
G Fertility intentions

G.1 Are women revising their fertility expectations?

As discussed in chapter 2, rising fertility levels for women can reflect three factors:

- recuperation — the realisation of births that were formerly postponed as women shifted the timing of their births to older ages
- anticipation — Births brought forward in time, but with no change in the expected completed fertility rate
- quantum effects — increases in a woman's expected completed (lifetime) fertility.

It is difficult to distinguish the relative role of these three factors over just a few years, which is problematic since they have different policy implications. However, the Household, Income and Labour Dynamics in Australia (HILDA) survey provides some evidence about the role of the quantum effect, since it can be used to analyse changes in women's expectations of future births. This appendix considers the causes of the changes in fertility over the five year period from 2001 to 2006, which was a period of rising fertility at the aggregate level.

HILDA is a household-based panel study that began in 2001. It collects information about economic and subjective well-being, labour market dynamics and family dynamics, with the latter relevant to this report.

The survey asks female (and male) respondents several questions about previous and anticipated fertility:

- a) the number of children ever had — 'parity' (P)
- b) the desire for children in the future (D). The strength of the desire was measured on a Likert scale between 0 and 10 — with low (high) values indicating a negative (positive) attitude to having future children
- c) the likelihood of having future children (L). The likelihood is also measured on a scale between 0 to 10, with scores of 5 or less interpreted as 'unsure or unlikely' to have a child

-
- d) the number of additional children (I) a person intends to have (an estimate of the actual number of such children).

The survey can be used to derive several measures of changing fertility intentions¹ and attitudes over time:

- $\Delta(P_t+I_t)$ provides an indicator of the change over time in the expected completed fertility (ECF). It may be appropriate to condition the analysis on age (or cohort). However, as noted by Rebecca Kippen in commenting on a draft of this report, it is not appropriate to condition the analysis on children already had. Given postponement, that would inevitably suggest a quantum effect even when none existed.
- Changes in D and L may indicate changes in people's latent desires for children and the likelihood these will be realised.

An issue in interpreting any results is the longstanding problem of distinguishing cohort, age and period effects on expected completed fertility. This stems from the fact that the cohort at time T is defined simply as T less age, so that, in the absence of identifying restrictions, it is only possible to isolate the effects of two factors, implicitly assuming that the omitted one is irrelevant.

Cohort effects will arise if people of different generations have different inherent preferences or capacities for fertility. Period effects can arise when the economic or social environment changes over time, prompting women to revise their expected number of children. Age effects are different in character because their presence requires that younger people systematically under or overestimate their completed fertility, regardless of their cohort or of the social and economic environment. This violates the often-applied assumption in economics of 'rational expectations'.²

Nevertheless, applying rational expectations may be too strong an assumption. Forecast bias could arise in several ways. Women could be overly optimistic about being able to have children later, forgetting the risks of not being able to partner or of sub-fecundity. That would suggest that the ECF declines with age. Some

¹ It can also do so for men, but most of this appendix concentrates on women, since they have greater control over their reproductive lives.

² This assumption does not require that people are accurate forecasters of their future fertility and nor does it require that the variance of forecast errors is constant over time — these could be expected to fall as women age. Rather rational expectations requires that, *for any given information at hand at the time of the forecast*, the expected error is zero. Notably, a failure to account for period changes in fertility due to future unanticipated economic and social events does not violate rational expectations because women do not, by definition, know of these beforehand. But women do know they will age, so rational forecasts should (on average) factor any age-related impacts on completed fertility.

aggregate survey evidence supports this contention. The expected fertility of more recent cohorts exceeds the long-run total fertility rates used in most current Australian demographic projections. That could mean those projections will underestimate future fertility, but it is also consistent with overestimation of future fertility by women.

Alternatively, an opposing bias could arise if preferences for children, careers and lifestyles may not be stable over age, so that some younger women underestimate their higher future preferences for children and, consequently, the number they ultimately bear. Both biases could be present, but manifested at different ages.

If rational expectations is not assumed, a general model might allow for period, cohort *and* age effects. In that instance, it is much harder to attribute changes to period effects. However, box G.1 shows that in realistic circumstances a regression of expected completed fertility against a dummy variable for 2006 and women's age or cohort will produce an estimate of the period effect that is, if anything, underestimated.

Balanced and unbalanced data

Where appropriate, we show results for both 'balanced' and 'unbalanced' samples. A balanced sample is one where observations on each person are available in both 2001 and 2006. Comparing across a balanced sample means that results relate to people from the same cohorts. It does not mean an absence of cohort effects — people from different cohorts may respond differently to period effects.

Balanced data control for changes in the mix of cohorts over time, though, in the context of the purposes of this study, the weights used for unbalanced data will largely deal with this issue anyway. Unbalanced results may also be more reliable because they are based on significantly larger samples and allow greater variation in some relevant variables (such as age). The construction of the HILDA survey in different waves particularly affects the sample size of balanced datasets. In wave 1, women from 17 years up to age 54 years were asked questions about their fertility, whereas in wave 6, only women aged 17 to 44 were asked. This means that a balanced sample requires that the ages covered are from 17 to 39 years in wave 1, and from 22 to 44 in wave 6, which excludes many respondents.

The results

Descriptive data analysis suggests some changes in the pattern of expected completed fertility over time.

Box G.1 Distinguishing period, age and cohort effects

A general formulation of period, cohort and age effects would allow year-by-year changes in all factors, but for the sake of illustrating the issues, we assume an additive linear form for the effects:

$$C_{it} = \alpha_1 + \alpha_2 age_{it} + \alpha_3 cohort_{it} + \alpha_4 Y2006_{it} + \varepsilon_{it} \text{ where } t \text{ is either } 2001 \text{ or } 2006 \quad \{1\}$$

where C_{it} is the expected completed fertility of an individual i at time t , cohort is the year born, $Y2006$ is a dummy equal to 1 in 2006 and 0 in 2001 to capture the period effect, and ε is a white noise error term. The form of {1} simplifies any actual fertility behaviour since it allows for the possibility of 'fractional' children, but it provides ease of exposition.

Consider a person aged 20 in 2001. Their predicted C is $\alpha_1 + 20\alpha_2 + 1981.\alpha_3$. In 2006, this person is aged 25 years and their predicted C is $\alpha_1 + 25\alpha_2 + 1981.\alpha_3 + \alpha_4$, so that the change in C from 2001 is $5\alpha_2 + \alpha_4$. Without identifying restrictions, the general model cannot be estimated due to linear dependence, so that only one pair of the three possible effects can be modelled. Suppose that C was estimated as a function of cohort and $Y2006$, so that:

$$C_{it} = \hat{\beta}_1 + \hat{\beta}_3 cohort_{it} + \hat{\beta}_4 Y2006_{it} + \xi_{it} \quad \{2\}$$

In that case, for the identical person above, we estimate that the change is $\hat{\beta}_4$, solely a period effect, when in fact some of the change is due to the effect of the (omitted) changing average age in the sample. If $\alpha_2 > 0$ then this means that $\hat{\beta}_4$ is biased upwards as a measure of the true period effect. If $\alpha_2 < 0$ then this means that $\hat{\beta}_4$ is biased downwards.

If, on the contrary, suppose that C was estimated as a function of age and $Y2006$, so that:

$$C_{it} = \hat{\phi}_1 + \hat{\phi}_2 Age_{it} + \hat{\phi}_4 Y2006_{it} + \mathcal{G}_{it} \quad \{3\}$$

In that case, for the identical person above, the expected change in C is $5\hat{\phi}_2$ due to an age effect and $\hat{\phi}_4$ to the period effect. It is straightforward to show that $\hat{\phi}_2 = -\hat{\beta}_3$ and $\hat{\phi}_4 = \hat{\beta}_4 + 5\hat{\beta}_3$ (so that the expected total change is $\hat{\beta}_4$ as above, but with a different attribution to age and period effects). There is a reasonable prior that the cohort effect is negative ($\alpha_3 < 0$). In that case, if the age effect is also negative ($\alpha_2 < 0$), then $\hat{\phi}_4$ is biased downwards.

If rational expectations hold, the best estimate of α_4 will be that based on {2}, but even if rational expectations does not hold, there is a reasonable prospect that period effects will be underestimated. There are various techniques for distinguishing period, cohort and age effects through identifying restrictions, with little consensus on the best methodology. Nevertheless, further research could usefully apply several such restrictions to examine their implications for estimates of period effects.

There is a lower likelihood of expected lifetime childlessness in 2006 than 2001, and a corresponding increase in the likelihood of having just one child (table G.1). The picture for parity 2 and above suggest only small changes of indeterminate sign. This picture is consistent with a quantum effect, but could be confounded by age and cohort effects.

Table G.1 Distribution of expected completed fertility (ECF)
Balanced sample^a

<i>Share of women in main reproductive years by number of ECF</i>				
<i>Number of expected completed children</i>	<i>Unweighted</i>		<i>Weighted</i>	
	2001	2006	2001	2006
	%	%	%	%
0 ^c	14.1	11.8	15.4	14.0
1	8.6	10.4	8.5	10.6
2	41.8	42.4	42.6	42.5
3	23.5	23.8	23.1	23.1
4+	11.9	11.6	10.4	9.8
Total	100.0	100.0	100.0	100.0

^a The results are based on survey responses about expected lifetime fertility from women aged 17 to 39 years in 2001 (and since it is a balanced sample, those aged 22 to 44 years old in 2006). For example, the table shows that in 2001, 14 per cent of these women expected to have no children over their a lifetime, but that five years later, the same group of women had revised this number down to 11.8 per cent. The number of observations were 4258 unweighted and 3648 weighted (with the latter based on longitudinal weights).

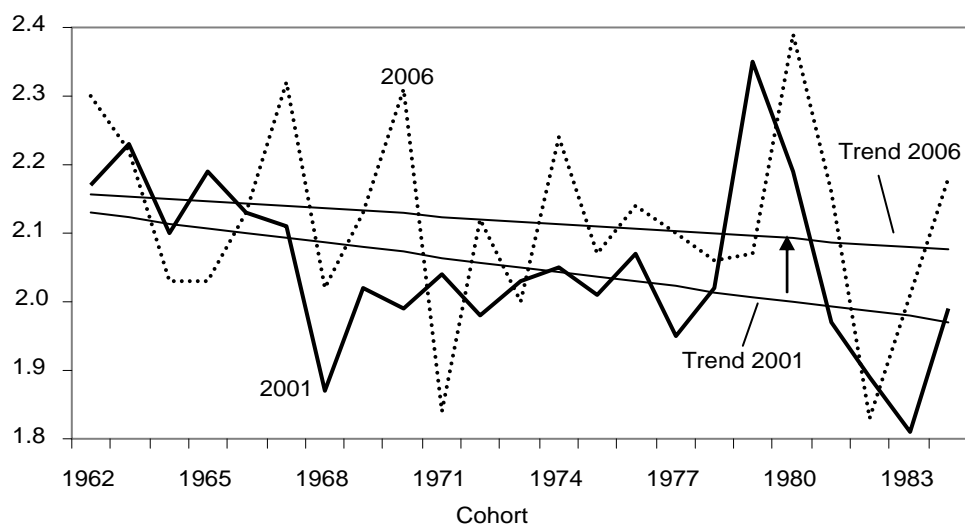
Source: HILDA database (waves 1 and 6).

The results for cohorts and age presents a more complex picture. In any given period, more recent cohorts tend to have slightly lower expected completed fertility than older cohorts. This is consistent with several hypotheses about the behaviour of women of more recent versus older generations. For example, the differences might entail a lower inherent desirability of children, differences in aspirations for careers, or greater selectivity of partners. But the differences are modest, with expected fertility still being around two for the younger and older cohorts of women in the sample — none of whom have completed their reproductive lives (figure G.1).

For any given cohort, there is a tendency for higher expected fertility in 2006 than 2001, which is evidence of a quantum effect. This shows up as the shift in the trend lines in figure G.1. There is a tendency for greater positive changes in the fertility of younger cohorts than older cohorts. A possible explanation for this is that older women have only a few years of reproductive life left and, accordingly, less opportunities than young women to take advantage of an environment more conducive to childbearing.

Figure G.2 summarises the *changes* in expected completed fertility between 2001 and 2006 as a function of cohort and age. Both show a tendency for higher fertility in 2006, with more bars above zero than below.

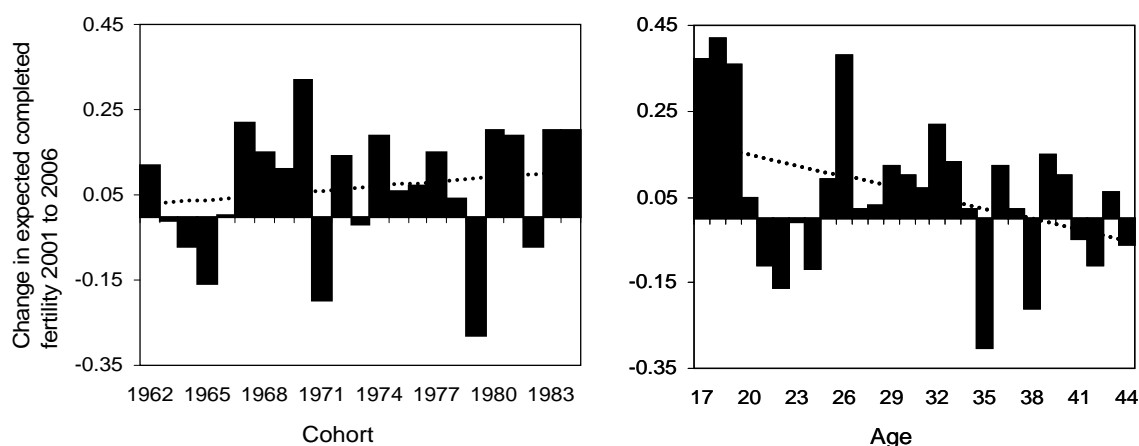
Figure G.1 **Expected completed fertility for different cohorts of women ^a**



^a Cohort is the year of birth of the woman. The results are based on unbalanced data weighted by cross-sectional weights. Balanced data using longitudinal weights produced a similar qualitative picture, except that the effects for younger cohorts were even greater relative to older cohorts.

Data source: HILDA database (waves 1 and 6).

Figure G.2 **Changes in expected completed fertility 2001 to 2006, cohorts and ages^a**



^a The left-hand side graph show the average change in ECF from 2001 to 2006 for cohorts born from 1962 to 1984. The other graph show this change for people of different ages. So, the average ECF of someone aged 25 in 2001 would be compared with the ECF of someone aged 25 in 2006. Note that this means the comparison is between people from different cohorts. The results shown are for weighted unbalanced data. The dotted lines show the trends in the changes by cohort and age. For instance, in the case of cohorts, there is a tendency for the change in ECF to be greater for more recent cohorts.

Data source: HILDA database (waves 1 and 6).

Some model results

A simple model of completed fertility summarises these period, cohort and age effects (table G.2), and finds statistically significant period effects.³ The results imply that more recent cohorts (or younger people) experienced an increase in their expected completed fertility between 2001 and 2006 of up to 0.15 children per woman (table G.3). There was effectively no increase for cohorts of women born prior to the mid-1960s. As noted above, a likely explanation is that their fertility was close to completed already in 2001, with little scope for a change. Results for males echo those of females, except that males expect, on average, to have a lower lifetime number of children than women. (In part, this may explain why women's ideal number of children may not be realised).

These results are based on ordinary least squares, which are easy to interpret. However, fertility levels at the individual level must assume an integer value and predictions of negative outcomes are possible under OLS, but are clearly untenable. Nevertheless, analysis using a Poisson model found qualitatively similar effects.

An alternative approach is multinomial regression analysis, which considers the probability of varying parities in 2001 and 2006. Multinomial regression analysis confirms that, controlling for cohorts, fewer women expect to experience lifetime childlessness in 2006 than in 2001 (table G.4). There is a corresponding increase in the expectation of just having one child (and for more recent cohorts, also two and three children). There is also an increase in women's subjective view about the desirability and likelihood of future children (table G.5).

Overall, while not definitive, the HILDA results are consistent with a quantum increase in fertility from 2001 to 2006.

³ The simple model selected is conceptualised as a local approximation to Australia's recent fertility history, but linear cohort effects cannot be realistic in the long run as that would imply infinite or negative long-run expected fertility.

Table G.2 Expected completed fertility
Females and males, In 2001 and 2006

<i>Models</i>	<i>Females</i>	<i>Males</i>
	<i>Coefficients & tests</i>	
<i>The 'cohort' representation</i>		
Constant	18.08 (3.3)	34.76 (8.8)
Y2006 (Dummy for 2006 wave)	-14.65 (1.9)	-17.64 (3.2)
Cohort (year of birth)	-0.00813 (2.9)	-0.0167 (8.3)
Interaction (Cohort×Y2006)	0.00746 (1.9)	0.00898 (3.2)
Significance of Y2006 variables	0.019	0.004
<i>The 'age' representation^b</i>		
Constant	1.819 (20.4)	1.388 (18.4)
Y2006	0.277 (2.2)	0.293 (2.8)
Age of respondent (Age)	0.00813 (2.9)	0.0167 (8.3)
Interaction (Age×Y2006)	-0.00746 (1.9)	-0.00898 (3.2)
Significance of Y2006 variables	0.057	0.004

^a Estimation is by weighted least squares of the unbalanced dataset (comprising 6930 observations). In contrast to the results above, the balanced dataset (based on significantly fewer observations) found no impact for the cohort or the interaction term, with a (statistically insignificant) small increase in expected completed fertility of 0.003 babies per woman from 2001 to 2006. There was also no significant period effect for males using the balanced dataset. ^b The 'age' representation was estimated, but given lack of identifiability its coefficients can be derived from the cohort representation. Namely, in a regression of $ECF = \alpha_1 + \alpha_2 \text{ Cohort} + \alpha_3 \text{ Y2006} + \alpha_4 * \text{ Cohort} * \text{ Y2006}$ compared with $ECF = \beta_1 + \beta_2 \text{ Age} + \beta_3 \text{ Y2006} + \beta_4 * \text{ Age} * \text{ Y2006}$, then $\beta_1 = \alpha_1 + 2001 * \alpha_2$, $\beta_2 = -\alpha_2$, $\beta_3 = \alpha_3 + 2006 * \alpha_4$ and $\beta_4 = -\alpha_4$. This underlines the fact that the regressions are not different ones, so the impacts of cohorts and age cannot be distinguished from each other.

Source: PC calculations based on waves 1 and 6 of HILDA.

Table G.3 Implied quantum effects by cohort, 2001 to 2006

Women and men

cohort	<i>Females</i>			<i>Males</i>		
	2001 value	2006 value	change	2001 value	2006 value	change
Expected lifetime children per person						
1962	2.129	2.115	-0.013	1.995	1.973	-0.021
1963	2.121	2.115	-0.006	1.978	1.966	-0.012
1964	2.113	2.114	0.001	1.961	1.958	-0.003
1965	2.105	2.113	0.009	1.945	1.950	0.006
1966	2.096	2.113	0.016	1.928	1.942	0.015
1967	2.088	2.112	0.024	1.911	1.935	0.024
1968	2.080	2.111	0.031	1.894	1.927	0.033
1969	2.072	2.111	0.039	1.878	1.919	0.042
1970	2.064	2.110	0.046	1.861	1.912	0.051
1971	2.056	2.109	0.054	1.844	1.904	0.060
1972	2.048	2.109	0.061	1.828	1.896	0.069
1973	2.040	2.108	0.069	1.811	1.888	0.078
1974	2.031	2.107	0.076	1.794	1.881	0.087
1975	2.023	2.107	0.083	1.778	1.873	0.096
1976	2.015	2.106	0.091	1.761	1.865	0.104
1977	2.007	2.105	0.098	1.744	1.858	0.113
1978	1.999	2.105	0.106	1.727	1.850	0.122
1979	1.991	2.104	0.113	1.711	1.842	0.131
1980	1.983	2.103	0.121	1.694	1.834	0.140
1981	1.974	2.103	0.128	1.677	1.827	0.149
1982	1.966	2.102	0.136	1.661	1.819	0.158
1983	1.958	2.101	0.143	1.644	1.811	0.167
1984	1.950	2.101	0.151	1.627	1.804	0.176

Source: Table G.1.

Table G.4 What share of women expect to be childless or to have some children?

Results from multinomial regression analysis, 2001 and 2006 waves^a

Women's expected completed number of children	<i>Balanced data</i>			<i>Unbalanced data</i>		
	2001	2006	Change	2001	2006	Change
	Proportion of women (%)			Proportion of women (%)		
<i>1970 cohort</i>						
0 children	13.7	11.5	-1.9	14.7	12.1	-2.2
1 children	8.9	10.6	2.1	9.5	10.1	0.8
2 children	41.7	42.4	0.3	40.8	41.8	0.7
3 children	23.6	23.9	0.0	22.9	24.2	1.2
4 children	8.8	8.2	-0.7	8.7	8.5	-0.2
5 or more children	3.3	3.4	0.2	3.4	3.2	-0.3
<i>1980 cohort</i>						
0 children	16.3	13.8	-2.5	17.6	14.5	-3.0
1 children	6.6	8.0	1.3	6.7	7.2	0.5
2 children	42.7	43.9	1.1	41.6	42.8	1.2
3 children	23.2	23.7	0.5	23.3	24.8	1.5
4 children	8.9	8.3	-0.6	8.5	8.4	-0.1
5 or more children	2.3	2.4	0.1	2.3	2.2	-0.1

^a The table shows the predicted proportion of women having 0,1 to 5+ children over their lifetimes. Parity shares for two cohorts are compared — the group of women born in 1970 and those aged in 1980. The 2001 column shows the predictions of lifetime fertility by the two cohorts in 2001, while the 2006 column shows the revised expected lifetime fertility. For example, in 2001, 16.3 per cent of the 1980 cohort expected to be childless, while in 2006, 13.8 per cent expected to be childless. The change may be due to a period effect (or to age biases — see the main text). Results are unweighted as the multinomial logit estimation routine in the software used to calculate the estimates had no provision for weights.

Source: PC calculations based on waves 1 and 6 of HILDA.

Table G.5 Changes to the desire for, and likelihood of, future children
2001 and 2006^a

Likert scale	Desire for future children		Likelihood of having future children	
	2001	2006	2001	2006
0 (Low))	42.6	33.4	45.7	36.5
1	2.6	3.3	4.3	5.0
2	3.0	3.1	3.2	3.6
3	2.0	2.1	2.2	2.5
4	1.3	1.7	1.5	2.1
5	7.1	6.6	8.0	6.9
6	2.8	3.0	2.4	2.8
7	4.2	5.3	3.9	5.6
8	6.0	8.2	6.2	8.7
9	4.5	6.6	4.5	6.4
10 (High)	23.8	26.7	18.1	19.7

^a Based on the weighted unbalanced dataset (which means that the average age of the waves does not change appreciably).

Source: PC calculations based on waves 1 and 6 of HILDA.

G.2 The issue of mismatch

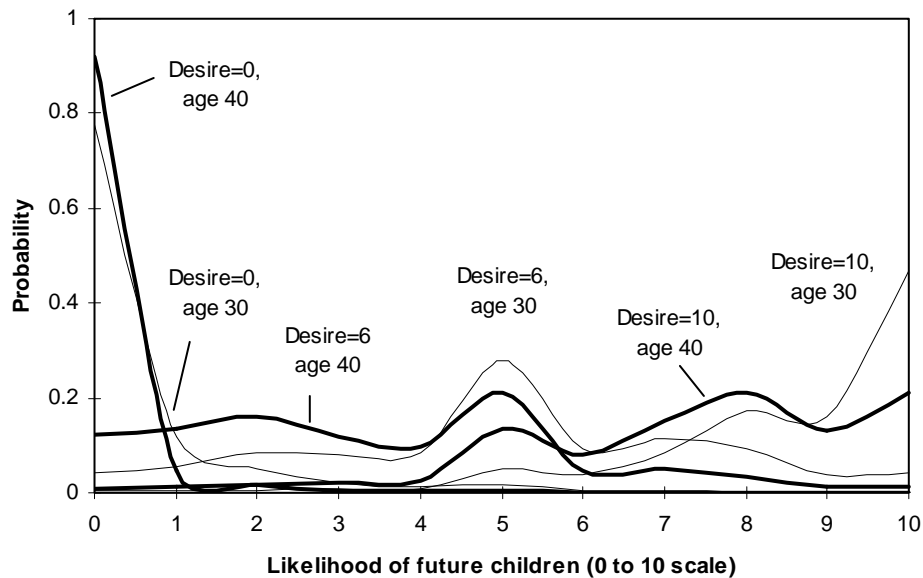
As discussed in chapter 4, many studies find a gap between the personally ideal and expected fertility of people. In HILDA, this gap can be assessed by considering the relationship between the desire for children (D) and either the mother's subjective rating of the likelihood of future children (L) or her intention to have future children (F).⁴ D and L are measured using a scale from 0 to 10 (as discussed above), rather than as a number of children, but should still adequately represent the extent of the coincidence between the inherent desire for children and the likelihood that women's preferences will be realised.

The data suggest that there is a strong, but incomplete, correspondence between the desire for, the likelihood of, and intentions to have future children. Looking first at the link between desire and likelihood (figure G.3), women of all ages with a low desire to have future children uniformly say that it is unlikely they will have future children. However, the converse is not true. While women with a high desire to have future children believe that this will often be realised, the older the woman the less optimistic they are. For instance, a woman aged 40 years old with a very strong desire for future children has only a 20 per cent chance of having an equally high

⁴ F is an indicator variable equal to one if a woman says she intends to have one or more future children and zero otherwise (that is, $F=1$ if $I>0$, else $F=0$).

likelihood of having future children (that is, a score of 10 on ‘desire’ and 10 on ‘likelihood’).

Figure G.3 **Is the desire for children likely to be achieved?**

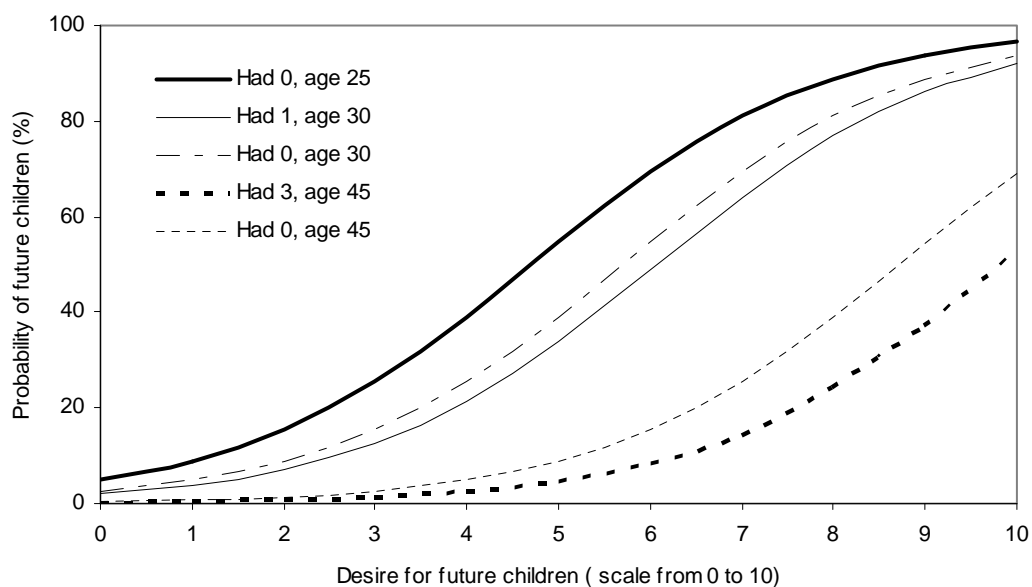


a The graph shows the relationship between the desire for future children (measured from 0 to 10) and the likelihood of actually having future children also on a 0 to 10 scale). For any particular score for desire (say $D=6$) there is some probability of getting a particular score in the likelihood indicator (say $L=7$). The graph shows these probabilities for women of different ages and with varying measures of desire for children. For example, a woman aged 30 with $D=6$ (ie a medium level desire for children) has around a 10 per cent chance of saying that L equals 7, but around a 30 per cent chance of saying that L equals 5.

Source: PC calculations based on wave 5 of HILDA.

Similarly, the correspondence between the desire to have more children and the intention to have one or more future children (figure G.4) declines with greater age and with parity. The former may reflect the fact that fertility declines with age, affecting women’s views about what they can realistically expect. The latter may reflect the costs of additional children and partners’ preferences about the number of ideal children.

Figure G.4 **Fertility intentions correspond closely to fertility desires^a**
Wave 5 of HILDA, 2005



^a Based on a logit regression of intentions for more children (F) against the desire for children (D), age, children ever had and a constant. 2005 (wave 5) rather than 2006 (wave 6) of HILDA was used because of a survey complication that could affect the validity of inferences about the relationship between F and D. In 2001 and 2006 only women who gave an answer of 6 or more on the likelihood of future children were asked about their future number of intended children (presuming that a score below 6 would imply zero future intended children). In wave 5, the order of questions was different, so that all women were asked how many children they intended to have and *then* questions about the desire and likelihood of children. About five per cent of women who said they intended to have more children gave an answer of 5 or less on the likelihood of future children. By implication, some women who intended to have future children are probably omitted from the 2001 and 2006 surveys. Depending on the value of D for this omitted group, this could bias the relationship between desire for children and intentions to have one or more children. Consequently, wave 5 was used as it provides more complete data for measuring the association between F and D.

Source: PC calculations based on wave 5 of HILDA.