January 2021
TTRP 21-01

2021 Intergenerational Report
Treasury Technical Research Paper Series

Preliminary Fertility Rate Projections for the 2021 NSW Intergenerational Report

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[1] The views in this paper are those of the author and do not necessarily reflect those of NSW Treasury.
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Acknowledgement

NSW Treasury acknowledges the Traditional Owners of the land on which we live and work, the oldest continuing cultures in human history.

We pay respect to Elders past and present, and the emerging leaders of tomorrow.

We celebrate the continuing connection of Aboriginal and Torres Strait Islander peoples to Country, language and culture and acknowledge the important contributions Aboriginal and Torres Strait Islander peoples make to our communities and economies.

We reflect on the continuing impact of policies of the past, and recognise our responsibility to work with and for Aboriginal and Torres Strait Islander peoples, families and communities, towards better economic, social and cultural outcomes.

Contents

Abstract

The New South Wales (NSW) fertility rate is a key driver of population size, composition and age structure, with impacts for the long-run economic and fiscal position of the State. The NSW total fertility rate (TFR) is expected to structurally decline over the next 40 years. This paper sets out reasons why the NSW long-run fertility rate is projected to decline from its 2019-20 level of 1.67 babies per woman to 1.63 by 2032. The paper recommends that the 2021 NSW Intergenerational Report (IGR) utilise a constant long-run TFR assumption of 1.63 from 2032.

This recommendation, which is substantially lower than the 2016 NSW IGR long-run TFR assumption of 1.95, is supported by a review of the long-run drivers of fertility. In particular, trends around female education and workforce participation, and delays in major life transitions such as moving out of the family home and partnering, are expected to continue to contribute to the delay in first births and ultimately to further declines in the TFR from the already record lows of today.

In reviewing the modelling methodology, the possible use of a predictive model for the long-run TFR was tested, using a panel modelling approach with potential explanators drawn from NSW Local Government Area (LGA) level data. However, no sufficiently robust correlations were found for IGR modelling purposes. As such, it is recommended that as per past practice, a constant long-run TFR assumption be used.

In setting this long-run TFR assumption, it is found that the 10-year historical average approach utilised in the 2016 IGR is out of step with international methodologies and alone cannot effectively capture expected future trends in the fertility rate. Instead, it is recommended that the long-run TFR be informed by the work of Professor Peter McDonald for the Commonwealth Treasury Centre for Population, which provides a new modelling approach for estimating the long-run TFR and a preferable baseline for the 2021 NSW IGR.

A sensitivity analysis of the long-run TFR assumption on key indicators reveals slower population growth associated with the lower TFR over the projection period and an increased aged dependency ratio. Real Gross State Product (GSP) per capita is found to be inversely correlated with the TFR in the long run.

JEL Classification Numbers: J10, J11, J13

Keywords: fertility, total fertility rate, long-term projections, population, ageing

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Note

The author thanks Dougal Horton, Devang Tailor and Andrew Stone for their substantive contributions to the modelling in this paper. Luke Maguire for his guidance, oversight and review. Our demography colleagues at the NSW Department of Planning, Industry and Environment, including Angelique Parr, Andrew Tice and Kevin Gock, as well as demographic experts Kim Johnstone, Edith Grey and Thomas Wilson for their review and comments on earlier drafts. Stephen Walters, Aruna Sathanapally and Joann Wilkie for their feedback on various drafts. Lastly, Professor Peter McDonald and the Commonwealth Treasury Centre for Population, and all other authors from which this paper is referencing.

1. Introduction

An important factor in any long-term demographic modelling is the number of births within the population. Births are one component of the population change equation, with the balance between births and deaths representing natural population change. Over a 40-year horizon, different assumptions about the number and timing of births can have a significant impact on the size, composition and age structure of the population, with important economic and fiscal implications.

The most common measure of a population's birth rate is the Total Fertility Rate (TFR). The TFR represents the average number of children born to a woman over her lifetime, assuming current age-specific fertility rates were experienced for every year of her reproductive life (see Box 4.1 below for detailed definition).

The TFR in New South Wales (NSW) and across Australia has fluctuated substantially over the past century, driven by significant social, economic and cultural change over this period. Since the late 1970s, the NSW TFR has been below replacement level (which is around 2.1 births per woman)[2] and is currently at the lowest rate on record at 1.67 births per woman.[3] Sub-replacement fertility rates have created a reliance on strong overseas migration to maintain and grow the State's population levels, as is the experience for many Organisation for Economic Co-operation and Development (OECD) countries.

NSW Treasury last published long-term TFR projections in the 2016 NSW Intergenerational Report (IGR). TFR projections for the 2016 IGR were developed using a historical average methodology, which resulted in a long-run NSW TFR assumption of 1.95 births per woman over the projection period to 2055-56. This paper assesses the long-run TFR assumption and proposes a revised TFR and methodology for the next NSW IGR, to be published in 2021.

Box 4.1 Total Fertility Rate

The TFR represents the average number of children born to a woman over her lifetime, assuming current age-specific fertility rates were experienced for every year of her reproductive life. It is constructed by summarising all age-specific fertility rates (ASFRs) in a given year, as described below:

$$TFR_t = \frac{\sum_{a=15}^{49} ASFR_{t,a}}{1000}$$

The TFR reported in the IGR is a period measure of fertility, which is an aggregate of birth rates across all age groups at a single point in time (usually a year). The alternative is to take a cohort perspective, which looks at the lifetime experience of childbearing for a cohort of women (usually born in the same year). Completed family size indicates the average number of children that women of a specific cohort may have (or did have) over the course of their life.

Period measures are more volatile than cohort measures of fertility, as they are more affected by conditions in the year they are measured, reflecting both the ages at which women have children (tempo component) and the number of births women ultimately have (quantum component). If women delay having children to later ages, but still have the same overall number of children, the period TFR will fall for a period of time (as the birth rates of younger women fall), then rise later (as these same women have children at an older age). Period measures are, however, timelier and easier to compute, highlighting shorter-term developments that are not captured through cohort measures.

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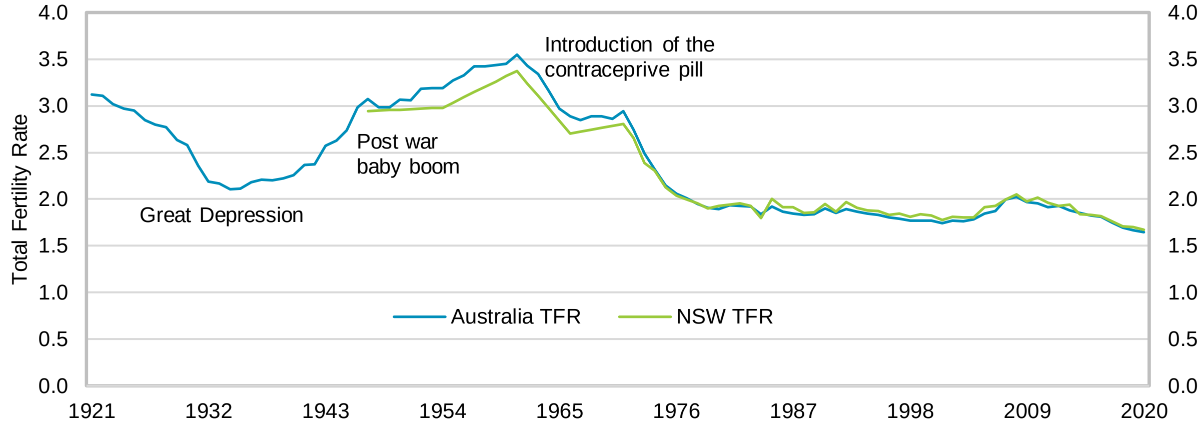
[2] Replacement level fertility, represented by a TFR of 2.1, is the level required for each generation to exactly replace itself. This reflects the replacement of both parents, as well as a small buffer to account for child mortality, maternal mortality and sex at birth bias towards males.
[3] Latest published actual for NSW, ABS 3101.0 (June 2020 release).

2. Overview

I) History of fertility in New South Wales and Australia

Childbearing in NSW fell to its lowest rate on record in 2019-20 following a period of steady decline over the past decade. Chart 1 below shows the behaviour of the TFR for both Australia and NSW over the past century.[4] The Australian TFR closely mirrors levels seen in NSW since state level data has been available and provides a good proxy for the NSW TFR prior to the availability of state level data from 1947.

Chart 1: TFR comparison of NSW and Australia[5]



Source: ABS 3105.0; ABS 3301.0; NSW Treasury

The national TFR was estimated at around 3.1 babies per woman in 1921, before dropping to around 2.1 babies per woman by 1935 reflecting the impact of the Great Depression of the 1930s. Fertility rates then increased during the 'baby boom' following the Second World War, reaching a high of 3.5 babies per woman in 1961. Following the introduction of the contraceptive pill in Australia in 1961 fertility rates dropped dramatically, as women gained access to greater control over pregnancy and childbirth. By the late 1970s this steep decline was largely complete, with Australia's TFR dropping below replacement level in 1976. This decline coincided with other significant economic and social changes over this period, including increasing opportunities for women to participate in the workforce, the introduction of no-fault divorce in 1975, and changes to abortion law in NSW in 1971.

Since the late 1970s, both the State and the national TFRs have been relatively stable in comparison to the decades prior, showing a very slight trend downwards over this period. The modest rise in both the State and national TFRs in the mid-2000s was a likely reflection of a combination of cyclical influences, including a sustained period of economic growth over the decade prior, catch up of delayed births for women in their 30s[6] and changes to government family support payments. Following the onset of the global financial crisis in 2008, both the state and national TFRs have been in steady decline, with 2019-20 seeing the lowest fertility rates since records began (1.67 births per woman in NSW and 1.65 nationally). Although the NSW TFR is at record lows, population growth has seen the total number of births remain steady over the past five years, at around 98,000-99,000 births per year.[7]

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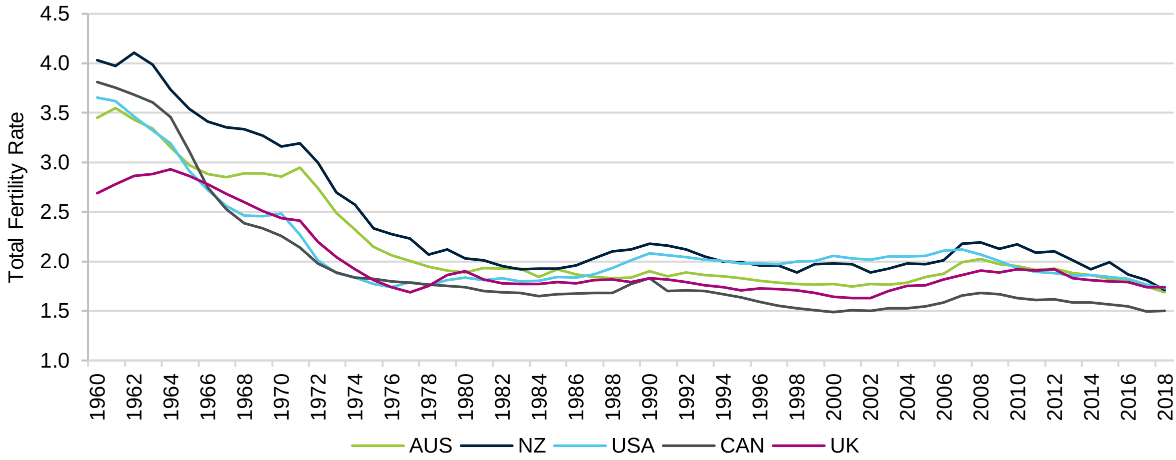
[4] Between 1947 and 1971, estimated resident population was not available to calculate the TFR for NSW on an annual basis, hence linear interpolation has been used to calculate data points for the intervening years between each census.
[5] Note that data up to 2013 is reported on a calendar year basis, and data from 2014 onwards is based on financial year (for example 2014 represents the 2013-14 financial year).
[6] McDonald, P and Kippen, R 2011
[7] ABS 3301.0 Births 2018. Note data is based on date of registration of birth.

II) Fertility trends internationally

The evolution of Australia's fertility over the past 60 years has been broadly in line with that of other English-speaking OECD countries (see Chart 2). New Zealand, the United Kingdom, Canada and the United States all experienced a significant decline in their respective TFRs through the 1960s and 1970s before stabilising at or below replacement level, with a more marked decline present over the past decade. The Australian TFR of 1.7 sat slightly above the OECD average of 1.6 in 2018[8] and has since dropped closer to this average.

Chart 2: TFR comparison Australia and Selected OECD Countries



Source: World Bank fertility rate database; ABS 3301.0; NSW Treasury

Australia's TFR has not dropped as dramatically as some Asian and European jurisdictions, including Singapore, South Korea, Japan, Hong Kong, Portugal, Spain, Greece, Italy and many former Eastern Bloc countries, who all have TFRs below 1.5 births per woman.[9] McDonald (2020) suggests this divergence between the moderately low fertility countries (between 1.5 and 2.1 births per woman) and the very low fertility countries (under 1.5 births per woman) is the result of the higher levels of support for women to combine work and family in the moderately low fertility countries.

III) Age-specific fertility rates

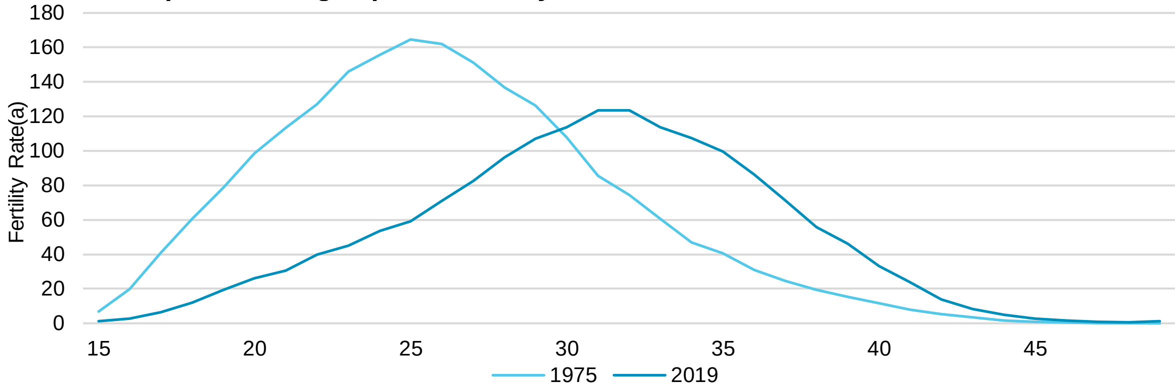
Age specific fertility rates measure the number of births to women of a specified age group in a particular year. Age specific fertility rates have changed over time, with women increasingly having children at older ages (see Chart 3). The median age of mothers in NSW has risen from 25.9 in 1975 to 31.5 in 2019.[10] Since 2000, the fertility rate of women in their early 30s has been higher than all other groups. This primarily reflects a softening in birth rates of women in their 20s as they instead have children in their 30s, as well as a decline in teenage fertility, which has dropped over 75 per cent from 1975 rates.

This long-term trend towards later childbirth correlates with smaller families. Women seeking to have one or two children may wait until they are older to do so, and even for those who seek larger families, having their first child later in life reduces the number of years available for subsequent births. The long-term trend towards women having their first child later in life also increases the chance of childlessness. As such, the longer the period of delay, the lower the overall level of

[8] OECD Data, 2018
[9] World Bank, fertility database, 2020
[10] Defined as the median age of mother at confinement, which measures the median age of females who gave birth in a particular year (ABS Births 3301.0)

recuperation.[11] While some women attempt to extend their reproductive years through assisted reproductive technology, such procedures account for less than five per cent of births in Australia annually.[12]

Chart 3: Comparison of age-specific fertility rates for NSW



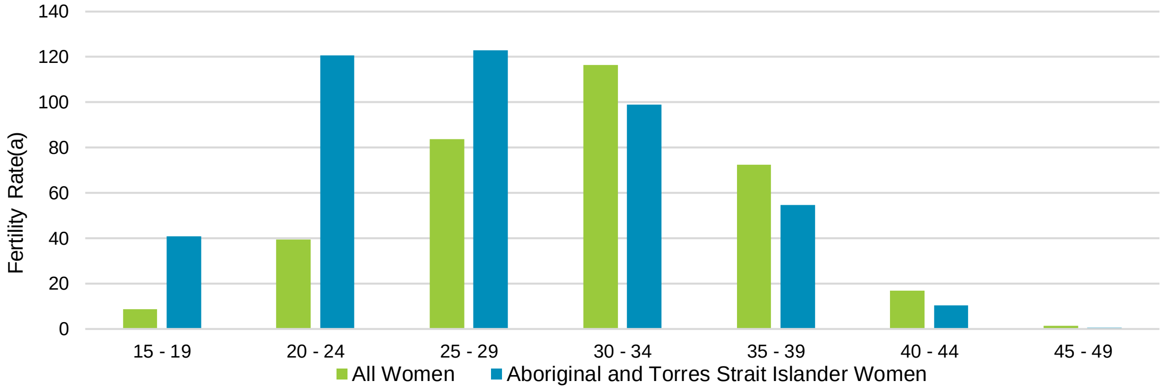
Source: ABS 3301.0; NSW Treasury
Notes: (a) represented as births per 1000 women

IV) Differences across regions and groups

Aboriginal and Torres Strait Islander fertility

Aggregate state and national fertility levels do not reveal differences between social and cultural groups within the overall population. Notably, Aboriginal and Torres Strait Islander women have a much higher TFR (around 2.25 births per woman in NSW)[13] compared to the state average (1.67 births per woman) and make up approximately 3.4 per cent of the NSW female population. On average, Aboriginal and Torres Strait Islander mothers also have children younger, with a median age at childbirth of 26.5 in 2019, approximately five years younger than the median age of all mothers (31.5 years). Chart 4 below outlines the differences in age specific fertility rates for Aboriginal and Torres Strait Islander mothers versus all mothers.

Chart 4: NSW TFR comparison Aboriginal and Torres Strait Islander and all women



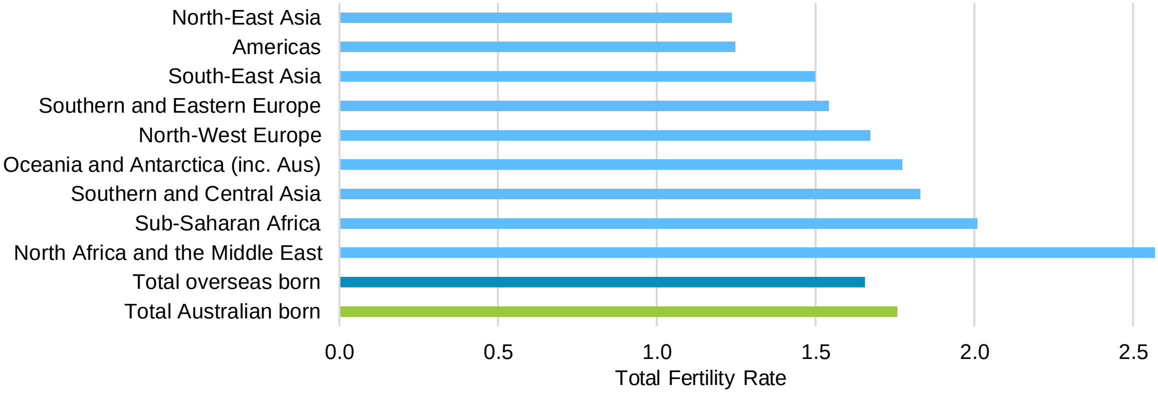
Source: ABS 3301.0; NSW Treasury
Notes: (a) represented as births per 1000 women

[11] The term ‘recuperation’ relates to fertility postponement across younger ages, followed by a subsequent compensatory fertility increase at higher reproductive ages.
[12] Newman, J et al. 2020
[13] ABS 3301.0

Migrant fertility

A larger subgroup within the Australian population are persons who have immigrated to Australia, with approximately 30 per cent of the NSW population born overseas.[14] On average, women born overseas have a lower fertility rate compared with Australian born women, particularly women born in North East and South East Asia and the Americas (US, Canada, Central and South America) (see Chart 5).

Chart 5: Australian TFR comparison by region of birth of mother (2018)



Source: ABS 3301.0; NSW Treasury

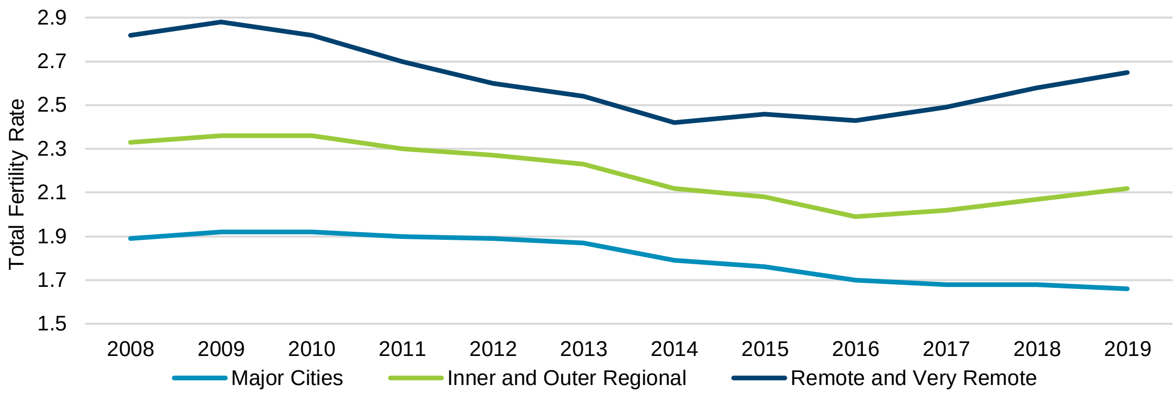
In 2018, women born overseas had a TFR of 1.65 compared to 1.76 for Australian born women. However, a further breakdown of this difference by visa type reveals that the fertility rate among Australian born woman and permanent visa holders is almost identical, with lower fertility among immigrants exclusively attributable to temporary migrants who are less likely to give birth while in Australia.[15] Interestingly, the opposite is found in most OECD and European Union (EU) countries, with immigrant females tending to have a higher TFR than the local population.[16] This difference can likely be partially attributed to Australia's strong focus on skilled migration, with eligibility for permanent and temporary visas strongly linked to engagement in skilled work or study (during which time women are less likely to be seeking to have a child, or be in a position to do so).

Regional and inter-state comparison

Fertility rates vary across Australia, reflecting geographic differences in the various social and economic factors that influence fertility. Of particular importance when comparing differences in fertility across jurisdictions is the relative degree of urbanisation (see Box 2.1). Within NSW, the TFR in major cities is consistently lower than in regional and remote areas (see Chart 6).[17] In 2019, the fertility rate in major cities was 37 per cent lower than in remote and very remote locations (1.66 versus 2.65), and 22 per cent lower than inner and outer regional areas (with a TFR of 2.12).

[14] Based on 2016 ABS census data
[15] McDonald, P 2020
[16] OECD/European Union 2015
[17] See ABS 3101.0 for definitions of these geographical breakdowns

Chart 6: TFR regional comparison for NSW



Source: ABS 3101.0; NSW Treasury

Box 2.1 Is urbanisation still important for modelling fertility in NSW?

Demographic literature supports the finding that fertility rates vary geographically, with a strong correlation between increasing urbanisation and declining fertility. In line with this finding, NSW data shows a clear difference between the average TFR in city, regional and remote areas (see Chart 6). This suggests that further increases in the urbanisation rate could be met with further declines in the fertility rate.

While the data shows a clear and consistent difference in fertility rates across varying levels of urbanisation, the question of causation is hard to isolate. There are many drivers such as housing costs, lifestyle factors, education levels and work opportunities for women all interlinked with choices around family size and timing of children. It is therefore not necessarily clear that increased urbanisation, on its own, drives lower fertility, or whether other factors drive both fertility and urbanisation trends.

As at the 2016 national census, the urbanisation rate in NSW was estimated at 90.7 per cent (and 89.8 per cent for Australia more broadly).[18] The rise in urbanisation in NSW has slowed substantially over the past half century. Urbanisation increased by 3.5 percentage points between 1961 and 1971, but only by 1-1.5 percentage points per decade throughout the 2000s, likely reflecting the already very high rates of urbanisation. In the context of COVID-19 and the shift towards more flexible working arrangements, the move towards urban centres could be expected to further slow into the future.

In order to understand the continuing importance or otherwise of urbanisation for fertility modelling in the NSW IGR context, an assumption must be made around any future increase in urbanisation in NSW over the coming decades, as well as the sensitivity of the State's TFR to the degree of urbanisation. Given the continual increases in urbanisation in NSW over recent history (albeit very marginal), it could reasonably be assumed that this trend would continue over the coming decades.

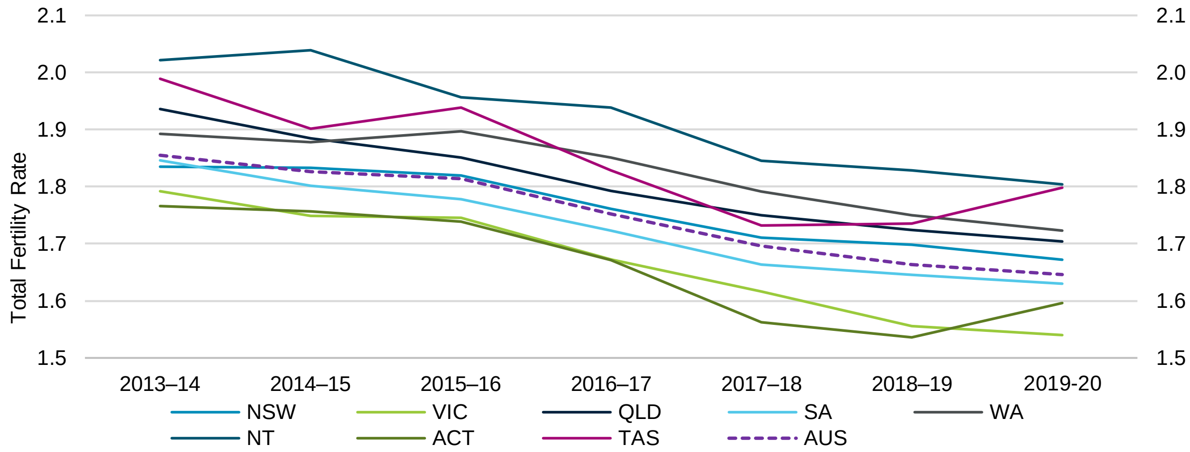
Looking at the impact on the TFR, taking a high end assumption where urbanisation continued at the rate of the past 25 years and a complete convergence in TFRs of those moving from rural areas to the urban rate, the projected impact on the NSW TFR would be a decline of approximately 0.04 percentage points over the next four decades.[19] This suggests that future rises in urbanisation are unlikely to be materially significant to the State's TFR, even over a 40-year horizon.

[18] ABS 3105.0 Australian Historical Population Statistics 2019
[19] Based on NSW Treasury analysis

Fertility rates also differ across States and Territories, with the Northern Territory having the highest TFR in the country at 1.80 births per woman (see Chart 7). High fertility in the Northern Territory is driven by large remote populations (and associated factors such as reduced access to education, health care and employment) with over 40 per cent of the population living in areas classified as remote or very remote. At the opposite end of the scale, Victoria's TFR is the lowest in the country at 1.54 and is closely followed by the Australian Capital Territory at 1.60. Both Victoria and ACT's consistently low TFRs compared to other jurisdictions may reflect their smaller regional populations, lack of remote communities, and high levels of female education and workforce participation.

Looking at change over time, Victoria has also seen the largest decline in the TFR of all states and territories, dropping by 14.1 per cent (or 0.25 births per female) over the six years from 2013-14 to 2019-20. By comparison, the decline in the TFR in NSW was the lowest in the country, dropping by only 8.9 per cent (0.16 births per female) over the same period.

Chart 7: TFR comparison across states and territories



Source ABS: Release 3101.0; NSW Treasury

3. Drivers of fertility

There are a host of factors that influence the timing and ultimate lifetime number of children women have. Some relate to short-term cyclical responses and others reflect longer-term structural factors, such as social and economic changes over time. The TFR in any given year is the outcome of the upwards and downwards pressure these cyclical and structural factors exert. This section explores the major factors that have contributed towards patterns of delayed and low fertility in NSW over recent decades and how they might influence future TFRs. Understanding these drivers, how they change, and how they might influence TFRs over time will help to inform 2021 IGR TFR projections.

I) What has been driving the decline in fertility rates?

Rapid growth of tertiary education for women

Increased educational attainment among women is one of the primary forces behind the postponement and decline of childbearing over recent decades.[20] The long-run trend towards higher levels of educational attainment for women (and increased time spent in education) continued through the 2000s, with women now more likely to hold a bachelor's degree or above than men (33.3 per cent

[20] Bui, Q and Miller, C 2018; Livingston, G 2015

versus 26.8 per cent).[21] On average, the higher a woman's education, the fewer children she has. In 2016, 20 per cent of women in their forties with a degree or higher qualification had no children, compared to 15 per cent of women of this age without a post-school qualification.[22]

The link between education and fertility decisions comes down to timing and costs. Increases in the average age at completion of education have been found to account for a large portion (if not the majority) of the shift to later first-birth timing in the United Kingdom and France.[23] Generally, women wait until they have completed their education to commence childbearing, and as the share of women pursuing tertiary education increases, so has the average age at which women have their first child. Longer durations spent in education also bring about delays in other major life events, including later partnership formation, career anchorage and housing stability, and as such, contributes to later onset of childbearing and reduced family sizes. Rising educational attainment also increases the opportunity costs associated with childbearing for women and preferences around family size. As women's career prospects, earning potential and independence improve, so too do the trade-offs of having children.

Deteriorating economic position of young adults

Economic and financial challenges for young adults have reduced the viability of forming families at these ages.[24] A recent Productivity Commission report found that between 2008 and 2018, the average real income of young people (aged 15-34) declined, while older Australians' incomes continued to increase.[25] The report suggests that since the Global Financial Crisis, young Australians have found it more difficult to secure employment following the completion of education, reducing bargaining positions for starting wages. As such, young workers have been turning to jobs that do not fully use their qualifications or to part-time/casual work.

Over this same period, Commonwealth Government support decreased for many students and young parents as eligibility for Youth Allowance and Family Tax Benefits were tightened, reducing the affordability of having children. The COVID-19 crisis is also likely to reinforce these challenges, with young people more likely to be casual or part-time workers and disproportionately affected through loss of employment or reduced hours, with potentially enduring impacts on labour market outcomes.

The rise of precarious work and declining real wages for young people is combined with declining housing affordability. Since the mid-1990s Australian house prices and rents have risen substantially in real terms and as a proportion of household income.[26] This is particularly important for younger generations and people of childbearing age that can find it more difficult to enter to the property market, leading to increased uncertainty and insecurity.[27] These trends also contribute to young people residing for longer periods in their parental home, where it is less likely that they will partner and have a child of their own.

Increased female workforce participation and real wages

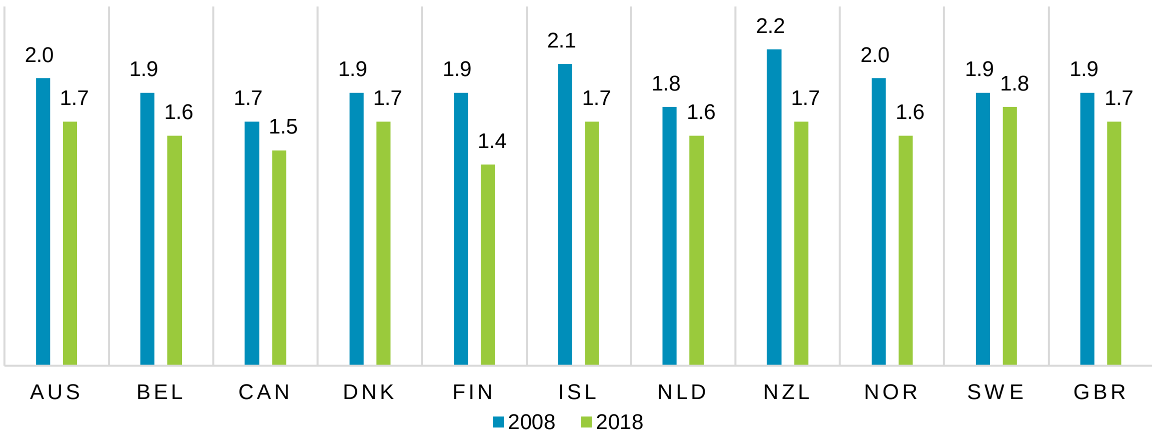
The relationship between women's labour force participation and the TFR has changed over time and varies between age and income groups. In general, as women's labour force participation and real wages have increased, trade-offs around childbearing have also increased for prospective mothers, and preferences around childbearing have changed, reducing overall fertility. Increasing access to

[21] ABS Cat. 6227.0 Education and Work, data as at May 2020
[22] Qu, L 2020, research based on 2016 ABS census data
[23] Bhrolcháin, N & Beaujouan, E 2012
[24] Sobotka, T 2017
[25] Productivity Commission 2020
[26] Daley, J et al. 2018
[27] Grattan Institute 2018

flexible working conditions over the past two decades, as well as increased availability of childcare and more generous government childcare subsidies have helped to somewhat offset the opportunity costs of childbearing for women, however there is little consensus on the relative impact.[28] The move towards gender equality in the home and the increasing role of fathers in caring responsibilities for children has also likely played a part in reducing the trade-offs for mothers between work and family.

It is noteworthy that despite having some of the world's most progressive family support policies, fertility rates have been falling in countries such as Finland, Norway, Sweden, Iceland, the United Kingdom and New Zealand over the past decade (see Chart 8).[29] This indicates the likely importance of broader economic and social influences on the fertility rate, outside of government and industrial policy settings.

Chart 8: TFR selected country comparison 2008 and 2018



Source: OECD Fertility Rates 2018

Shifts in family formation and social norms

Diversification in family formation, changing patterns in partnering and shifting attitudes and social norms around having children have contributed to lower fertility rates over recent decades. The rate of marriage has been declining in Australia over the past three decades and couples have been marrying later.[30] Over the same period, cohabitating relationships have become increasingly common, as well as lower overall rates of partnering and increased acceptance of diverse family formations. More couples are also making the choice to not have children. Overall, these shifts in family formations, combined with a trend towards partnering at older ages, have led to delayed childbearing, increased incidence of childlessness and lower overall fertility rates.[31]

II) Will these trends continue?

Sobotka (2017) hypothesises that the shift to later childbearing could continue for two to three more decades, given that trends towards economic instability, shifts in family formation and higher levels of postsecondary education for youth are expected to continue.

Some recent studies have also argued that current patterns around later childbearing and low fertility may have a strong influence on future fertility behaviour, where a 'feedback loop' of corresponding

[28] Productivity Commission 2008
[29] OECD data 2018
[30] AIFS, Couple Relationships 2020
[31] Fisher, K and Charnock, D 2003, University of Melbourne, HILDA survey

changes in cultural values and norms related to having children is created.[32] This is where the childbearing behaviour of family members, peers, colleagues and friends influences the childbearing intentions and behaviour of others.[33] These theories would suggest that trends towards fertility postponement and childlessness could continue to increase through self-reinforcing social norms.

The question that follows is how much further the average age of motherhood can increase given the biological limits to childbearing, and how this might be supported by assisted reproductive technologies (ART) into the future. As the accessibility and affordability of ART improves, it is possible that women who do not have children until later in life may have greater opportunity to have a larger family. To date, however, it has been found that any impact of ART is very small and could only have a substantive impact on the TFR if used more by women at younger reproductive ages.[34]

III) Fertility rates and the economy

Economic conditions and uncertainty

Decisions around childbearing are greatly influenced by the state of the economy and jobs market, particularly in the short term, with a well-established pro-cyclical relationship.[35] Steady periods of economic growth increase people's confidence about the future and income prospects, in turn creating greater willingness to incur the costs of raising children. This relationship also holds for periods of economic downturn, where higher levels of uncertainty about the future and concerns for job security are accompanied by lower fertility rates (see Box 3.1 for discussion of COVID-19 impacts). The impact on childbearing decisions to changes in the business cycle may lead to temporary changes in the TFR as potential parents decide whether to delay or abandon plans to have a child. Importantly, these decisions do not necessarily impact lifetime fertility rates, and may simply impact the timing of having a child. Given this pro-cyclical relationship between economic conditions and fertility, it is important long-run TFR projects reflect the structural drivers rather than short-run cyclical factors.

Box 3.1 What impact will COVID-19 have on fertility?

There are a range of factors that are likely to influence both the size and duration of the impact of the current COVID-19 pandemic on the TFR, many of which are hard to quantify until the full impact of the pandemic is known. Insights can, however, be drawn from other economic shocks in the past to help understand what factors to consider and their potential impact for fertility decisions within the COVID-19 context.

The first, and potentially, most important consideration is the impact of the broad economic downturn that is continuing to unfold. There is a wealth of research showing that fertility tends to be pro-cyclical, with strong economic conditions having a positive impact on fertility rates, and vice versa.

[32] Huinink, J and Kohli, M 2014; Zeman, K et al. 2018
[33] Bernardi, L and Klarner, A 2014
[34] Te Velde, E et al. 2012; Kocourkova, J et al. 2014; Habbema, J et al. 2009
[35] Munnell, A et al. 2019; Sobotka, T et al 2011; Lanzieri, G 2013; Matysiak, A et al. 2020

Box 3.1 What impact will COVID-19 have on fertility? (Cont.)

These cyclical movements can be seen in Australia, most notably the baby bust of the Great Depression in the 1930s. Australia's early 21st-century increase in the TFR also coincided with a period of strong economic growth, which was subsequently followed by a downturn in the TFR from 2008 following the Global Financial Crisis. Similar trends can be seen across the United States and Europe over the same period. This behaviour is predominantly due to the underlying uncertainty and economic disruption experienced by prospective parents, whether that be employment, housing or access to goods and services.

Importantly, these cyclical waves are found to be relatively small and of short duration. As such, the impact on fertility rates is found to be temporary, resulting in short-term swings in fertility rates rather than long-term alterations in fertility patterns that are typically caused by other long-run drivers. This is also reflective of the finding that economic downturns typically lead to a postponement of childbearing, especially first births, which can later be largely recuperated during times of economic prosperity.[36]

More broadly in relation to high mortality events such as famines, natural disasters and other epidemics, a similar well-established linkage can be found where birth rates tend to fall and then bounce back soon afterwards. This relationship holds for influenza outbreaks in 1918 in Sweden, Norway, Taiwan, Japan, India and the United States, the SARS outbreak in Hong Kong in 2002, as well as Ebola in West Africa in 2016.

The scale of the decline in birth rates is found to be linked to the scale of the disaster, with higher death and infection rates causing deeper declines in birth rates. Given this, it can be expected that the impact of COVID-19 on birth rates will be highly dependent on the success of containment measures and scale of loss of human life. In Australia this impact is expected to be immaterial, as COVID-19 related mortality rates have been among the lowest of all OECD countries. Other countries where containment measures have been less successful, such as the United States, Spain, Italy and the United Kingdom are more likely to see reductions in fertility rates in response to mortality effects.

Counter to the points above, there are arguments that prolonged periods of co-location could result in a 'quarantine baby bump'. Some evidence suggests a small increase in birth rates following mild storm situations as couples shelter together for extended periods of time.[37] However, serious storms tend to have an opposite effect, likely due to income losses and economic damage, indicating this may be the more dominant factor. Extended periods in quarantine may also undermine couple formation as people's movements and access to social activities are restricted, or exacerbate intra-relationship issues, particularly under circumstances of financial stress. This could lead to lower partnering rates, with implications for the TFR.

While evidence suggests a likely short-run downturn in fertility rates, followed by a potential upswing during the recovery phase, the effects of COVID-19 on fertility rates will not be universal and unidirectional. The impact, scale and duration will be highly dependent on the success of government containment measures and interventions to support the economy and jobs as well as people's personal behaviours and perceptions of the future. Overall, it is likely that whatever the impacts of COVID-19, it will only hold in the short-run, with long-run fertility remaining primarily driven by other overarching factors such as education, lifestyle and cost.

4. Modelling Future Fertility

I) Former IGR fertility assumptions and methodologies

To date, NSW has released three IGRs, the first in 2006, followed by 2011 and 2016.[38] At each NSW IGR the long-run TFR assumption has been progressively revised upwards. This section will explore the methodologies and assumptions that were used for these reports.

NSW 2016 IGR TFR assumption and methodology

The 2016 NSW IGR had a long-run TFR assumption of 1.95 births per woman, which reflected the average TFR in NSW for the preceding 10 years. This modelling assumption entailed a gradual near-term increase in the State's assumed TFR, from 1.85 (as recorded in 2015) to 1.95 by 2021, before remaining at this rate for the 35-year projection period. This assumption was slightly higher than the national 10-year average of 1.91 and higher than the long-run assumption of 1.90 for Australia used in the Commonwealth Government's 2015 Intergenerational Report. Since 1980, the national TFR has been lower than the NSW TFR in every year bar 1984 and 2014.

The 2016 IGR TFR profile was calculated using age-specific birth rates for NSW from the Australian Bureau of Statistics based on the Births (cat no 3301.0) release. These age-specific fertility rates were then converted into a probability distribution for each year in the time series (1975-2014).

Richards curves were then used to project the mean and standard deviation of the age of mothers to 2056. These projected means and standard deviations were applied to a standard normal distribution curve, which was adjusted to be consistent with the 2010 distribution of births by age of mother. This provides a probability distribution of the mother's age at the time of childbirth over the projection period. This distribution was combined with the long-run TFR assumption to yield age-specific birth rates, which when applied to the overall female population, provide an estimate of the number of births each year.

Previous NSW long-run TFR assumptions

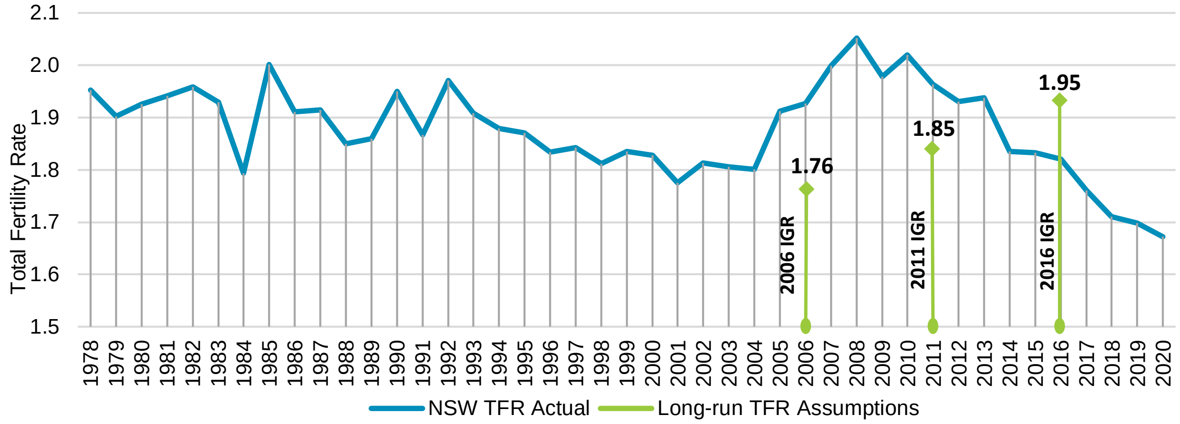
The 2006 and 2011 NSW IGRs used relatively lower long-run TFR assumptions than the 2016 IGR. The 2006 NSW IGR assumed a fall in the TFR from 1.79 in 2004 (which was the latest actual at the time of writing)[39] to 1.76 in the long run. This assumption was formulated just prior to the beginning of the unforeseen baby 'bump' experienced through the mid-2000s.

The 2011 IGR revised the long-run NSW TFR assumption up to 1.85, slightly higher than the current year estimate at the time of writing of 1.83 for 2009.[40] The report states that this higher long-run fertility rate assumption was chosen due to the observed rise in fertility since the 2006 IGR.

Chart 9 below shows the NSW TFR actuals in comparison to the long-run assumption made at each IGR.

[36] McDonald, P 2020
[37] Stone, L 2020
[38] The 2006 and 2011 intergenerational reports were formally known as the Long-Term Fiscal Pressures Reports.
[39] Note this TFR has since been revised upwards by the ABS
[40] Note this TFR has since been revised upwards by the ABS

Chart 9: Comparison of NSW actual TFR and long-run IGR TFR assumptions



Source: ABS 3105.0; ABS 3301.0; NSW Treasury

II) Selected International methodologies

A variety of methodologies are used internationally to create assumptions for the long-run TFR, many of which rely on combinations of data analysis and judgement-based decision making.

Statistics Canada assumptions of future fertility are created based around an examination of historical and recent trends within and outside of Canada, a review of academic and international literature, as well as qualitative comments and quantitative estimates provided by respondents in a survey of experts of future demographic trends.

Statistics New Zealand population projection assumptions are formulated around analysis of short-term and long-term historical trends, recent trends and patterns observed in other countries, and government policy. Similarly, in the United Kingdom, the Office of National Statistics fertility assumptions for future projections are produced by reviewing past trends and modelling of plausible future scenarios. They also consult with a panel of independent academic experts working in the field of demography to discuss the possible forces that may influence future demographic behaviour and conduct research to inform scenarios that best reflect future trends.

Alternatively, the United States Census Bureau use a convergence approach for modelling the long-run TFR. For the most recent 2017 National Population Projections, age-specific fertility rates were projected to 2060 by assuming linear convergence in the year 2100 of the age-specific fertility rates of six nativity origin groups. The 2100 convergence point is the average age-specific fertility rates of the ‘native white’ population for the years 2004 to 2015. They then interpolate age-specific fertility rates from 2015 to 2100 by age and nativity. The projected age-specific fertility rates are then multiplied by the population of women at each age and nativity group to calculate the projected number of births from 2016 to 2060. In the Australian context, this approach would be less appropriate given the lower degree of stratification in fertility between major population sub-groups.

III) Testing a predictive modelling option for NSW

All three previous NSW IGRs utilised a constant long-run TFR assumption to model the future population and fiscal gap. In reviewing the fertility modelling methodology for the 2021 IGR, this section considers the viability of using an alternative modelling approach utilising a non-constant long-run TFR or predictive model.

Data quality and availability

Efforts to find a meaningful statistical relationship between the NSW TFR and specific variables is limited by data quality and availability. Annual TFR data is available for NSW back to 1947 (73 years) and further if using the national TFR as a proxy. However, obtaining a correspondingly long time-series of annual data for other potentially correlated variables is challenging (for example, measures of economic well-being, confidence about future personal circumstances, housing prices, housing affordability, relative levels of urbanisation and religious affiliation). Even if focused only on data from the past 30 years, data quality is negatively impacted by the need to splice or join together different data sources and interpolate values for variables that are not captured annually (such as the five-yearly census).

Identifying statistical relationships between individual variables and the TFR is further complicated by factors which create tempo effects in the data, including the changing age structure of mothers, 'recuperation effects'[41], and short-term cyclical movements in the TFR in response to economic conditions. In the past, combinations of these factors have resulted in short-lived 'blips' in fertility, making it more challenging to accurately identify the correlation between fertility and longer-term drivers. Given this, in order to develop a consistent and considered modelling position for the long-run TFR, it is important to not only examine and respond to annual events, but to also understand underlying long-run forces and how they might influence the future fertility rate.

Panel modelling of the TFR and explanator variables

A panel modelling approach was tested to find correlations between the NSW TFR and an array of potential explanators drawn from NSW Local Government Areas (LGA) level data, such as the cost of housing, the level of urbanisation, real wage growth, religious affiliation and others. This approach was taken in order to increase the degrees of freedom in the model and the capacity of the model to robustly identify key influences on the NSW fertility rate. The use of LGA-level data (as opposed to state level data) also allowed for much greater variability in several key explanatory variables, enhancing the scope to reliably explain shifts in fertility.[42]

Overall, LGA-level modelling of the TFR in terms of those explanators for which suitable panel data were able to be obtained did not yield sufficiently robust relationships for IGR modelling purposes. That is, no variables were found to have the very strong causal relationship that would be necessary to support the adoption of a non-constant long-run TFR forecasting model. Specifically:

- Although some specifications[43] yielded coefficient estimates that appeared to be statistically significant (i.e. were highly unlikely to be driven by chance, *assuming* that the model specification reflected the true data generation process), these coefficient estimates were subject to large fluctuations (including sign reversal), even following only minor tweaks to the model specification.

[41] A tempo effect relating to fertility postponement (fertility decline across younger ages) and subsequent recuperation (a compensatory fertility increases at higher reproductive ages) causing fluctuations in the TFR across years.
[42] For example, data on religious affiliation, in addition to displaying variety in behaviour over time at an LGA level, also varies substantially between different LGAs, creating scope for modelling to detect effects that would be very difficult to discern at an aggregate State level. The introduction of LGA data does, however, introduce a high degree of selectivity and statistical noise.
[43] Model specification refers to the determination of which independent variables should be included in or excluded from a regression equation.

- The only semi-robust finding from the many model variants tested was religious affiliation, which returned a strong positive correlation with higher fertility (i.e. LGAs with higher reported levels of religious affiliation tended to have higher TFRs). However, even with this stronger result, it was difficult to place definitive figures on the relevant sensitivity of coefficients due to high volatility in specific coefficient estimates in response to modest changes in model specification.
- Problems with finding robust explanators for changes in TFR were especially acute in relation to LGA-level proxies for both urbanisation (e.g. population density) and drought conditions.

Given these findings, it is recommended that the 2021 IGR should continue to follow past practice, utilising a constant long-run TFR value.

IV) Choosing a constant long-run TFR assumption

The panel modelling approach outlined above found no clear fertility drivers which could be modelled in a predictable way to produce a projected TFR profile for the 2021 IGR. The challenge then centres on how to best choose a long-run constant TFR level that is most likely to align with future fertility rates based on what we know today.

If we were to continue using the 10-year average approach to derive the long-run TFR assumption (as per the 2016 IGR), this would result in a long-run TFR assumption for the 2021 IGR of 1.86. While this would provide a consistent basis for calculation of the long-run TFR in line with the previous methodology, this approach also raises some risks. The 10-year average approach would see the long-run TFR set markedly above the latest NSW actual for 2019-20 (1.67) and require fertility rates to *rise* substantially over the first decade of the modelling horizon. This would be in contrast with the steady decline in the NSW TFR seen over the past decade, calling into question the usefulness of this approach in proving a realistic proxy for the future.

Further, as discussed in Section 3, an analysis of long-run drivers of fertility does not support a significant rise in fertility over the next decade. The 10-year average approach is also highly susceptible to distortion by short-run cyclical fluctuations in the TFR, such as that seen through the mid-late 2000s, which lead to a higher long-run TFR assumption despite declining actuals. Given these limitations, it is recommended that a new approach to modelling the long-run TFR be considered. One such piece of work has recently been commissioned by the Commonwealth Treasury Centre for Population and conducted by fertility expert, Professor Peter McDonald.[44] Professor McDonald's paper provides projections for both national and state and territory TFRs over both the short and long-term and is based on an analysis of the trends in the age of mothers, recuperation rates and overall changes in lifetime fertility.[45]

The paper finds that for every cohort since those born in 1960, cumulated cohort fertility fell relative to the 1960 birth cohort up until age 30. From age 31 onwards, recuperation (partially making up for the delayed births) occurred. This finding is driven by an understanding that fertility up to age 30 is heavily influenced by the timing of first births which is responsive to shocks and cyclical factors such as economic downturns. From age 31 onwards, fertility is less elastic and more influenced by the preference for the total number of children by the end of the childbearing ages. As such, the broad approach is to consider future fertility up to age 30 in terms of cross-sectional trends and then fertility

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[44] McDonald, P 2020
[45] The analysis utilises previously unpublished births data from the Australian Bureau of Statistics that the Centre for Population converted into fertility rates by single year of age, state and territory and financial year by occurrence.

after age 30 in terms of the final outcomes for each birth cohort of women, along with compositional changes in the population.

The projections presented represent a downward revision to previously held long-run TFR assumptions at both the national and state level and provide a more robust approach to predicting future trends than the previous historical average methodology. The paper points to the NSW TFR reaching 1.63 by the early 2030s. For further information on the methodology, results and recommendations of this work, please refer to McDonald (2020) directly.

5. Sensitivity testing

This section outlines the results of sensitivity testing under various fixed long-run TFR assumptions for population, ageing and Gross State Product (GSP). All three cases presented below follow the same TFR forecasts up to 2024, including the expected impact of COVID-19. From 2025, the TFRs then converge in a linear fashion to the respective long-run assumptions by 2032 and are held constant at this level through the remainder of the projection period to 2061.

V) Long-run value inputs

The three long-run assumptions presented for sensitivity analysis are:

High 2016 IGR long-run TFR assumption (1.95)

Mid Professor McDonald's long-run TFR projection for NSW (1.63)

Low An ultra-low long-run TFR assumption (1.45)

The high value represents the 2016 IGR assumption of 1.95, and provides a comparison point to the previous publication. The middle value is based on the projections by Professor McDonald as discussed in the previous section and is a reasonable central option from which to benchmark. Finally, the low value, seeks to demonstrate the impact of a very low fertility situation in the long-run and is roughly equivalent to other ultra-low fertility nations with TFRs under 1.5. It should be noted that the long-run assumptions analysed are for the purposes of sensitivity testing only and do not necessarily represent expected outcomes.

All scenarios assume that over the long-run, annual Australian net overseas migration is 235,000, consistent with the Australian Government's Population Statement (December 2020), and annual NSW interstate migration is assumed at a net loss of 17,500.

VI) Short-run and transition pathway

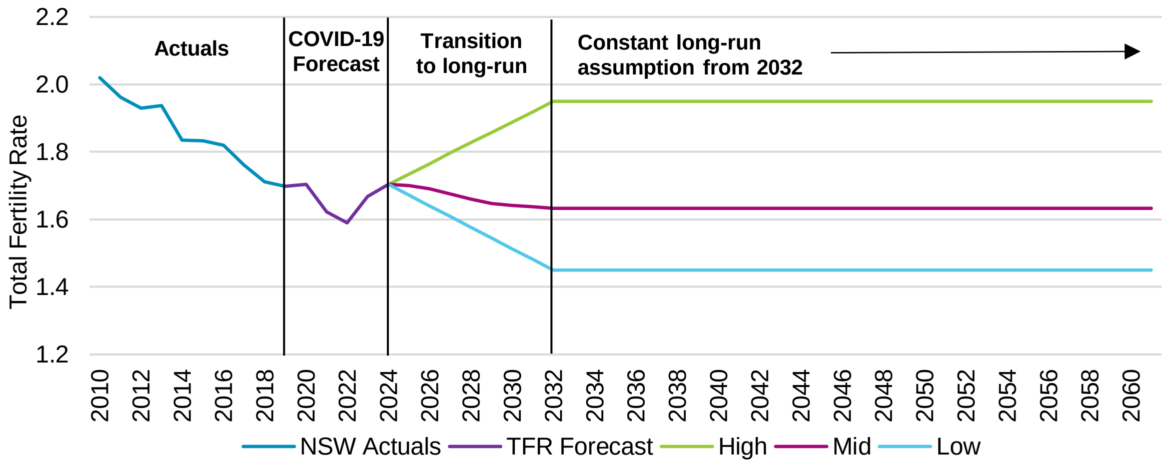
The near-term forecasts have been developed by Professor Peter McDonald and have been endorsed at the state level for NSW by an expert panel of demographers and academics from across Australia. Professor McDonald's forecasts assume a delay in childbearing due to COVID-19 with reductions to the TFR from 2020-21. This drop in fertility is then followed by an 80 per cent recuperation in delayed births by 2023-24[46], as shown in Chart 10 below. Fertility is not expected to be impacted by COVID-19 in the long-run, as such, after 2023-24 fertility resumes its transition pathway towards the long-run assumption. Given that COVID-19 only represents a short-term shock

[46] McDonald, P 2020

to the TFR, the forecast period has been held constant for the purposes of sensitivity testing on the long-run assumption.

Chart 10 below shows the COVID-19 forecasting period and long-run transition pathway and how each of the three tested TFR assumptions would track over the 40-year projection period.

Chart 10: Comparison of long-run TFR assumptions



Source: ABS 3301.0; NSW Treasury

VII) Impact on population

Table 4.1 below shows projections of the NSW population (level and annual growth rates) for selected years under each of the above outlined long-run assumptions. By the end of the 40-year projection period to 2060-61, the difference in the NSW population under the previous 2016 IGR assumption (1.95) and the new middle case (1.63) is approximately 765,000 persons. Under the ultra-low scenario (1.45), the NSW population projection is even lower, sitting approximately 420,000 persons less than the middle case.

Table 4.1 Comparison of scenarios under alternative long-run TFR assumptions

		2018-19	2030-31	2040-41	2050-51	2060-61
High (1.95)	Population	8,086,837	9,043,892	10,128,143	11,204,305	12,251,965
	% Growth	1.34	1.21	1.09	0.95	0.88
Mid (1.63)	Population	8,086,837	8,976,493	9,860,624	10,712,562	11,486,360
	% Growth	1.34	1.03	0.90	0.77	0.66
Low (1.45)	Population	8,086,837	8,940,183	9,710,283	10,436,772	11,065,888
	% Growth	1.34	0.92	0.79	0.66	0.53

Source: NSW Treasury

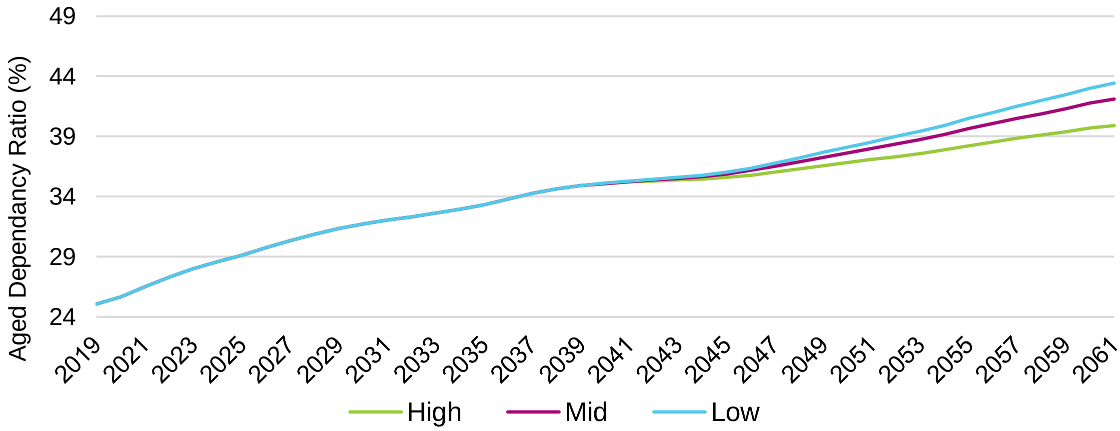
VIII) Impact on aged dependency ratio

The aged dependency ratio provides a measure through which to understand the impact of different fertility assumptions on the ageing population. The aged dependency ratio is the ratio of those aged 65 and over to those aged 15-64 (the working age population). This measure compares the number of people of traditional working age to the number of people who depend on their productivity.

Under all scenarios the aged dependency ratio is increasing, but by varying degrees. Under the former long-run TFR assumption (1.95), there is a slightly better outcome than the new baseline scenario, with an aged dependency ratio of 39.9 per cent and 2.5 people of traditional working age for each person aged 65 and over by 2061. This would represent a significant decrease from the four to one ratio currently and seven to one ratio of 45 years ago. Alternatively, under the lowest long-run TFR tested (1.45), the aged dependency ratio increases from 25.1 per cent to 43.4 per cent by 2060-61. Under this scenario, by 2061 there will be 2.3 people of traditional working age supporting each person aged 65 and over.

A higher aged dependency ratio indicates a relatively older population, which all else being equal, results in higher growth in health expenses, lower workforce participation, lower growth in government revenues, and therefore a higher fiscal gap. Chart 11 and Table 4.2 below show the age dependency ratio under all three scenarios over time.

Chart 11: Comparison of aged dependency ratios under various long-run TFR assumptions



Source: NSW Treasury

Table 4.2 Comparison of aged dependency ratios under various long-run TFR assumptions

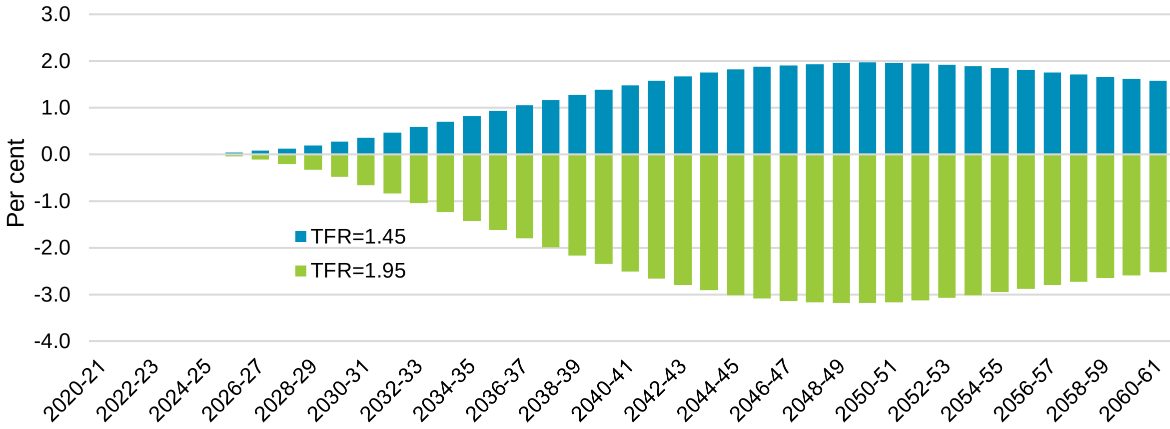
		2019	2031	2041	2051	2061
High (1.95)	ADR	25.1	32.0	35.2	37.1	39.9
	Working age to 65+	4.0	3.1	2.8	2.7	2.5
Mid (1.63)	ADR	25.1	32.0	35.3	38.0	42.1
	Working age to 65+	4.0	3.1	2.8	2.6	2.4
Low (1.45)	ADR	25.1	32.0	35.3	38.6	43.4
	Working age to 65+	4.0	3.1	2.8	2.6	2.3

Note: 'Working age to 65+' represents the number of working aged persons (15-64) to every person aged 65 and over.

IX) Impact on Gross State Product per capita

The long-term TFR assumption also impacts projections of real GSP per capita. All else being equal, a higher TFR assumption results in lower GSP per capita over a 40-year projection period. Under the high TFR assumption of 1.95, NSW real GSP per capita would be 2.5 per cent lower in 2060-61, compared to the baseline assumption of 1.63 (Chart 12).

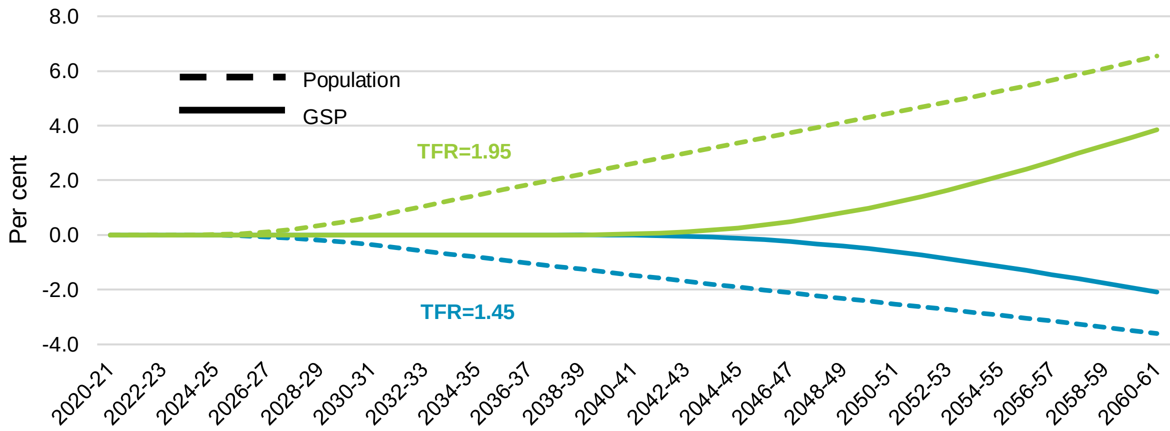
Chart 12: Impact of higher and lower TFR assumptions on Real GSP per capita



Note: This chart shows the annual per cent difference in real GSP per capita for the high and low TFR scenarios compared to the projected outcomes under the baseline scenario (NSW TFR = 1.63).
Source: NSW Treasury

The higher TFR assumption leads to relatively higher population growth and a younger population. This results in both GSP and population to be relatively higher compared to the baseline scenario. The relative difference in GSP, however, is smaller than for population. The direct impacts of a higher TFR on population do not flow through to employment and hours worked, and therefore GSP, until the first cohorts born under a higher TFR assumption reach the working age of 15, whereas the impacts on total population levels are immediate (Chart 13). As a result, real GSP per capita is lower compared to the baseline scenario (1.63). The opposite holds for the lower TFR assumption of 1.45, with real GSP per capita projected to be 1.6 per cent higher in 2060-61 compared to baseline.

Chart 13: Impact of higher and lower TFR assumptions on GSP and population



Note: This chart shows the annual per cent difference in real GSP and population for the high and low TFR scenarios compared to the projected outcomes under the baseline scenario (NSW TFR = 1.63). The transition to the higher/lower TFR assumption commences in 2024-25.
Source: NSW Treasury

6. Conclusion

This paper recommends that the 2021 NSW IGR utilise a constant long-run TFR assumption that is substantially below the 2016 IGR assumption of 1.95 to better reflect long-run trends in fertility. McDonald (2020) provides an appropriate benchmark of 1.63, with rates converging to this assumption over the medium-term.

This recommendation is supported by a review of the long-run drivers of fertility, which reveal downward pressure on the future fertility rate. In particular, trends around female education and workforce participation and delays in major life transitions such as moving out of the family home and partnering are expected to continue to contribute to later first births and ultimately to further declines in the TFR from the already record lows of today.

In reviewing the modelling methodology, the possible use of a predictive model for the long-run TFR was tested, however no sufficiently robust correlations were found for IGR modelling purposes. As such, it is recommended that as per past practice, a constant long-run TFR assumption be used.

In setting this long-run TFR assumption, it is found that the 10-year historical average approach utilised in the 2016 IGR is out of step with international methodologies and alone cannot effectively capture expected future trends in the fertility rate. Instead, it is recommended that the long-run TFR be informed by the work of Professor Peter McDonald for the Commonwealth Treasury Centre for Population, which provides a new modelling approach for estimating the long-run TFR and a preferable baseline for the 2021 NSW IGR.

A sensitivity analysis of the long-run TFR assumption on key indicators reveals slower population growth associated with the lower TFR over the projection period and an increased aged dependency ratio. By 2061, the aged dependency ratio is projected to be 2.2 percentage points higher under a TFR of 1.63, compared to the previous IGR assumption of 1.95. Average annual population growth over the projection period is 0.16 percentage points lower. Real GSP per capita is found to be inversely correlated with the TFR in the long run, projected to be around 2.5 per cent higher in 2061 compared to outcomes under the 1.95 assumption.

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