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RESEARCH ARTICLE

Geographic variation in parity progression in Australia

Edith Gray | Ann Evans

School of Demography, Research School of Social Sciences, The Australian National University, Canberra, Australia

Correspondence
Edith Gray, School of Demography, The Australian National University, Building No. 9, Acton ACT 2601, Canberra, Australia.
Email: edith.gray@anu.edu.au

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Abstract

Australia has moderately high fertility compared to many Western-industrialized countries. The current total fertility rate is around 1.88, but fertility levels are not uniform across the country. There is a distinct geographic pattern with the total fertility rate about 0.5 higher in remote and very remote Australia (2.33) compared to major cities (1.82). In this paper, we examine 2 explanations for this pattern: the compositional hypothesis and the contextual hypothesis. Using event-history methods with joint modelling to investigate parity progression, we find that after taking into account differences in age, country of birth, indigenous status, relationship status, education levels, and economic activity, women living in smaller towns in regional Australia are more likely to have a first, second, and third birth. Further, there is lower propensity to have a first child in inner or middle city areas that are characterized by smaller and more expensive housing than suburban or regional areas.

KEYWORDS

Australia, fertility, geographical variation, parity progression

1 | INTRODUCTION

Australia presents an interesting case for examining the geographic distribution of fertility. It is one of the largest countries in the world and also one of the most urbanized with over 75% of the population living in cities of over 100,000 residents (Department of Infrastructure and Transport, 2013). Demographic characteristics, including socio-economic levels and ethnic background, vary widely between those living in different sized cities, as well as between city dwellers and people living in rural or remote regions of the country.

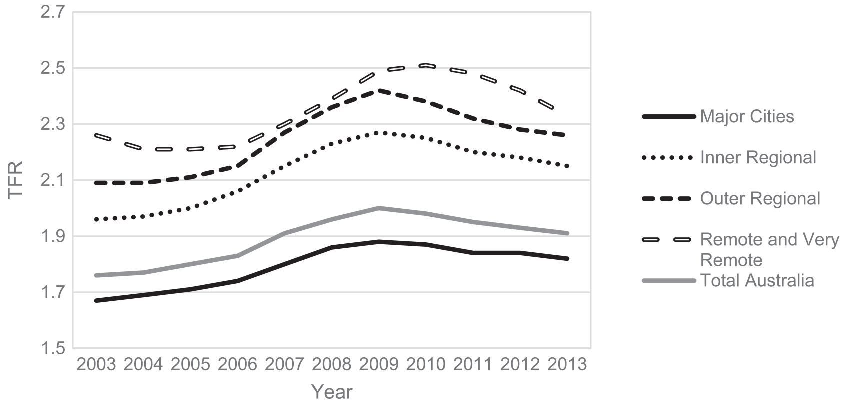
Fertility rates also differ considerably across the country and are significantly higher in smaller towns and remote localities compared to cities. The national total fertility rate (TFR) is 1.88, but in remote parts of Australia, it is 2.33, and in major cities, it is just 1.82 (ABS, 2014a).[1] The highly urbanized nature of the Australian population means that the national TFR is strongly affected by the fertility levels in cities where the majority of people live. However, the higher fertility levels of rural areas have an important elevating effect on national TFR, as seen in Figure 1.

To date, few studies have examined the geographic distribution of fertility in Australia in any depth. In this paper, individual-level longitudinal (2001–2012) data from the Household, Income and Labour Dynamics in Australia (HILDA) survey are used to examine the extent to which geography is an important determinant of childbearing. We jointly model the likelihood of having a first, second, or third child among women aged 16–44 living across Australia and investigate whether the effect of geography, if any, varies by parity. We further determine whether the spatial variation in parity progression persists even after controlling for compositional factors or differences in people's socioeconomic and demographic characteristics.

2 | BACKGROUND

Australia is not unique in having higher rural fertility than urban fertility. A similar pattern of lower fertility in cities and higher fertility in rural areas or smaller towns has been observed in many developed countries including Finland (Kulu, 2013) and other Nordic countries (Kulu, Boyle, & Andersson, 2009), Germany (Hank, 2002), the Netherlands (de Beer & Deerenberg, 2007), Britain (Fiori, Graham, & Feng, 2014), and other European countries (Basten, Huinink, & Klüsener, 2011). Although

[1]Based on the Australian Bureau of Statistics Remoteness Area classification.



Source: Australian Bureau of Statistics (2014), Births Australia 2013. Catalogue number 3301.0. Table 5.1 Births, Summary, Remoteness Areas

FIGURE 1 Total fertility rate (TFR) by remoteness area (2003–2013)

these studies have used different approaches and different levels of geographic disaggregation, they all observe considerable spatial variation in fertility and higher rates of childbearing in rural areas.

Two explanations have been suggested for this pattern. One is the compositional hypothesis that posits that people living in urban and rural areas have different socioeconomic and demographic characteristics, such as education levels or age profiles, and if these characteristics are also related to fertility that could explain why fertility levels may differ across geographic areas (Fulda, 2015). The contextual hypothesis, on the other hand, suggests that there is something more, over, and above a compositional effect, which has a positive or negative effect on fertility. Contextual factors could include structural reasons such as differences in local labour markets, environmental factors, or differences in cultures and attitudes regarding childbearing (Basten et al., 2011).

2.1 | Compositional effects

Much of the urban–rural differences in fertility are thought to be due to a compositional effect or "residential sorting" (Fiori et al., 2014). As Wilson notes, "different sorts of people live in different places and have different size families" (2015: 96). This compositional hypothesis represents the individual or microlevel demographic or socioeconomic characteristics of people and what effects these have on childbearing and therefore the overall fertility of the areas they live in. For example, people in rural areas may have lower levels of education. If lower levels of education are associated with higher levels of childbearing, then the fact that there are more people with lower levels of education living in rural areas could explain why, as a whole, rural areas tend to have higher fertility. Similarly, if people in urban areas are less likely to be in a relationship, then this could contribute to differences in fertility. The 2011 Census of Australia shows large geographical differences in the propensity to be married or cohabiting. Among women aged 20–24, 20% of those living in major cities are either cohabiting or married, compared to 30% of their peers in inner or outer regional locations (ABS, 2011).

In addition to socioeconomic characteristics such as income and education, each country or region studied may also have its own unique influences that could affect the geographic pattern of fertility. In Australia, one important compositional factor to consider is regional differences in the percentage of residents who are indigenous. National statistics show that Aboriginal and Torres Strait Islander women have larger families, with a TFR of 2.34 (ABS, 2014a). Aboriginal and Torres Strait Islander people are also 12 times as likely to live in remote or very remote areas as non-Indigenous people (22% compared with 2%, ABS, 2014b). The country of birth of a person is also important to consider as Australia has a large percentage of residents born overseas. Australia's overseas-born residents tend to have lower rates of childbearing—although there are some differences by country of birth. Those from English-speaking countries such as the United Kingdom and New Zealand tend to have fertility rates similar to Australian-born women, whereas those from North-East Asia (China, Hong Kong, South Korea, and Japan) tend to have lower fertility (ABS, 2015). The overseas-born population not only has a different fertility profile to the Australian-born population, they are also much more likely to live in capital cities (ABS, 2014b). Controlling for country of birth and indigenous status should therefore go some way to explaining differences in the regional variation of fertility levels.

We acknowledge that the composition of a place is not a static concept. Geographies change as different people move in and out of areas. So the composition of the population may be affected by migration to or from an area. Scholars have noted that short-term mobility is often associated with a change in life course circumstances, such as a change in family size and birth of a child (Clark & Huang, 2003; Haynes & Martinez, 2015; Kulu, 2008; Kulu & Steele, 2013; Rossi, 1980). Rural areas or peripheries of large cities may be seen as more suitable places to raise children leading to selective migration to these areas by those who are interested in starting a family. Similarly, those with less interest in childbearing may selectively migrate to cities (Hank, 2001). This selectivity hypothesis is just one theory of how rural–urban and urban–rural migration may relate to fertility. Some other hypotheses that have been proposed include the socialization hypothesis, the adaptation hypothesis, and the disruption hypothesis (Kulu, 2005). The socialization hypothesis suggests that migrants will have been strongly influenced by the fertility norms in their place of origin and maintain childbearing behaviour similar to the stayers of their place of origin, even after they have migrated. In contrast, the adaption hypothesis suggests that migrants will be influenced by their new environment and take on and exhibit similar childbearing behaviour to that which prevails at the destination they have migrated to. Finally, the disruption hypothesis suggests that immediately after a movement, the fertility of migrants may be limited by the disruption caused by the migration itself (Kulu, 2005).

2.2 | Contextual factors

If compositional factors do not explain all of the geographic variation in fertility levels, then it could be argued that contextual factors are at work. As Lupton and Kneale (2010) put it, the idea is that living in a particular place may exert an independent influence such that people with similar socioeconomic characteristics may act differently depending on location. For fertility behaviour, this could be because of structural factors or more abstract pathways such as differences in social norms and social networks (Fiori et al., 2014). Relevant structural factors could be economic conditions such as the local labour market, material factors such as the availability of and affordability of housing, or the supply of family-oriented services and infrastructure (Basten et al., 2011). Lack of available abortion services in regional and rural areas could also affect fertility (Evans, 2003). These structural factors may be particularly important for a country such as Australia where distances between places can be very large. For example, due to differential access and availability of health services, Australian women in urban areas are significantly more likely to have ever used emergency contraception compared to those in regional or remote areas (Smith, Rissel, Richters, Grulich, & Visser, 2003). Other contextual factors may be harder to quantify. Living in a smaller rural town, young women may not feel comfortable getting contraception from local doctors or health care providers due to confidentiality concerns. This has been suggested as a possible contributing factor to high teenage pregnancy rates in some parts of rural Australia (Quine et al., 2003; Roberts, Graham, & Barter-Godfrey, 2011).

Social norms and networks may also indirectly affect childbearing behaviour. It has been proposed that if a particular location has high fertility, this may have a "contagion" effect on others living in the area as they are influenced by this high-fertility setting and prompted to have children of their own. There has been some research that has looked into so-called neighbourhood effects on teenage pregnancy, but the results have been weak or mixed (Arai, 2007; Evans, 2001; Lupton & Kneale, 2010).

The degree to which compositional effects can explain geographic differences is still a matter for much debate. For the United Kingdom, Fiori et al. (2014) concluded that although the distribution of individual demographic and socioeconomic characteristics account for some of the variability in fertility levels, there are still other factors that are also at play. In Western Germany, Hank (2002) argues that regional variation in fertility is accounted for almost exclusively by the spatial distribution of individual characteristics. Examining small-area differentials in NSW using the 1986 Census, Wilson (1990) came to the conclusion that compositional factors "explain away" most of the differences in fertility levels in Australia and that it is inherently uninteresting to include a spatial perspective in the analysis of fertility in developed countries.

In Australia, beyond descriptive statistics, very little analysis has been conducted taking a more in-depth look at fertility differentials from a geographic perspective (Faulkner, 2005). In this paper, we examine the geographic variation of fertility in Australia in greater detail. Using individual-level survey data, we investigate to what degree differences in the characteristics of individuals explain the pattern of higher fertility in regional Australia.

2.3 | Data and definitions

We use longitudinal panel data from the HILDA; 12 waves of data, from 2001 to 2012. Using event-history analysis, we model the likelihood of having a first, second, and third birth for women and examine the effect of geography after controlling for individual-level characteristics. The sample is restricted to women aged 16 to 44 who are in the survey for at least two waves. For the transition to first births, 3,798 women are studied over 18,602 person-years. During the period of study, about one quarter of women had a first birth (1,065 first births). For the second birth transitions, 1,828 women are studied over 6,354 person-years. During this period, nearly half progress to have their second child (889 births). For the third birth analysis, 1,894 women are studied over 8,267 person-years. During this period, 20% have a third child (382 births).

We use multilevel logistic regression to model the transition to birth. Multilevel modelling is used to take into account that we have multiple observations (waves) per individual with some variables changing within persons over time. The three parity transitions were modelled jointly using the applied MultiLevel (aML) software package to take into account unobserved heterogeneity.

$$\ln h^{(b1)}(t) = yT(t)^{(b1)} + \sum \beta^{(b1)} X(t) + \varepsilon_i,$$

$$\ln h^{(b2)}(t) = yT(t)^{(b2)} + \sum \beta^{(b2)} X(t) + \varepsilon_i,$$

$$\ln h^{(b3)}(t) = yT(t)^{(b3)} + \sum \beta^{(b3)} X(t) + \varepsilon_i,$$

where $\ln h$ is the log-hazard of the birth and superscripts ($b1$), ($b2$), and ($b3$) denote first, second, and third births, respectively. The log-hazard of each birth is assumed to be a function of the baseline log-hazard, $yT(t)$, which is a piecewise-linear spline. The spline is a transformation of a continuous variable into a vector of variables, where each new variable represents the original variable on a specific segment of its range (Lillard & Panis, 2003). It offers a convenient and flexible way to specify the baseline hazard. For first birth, $yT(t)^{(b1)}$ reflects age, starting from age 15 and with nodes at age 20, 25, 30, and 35 years. For second and third births, it represents time since previous birth with nodes at 4 and 7 years. The individual-level residual (ε_i) is included in all three equations and takes into account unobserved characteristics among individual women that may make them more or less likely to have children.

2.4 | Geography

The main explanatory variable of interest is geographic location. There are many different ways to classify different categories of where people live in Australia, and there is considerable debate about the advantages and disadvantages of different systems (McGrail & Humphreys, 2009). In this paper, we identify the local government areas that respondents live in and operationalize geographical location as a time-varying variable using five categories:

1. inner and middle suburbs of capital city,
2. outer suburbs of capital city,
3. other city with a population of 20,000+,

4. smaller town or place in Inner Regional Australia, and
5. outer regional, remote, or very remote Australia.

It is important to distinguish between central cities and outer suburbs of these cities as suburban fertility is often markedly higher in the periphery of large cities (Kulu & Washbrook, 2014; Kulu et al., 2009). For Sydney, Brisbane, and Melbourne, the distinction between inner or middle and outer suburbs was based on the classification used by the Bureau of Infrastructure, Transport and Regional Economics (2013). For the other capital cities, Canberra, Adelaide, Perth, Hobart, and Darwin, suburbs were coded manually as belonging to either the inner or middle of the city or in the outer periphery based on the suburbs' location and distance to the city centre. As two thirds of the Australian population lived in one of the eight capital cities in 2013 (ABS, 2015), we identify the capital cities of each state or territory as they have levels of services that may not be available in other cities.

The remaining categories, (4) smaller town or place in inner regional Australia and (5) outer regional, remote, or very remote Australia, rely on the ABS ASGC 2001 Remoteness area classification. These remoteness area classifications are themselves based on the Accessibility/Remoteness Index of Australia, which is an index based on physical road distance to the nearest service centre or urban locality of different sizes: Accessibility/Remoteness Index of Australia values range from 0 (*highly accessible*) to 15 (*very remote*) (University of Adelaide, 2015). It is important to note that in our analysis, Local Government Areas (LGAs) are classified as belonging to category 4 or 5 only if they have not been assigned to one of the other categories. For example, according to the Remoteness Area classification, Toowoomba is classified as "Inner Regional Australia," but in our analysis, it is classified as "other city with a population of 20,000."

2.5 | Compositional characteristics

As outlined previously, different areas may have a different composition of people. In our models, we control for individual's relationship status, education level, economic activity, and country of birth. Relationship status is captured by a time-varying variable distinguishing between those who are married, cohabiting, and single. The education variable distinguishes between those who have completed a university course, a certificate or diploma, and year 12 and year 11 or below. Activity level is lagged by 1 year, to capture people's involvement in the labour market at a time before pregnancy. It has four categories: employed, unemployed, not in labour force, and full-time student.

Country of birth and indigenous status, are important compositional characteristics in Australia. We investigate the role of country of birth and indigenous status using a variable that classifies people into four categories: (a) Australian born of non-Indigenous background, (b) Australian born of Aboriginal or Torres Strait Islander background, (c) born overseas in English-speaking country, and (d) born overseas in non-English-speaking country. We expect that Aboriginal and Torres Strait Islander women are more likely to have a second and third birth than women of other backgrounds. For the other countries, we expect that those born in non-English speaking countries to have a slightly lower likelihood of having a first, second, and third birth. In our data among those born overseas, most person-years are contributed by those born in the Philippines, China, and Vietnam, and their fertility rates in Australia tend to be lower than Australian-born women (ABS, 2014a).

2.6 | Control variables

The sex of the existing children is included as an explanatory variable for the higher order parities. For the second birth model, we classify whether the first child is male or female. For the third birth model, we classify whether the first two children were (a) male and female, (b) both males, and (c) both females. Previous research from Australia has shown that parents who have a son or a daughter are equally likely to have a second birth (there is a two-child norm in Australia), but at higher parities, parents of two boys are more likely to progress to a third birth than parents with a son and a daughter or two daughters, indicating a daughter preference (Gray, Evans, Anderson, & Kippen, 2010).

Acknowledging that migration and housing moves are often associated with changes in life course circumstances, we also consider whether the respondent has moved since the last wave. We distinguish between those who have not moved, those who moved from another area of a similar population density, those who moved from less densely populated area, and those who moved from a more densely populated area. We also include the number of bedrooms in the current residence, as an additional child may necessitate an extra bedroom for accommodation.

Table 1 shows the percentage distribution of the independent variables for those with zero, one, and two children. Except for the nontime-varying variables, such as country of birth, the percentages shown refer to the distribution across the person-years in the dataset rather than to persons, so these do not reflect the actual distribution of the characteristics across the different respondents. Nevertheless, some general patterns can be made out. For example, at zero parity, there is a higher percentage of person-years being single compared to married or cohabiting. Similarly, for people who already have children, there are more observations of women at parity 1 or 2 who are not in the labour market compared to women with no children.

3 | RESULTS

3.1 | First births

In the first model of Table 2, we see the association between location and the hazard of first birth controlling only for age. A clear geographic pattern is evident with first birth transitions being higher in all locations compared to inner and middle suburbs of capital cities, particularly in inner regional small towns and outer regional or remote areas. In the next step (model 2), country of birth and relationship status are added. Compared to Australian-born women (not of Aboriginal or Torres Strait Islander background), those born overseas, particularly in non-English-speaking countries, are at lower risk of having a first birth. Conversely, those of Aboriginal or Torres Strait Islander background are more likely to have a first birth. Not surprisingly, women who are married are more likely to have a first birth compared to cohabiting or single women. Adding country of birth and relationship

TABLE 1 Distribution of independent variables (percentages) included in first, second, and third birth analysis

	Parity 0	Parity 1	Parity 2
Location			
Capital city (inner/middle suburbs)	48	39	36
Capital city (outer suburbs)	20	24	24
Other city, 20,000+ population	18	20	21
Inner regional Australia	7	8	10
Outer regional Australia or remote/very remote	7	9	9
Country of birth^NTV			
Australian born	81	74	74
Overseas—English speaking	5	7	8
Overseas—non-English speaking	10	15	14
Australian—Aboriginal or Torres Strait Islander	4	4	3
Relationship status			
Married	18	55	69
Cohabiting	22	22	15
Single	60	24	16
Highest education level			
University	27	30	29
Certificate/diploma	20	26	27
Year 12	29	19	17
Year 11 or below	25	25	27
Activity (lagged by one wave)			
Employed	59	62	64
Unemployed	4	4	3
Not in labour market	6	31	31
Full-time student	31	3	1
Movement since last wave			
No move	93	95	97
From area of similar population density	2	2	1
From area of lower population density	2	1	1
From area of higher population density	2	2	1
Number of bedrooms			
1–2	27	20	7.4
3	39	51	50
4	25	24	35
5+	10	4	7
Time since previous birth			
0–4 years		49	25
5–7 years		17	18
8+ years		34	57
Age at previous birth			
<24		35	19
25–29		30	30
30–34		23	32
35+		12	17
Sex of first child^NTV			
Male		49	
Female		51	
Sex of first two children^NTV			
Mixed			50
Both boys			25
Both girls			25
Total %	100	100	100
Total person-years	18,602	6,354	8,276
Total persons	3,798	1,828	1,894

Note. NTV = nontime-varying variables—ones that are fixed in time and do not change.

status leads to lower coefficients in the location categories, although they remain significant. This indicates that at least some of the differences in fertility by location are due to variation in the country of birth and marital status of respondents in different locations.

Model 3 adds the socioeconomic variables of highest level of education and activity. Women who did not complete year 12 education are significantly more likely to experience a first birth, compared to the reference category who completed year 12. Women who were not employed in the previous wave are more likely to have a first birth, but students are less likely. The effect of location has been muted but still remains strong and significant.

Number of bedrooms in the current residence is associated with childbearing, in that people living in a house with one to two bedrooms are less likely to have a first birth than those living in a three-bedroom house. Conversely, those in a four-bedroom property are more likely to have a first child. The measure of movement since last wave is not significant for first births.

3.2 | Second births

Unlike for first births, for second births, as seen in Table 3, location appears to have no impact on the hazard of having a birth in the base model. After adding controls for country of birth, relationship status, and age at previous birth (model 2), we find that in comparison to women living in inner and middle suburbs of capital cities, those in outer suburbs, in inner regional smaller towns, or in remote areas are more likely to have a second birth. However, the effect is small and only significant at the 10% level. When we add education and activity status (model 3), we find that the effect of location becomes stronger. Although the effect is not as strong as that for first births, women in small towns of inner regional areas, or those in outer regional and very remote areas, are more likely to have a second child.

The variable reflecting years since the first child is born indicates that the risk of having a second child increases sharply in the first 4 years and then declines. In terms of country of birth, we see the same pattern as observed with first births: Overseas-born women are less likely to have a second child and those of Aboriginal or Torres Strait Islander background are more likely to. Cohabiting and single women are less likely to have a second child compared to married women, and age at previous birth is also important. The sex of the first child had no effect on the risk of having a second child.

TABLE 2 Hazard model for first birth (parameter estimates and standard errors)

	Model 1		Model 2		Model 3		Model 4	
	Coeff.	Sig.	Coeff.	Sig.	Coeff.	Sig.	Coeff.	Sig.
Constant	−7.24	***	−4.13	***	−4.06	***	−4.01	***
Age (slope)								
15–19	0.44	***	0.27	**	0.23	*	0.20	*
20–24	0.03		−0.09	**	−0.08	*	−0.11	*
25–29	−0.10	***	−0.16	***	−0.15	***	−0.17	***
30–34	0.19	***	0.14	***	0.15	***	0.16	***
35+	0.02	***	0.03	***	0.03	***	0.03	***
Location								
Inner and middle capital city (ref)	1.00		1.00		1.00		1.00	
Outer suburbs of capital city	0.58	***	0.41	***	0.34	***	0.18	***
Other cities pop 20,000+	0.53	***	0.34	***	0.23	**	0.09	*
Inner regional smaller towns	0.94	***	0.67	***	0.59	***	0.52	***
Outer regional, remote, very remote	0.86	***	0.57	***	0.42	***	0.34	***
Country of birth								
Australian born (ref)			1.00		1.00		1.00	
Overseas—English speaking			−0.49	**	−0.49	**	−0.51	***
Overseas—non-English speaking			−0.61	***	−0.75	***	−0.70	***
Australian—Aboriginal/Torres Strait Islander			1.16	***	0.87	***	0.82	***
Relationship								
Married (ref)			1.00		1.00		1.00	
Cohabiting			−1.24	***	−1.24	***	−1.22	***
Single			−2.83	***	−2.81	***	−2.64	***
Highest level of education								
University					−0.03		0.05	
Certificate/diploma					0.07		0.15	
Year 12 (ref)					1.00		1.00	
Year 11 or below					0.27	***	0.25	**
Activity (year before)								
Employed (ref)					1.00		1.00	
Not employed					0.84	***	0.91	***
Student					−1.28	***	−1.18	***
Number of bedrooms								
1–2							−0.66	***
3 (ref)							–	
4							0.22	**
5+							0.16	
Movement since last wave								
No movement (ref)							1.00	
Moved from area of similar population density							0.15	
Moved from less populated area							0.14	
Moved from more populated area							−0.02	
Standard deviation of woman-level residuals	1.03	***	0.94	***	0.92	***	0.87	***

*$p < .10$.

**$p < .05$.

***$p < .01$.

Once again living in a house with one to two bedrooms is associated with a lower risk of having a second child compared to living in a three-bedroom home. Adding the movement variable makes little difference to the overall model.

3.3 | Third births

Turning to the transition from second to third births, in Table 4, we find that women living in small towns in Inner Regional Australia, as well as

TABLE 3 Hazard model for second birth (parameter estimates and standard errors)

	Model 1		Model 2		Model 3		Model 4	
	Coeff.	Sig.	Coeff.	Sig.	Coeff.	Sig.	Coeff.	Sig.
Constant	−4.56	***	−4.24	***	−4.51	***	−4.42	***
Years since previous birth (slope)								
0–4	0.80	***	0.87	***	0.92	***	0.91	***
4–7	−0.58	***	−0.57	***	−0.55	***	−0.54	***
8+	−0.06	*	−0.06	*	−0.06	*	−0.06	*
Location								
Inner and middle suburbs of capital city (ref)	1.00		1.00		1.00		1.00	
Outer suburbs of capital city	0.18		0.19	*	0.22	**	0.22	*
Other cities pop 20,000+	−0.08		−0.01		0.07		0.06	
Inner regional smaller towns	0.25		0.29	*	0.34	**	0.33	**
Outer regional, remote, very remote	0.15		0.28	*	0.35	**	0.34	**
Country of birth								
Australian born (ref)			1.00		1.00		1.00	
Overseas—English speaking			−0.45	**	−0.49	**	−0.50	***
Overseas—non-English speaking			−0.99	***	−1.14	***	−1.13	***
Australian—Aboriginal or Torres Strait Islander			0.29	***	0.26		0.26	
Relationship								
Married (ref)			1.00		1.00		1.00	
Cohabiting			−0.47	***	−0.43	***	−0.43	***
Single			−1.98	***	−1.96	***	−1.93	***
Age at previous birth								
<24 (ref)			1.00		1.00		1.00	
25–29			0.25	**	0.21	*	0.21	*
30–34			0.56	***	0.47	***	0.46	***
35+			−0.17		−0.23		−0.19	
Sex of first child								
Male (ref)			1.00		1.00		1.00	
Female			−0.08		−0.10		−0.09	
Highest level of education								
University					0.23	*	0.29	
Certificate/diploma					−0.13		−0.37	**
Year 12 (ref)					1.00		1.00	
Year 11 or below					−0.49	***	−0.55	***
Activity (year before)								
Employed (ref)					1.00		1.00	
Not employed					0.63	***	0.91	***
Student					−0.59	**	−0.46	
Number of bedrooms								
1–2							−0.68	***
3 (ref)							1.00	
4							−0.03	
5+							0.10	
Movement since last wave								
No movement (ref)							1.00	
Moved from area of similar population density							−0.59	*
Moved from less populated area							−0.14	
Moved from more populated area							−0.81	*

*$p < .10$.

**$p < .05$.

***$p < .01$.

TABLE 4 Hazard model for third birth (parameter estimates and standard errors)

	Model 1		Model 2		Model 3		Model 4	
	Coeff.		Coeff.		Coeff.		Coeff.	
Constant	−5.70	***	−5.10	***	−5.52	***	−5.16	***
Years since previous birth (slope)								
0–4	0.60	***	0.61	***	0.67	***	0.70	***
4–7	−0.52	***	−0.53	***	−0.49	***	−0.50	***
8+	−0.05		−0.07	*	−0.06		−0.05	
Location								
Inner and middle suburbs of capital city (ref)	1.00		1.00		1.00		1.00	
Outer suburbs of capital city	0.30	*	0.17		0.29	*	0.29	*
Other cities pop 20,000+	0.10		−0.14		0.04		0.04	
Inner regional smaller towns	0.61	***	0.43	**	0.59	**	0.58	**
Outer regional, remote, very remote	0.58	***	0.37	*	0.52	**	0.49	**
Country of birth								
Australian born (ref)			1.00		1.00		1.00	
Overseas—English speaking			−0.59	**	−0.59	**	−0.58	**
Overseas—non-English speaking			−0.28		−0.45	**	−0.44	**
Australian—Aboriginal or Torres Strait Islander			0.22		0.06		0.01	
Relationship								
Married (ref)			1.00		1.00		1.00	
Cohabiting			0.02		0.02		−0.04	
Single			−0.88	***	−0.89	***	−0.86	***
Age at previous birth								
<24 (ref)			1.00		1.00		1.00	
25–29			−0.33	**	−0.38	**	−0.32	*
30–34			−0.68	***	−0.76	***	−0.71	***
35+			−0.76	***	−0.98	***	−1.02	***
Sex of first two children								
Mixed (ref)			1.00		1.00		1.00	
Both male			0.55	***	0.56	***	0.54	***
Both female			0.28	*	0.28	*	0.27	*
Highest level of education					0.28		0.29	
University					−0.38	**	−0.41	**
Certificate/diploma								
Year 12 (ref)					1.00		1.00	
Year 11 or below					−0.63	***	−0.67	***
Activity (year before)								
Employed (ref)					1.00		1.00	
Not employed					0.92	***	0.91	***
Student					−0.50		−0.49	
Number of bedrooms								
1–2							−0.21	
3 (ref)							1.00	
4							0.12	
5+							0.47	**
Movement since last wave								
No movement (ref)							1.00	
Moved from area of similar population density							0.61	
Moved from less populated area							0.03	
Moved from more populated area							0.31	

*p < .10.

**p < .05.

***p < .01.

in outer regional or remote areas, are significantly more likely to have a third child compared to those in capital cities. There is no difference between capital cities or other cities with a population of over 20,000 residents.

Adding controls for country of birth or ethnicity, relationship status, age at previous birth, and the sex of the first two children however significantly diminishes the effect of location. In the final model, we find that there remains some significant differences by geographic location: The likelihood of transitioning to a third birth is significantly higher for those in inner regional or outer regional Australia compared to inner and middle suburbs of capital cities.

Other important determinants of having a third child include the number of years since the previous child was born. The risk of having a third birth increases sharply in the first 4 years after the second child is born before declining. Women born overseas are less likely to have a third child, as are those who are single. Interestingly, for third births there is no significant difference between cohabiting and married women in the risk of having a third child.

Living in a four-bedroom house is associated with a higher chance of having a third birth compared to living in a three-bedroom house.

In all models, the standard deviation of the individual-level residuals is significantly different from 0, indicating that there are unobserved women-specific characteristics that affect all birth rates. This indicates that joint modelling was appropriate to control for selectivity among the women in terms of their likelihood of progressing to a higher order child.

4 | DISCUSSION

The aim of this study was to examine whether place matters when it comes to fertility, even after taking into account compositional differences. We found that after taking into account differences in age, country of birth, indigenous status, relationship status, education levels, and economic activity, women living in smaller towns in Inner Regional Australia are more likely to have a first, second, and third birth. For first births, we find that in capital cities, those living in the inner or middle suburbs, where houses are traditionally smaller and more expensive, are less likely to have a first birth. For the other parities, there is little difference between the inner/middle and outer suburbs or between capital cities and other major cities—the key difference is between cities and regional areas.

Overall, in terms of the strength of the relationship between fertility and location, we find it is weakest for second births. In Australia, there is a strong two-child norm (Gray et al., 2010), so it is not surprising that the main variables explaining the probability of having a second child have more to do with the woman's own age and relationship status rather than external variables such as geography.

Other factors are consistent with previous findings. For example, as expected, women of Aboriginal or Torres Strait Islander background are more likely to have a first birth compared to non-Aboriginal Australian-born women. Overseas-born women, particularly those from non-English-speaking countries (in our sample, primarily China, Vietnam, and the Philippines), are less likely to have a child at all parities.

One important feature of different areas is the housing stock and the size of the houses. Traditionally, houses in outer suburbs of capital cities tend to be larger than houses in the inner and middle suburbs. Similarly, houses in regional areas are larger and have larger blocks of land. We did find that the number of bedrooms does explain some of the differences in the link between geography and having a first birth. For second and third births, number of bedrooms is still an important determinant, but it has less of an impact on attenuating the relationship between childbearing and location.

In HILDA, the reasons why people moved are asked every wave and exploratory analysis of the reasons (not shown) does suggest that people who have moved in the last wave and who have recently experienced childbirth are more likely to state that the reason they moved was to move to a larger house. Although the data are available in HILDA, we have not looked at the sequence of events and whether the move occurs before or after childbirth as previous research has shown there may be strong joint determination and simultaneity between these sort of movements and childbearing. Depending on people's financial capabilities and the housing market, some people may move to a larger house in anticipation of starting or growing a family, whereas others may wait until after the child is born.

The compositional hypothesis suggests that individuals with similar characteristics will have similar fertility levels regardless of where they live, whereas the contextual hypothesis suggests that individuals orient their fertility behaviour based on regional opportunities and restrictions (Fulda, 2015). In reality, these explanations are not mutually exclusive and both the composition factors and contextual factors, which are harder to measure, are likely to influence fertility.

Although we do find evidence that place is important in influencing fertility behaviour among Australian women after controlling for key demographic and socioeconomic characteristics, we note the following caution. Some variables associated with fertility decision making, such as religiosity, are not included in the models due to lack of data. If these omitted variables are also linked to geographic location then they might explain some of the differences in childbearing by location. Another limitation is that the original sampling frame of HILDA excludes census districts classified as remote or sparsely populated (Watson & Wooden, 2002); these findings underrepresents people living in remote or very remote Australia.

Furthermore, our unit of analysis was at the individual level, and due to data limitations, we were not able to directly include and examine contextual level factors such as the unemployment rates in local government areas or other factors such as the availability of childcare in this paper. As Hank (2002) points out, ideally, regional characteristics and individual childbearing decisions need to be placed into a unifying theoretical framework, while individual-level data need to be merged with aggregate information on the spatial context. We agree that such research would be beneficial.

Whether or not fertility differentials in Australia are due to purely compositional effects or not, we believe that the spatial variation in fertility is still an area that deserves more attention. From a policy perspective, it is important to have a better understanding of subnational fertility trends and behaviours for forecasting and planning purposes. This is especially important in a country such as Australia where service provision outside of major centres is costly and logistically challenging.

De Beer and Deerenberg (2007) note that because subnational fertility trends are important for projection purposes, without having an explanation for the regional differences, it is difficult to decide whether changes observed in the past are likely to continue in the future and, if so, to what extent. Although this analysis could not disentangle whether other migration theories such as socialization, adaptation, and disruption are involved in explaining regional differences, we have shown that composition factors and place are both important for explaining fertility progression.

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REFERENCES

Arai, L. (2007). Peer and neighbourhood influences on teenage pregnancy and fertility: Qualitative findings from research in English communities. *Health and Place*, *13*(1), 87–98. https://doi.org/10.1016/j.healthplace.2005.10.003

Australian Bureau of Statistics (ABS). (2011). Census 2011, TableBuilder. RA by AGE5P – Age in Five Year Groups, SEXP and MDCP. Counting: Persons, Place of Usual Residence.

Australian Bureau of Statistics (ABS). (2014a). Births, Australia 2013. Catalogue No. 3301.0. Canberra.

Australian Bureau of Statistics (ABS). (2014b). Australian social trends 2014. Catalogue No. 4102.0. Canberra.

Australian Bureau of Statistics (ABS). (2015). Regional population growth, Australia, 2013–14. Catalogue No. 3218.0. Canberra.

Basten, S., Huinink, J., & Klüsener, S. (2011). Spatial variation of subnational fertility trends in Austria, Germany and Switzerland. *Comparative Population Studies*, *36*(2–3), 573–614. https://doi.org/10.4232/10.CPoS-2011-08en

Bureau of Infrastructure, Transport, and Regional Economics. (2013). Population growth, jobs growth and commuting flows—A comparison of Australia's four largest cities. Report 142, Department of Infrastructure and Regional Development Canberra, Australia. https://bitre.gov.au/publications/2013/files/report_142.pdf

Clark, W. A., & Huang, Y. (2003). The life course and residential mobility in British housing markets. *Environment and Planning A*, *35*(2), 323–339. https://doi.org/10.1068/a3542

de Beer, J., & Deerenberg, I. (2007). An explanatory model for projecting regional fertility differences in the Netherlands. *Population Research and Policy Review*, *26*(5), 511–528. https://doi.org/10.1007/s11113-007-9040-y

Department of Infrastructure and Transport. (2013). State of Australian cities 2013. Canberra: Department of Infrastructure and Transport, Major Cities Units. http://www.infrastructure.gov.au/infrastructure/pab/soac/

Evans, A. (2001). The influence of significant others on Australian teenagers decisions about pregnancy resolution. *Family Planning Perspectives*, *33*(5), 224–230. https://doi.org/10.2307/2673786

Evans, A. (2003). The outcome of teenage pregnancy: Temporal and spatial trends. *People and Place*, *11*(2), 39–49. http://arrow.monash.edu.au/hdl/1959.1/481549

Faulkner, D. (2005). The spatial dynamics of fertility in South Australia 1976 to 1996. Ph.D Thesis. The University of Adelaide.

Fiori, F., Graham, E., & Feng, Z. (2014). Geographical variations in fertility and transition to second and third birth in Britain. *Advances in Life Course Research*, *21*, 149–167. https://doi.org/10.1016/j.alcr.2013.11.004

Fulda, B. (2015). Culture's influence regionally differing social milieus and variations in fertility rates Max Planck Institute for the Study of Societies, Discussion Paper 15/4. http://www.mpifg.de/pu/mpifg_dp/dp15-4.pdf

Gray, E., Evans, A., Anderson, J., & Kippen, R. (2010). Using split-population models to examine predictors of the probability and timing of parity progression. *European Journal of Population*, *26*(3), 275–295. https://doi.org/10.1007/s10680-009-9201-2

Hank, K. (2001). Regional fertility differences in Western Germany: An overview of the literature and recent descriptive findings. *International Journal of Population Geography*, *7*(4), 243–257. https://doi.org/10.1002/ijpg.228

Hank, K. (2002). Regional social contexts and individual fertility decisions: A multilevel analysis of first and second births in Western Germany. *European Journal of Population*, *18*(3), 281–299. https://doi.org/10.1023/A:1019765026537

Haynes, M., & Martinez, A. (2015). Modelling the relationships between household residential mobility and childbearing in Australia. Life Course Centre Working Paper Series No. 2015–01. University of Queensland, Brisbane.

Kulu, H. (2005). Migration and fertility: Competing hypotheses re-examined. *European Journal of Population*, *21*(1), 51–87. https://doi.org/10.1007/s10680-005-3581-8

Kulu, H. (2008). Fertility and spatial mobility in the life course: Evidence from Austria. *Environment and Planning A*, *40*(3), 632–652. https://doi.org/10.1068/a3914

Kulu, H. (2013). Why do fertility levels vary between urban and rural areas? *Regional Studies*, *47*(6), 895–912. https://doi.org/10.1080/00343404.2011.581276

Kulu, H., Boyle, P. J., & Andersson, G. (2009). High suburban fertility: Evidence from four northern European countries. *Demographic Research*, *21*(31), 915–944. https://doi.org/10.4054/DemRes.2009.21.31

Kulu, H., & Steele, F. (2013). Interrelationships between childbearing and housing transitions in the family life course. *Demography*, *50*(5), 1687–1714. https://doi.org/10.1007/s13524-013-0216-2

Kulu, H., & Washbrook, E. (2014). Residential context, migration and fertility in a modern urban society. *Advances in Life Course Research*, *21*, 168–182. https://doi.org/10.1016/j.alcr.2014.01.001

Lillard, L., & Panis, C. (2003). aML multilevel multiprocess statistical software, version 2.0. Los Angeles, CA: EconWare.

Lupton, R., & Kneale, D. (2010). Are there neighbourhood effects on teenage parenthood in the UK, and does it matter for policy? A review of theory and evidence. London School of Economics, STICERD Research Paper No. CASE141.

McGrail, M., & Humphreys, J. (2009). Geographical classifications to guide rural health policy in Australia. *Australia and New Zealand Health Policy*, *6*(28). https://doi.org/10.1186/1743-8462-6-28

Quine, S., Bernard, D., Booth, M., Kang, M., Usherwood, T., Alperstein, G., & Bennett, D. (2003). Health and access issues among Australian adolescents: A rural–urban comparison. *Rural and Remote Health*, *3*(245), 1–11.

Roberts, S., Graham, M., & Barter-Godfrey, S. (2011). Young mothers' lived experiences prior to becoming pregnant in rural Victoria: A phenomenological study. *Australian Journal of Rural Health*, *19*(6), 312–317. https://doi.org/10.1111/j.1440-1584.2011.01228.x

Rossi, P. (1980). *Why families move*. Beverley Hills, CA: Sage Publications.

Smith, A., Rissel, C., Richters, J., Grulich, A., & Visser, R. (2003). Sex in Australia: Reproductive experiences and reproductive health among a representative sample of women. *Australian and New Zealand Journal of Public Health*, *27*(2), 204–209. https://doi.org/10.1111/j.1467-842X.2003.tb00809.x

University of Adelaide. (2015). ARIA (Accessibility/Remoteness Index of Australia) https://www.adelaide.edu.au/apmrc/research/projects/category/about_aria.html

Watson, N., & Wooden, M. (2002). HILDA project technical paper series. No. 1/02, May 2002 [Revised October 2002] The Household, Income and Labour Dynamics in Australia (HILDA) Survey: Wave 1 Survey Methodology.

Wilson, M. (1990). The end of an affair? Geography and fertility in late post-transitional societies. *Australian Geographer*, *21*(1), 53–67. https://doi.org/10.1080/00049189008702999

Wilson, T. (2015). The demographic constraints on future population growth in regional Australia. *Australian Geographer*, *46*(1), 91–111. https://doi.org/10.1080/00049182.2014.986786

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