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# Changing education, changing fertility: a decomposition of completed fertility in Australia



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## Abstract

### Background

The expansion of education in Australia, particularly for women, is one of the most significant social changes of the last five decades. The relationship between education and fertility has been widely studied, showing that increases in higher education for women are consistently associated with lower fertility. Given the close link between education and fertility, this paper questions what effect the changing educational profile of Australian women has had on overall fertility trends.

### Aims

This paper investigates the effect of the increase in education on completed fertility by decomposing the change in overall completed fertility into two components: (1) change in completed fertility as a result of the proportion of women in different education categories and, (2) changes in completed fertility of women in each education category.

### Data and methods

The study uses 2016 Census data on the number of children ever born of five cohorts of women born between 1952 and 1976. Decomposition is used to distinguish the effects of the two components.

### Results

The educational composition of women in these cohorts is dramatically different, with an increasing number of women having completed tertiary education in later cohorts. Completed fertility has also changed across successive cohorts. We find that for the earliest cohorts most of the decline is due to declines in completed fertility within education categories, but for later cohorts the decline is attributable to increases in the proportion of women with higher levels of education.

### Conclusions

Despite tertiary education becoming much more common, fertility within this group remains lower than other education groups. While other countries have seen a narrowing of the gap in fertility rates between education groups, this pattern is not found in Australia.

### Key words

Education; fertility; fertility decline; children ever born; Census; decomposition.

## 1. Introduction

The expansion of education in Australia is one of the most significant social changes of the last five decades. The 2016 Census marked the first time in Australian history that the proportion of women aged 40-44 with a university degree (36 per cent) exceeded the proportion with no post-school qualification (30 per cent). This is a remarkable increase from 30 years earlier when just 5 per cent had a university degree and 70 per cent had no post-school qualification (ABS 1988). Given the close link between education and fertility, we question what effect the changing educational profile of the population has had on overall fertility trends over time. As the category of women with higher educational qualifications has become less selective (Adsera 2017), has the negative relationship between educational attainment and fertility weakened for younger cohorts?

The relationship between education and fertility has been one of the most widely studied topics in demography. Decades of research has consistently found that at both the individual and population level, higher education is almost universally associated with lower fertility (Cochrane 1979; Caldwell 1980; Rindfuss et al. 1996; Musick et al. 2009). Women with higher levels of education tend to start childbearing later, have fewer children overall and are more likely to be childless. The reasons for this are numerous and include the 'incarceration effect' of longer time spent enrolled in education which delays the start of family formation (Heck et al. 1997; Ní Bhrolcháin and Beaujouan 2012), economic considerations including increased opportunity costs, changes in cultural or attitudinal factors such as increased knowledge and decision-making power regarding contraceptive use, and different values regarding gender and family dynamics (Fort et al. 2016; Neels et al. 2017).

Over time, the difference in fertility between those with high and low education, can develop in three ways. They can: (1) narrow, (2) widen, or (3) stay stable. Recent research looking at change in educational differences across cohorts has been mixed. In South Korea, Yoo (2014) found that educational differences in completed fertility almost disappeared as the country went through the fertility transition. Similarly, in Denmark, Norway and Sweden education differences in cohort fertility have virtually disappeared in younger cohorts (Jalovaara et al. 2018; Andersson et al. 2009). However, a convergence of fertility across educational categories is not evident in all countries. A cross-national study of 25 European countries found that over time the negative gradient had remained strong in the Mediterranean and post-communist countries (Merz and Liefbroer 2017). In Great Britain, women with degree-level qualifications still have smaller family sizes than those with lower levels of education and this difference in quantum appears to have widened in recent years (Berrington et al. 2015).

Evidently the relationship between education and fertility is complex and varies not only over time, but also from country to country according to institutional contexts such as family policies, labour market characteristics and gender norms (Liefbroer and Corijn 1999; Sobotka et al. 2017). It is suggested that educational differences in cohort fertility have all but disappeared in Nordic countries because their welfare-state policies focus on supporting gender equality and allowing men and women to combine family and work (Andersson et al. 2009; Kravdal and Rindfuss 2008).

This paper investigates the effect of the increase in education on completed fertility, examining the completed fertility rate of five cohorts of women in Australia born between 1952-56 and 1972-76 – cohorts which experienced large changes in education patterns. These cohorts also experienced considerable change in completed fertility. To consider these changes, we decompose the overall

change in completed fertility to analyse how it changed due to two factors: changes in the proportion of women in each education category, and changes in fertility of women in education categories. We note that many other changes in family formation also occurred for these cohorts including increases in non-marital childbearing, divorce and cohabitation without marriage.

Drawing on this analysis, we determine what proportion of the change in completed fertility across cohorts is due to the changing education patterns, and what proportion is due to changing fertility patterns within education categories. We begin by outlining recent trends in education, focusing on the period of 1960s to 1990s, the time period when most of the women in these cohorts would have been completing secondary education and gaining post-school qualifications. We then examine differences in completed fertility across education categories and how this has changed over time.

## 2. The expansion of education since the 1960s

The 1960s marked the large-scale expansion of secondary schooling in Australia. During the 1960s and 1970s there was growing political and public support for a system of comprehensive high schools which would enrol everyone regardless of merit or aptitude (Campbell and Proctor 2014). The influential 1973 Karmel report called for reform in the education sector including establishing standards of achievement and ensuring adequate resourcing. It also addressed the existing gender inequality in male and female school completion. The report influenced a large increase in Commonwealth funding during the Whitlam government of the early 1970s. However, the economic crisis of the later 1970s and early 1980s, which was marred by high unemployment and inflation, led to restrictions on education expenditure (Burke and Spaul 2001).

There are many different measures that can be used to show how education has expanded, but one of the most common is the participation rate at selected ages. The participation rate measures the proportion of the population at a selected age enrolled in an educational institution. The participation rate at age 16 from 1966 to 2000 is shown in Figure 1. There was a dramatic rise in participation at age 16 throughout the 1960s, a plateau in the late 1970s and 1980s which may have been due to the economic crisis, followed again by an increase in the 1980s. In the mid-60s less than half of boys and girls aged 16 attended school. By 1970 this had increased to 55 per cent and 47 per cent respectively, and by 1980 to 56 and 60 per cent, with girls surpassing boys in the mid-1970s.

Another education indicator often used to study trends over time is apparent retention rate to Year 12, which is the final year of high school completed at around age 18. This apparent retention rate is expressed as the number of students of a particular sex enrolled in Year 12 as a percentage of the cohort of students of the same sex who first commenced secondary schooling (Le and Miller 2002). In 1971 the apparent retention rate to year 12 was 27 per cent for females and 34 per cent for males. By 1991 this had increased to 77 per cent for females and 66 per cent for males. From 1976 the percent of female students continuing to Year 12 exceeded that of males, although this is partly explained by the greater uptake of trade and apprenticeship courses by males than females after completing Year 10 (ABS 1993 p. 95).

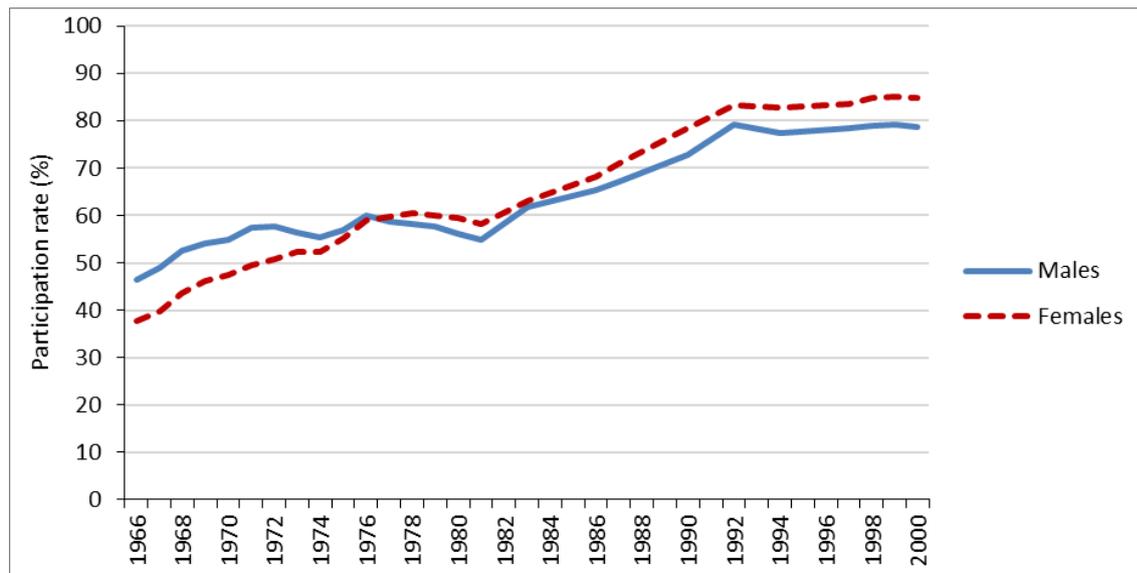


Figure 1: Participation rate in school at age 16 by sex, 1966-2000

Source: Anderson and Vernon 1983; Long et al. 1999; ABS 2001, 2009.

In line with increasing school completion already noted, there has also been an increase in the population with tertiary education. The increase in the total enrolment in higher education is shown in Figure 2. Part of the increase shown is a consequence of the progressive upgrading to degree status of courses which were at diploma level or lower. This includes many vocational-oriented qualifications in fields such as teaching, accounting, surveying, and nursing, originally provided by the former institutes of technology, teacher's colleges, colleges of advanced education, and technical colleges (ABS 1993). The fields of teaching and nursing are disproportionately female, so these changes had a direct impact on the percentage of women completing degree qualifications.

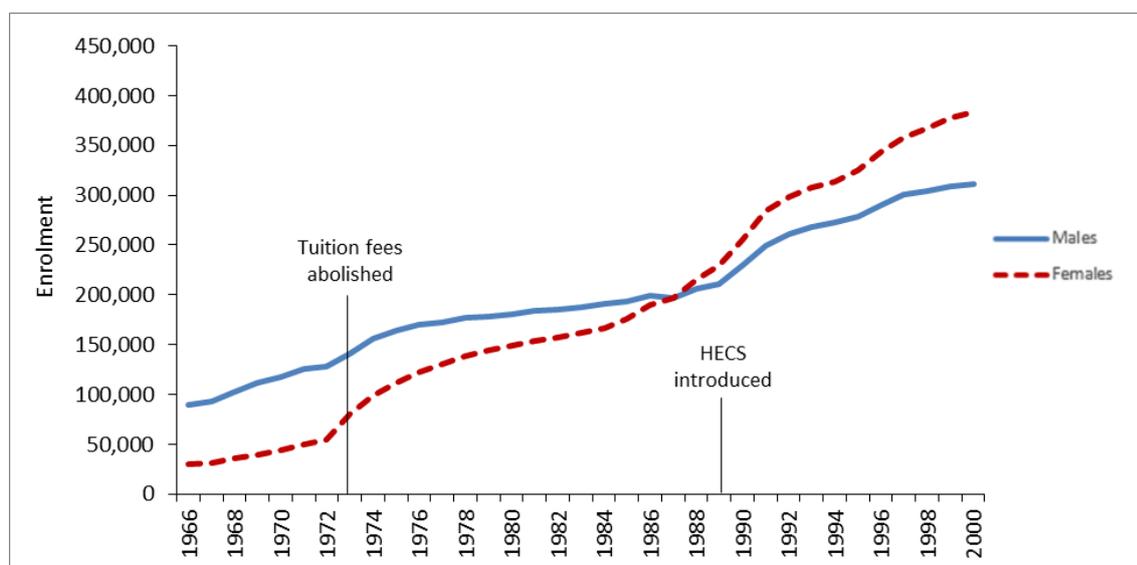


Figure 2: Total enrolment in higher education by sex, 1966-2000

Note: Includes government Teachers Colleges from 1973 onwards. Includes non-government Teachers Colleges from 1974 onwards. Figures for years from 1985 to 1993 progressively include State-funded basic nursing students who would previously have been trained in hospitals.

Source: Department of Education, Training and Youth Affairs (2001)

The other change in the education landscape is the changing nature of government funding models. In the early part of this period students paid tuition fees which were largely covered by merit-based Commonwealth scholarships. In 1973 the Whitlam government abolished fees. The impact of this is evident in a small but steep increase in tertiary enrolment, especially for women. In 1987 the government re-introduced fees through the Higher Education Administrative Charge (HEAC) and in 1989 introduced the Higher Education Contribution Scheme (HECS), an interest free income-contingent loan for students to assist with payments of tuition fees (Chapman 2011). These funding changes have clearly impacted total enrolment for men and women during the period of early adulthood for the cohorts covered in this study.

### 3. Data and Methods

In order to examine the relationship between education and fertility we use data from the 2016 Census. The census collects information on the three key aspects needed for this analysis: highest level of education, age, and number of children ever born. As seen in Figures 1 and 2, the key period of educational expansion was in the 1960s to 1990s. To capture the experience of women going through secondary school and university during this period, we selected women born in a 19-year period from 1952 to 1976, split into five birth cohorts: 1952-56, 1957-61, 1962-66, 1967-71, 1972-76. At the time of the 2016 Census they were aged 60-64, 55-59, 50-54, 45-49 and 40-44 respectively (Table 1).

Table 1: Cohort birth years and age at Census

Cohort	Age at 2016 Census	Year turned 16
1952-56	60-64	1968-72
1957-61	55-59	1973-77
1962-66	50-54	1978-82
1967-71	45-49	1983-87
1972-76	40-44	1988-92

Detailed education categories are constructed from two variables: highest level of schooling and highest level of post-school qualifications gained. We were particularly interested in looking at detailed categories of educational attainment to gain a richer insight on the differences between high and low education.

Our measure of completed fertility is based on the census question asked of all females aged 15 and over: how many babies they have ever given birth to. Using this 'children ever born' variable we calculate cohort fertility or average completed family size for each education category within each cohort. Cohort completed fertility is calculated by multiplying the number children by the total number of women, including those who have no children. For the cohort born in 1972-76 who are aged 40-44, childbearing is not fully complete. However, we note that in 2017, just under 5 per cent of births were to mothers aged 40 or over (ABS 2018), and more than half of these births were at

ages 40 and 41, so the overall impact of right-censoring and loss of information about future births for this group is relatively small.

We begin by outlining the educational composition and completed fertility for each cohort. We then decompose the overall change in completed fertility to see how it changed due to two factors: the proportion of women in a particular education category, and the completed fertility of women in that education category. We use Das Gupta's (1993) decomposition method developed as a Stata program by Li (2017). As we are only using one factor (education) the formula to calculate the effect of education and composition, respectively is:

$$\text{Education composition effect} = \sum_i \frac{\frac{n_{ia} + n_{ib}}{n_a + n_b}}{2} \times CFR_{ib} - \sum_i \frac{\frac{n_{ia} + n_{ib}}{n_a + n_b}}{2} \times CFR_{ia}$$

$$\text{Fertility rate effect} = \sum_i \frac{CFR_{ia} + CFR_{ib}}{2} \times \frac{n_{ib}}{n_b} - \sum_i \frac{CFR_{ia} + CFR_{ib}}{2} \times \frac{n_{ia}}{n_a}$$

where  $CFR$  is the completed fertility rate,  $n$  is the population,  $i$  is education category, and  $a$  and  $b$  are the two populations being compared. For any two populations in this simple decomposition the difference between completed fertility rates is attributed to fertility or education composition, with these two components adding up to 100 per cent.

## 4. Results

### 4.1. Change in completed fertility

As expected, due to the rise of education for women in the recent past, the educational composition of women in these cohorts is dramatically different (Figure 3). The major change in education has been a decline in the proportion of women who only completed Year 10 or below, from 30 per cent among the 1952-56 cohort to 10 per cent in the youngest cohort. In turn there has been a corresponding increase in women who have a Bachelor's degree, from 13 per cent in the earliest cohort to 23 in the latest cohort. Those with complete high school (Year 12) rose slightly, as did all categories of post-school qualification, except basic vocational.

Completed fertility has also changed across successive cohorts of women. Overall, completed fertility has fallen from 2.23 in the 1952-56 cohort to 1.97 in the 1972-76 cohort. Figure 4 shows how completed fertility has changed across the cohorts by education level. At higher levels of education completed fertility has declined more or less steadily, whereas for Year 11 and Year 10 or below, after a decline in the middle cohorts, we see a rise again in fertility for the most recent cohort. For example, for Year 10, completed fertility fell from 2.44 among the 1952-56 cohort to 2.34 for women born in 1962-66. It then increased again to 2.43 for the 1972-76 cohort. This change of fertility for women in the lowest education categories are aligned with the dramatic decline of women in these education categories suggesting that the underlying composition of these groups has changed over time.

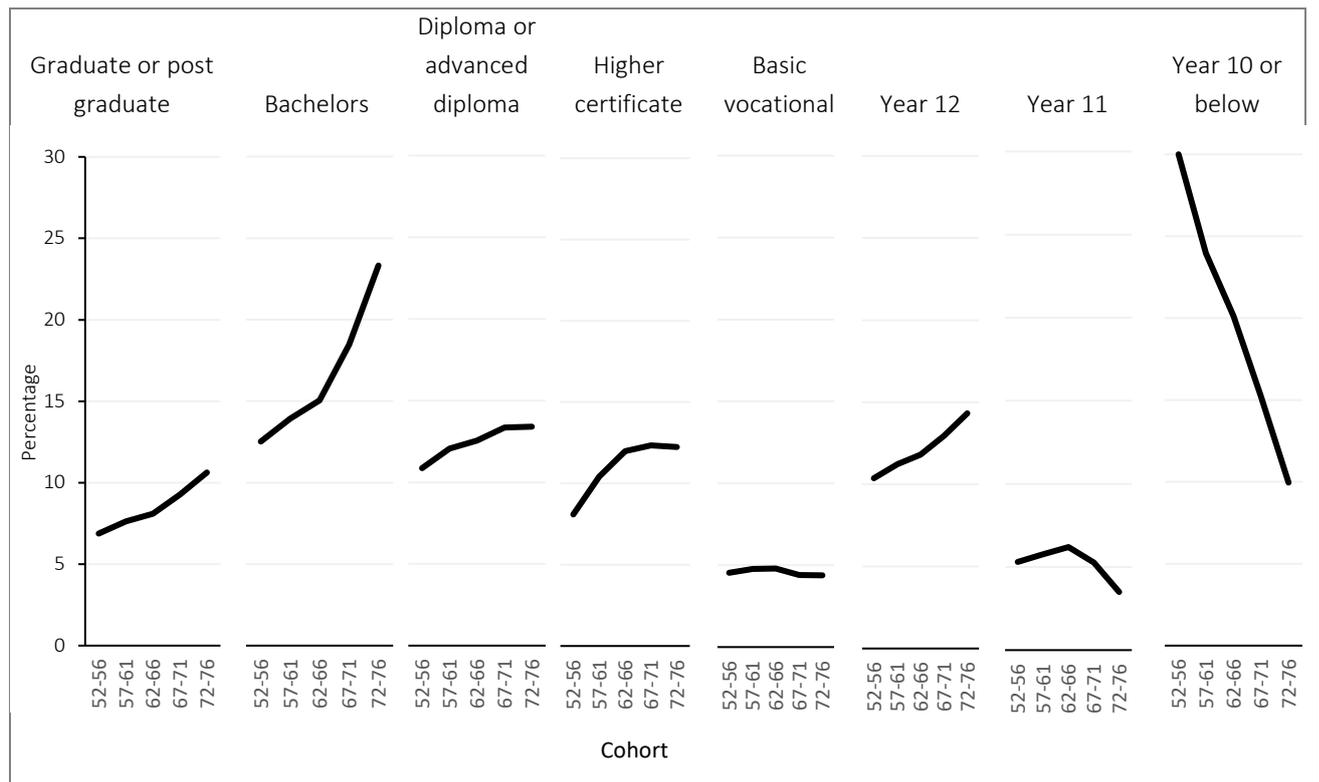


Figure 3: Percentage distribution of women by highest level of education and birth cohort

Source: ABS 2019 – authors’ calculations

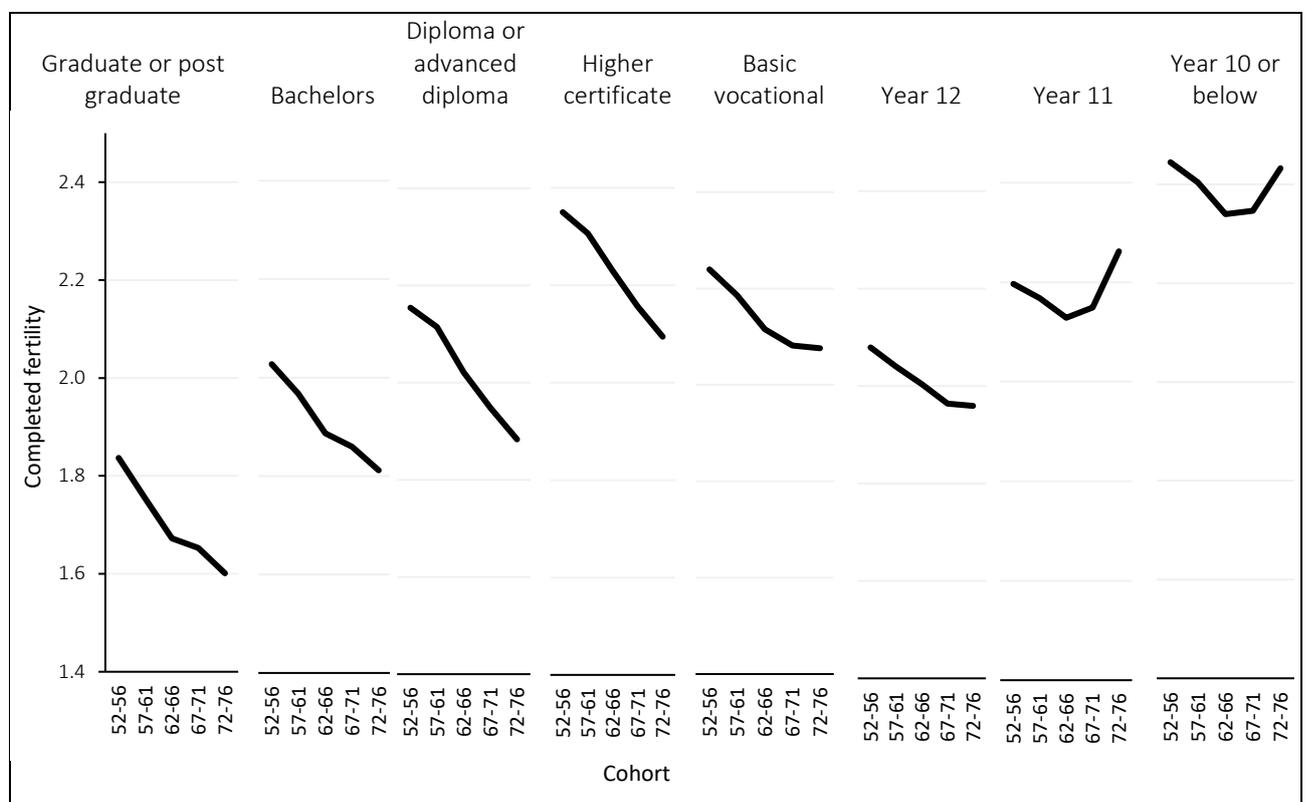


Figure 4: Completed fertility by highest level of education and birth cohort

Source: ABS 2019 – authors’ calculations

The pattern of change in completed total fertility from the 1952-56 cohort to the 1972-76 cohort is shown in Figure 5. Figure 5 also shows the contribution to completed fertility according to the women's highest level of education. Not only did completed total fertility decline across the cohorts but the contribution by each category also changed. Most notably the contribution of completed fertility by women with Year 10 or below schooling declined, whereas the contribution to completed fertility by women with a Bachelor's degree increased. The contribution of an education level to completed total fertility can decline if the proportion of women in that category decreases, or their completed fertility rate decreases, or both. In the next section we decompose the change in completed fertility rate to these two factors: compositional change in education categories and actual change in fertility within education categories.

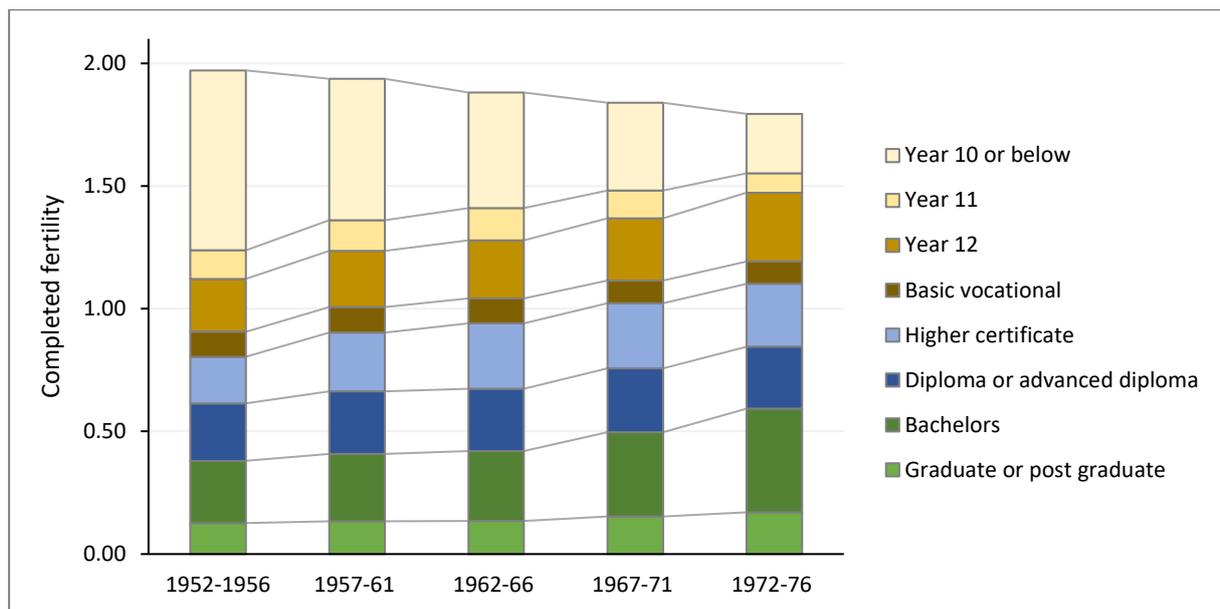


Figure 5: Relative contribution of education categories to overall completed fertility, by cohort

Source: ABS 2019 – authors' calculations

#### 4.2. Decomposing fertility rates and educational composition

With this decomposition we can separately identify changes in completed fertility attributable to changes in the educational distribution as well as changes in fertility within each educational group. If, over time, the proportion of women in different educational groups changed but the completed fertility within each group remained the same then changes in total completed fertility would be 100 per cent due to changes in education composition. Similarly, if the educational composition stayed the same, but fertility changed within the education groups, then 100 per cent of change in overall fertility could be attributed to fertility rate changes.

The decomposition of completed fertility by cohort is shown in Table 2. Comparing the 1952-56 cohort with the 1957-61 cohort we see a decline of 0.07 children, from 2.23 to 2.16. Of this decline, 72 per cent can be attributed to changes in fertility rates and 28 per cent to changes in educational composition. Comparing the 1962-66 cohort with the 1957-61 cohort, there is a decline of 0.08 in completed fertility from 2.16 to 2.08. This decline was primarily due to declines in fertility across all education groups, with only 15 per cent attributable to changes in the composition of women across education categories. For the next two cohorts, completed fertility declined by 0.06 and this was

attributable fairly evenly due to declines in fertility and changes in the composition across education categories. The majority of the decline between the two most recent cohorts is attributable to changes in the composition across education categories.

Table 2: Decomposition of completed fertility

	Completed fertility of cohort	Completed fertility of previous cohort	Difference	Change attributable to:	
				Fertility rate effect (%)	Composition effect (%)
1952-56	2.23	-			
1957-61	2.16	2.23	-0.07	72	28
1962-66	2.08	2.16	-0.08	85	15
1967-71	2.02	2.08	-0.06	53	47
1972-76	1.97	2.02	-0.05	31	70
Total (1952-57 to 1972-61)			-0.26	56	44

Source: ABS 2019 – authors' calculations

Next we look in more detail at how fertility and education composition contributed to the decline in completed fertility between the cohorts. For each education category, Figure 6 shows the effect on fertility of the changing proportion of women in that education category (proportion), and the changing fertility (rate) within each education group. The corresponding table can be found in the Appendix.

For example, as seen above, between the 1952-57 and 1957-61 cohorts completed cohort fertility declined by 0.07. Between these two cohorts the education composition of women changed, and the fertility of women within education categories also changed. For these cohorts, the increase in the proportion of women with a Graduate diploma, Masters or PhD contributed 0.013 to the difference in overall cohort fertility. The decline of fertility among women with a post-graduate degree contributed to -0.006, leading to an overall positive impact of 0.007. If we add up all the positive and negative effects of composition and fertility within each of the education categories it equals -0.07.

For the two highest levels of educational attainment, Postgraduate and Bachelor, between every cohort comparison there was a positive effect on overall completed fertility due to increasing proportion of women with these degrees but a negative effect due to declining fertility in these education categories. However, the negative influence of declining fertility within the education categories was not large enough to offset the positive impact of increasing proportion of women with degrees leading to an overall positive effect on fertility. The increasing proportion of women with a Bachelor's degree had a particularly positive effect on completed fertility for the most recent cohorts, and the offsetting negative effect in the fertility rate among women with a Bachelor's degree was only minor in comparison. As a result, between the 1962-66 and 1967-71 cohort, women with a Bachelor's degree contributed 0.059 to the difference between overall completed fertility. The Diploma level had a negligible effect on differences in fertility over time, as did Certificate I and IV. For Certificate III and IV initially the increasing composition of women in the oldest cohorts had a positive effect, but in the in later cohorts the effect was minor.

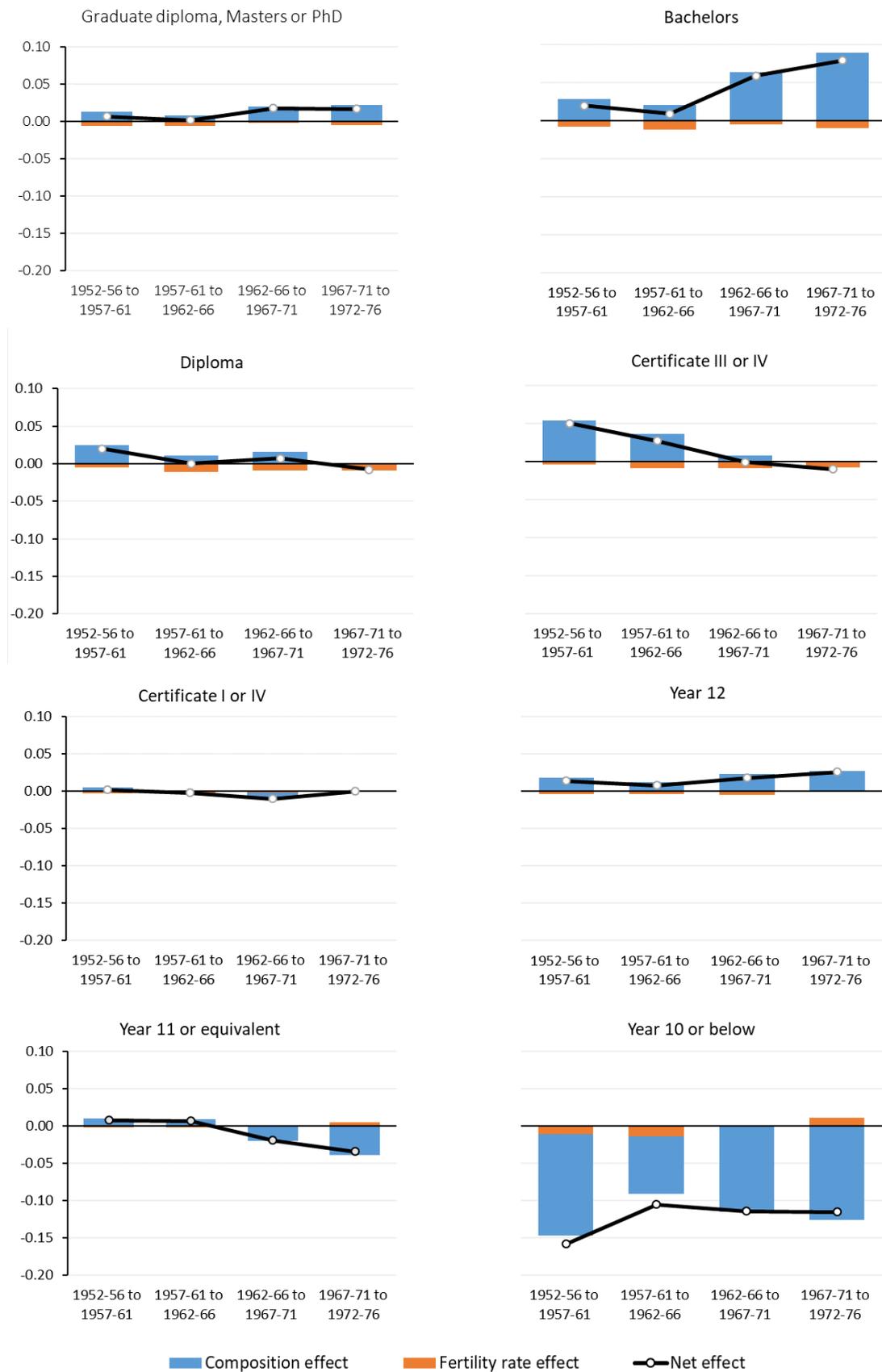


Figure 6: Decomposition by cohort and detailed education categories

Source: ABS 2019 – authors’ calculations (full results in Appendix)

For Year 12 the increasing composition coupled with very little change in their fertility rate led to an overall positive, though small, contribution to changes in completed fertility. For Year 11 an interesting pattern emerges. For the early cohorts there was an increasing proportion of women in Year 11 and a small but declining rate of fertility. In the most recent cohorts this switched and the proportion with Year 11 declined, but the fertility of women with Year 11 education increased. The overall impact on fertility was negative for the most recent cohorts. For Year 10 we see the strongest effect of proportion and fertility rate. For each cohort comparison, the declining proportion in this education category had the effect of decreasing completed fertility. Among the older cohorts in this group fertility also declined but in the younger cohorts it increased.

## 5. Conclusions

For older cohorts of Australian women, attaining a degree was a rare occurrence and it was unusual to combine work and family. Today the proportion of women with a degree has increased dramatically, and women with a degree are no longer such a selective group. One might therefore expect that the negative gradient between education and fertility would have weakened over time. In Australia, we found no evidence of this. Instead, as in Britain, we find large and widening educational differences. The increasingly large proportion of women with university degrees are still experiencing declining fertility while women with Year 11 or below schooling appear to have become an increasingly small and select proportion of the population with increasing fertility rates. These are also women with the lowest investment in human capital and the most precarious attachment to the labour force. In terms of the institutional support for women wanting to combine work and childbearing, Australia still lags behind many European and Scandinavian countries (Heard and Arunachalam 2015). The continued barriers to combining motherhood and work for educated women is likely one explanation for why in Australia we continue to see educational differences in fertility.

In terms of the effect overall, we find that for older cohorts the primary component of change in completed fertility was declining fertility. In the most recent cohort there is evidence that a composition effect due to changing educational trends is now the primary driver of declining fertility. In particular, the impact of the growing group of women with a Bachelor's degree and the shrinking proportion of women who have not completed high school reflects the growth in higher education enrolment shown in Figure 2.

Using detailed education categories also enables us to capture the differences between high and low education. We find large differences in the pattern of fertility between the Year 12, Year 11 and Year 10 or below-groups which are often grouped together in other studies as 'no post school qualification'. While Year 12 followed the same composition and rate trend as the Bachelor's level (increasing composition, declining fertility), the incomplete secondary groups were very different signalling an increasing marginalisation of women with very low levels of education.

It is important to note that we use highest completed level of education at the time of the Census as our indicator of educational attainment. This anticipatory approach could possibly lead to a bias in the estimates of the educational gradient as the attainment of the highest level of education may change across the reproductive life course and may have occurred after childbearing (Hoem and

Kreyenfield 2006). In addition, because we include women up to the age of 64 the results presented may also be biased by differential mortality to the extent that mortality varies by education (Hoem and Kreyenfield 2006).

Australia has one of the highest levels of tertiary education completion in the world. Nearly 50 per cent of young adults (25-34 year-olds) in Australia have attained a tertiary qualification, one of the highest across OECD countries and considerably above the OECD average of 43 per cent. Given the significant increase in education, and the continued rising levels of education for women, future national fertility levels will in large part be determined by the childbearing of the increasingly large proportion of women with higher education (Heard and Arunchalam 2015). It is difficult to predict whether these differences will continue to diverge or whether they will follow European trends and begin to narrow. This will largely depend on the childbearing patterns of the increasingly select group who do not complete high-school, and the fertility of those with university degrees. Both can be significantly influenced by supportive family policy.

### Key messages

- Australia has seen a widespread increase in the level of education of women, and a corresponding decrease in completed fertility.
- Decomposition analysis allows a separation of the components of fertility decline into two parts: decline due to a change in the composition of education categories, and decline due to changes in fertility rates of cohorts.
- For older cohorts, most of the decline is due to declining fertility rates. For the youngest cohort, the decline is due to changing education composition.
- Focussing on the different education levels provides additional insight into fertility change by level of education. Incomplete secondary schooling has a declining effect on completed fertility while tertiary education has a substantial and growing contribution on the change in completed fertility.
- Overall, the gap between completed fertility by highest level of education is growing.

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## Appendix

Table A: Detailed decomposition of change in completed fertility due to composition and due to fertility rate, by highest level of education

		Cohort			
		1952-56 to 1957-61	1957-61 to 1962-66	1962-66 to 1967-71	1967-71 to 1972-76
<i>Graduate diploma, Masters or PhD</i>	Composition effect	0.013	0.008	0.02	0.022
	Fertility rate effect	-0.006	-0.006	-0.002	-0.005
	Total effect	0.007	0.002	0.018	0.017
<i>Bachelor</i>	Composition effect	0.028	0.021	0.064	0.089
	Fertility rate effect	-0.008	-0.012	-0.005	-0.01
	Total effect	0.02	0.009	0.059	0.079
<i>Diploma or Advanced Diploma</i>	Composition effect	0.025	0.011	0.016	0.001
	Fertility rate effect	-0.005	-0.011	-0.009	-0.009
	Total effect	0.02	0.00	0.007	-0.008
<i>Certificate III or IV</i>	Composition effect	0.054	0.036	0.008	-0.002
	Fertility rate effect	-0.004	-0.009	-0.009	-0.008
	Total effect	0.05	0.027	-0.001	-0.01
<i>Certificate I or II</i>	Composition effect	0.005	0.001	-0.008	0.00
	Fertility rate effect	-0.003	-0.003	-0.002	0.00
	Total effect	0.002	-0.002	-0.01	0.00
<i>Year 12</i>	Composition effect	0.018	0.012	0.023	0.027
	Fertility rate effect	-0.004	-0.004	-0.005	-0.001
	Total effect	0.014	0.008	0.018	0.026
<i>Year 11 or equivalent</i>	Composition effect	0.01	0.009	-0.02	-0.039
	Fertility rate effect	-0.002	-0.002	0.001	0.005
	Total effect	0.008	0.007	-0.019	-0.034
<i>Year 10 or below</i>	Composition effect	-0.147	-0.091	-0.115	-0.126
	Fertility rate effect	-0.011	-0.014	0.001	0.011
	Total effect	-0.158	-0.105	-0.114	-0.115
<i>Not stated</i>	Composition effect	-0.026	-0.019	-0.014	-0.01
	Fertility rate effect	-0.006	-0.007	-0.002	0.00
	Total effect	-0.032	-0.026	-0.016	-0.01
	Column total	-0.07	-0.08	-0.06	-0.05