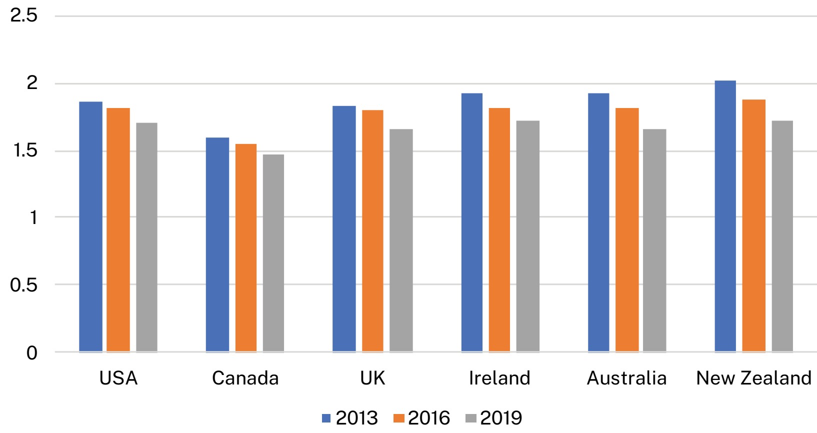

Figure 4.5: TFRs, English-speaking countries, 2013, 2016 and 2019.
Source: Author derived from reports of the statistical agencies of each country.

IGR mortality assumptions

Assumptions about future mortality rates in IGR5 are based on life tables produced by the ABS for 2017–19, to which the Australian Government Actuary's mortality improvement factors were applied.

Generally, it is considered that projections of future mortality are much more reliable than projections of future fertility. This is because almost all people who will die in the next 40 years are alive today and most are aged 40 and over at the commencement of the projection. Despite this, the IGR assumptions of future expectations of life at birth are quite variable across the IGRs, especially for men. For women, the assumed future expectations of life are quite similar for IGR2, IGR3 and IGR4. The IGR1 and IGR5 projections are also very similar but at a much lower level that the other three IGRs. Variations in male expectations of life were even greater (Figure 4.6).

These differences between the IGRs are important from a fiscal perspective because the highest government expenditures apply to persons aged 75 and over, now the ages at which most people die. In the 2018–20 life table for Australia (ABS 2022b), only 15 per cent of women die before their 75th birthday. Between 1971 and 2019, over five years of life on average was added to the expectation of life at age 75 for both men and women. This means an additional five years of government expenditure applying to an ever-growing older population. Furthermore, the Australian National

Transfer Accounts show that the average per person public expenditure on health for persons aged 75 years and over increased in real terms by a factor of six between 1981 and 2010 (Rice et al. 2016). The relatively low expectations of life projected in IGR5 imply lower levels of public expenditure than would be the case with the higher levels projected in IGR2, IGR3 and IGR4.

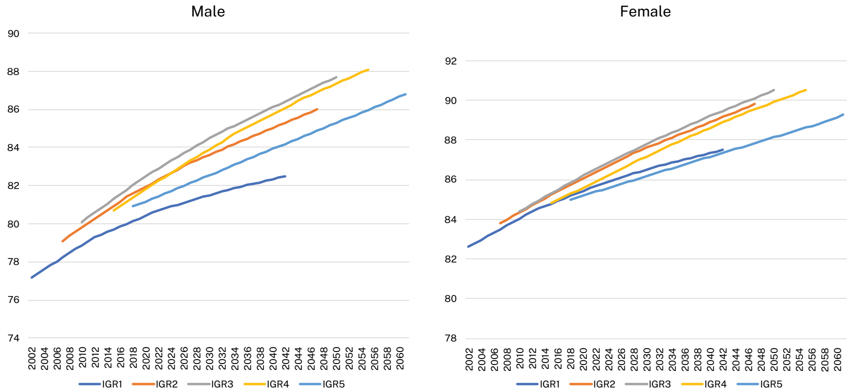

Figure 4.6: Expectation of life at birth assumptions in successive IGRs, males and females.

Source: Author, using information published in the five IGRs.

IGR migration assumptions

As described above, the Australian government has used overseas migration as a policy approach to mitigate population ageing since the early 2000s. As shown in Figure 4.7, each successive IGR has assumed a higher future level of NOM, rising from 90,000 in IGR1 to 235,000 in IGR5. The largest jump in assumed NOM occurs between IGR2 (2007) and IGR3 (2010), from 110,000 to 180,000. This increase, made initially by the Gillard government, was based upon reports made for the Department of Immigration in 2008 and 2010 (McDonald and Temple 2008, 2010). These reports concluded that the impact of immigration on GDP per capita (through mitigation of population ageing) was optimised if NOM was between 160,000 and 220,000. Since 2011, through several changes of government, the level of the government migration program has been set within this range and it is set to remain in this range until 2060 in the out years of IGR5.

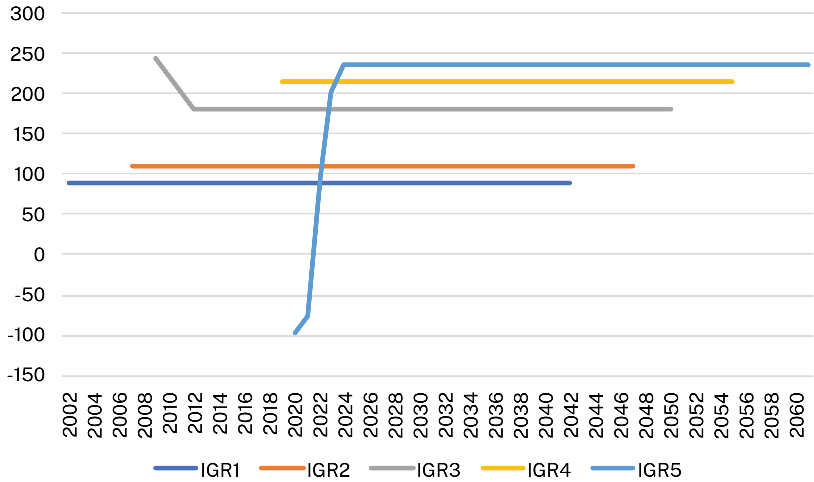

Figure 4.7: Net overseas migration assumptions in successive IGRs ('000s).

Source: Author, using information published in the five IGRs.

The annual migration program sets the indicative planning targets for grants of permanent residence in the skilled and family streams. In addition to these two streams, permanent residence grants are also made through the humanitarian stream (usually set around 13,500 per annum, but higher during periods of special need).

Population projections make assumptions about NOM, which is not the same as the number of grants of permanent residence that the government makes each year.[2] If the measured impact of migration on GDP per capita is based on the impact of NOM, how can this be reconciled with the setting of the annual permanent migration intake? The answer is that, although NOM fluctuates from year to year because of surges in temporary arrivals or departures, in the longer term, temporary migrants can only remain in Australia if they are granted permanent residence through the Permanent Migration Program. As the net impact of the combined movements of

2 NOM derives from the definition of the estimated residential population. A person is deemed to be a resident of Australia (as distinct from a visitor) if the person spends 12 months out of any given 16-month period in Australia. A NOM arrival is the arrival in Australia of a non-resident person who spends 12 out of the next 16 months living in Australia, while a NOM departure is the departure of a resident who spends 12 out of the next 16 months out of Australia. NOM is the excess of NOM arrivals over NOM departures. NOM is measured using passport movements. When a person leaves or enters Australia, the ABS applies a probability model that predicts whether the person will be a NOM departure or a NOM arrival after 16 months have elapsed. Sixteen months after the departure or arrival, ABS provides revised and final estimates of NOM.

Australian and New Zealand citizens is relatively small (less than 5 per cent of NOM from 2004–05 to 2015–16), in the long run, NOM and the migration planning levels (including the humanitarian stream) are very similar (McDonald 2018 and Figure 4.8). Nevertheless, temporary migration serves the very important purpose of providing a ready pool from which a majority of new permanent residents are selected.

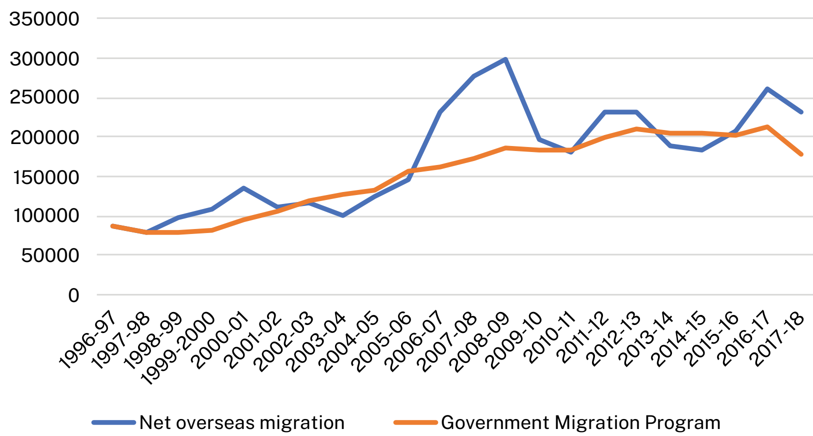

Figure 4.8: Annual net overseas migration (NOM) compared with the annual grants of permanent residence through the Permanent Migration Program, including the humanitarian stream, Australia, 1983–84 to 2016–17.

Source. Author, using ABS and Department of Home Affairs data.

For IGR5, Treasury provided the following explanation of its long-term NOM assumption as follows:

> The NOM assumption of 235,000 people per year over the long run reflects:
>
> **A.** the Permanent Migration Program (190,000 people per year from 2023–24)
>
> **B.** the Humanitarian Program (13,750 people per year)
>
> **C.** the flows of temporary migrants who reside in Australia for several years but do not transition to permanent residency (assumed to be a net inflow of 66,250 people per year, based on an historical average of the net inward flow of such migrants prior to the onset of the COVID-19 pandemic)

D. the flows of Australian citizens (assumed to be a net outflow of around 15,000 people per year, based on an historical average)

E. the number of permanent residents who subsequently emigrate (assumed to be a net outflow of around 20,000 people per year, based on an historical average) (adapted from Commonwealth of Australia 2021:157).

This explanation is clearly inconsistent with the argument made above that, in the long term, NOM will be equal to the sum of the Permanent Migration Program and the Humanitarian Program, that is A plus B, or 213,750 not 235,000. The Treasury explanation has two problems. First, it implies that the entire number of people granted permanent residence in a year (213,750 in the IGR5 assumption) are new arrivals to Australia. In fact, the majority of new permanent residence grants are made to persons already living in Australia on a temporary visa. The second problem is that the explanation implies that there will be an accumulation of 66,250 temporary residents every year for 40 years; that is, a total of 2.5 million temporary residents in 2060, most of whom would have lived in Australia for a very long time. If it is argued that some of these temporary residents would have become permanent residents, the permanent numbers in the Treasury explanation would have to be reduced accordingly.

For the past 75 years, Australian immigration policy has been based on permanent residence, with total opposition to people living in Australia on a temporary visa on a long-term basis. While this situation has applied to New Zealand citizens living in Australia, they have an agreed right to remain in Australia permanently, although they may not have formal permanent residence. However, a new trend has emerged in recent years that could lead to a long-term temporary population rather like that of the United States. A very large number of people, approaching 100,000, are in Australia at present having entered on a tourist or some other short-term visa and then claimed political asylum. Australia is required to provide temporary asylum to these people with full work rights until their case has been heard in the court. Because their number is so large, it takes a number of years before their cases are heard. For those for whom the case has been heard, the success rate is very low, well under 10 per cent. And those that have been unsuccessful in their legal argument have not been deported. Effectively, they are bogus asylum seekers for whom the aim, either their own or that of the organisers of the scam, is to work in Australia for as long as possible. Like workers in other countries in similar circumstances, they are highly vulnerable to exploitation.

Sensitivity analysis

IGR5 provides very limited sensitivity analysis. However, as far as production is concerned, the impact of variations of NOM and labour force participation upon GDP per capita are easily modelled using the method described in Appendix 4.1. Figure 4.9 shows the impact on GDP per capita in 2060 of varying levels of NOM relative to NOM equal to zero and of the further impact of applying the 2019 labour force participation rates of New Zealand replacing the rates projected for Australia in 2060. All other inputs are the same as those used in IGR5.

Compared with an assumption of zero NOM, GDP per capita in 2026 increases along the blue line in Figure 4.9 as NOM increases. The IGR5 assumption of NOM equal to 235,000 per annum would increase GDP per capita in 2060 by 9.1 per cent relative to a NOM of zero. NOM of 100,000 per annum would increase GDP per capita in 2060 by 4.8 per cent relative to NOM of zero. The blue curve indicates that there are diminishing returns to scale as the level of NOM is increased.

The orange line in Figure 4.9 mirrors the blue line but applies the labour force participation rates of New Zealand in 2019 in place of the IGR5 projected Australian rates of participation for 2060. New Zealand has near to the highest age-specific labour force participation rates of any OECD country.

Comparing the blue and orange curves, it can be concluded that the effect on GDP per capita in 2060 of an increase in participation to that of New Zealand (5.5 per cent with zero migration) would be equivalent to the effect of 125,000 NOM. Nevertheless, if Australia's labour force participation in 2060 was the same as that of New Zealand, increasing levels of NOM would further increase GDP per capita. With NOM equal to the IGR5 assumption and New Zealand labour force participation rates, GDP per capita in 2060 would be 15 per cent higher than it would be with zero migration and the projected 2060 Australian labour force participation rates.

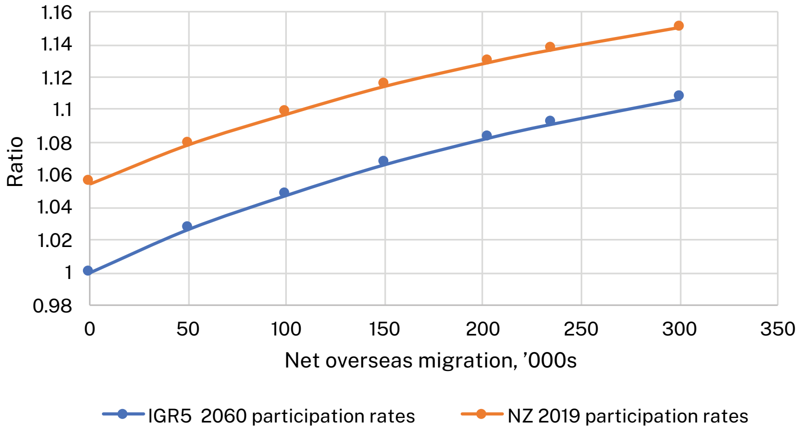

Figure 4.9: Sensitivity analysis of the impact of variations in migration and labour force participation on GDP per capita in 2060.

Blue: Ratio of GDP per capita in 2060 with varying levels of NOM to GDP per capita in 2060, compared with zero net migration.

Orange: Increase to GDP ratio in the blue curve if labour force participation rates for New Zealand in 2019 replace the Australian IGR 2060 projected rates.

Source: Author’s calculations.

Concluding remarks

IGR5 includes a useful summary comparative table of the demographic assumptions that were made in the five IGRs to date, here reproduced as Table 4.1.

Table 4.1: Summary of IGR demographic assumptions.

Intergenerational report	Total fertility rate	Net overseas migration	Period life expectancy at birth in 2050 (years)		Population June 2050
	Babies per woman	People (‘000)	Males	Females	People (‘000,000)
2021	1.6	235	85.7	88.4	35.3
2015	1.9	215	87.5	90.1	37.8
2010	1.9	180	87.7	90.5	35.9
2007	1.7	110	87.6	90.2	28.5
2002	1.6	90	83.2	88.2	25.7

Source: Reproduced from Commonwealth of Australia (2021:158).

The first four IGRs projected the TFR on the basis of the most recent trends in that measure prior to the formulation of the report, meaning that they were heavily influenced by recent changes in the timing of births. This explains the fluctuations across the reports. IGR5 instead projects the cumulated cohort fertility by age of each successive birth cohort of women and then translates this back into annual fertility rates by age and, hence, the total fertility rate. This is a better approach, but it is only reliable for a decade or so into the future. Beyond that, any projection of fertility is highly speculative.

Trends in mortality are much more regular than fertility trends, and so it is surprising that the variations in projected expectations of life at birth are so large across IGRs. The IGR projections of mortality have been based on relatively simple statistical trend models. For future IGRs, it may be wise to model age-specific mortality rates at ages 75 and over, using variables such as education, health status, behaviours such as smoking, alcohol consumption, exercise and weight, and trends in causes of death.

Future levels of NOM are a matter of government policy. For this reason, future levels may not reflect the past. IGR5, in its explanation of the assumed long-term level of NOM, provided an indication of thinking about future policy. In particular, the level of the Permanent Migration Program, which had been lowered to 160,000 in 2019, was returned to its previous, longer-term level of 190,000. While the justification of the assumption of 235,000 for NOM in IGR5 was flawed, there are definite indications that, prior to its defeat, the Morrison coalition government was planning NOM in excess of 200,000 per annum, and the new Labor government has not changed this policy direction. Nevertheless, there is potential fluidity in migration policy. The two most recent premiers of New South Wales have advocated successively for a halving of migration and a doubling of migration; Julia Gillard in 2010 said that she was not in favour of a 'big Australia', but in her first budget as prime minister, the level of the Permanent Migration Program was increased.

In December 2018, the Council of Australian Governments (COAG) assigned responsibility for population policy (primarily, immigration policy) to a committee consisting of the treasurers of the nine Australian governments. This places an economic emphasis on migration policy, and this probably explains why the Treasury models OLGA and FIONA

were used in IGR5 to demonstrate the economic effects of migration.[3] To support the new approach to population policy, in 2019, a Centre for Population was established in the Department of the Treasury in Canberra. The function of the centre is to assess, monitor and project changes to the size and distribution of Australia's population. The centre is the body that now has prime responsibility for the demographic assumptions used in the IGR and in all other Treasury modelling. Over time, this initiative should lead to a higher level of demographic expertise being applied to Treasury population projections, especially since the centre also consults broadly with academic demographers.

IGR1 generated considerable excitement and interest from the media because it was a novel approach. IGR5 did not have the same level of interest from the media and, one suspects, from Treasury itself. Perhaps a new approach is required. Given the uncertainty of projections as demonstrated by the variability across the IGRs and given the relatively arbitrary assumption of the future level of labour productivity, it may be preferable for the IGR to show the economic and fiscal implications of a much wider range of variation in the assumptions about future demography and labour force participation. This would better support consideration of alternative pathways.

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3 OLGA is the Overlapping Generations Model of the Australian economy, while FIONA is the Fiscal Impact of New Australians model.

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Appendix 4.1. Decomposition of variations in GDP per capita

Suppose there are two 3P projections to time t from time 0, Projection A and Projection B.

If we assume that both projections have experienced the same rate of growth of labour productivity between 0 and t, and the two projections have the same patterns of unemployment and hours of work between 0 and t,

then:

Per Capita $GDP(B)_t$/Per Capita GDP $(A)_t = P_t(A)/ P_t(B)*L_t(B)/ L_t(A)$

where:

$P_t(A)$ = Total population of projection A at time t

$P_t(B)$ = Total population of projection B at time t

$L_t(A)$ = Total labour force at time t

$L_t(B)$ = Total labour force at time t

Decomposing L into age- and sex-specific components:

$L = \sum P_i(M)*LFPR_i(M)+P_i(F)*LFPR_i(F)$

where:

$P_i(M)$ and $P_i(F)$ are the populations of males and females at age I, and

$LFPR_i(M)$ and $LFPR_i(F)$ are the male and female labour force participation rates at age i.

Rewriting the first equation:

Per Capita $GDP(B)_t$/Per Capita GDP $(A)_t = \sum p_i(M, A).LFPR_i(M, A)+p_i(F, A).LFPR_i(F, A)/ \sum p_i(M, B).LFPR_i(M, B)+p_i(F, B).LFPR_i(F, B)$

Where $p_i(M, A)$ is the proportion that males aged i represent of the total population in Projection A

This decomposition enables us to see the impact of variations in age structure of the population and changes in age- and sex-specific labour force participation rates on GDP per capita.

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