

## Fertility, desires and intentions: a longitudinal analysis

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As Australia has experienced sustained fertility decline over the last four decades, there has been public concern and debate about the implications of falling fertility and what to do to stabilise or reverse the fertility trend (Tefaghiorghis 2004b). However, there has recently been a reversal in the fertility trend, with the total fertility rate rising from 1.73 children per woman in 2001 to 1.81 children per woman in 2005 (ABS 2005:7).

The issues of fertility, family support, and balancing family and work responsibilities remain important, as demonstrated by the May 2004-2007 Federal Budgets. These Budgets increased assistance to families with dependent children to help them with the costs of raising children and balancing work, family and child rearing responsibilities. The Budget measures included increases in Family Tax Benefits, the introduction of a universal Maternity Payment in 1 July 2004 (renamed the Baby Bonus from 1 July 2007), the extension of entitlement to Large Family Supplement for each child after the third, and increasing child care provisions and benefits.

An earlier paper by the author (Tefaghiorghis 2006a) which examined whether or not there is congruence in future fertility desires and expectations between members of a couple found substantial incongruence. The earlier paper was a cross-sectional analysis of the 2001 Household, Income and Labour Dynamics in Australia (HILDA) Survey. As there are now five waves of HILDA data<sup>i</sup>, this paper will contribute to understanding future fertility course by examining individual fertility change trajectories and factors associated with individual fertility change. It will also examine whether or not there are changes in women's fertility desires, expectations and intended number of children over the 2001-2004 period. This descriptive and analytical study of fertility change is based on a primary analysis of the HILDA Survey Waves 1-5 datasets<sup>ii</sup>. This paper complements the author's (Tefaghiorghis 2004, 2005 & 2006) previous fertility research by bringing changes in fertility, desires, expectations and intended number of children into the picture.

The purposes of this paper are to:

- Analyse changes in women's marital status over the 2001- 2005 period.
- Describe changes in the number of children born to women aged 15-49 years in 2001 over 2001-05 according to women's number of children, age group and marital status in 2001,
- Analyse changes in fertility desires, expectations and intended number of children over 2001-04,

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<sup>1</sup> The views expressed or any errors in the paper are those of the author and do not necessarily represent the views of the Minister for Families, Community Services and Indigenous Affairs, and can't be taken in any way as expressions of Government policy.

- Analyse whether women who specified in 2002 the year they intend to have a child (or more children) did so during 2001-2005, and
- Model fertility change

There are limitations in using data on fertility desires, expectations and intended number of children, as this study proposes to do. This is because fertility expectations and intended number of children may not be consistent with future fertility behaviour. A literature review (Tesfaghiorghis 2004b) found that (a) that one should be ‘wary about attitudinal questions’ (McDonald 2001) and (b) that young women in Australia and most western countries may have high expectations about the number of children they will ultimately have but their expectations and intentions may be modified with time as their expectations are tempered by experience, knowledge and institutional constraints (McDonald 2001, Van de kaa 1998). Despite these shortcomings, it is useful to analyse fertility desires, expectations and intended number of children to understand future fertility behaviour.

This study will contribute to understanding of changes in fertility, desires, expectations and intended number of children by taking advantage of the longitudinal nature of the HILDA data. The analytical part will contribute to an understanding of the within-person variations in fertility and the factors associated with it.

## **Data and methods of analysis**

This analysis draws on the first five waves of HILDA datasets. A person-period dataset suitable for longitudinal analysis was created. This means that an individual has as many records as the number of waves/occasions. In this case every individual has five records each, corresponding to each of the five waves/occasions.

The analysis in the paper follows two approaches: a descriptive analysis and analytical approach using appropriate longitudinal models. The descriptive analysis draws on a balanced data panel of women aged 15-49 years in Wave 1 and who were surveyed in subsequent waves (2 to 5). This part of the analysis describes changes in marital status, number of children ever born, fertility desires, expectations and intended number of children for women who were aged 15-49 years in 2001.

The original sample contains 4,801 women aged 15-49 years in 2001. However, due to survey attrition only 3,188 of this original sample were surveyed in all five waves. Thus the balanced panel data, used in this analysis, comprises 3,188 women and their relevant characteristics. This analysis is population-weighted, using the longitudinal cross-wave weight.

The analytic part of the paper fits appropriate longitudinal models to the number of children born to women to quantify the within- subject variations in the number of children ever born to women during the five waves and the covariates affecting the within-subject fertility change. As the number of children ever born is count data, longitudinal models for normal response variables are not appropriate. The longitudinal models for discrete and count data and the associated software for fitting the models are not as developed as those for normal data. The number of children born data also poses additional modelling problem, as it has many women/subjects

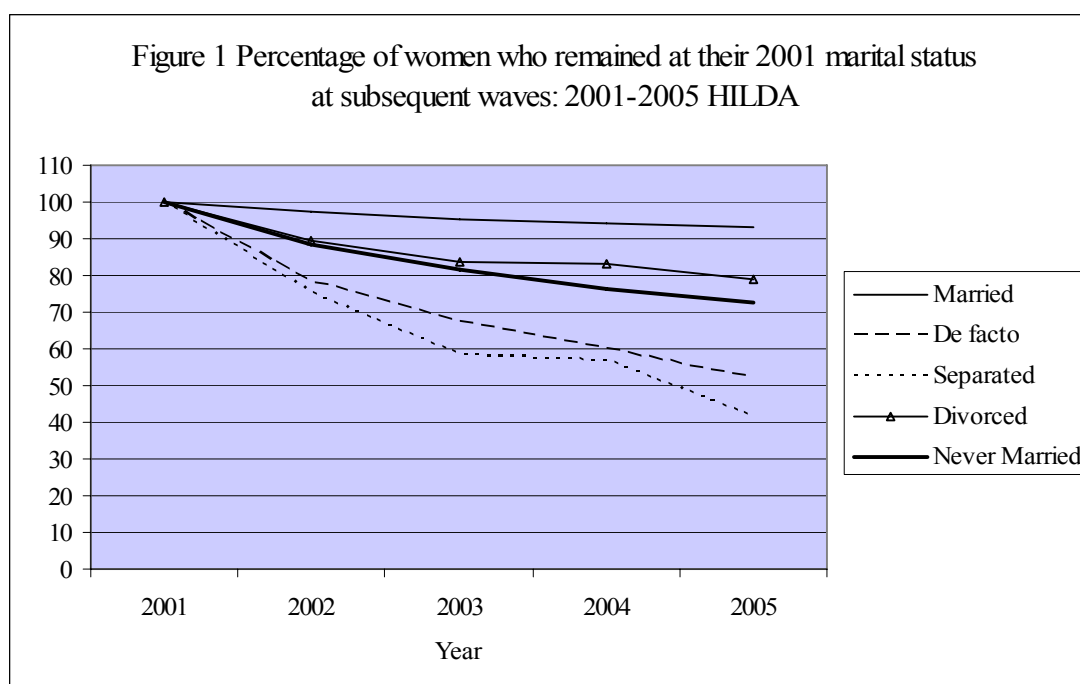
with zero observations. Thus, this paper employs recent methodological developments for fitting longitudinal models to count data with excess zeros.

### Changes in marital status

Women's marital status underwent substantial change over the period 2001-05, as shown in Figure 1. The exception is the widowed and the legally married, the latter referred as married in this paper. There was no change in the marital status of women who were widowed in 2001. Most women who were married in 2001 remained married over the 2001-05 period— 93.0 per cent were still married by 2005. However, there was substantial change in the other marital status categories, as is shown in Figure 1.

Figure 1 shows the proportion of women who remained in their 2001 marital status categories over the period 2001-05. The results are summarised as follows:

- The proportion of women who were separated in 2001 and remained separated declined to 75.1 per cent in 2002, to 56.8 per cent in 2004 and to 41.7 per cent in 2005.
- Of those who were in de facto relationships in 2001 about half of them (52.5 per cent) remained in de facto relationships by 2005.
- The proportion who were never married in 2001 and remained so declined to 88.2 per cent in 2002 and to 72.6 per cent in 2005.
- Compared to the separated, the de facto and the never married, the decline in the proportion divorced was relatively slow. It declined to 89.7 per cent in 2002, to 83.5 per cent in 2003, and to 78.7 per cent in 2005.



What marital status did those women who by 2005 had changed their 2001 marital status move to? The moves were:

- Married: 42 per cent separated, 34 per cent divorced, and 17 per cent moved into a de facto relationship and 7 per cent widowed.
- De facto: An increasing proportion of those who were in de facto relationships were, over the years, married. The majority (63 per cent) were married, 24 per cent moved to the never married status, and 13 per cent were divorced, widowed or separated.
- Separated: 60 per cent had divorced, 19 per cent moved into a de facto relationship, 16 per cent married and 5 per cent moved to the never married status.
- Never married: 53 per cent moved into a de facto relationship and 45 per cent married
- Divorced: 44 per cent married, 31 per cent moved into a de facto relationship, 17 per cent never married and 8 per cent widowed/separated.

The year-to-year-marital status transitions, given in Appendix Table 1, show only a small to modest movement in the status of the married, divorced and widowed. By contrast, the separated, de facto and never married showed larger year-to-year-transitions in their marital status:

- Of those who were in de facto relationships in 2001, 12 per cent married by 2002 and 6.7 per cent moved to never married. The figures for 2004 to 2005 were 14 per cent married and 10 per cent never married.
- Of those who were separated in 2001, 14 per cent were divorced and 11 had moved into another status within a year. The corresponding figures for the 2003-2004 transitions were 16 per cent divorced and 13 per cent into another status.
- The year-to-year movement of the never married was largely into de facto relationships while a smaller proportion got married.

## **Fertility Change**

Changes in fertility are measured by the number of children born reported by women in each wave and the number of women who gave births between waves. These are described in turn.

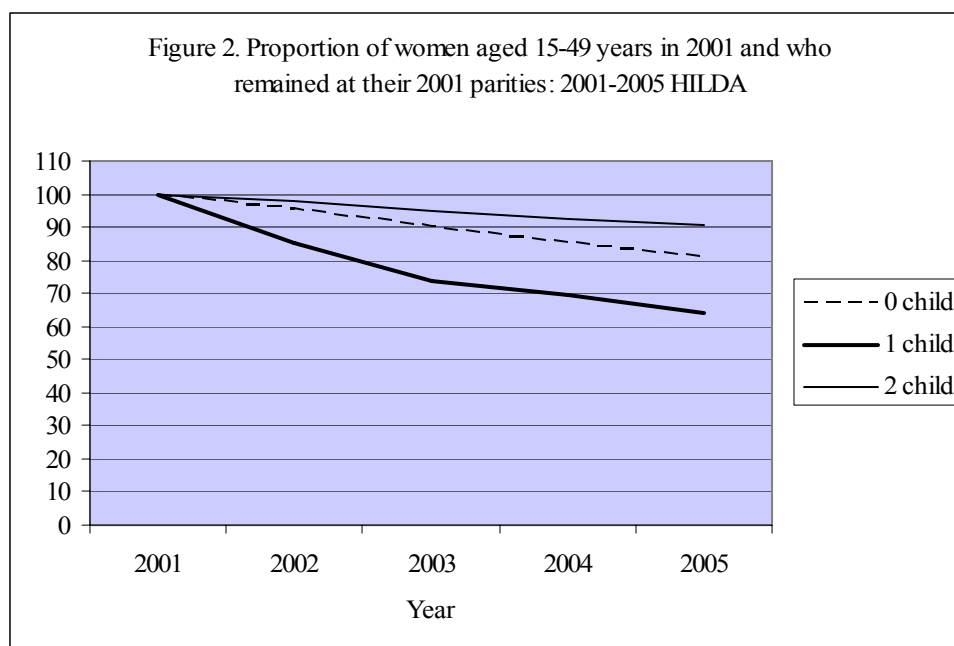
### **Number of children born:**

The numbers of children born to women were collected in all HILDA waves. The fertility transitions over the 2001-2005 periods for women who were aged 15-49 years in 2001 by number of children they had in 2001 are shown in Figure 2.

There has been marked fertility transitions for women with one child or no child in 2001. The birth transition for women with two children was slow. There was hardly any change for women with three or more children (figure not shown).

Figure 2 shows the proportion of women aged 15-49 years in 2001 who remained at their 2001 parities. These are:

- The proportion of women with one child in 2001 that did not go on to have one or more children declined to 85 per cent by 2002 to 74 per cent by 2003 to 70 per cent by 2004 and to 64 per cent by 2005.
- The proportion of women without a child in 2001 that did not proceed to have their first child declined to 96 per cent by 2002 to 90 per cent by 2003 to 85 per cent by 2004 and 82 per cent by 2005.
- The proportion with two children in 2001 that remained at that parity declined to 98 per cent by 2002 and to 90 per cent by 2005.



Being married or in a de facto relationship is associated with high birth transitions than is shown in Figure 2 for all women.

- Of women who were married and without a child in 2001, 49 per cent had borne children by 2005 (29 per cent one child and 20.0 per cent two or more children).
- Of women who were de facto the figure was 38 per cent.
- Of women who were married and had one child in 2001, 44 per cent had born two or more children by 2005 (37 per cent two children and 6 per cent three or more children).
- Of women who were de facto the figure was 29.3 per cent.

While most of the never married women without children in 2001 remained so (93 per cent), a significant proportion of those who had children in 2001 had borne more children. Of those with one child in 2001, the proportion that had borne two or more children by 2005 was 29 per cent. The proportion of those with two children that had borne three or more children was 16.0 per cent.

### **Number of women who gave birth between waves:**

The number of women who gave birth between waves was collected through the Self-Completion questionnaire from those who responded 'Yes' to 'Life events in the past year: Birth'. The births data excludes those who did not return the Self Completion questionnaire and those who refused /not answered. The proportion of women aged 15-49 years in 2001 that did not return a completed questionnaire was 9 per cent in 2002, 6 per cent in 2003, 6 per cent in 2004 and 8 per cent in 2005.

Bearing this data limitation in mind, a total of 857,947 women reported having a birth in the four-year interval (218,393 in 2001-02, 237,838 in 2002-03, 201,842 in 2003-04 and 198,874 in 2004-05).

With respect to mothers' age, those aged 25-34 years in 2001 comprised 70 per cent of all women who gave birth between 2001 and 2005. The proportion of all mothers that were aged 15-24 years and 35-44 years were similar between 2001 and 2002. But the latter's contribution were much lower from 2002 to 2005, as they were moving out of their childbearing years.

With respect to the 2001 marital status, 59 of all women who gave birth between 2001 and 2005 were married, 23 per cent were de facto and 15 per cent were never married. While the proportion of total women who gave birth that were married declined from 70 per cent in 2001-02 to 49 per cent in 2004-05, the share of the de facto increased from 15 per cent of all mothers in 2001-02 to 31 per cent in 2004-05. The figure for the never married also increased from 12 to 17 per cent .

Of the total de facto women in 2001 who gave birth in the period 2001-2005 a larger proportion, 46 per cent, were those who married since 2001. With respect to the never married women in 2001 that gave birth over the 2001-05 period, half of them were those who either married or moved into de facto relationships (25 per cent each).

### **Desire to have children**

The five waves of HILDA data also enable us to look at whether there has been a change in women's desires to have a child or more children than they already have. Respondents aged 18-55 years were asked the question 'Would you like to have a child of your own/more children in the future?' and were asked to pick a number ranging from 0, 'definitely would not like to have', to 10, 'definitely like'.

Though information on respondents aged 18-55 years was collected, the analysis in this and subsequent sections is limited to women aged 18-44 years. As most women aged 45 years and over are expected to complete their fertility, it would not be useful to analyse their fertility desires and expectations.

Changes in the desire to have children, the likelihood of having children and intended number of children over time are measured using mean scores according women's age group and number of children ever had in 2001. The comparison period does not include 2005. This is because fertility preference questions in Wave 5 are not comparable to those of Waves 1 to 4. While fertility preference questions in the first

four waves of HILDA were asked to all women, in Wave 5 it was only asked to women or their partners who were not sterilised or had no physical or health reasons not to have children/more children. Of the total women aged 15-40 years in 2001, the proportion of women that reported that they or their partners were sterilised in 2005 was 17 per cent

Table 1 presents mean scores on the desire to have a child or more children over the four waves according to women's age group and number of children born as of 2001. The results show that the desire to have children fell over time in respect to women's age and number of children in 2001. For example, the mean score for women aged 25-29 years in 2001 declined from 6.9 to 5.9. The mean score for women with one child in 2001 dropped from 5.7 in 2001 to 3.3 in 2004.

The desire to have a child or more children among women aged 18-24 years and those without children remained relatively strong and stable over time. Though the mean score for women aged 25-29 years declined, it had remained moderate. By contrast, the desire to have a child or more children among women aged 30 years and over and those women with two or more children was weak. The decline in fertility desire among older women is not surprising given that women are getting older and also having children (more children) over the period.

**Table 1 Women's 'would you like to have more children' mean scores across waves by women's age group and number of children born in 2001**

| Age group: 2001          | 2001 | 2002 | 2003 | 2004 |
|--------------------------|------|------|------|------|
| 18-24                    | 7.46 | 7.53 | 7.47 | 7.33 |
| 25-29                    | 6.93 | 6.33 | 6.23 | 5.87 |
| 30-34                    | 4.66 | 4.43 | 3.81 | 3.35 |
| 35-39                    | 2.24 | 1.95 | 1.83 | 1.49 |
| 40-44                    | 0.98 | 0.84 | 0.65 | 0.51 |
|                          |      |      |      |      |
| Total                    | 4.38 | 4.16 | 3.94 | 3.65 |
| Number of children: 2001 |      |      |      |      |
| None                     | 7.14 | 6.98 | 7.04 | 6.78 |
| One child                | 5.65 | 4.70 | 3.97 | 3.25 |
| Two children             | 1.76 | 1.77 | 1.42 | 1.22 |
| Three or more children   | 1.21 | 1.07 | 0.85 | 0.67 |

### Expectation of having children

Respondents were asked a follow-up question 'and how likely are you to have (a child/ more children) in the future?' Like the first question, responses ranged between 0, 'definitely not likely', to 10, 'definitely likely'.

Table 2 shows changes over time in the likelihood of having child/more children in the future, as measured by mean scores. It is clear that the likelihood of having children fell over time. Like the desire to have children, the likelihood of having children mean score fell slowly for women aged 18-24 years, from 7.3 in 2001 to 6.9 in 2004, compared to 6.5 to 5.2 for women aged 25-29 years. In the case of women with one child, the mean score declined from an average to a weak likelihood of having children.

While the mean scores for the desire to have children were higher than those for the likelihood of having children, the declines in the mean scores for the likelihood of having children were faster than the decline in the desire to have children (see Tables 1 & 2). This because the expectations of having children in the future are revised down as women get older and also have children.

**Table 2 ‘how likely are you to have a child/ more children in the future?’ Mean scores across waves by women’s age group and number of children born in 2001**

|                          |      |      |      |      |
|--------------------------|------|------|------|------|
| Age group: 2001          | 2001 | 2002 | 2003 | 2004 |
| 18-24                    | 7.34 | 7.37 | 7.09 | 6.93 |
| 25-29                    | 6.48 | 5.93 | 5.54 | 5.23 |
| 30-34                    | 4.00 | 3.60 | 2.95 | 2.46 |
| 35-39                    | 1.53 | 1.29 | 1.18 | 0.88 |
| 40-44                    | 0.34 | 0.34 | 0.29 | 0.17 |
|                          |      |      |      |      |
| Total                    | 3.87 | 3.64 | 3.35 | 3.08 |
| Number of children: 2001 |      |      |      |      |
| None                     | 6.58 | 6.55 | 6.39 | 6.10 |
| One child                | 5.02 | 3.94 | 3.13 | 2.60 |
| Two children             | 1.31 | 1.22 | 0.89 | 0.74 |
| Three or more children   | 0.78 | 0.60 | 0.52 | 0.40 |

How well does the expectation of having children reported in 2001 explain the number of births that occurred between 2001 and 2005? Table 3 presents the proportion of women aged 18-44 years in 2001 that reported having birth between waves according to their expectations of having children scores in 2001.

The findings in Table 3 generally show that a higher likelihood of having children in 2001 was associated with having a birth in subsequent waves. For example, the majority of women who said they were definitely likely to have children (score 10), 68.8 per cent, gave birth during the 2001-05 periods (column 7). A third of those with likelihood scores of 8-9 gave birth during the four-year interval. By contrast, only 4.1 of those women with zero score and 12.2 per cent of those with scores 1-3 gave birth during the period. The last column shows that 71.4 per cent of all mothers during the period were mothers whose likelihood of having children scores in 2001 were 8 to 10.

There was an apparent exception to the positive association between likelihood scores and the proportion of women that gave birth. Table 3 shows that a relatively high proportion of women with scores 4-5 gave birth than those with scores 6-7. The reason is not clear. Table 3 also shows that a higher proportion of women who said they were definitely likely to have children gave birth sooner rather than later, within the first two years. It is also interesting to note that an increasing proportion of women with scores 4-5 gave birth over time.



**Table 3 Per cent of women that gave birth during 2001-05 according to ‘how likely are you to have a child/ more children in the future?’ scores in 2001.**

| Likelihood Scores: 2001 | No. of women: 2001 | Percentage of women in 2001 who gave birth between waves |         |         |         |         | Per cent of all mothers |
|-------------------------|--------------------|--|---------|---------|---------|---------|-------------------------|
|                         |                    | 2001-02  | 2002-03 | 2003-04 | 2004-05 | 2001-05 |                         |
| 0                       | 1,564,077          | 0.8  | 0.7     | 1.2     | 1.4     | 4.1     | 7.8                     |
| 1-3                     | 350,679            | 2.1  | 5.1     | 2.4     | 2.6     | 12.2    | 5.1                     |
| 4-5                     | 313,962            | 5.0  | 5.3     | 7.8     | 8.2     | 26.3    | 9.9                     |
| 6-7                     | 227,201            | 4.9  | 4.0     | 5.7     | 3.3     | 17.9    | 4.9                     |
| 8-9                     | 375,644            | 5.2  | 10.7    | 10.4    | 10.5    | 36.7    | 16.6                    |
| 10                      | 674,026            | 22.3   | 20.4    | 13.6    | 12.4    | 68.8    | 55.8                    |
| Total                   | 3,505,590          | 6.2  | 6.6     | 5.6     | 5.3     | 23.7    | 831,289                 |

### Intended number of children

The analysis that follows focuses on changes to women’s intended number of children. Those women who were considered likely to have children in the future (those with scores of 6 and above) were further asked to state the number of children they intended to have.

In general there was a decline over time in the mean number of intended children, as shown in Table 4. While the mean number of intended children for women without children showed a consistent decline, from 2.4 children in 2001 to 2.1 children in 2004, it was not consistent for those with one child or for those with two or more children. There was a small increase over time in the mean number of intended children for women with one child in 2001. For women with two or more children there was an increase from 2001 to 2002 and then a decline.

**Table 4 Changes in mean number of intended children according to number of children women had in 2001.**

| Number of children: 2001 | Mean number of intended children* |      |      |      |
|--------------------------|-----------------------------------|------|------|------|
|                          | 2001                              | 2002 | 2003 | 2004 |
| None                     | 2.43                              | 2.32 | 2.16 | 2.06 |
| One child                | 1.32                              | 1.37 | 1.35 | 1.39 |
| Two or more children     | 1.23                              | 1.34 | 1.24 | 1.13 |
| Total                    | 2.10                              | 2.10 | 2.00 | 1.94 |

These results exclude those who may have intended to have children but were not asked because their scores on the question ‘how likely are you to have more children in the future’ were 5 or less

### Comparison of when to have the next child with the year of birth

In the 2002 HILDA Survey, women who intended to have children were asked ‘in which year do you intend to have (a/your next) child?’ This question was not asked of those whose scores were 5 or less on the question ‘how likely are you to have children in the future’. The purpose of this analysis is to investigate whether those who had

births between waves had births by the year they specified they would have their intended number of children. Another purpose is to check whether births had occurred to women who were not asked the question on number of children they intended to have.

The data for this analysis comes from the returned Self-Completion questionnaires on whether respondents or their partners had a birth in the past 12 months. It is worth noting that a moderate proportion of women aged 15-44 years in 2001 did not return a completed questionnaire in subsequent waves: 6.1 per cent in 2003, 6.4 per cent in 2004 and 8.7 per cent in 2005. These figures also vary according to the year women specified they intended to have the next child when asked in 2002.

Comparisons over time of proportions of women who gave birth between waves according to the year-categories specified in 2002 would not be reliable. This is because the numbers of women who did not return completed questionnaires affects both the numerator and denominator in each year. What is useful, instead, is to compare the relative distribution of women who gave birth between waves according to their responses in 2002 to the when to have the next child categories. This is done in Table 5. The not asked/question skipped category are those women whose likelihood of having children score was less than six.

The results in Table 5 show that the majority of women who gave birth between waves were those women who specified a shorter time period (five years or less) for having their next intended child. For example women who in 2002 specified that they intend to have the next child in 2002-04 accounted for 65 of all women who gave birth in 2002-03, 34.4 per cent in 2004-05 and 47 per cent overall. The proportion of women who gave birth after responding that they don't know but within the next 2 to 5 years was 10 per cent in 2002-03, 29 per cent in 2003-04, 25 per cent in 2004-05 and 21 per cent overall.

**Table 5 Distribution of women who gave birth in the past 12 months (%) according to the year they intended to have the next child when asked in 2002**

| Which year do you intend to have (a/your next) child?: 2002 | Proportion of total women who gave birth in |         |         |         |
|---|---|---------|---------|---------|
|   | 2002-03                                     | 2003-04 | 2004-05 | 2002-05 |
| 2002-04   | 65.2  | 37.0    | 34.4    | 46.9    |
| 2005 and beyond   | 3.4   | 2.6     | 3.0     | 3.0     |
| Don't know but within the next                              |   |         |         |         |
| 2 years   | 6.0   | 18.9    | 10.1    | 11.4    |
| 3-5 years   | 3.5   | 10.3    | 15.0    | 9.1     |
| 6+ years/unsure   | 3.3   | 6.6     | 9.0     | 6.1     |
| Not asked/question skipped                                  | 18.6  | 24.6    | 28.5    | 23.5    |
| Total—Per cent  | 100.0                                       | 100.0   | 100.0   | 100.0   |
| Number of mothers   | 232,589                                     | 194,812 | 186,953 | 614,354 |

Population weighted analysis

Table 5 also shows that a significant proportion of women who gave birth were those who were not asked the question on when they intend to have the next child. The share of total women who gave birth that was attributable to this group of women increased from 18.6 of all mothers in 2002-03 to 28.5 per cent in 2002-05 and 23.5 per cent overall. The results show that not asking the question on intended number of

children to women who had average or lower likelihood of having children scores was not expedient. The results could mean that women who rated their likelihood of having children as average or less in 2002 were unsure or thought it less likely to have a child or more children in the future at the time but had since changed their fertility behaviour.

### Modelling fertility change

The statistical model that represents change processes in longitudinal data is the multilevel model for change. The multilevel growth model answers two types of research questions: level-1 questions about within-person change and level-2 questions about between-person differences in change (Singer 1998, Singer and Willet 2003:47).

Longitudinal models are fitted in SAS using the procedures Mixed, GENMOD, NLMIXED and GLIMMIX macros (SAS 1999, Singer and Willet 2003:63-64, 224-32). The SAS Proc Mixed fits a multilevel model, which has two sub models. These are a level-1 sub model that represents individual change or individual growth model, and a level-2 sub model that represents systematic inter-individual differences in change (Singer and Willet 2003:49-63).

The research interest is how individual woman's fertility changes over time, as measured by number of children born to woman  $i$  at occasion  $j$ , represented by  $Y_{ij}$ . The scale of the temporal predictor in the individual growth model is time (Year-2001), which is centred on the first wave of HILDA data collection to reflect initial status. This centring of time on the first wave of data collection allows us to interpret the intercept as a woman's true value of number of children born at wave 1.

Longitudinal models that are fitted using the SAS Mixed procedure make the assumption that the response variable is continuous, normally distributed and the variance components have normal distributions. However, the response variable here, the number of children born to women, is a count variable. The distribution of women aged 15-49 years by number of children born is such that 39.7 per cent had no children, 13.9 per cent had one child, 25.7 per cent had two children, 13.7 had three children, 4.6 per cent had four children and 2.4 per cent had five or more children, with an overall mean of 1.4 children per woman. The distribution shows that the count response variable has an excess number of zero counts than is predicted by distributions such as Poisson or Negative binomial. Such a response variable is referred to as zero-inflated count data.

Recently there have been some methodological developments in modelling longitudinal zero-inflated count data with random effects (Hall 2000, Yau and Lee 2001, Cheung 2002 and Min and Agresti 2005). The modelling of zero-inflated count data consists of a two-stage modelling process with random effects to account for the correlations between repeated measurements per subject — the first stage models whether the response variable falls below or above zero, referred as the hurdle in hurdle models. The second stage uses a truncated model to explain the observations above the hurdle, the positive counts (Hall 2000, Yau and Lee 2001, Cheung 2002 and Min and Agresti 2005).

Min and Agresti (2005) developed several models that fit zero-inflated count data with random effects. This paper fitted two of their models (Min and Agresti 2005: 14-15, 18-18). These are the random effect Poisson Generalised Linear Mixed Model (GLMM) and the zero-altered Poisson model. The latter is preferred over the other complex models in accordance with Min and Agresti' (2005: 18) suggestion that 'In general, for repeated measures of count data with zero-inflation, the simpler models—the zero-altered random effect model or the cumulative logit random effect model—have the advantage of simplicity of interpretation'. The random effect considered in these models is the within person-variation.

The Poisson GLMM with random effect has the form:

$$\text{Log}(\mu_{ij}) = \beta_0 + \beta_1 x_{ijk} + b_i$$

$b_j \sim N(0, \sigma^2)$ , subject-specific-random effect.

$x_{ijk}$  — stands for the  $k^{\text{th}}$  covariate for individual  $i$  at occasion  $j$ .

The zero-altered random effect Poisson model has the form.

Let  $p_{ij} = P(y_{ij} > 0)$ , then the model has the following form:

$$\text{Log}(1 - \log(1 - p_{ij})) = \gamma_1 + \beta_0 + \beta_1 x_{ijk} + b_i$$

$$\text{Log}(\mu_{ij}) = \beta_0 + \beta_1 x_{ijk} + b_i$$

As above,  $b_i \sim N(0, \sigma^2)$  is a subject-specific random effect for both parts of the hurdle model, which is assumed to be the same.

$\gamma_1$  is a measure of zero inflation in the count data.

The dependent variable is the number of children born per woman. The first model fitted is the intercept and the main effect of time. Though, the main effect of time in the fitted random effect Poisson GLMM was positive, it was not significant. However, the fitted random zero-altered Poisson model, which handles zero inflation, shows a significant positive effect of time, 0.0134 ( $P < 0.05$ ). The within subject-variation,  $\sigma^2$ , was 0.40 and is highly significant ( $P < 0.0001$ ).

The following independent variables were used to explain the factors explaining individual change in the number of children per woman over the period:

Time=Year-2001, scaled to the first wave of HILDA Survey.

Age: hgage-30, scaled to the median age of childbearing.

Age-squared = Age\*Age

Employed; Full-time or part-time=1, 0= otherwise.

Educational level: 1=Diploma or higher, 0= otherwise.

Marital status: 1=married or de facto, 0=otherwise.

Age\_YCHILD: age of the youngest child in years

Log (HH\_disincome): Logarithm of household disposable income (households with negative incomes were excluded, 0.21 per cent).

Fertility preference variables were not included in the models, as the Wave 5 fertility preference questions were not comparable with Waves 1 to 4 questions. However in an earlier version of the paper that used Waves 1 to 4 datasets, it was found that the

likelihood of having children in the future had a significant negative effect on changes in the number of children born per woman (Tesfaghiorghis 2006b:10-1).

**Table 6 Parameter estimates of the Poisson and Zero-altered Poisson random effect models for modelling the number of children born per woman.**

| Parameter                         | Poisson  |        | Zero-altered |        |
|-----------------------------------|----------|--------|--------------|--------|
|                                   | Estimate | SE     | Estimate     | SE     |
| $\beta_0$                         | 0.4038   | 0.1563 | -0.0276      | 0.2192 |
| $\beta_{1-}$ (Age)                | 0.0452   | 0.0032 | 0.0828       | 0.0052 |
| $\beta_{2-}$ (Age-squared)        | -0.0009  | 0.0002 | -0.0018      | 0.0003 |
| $\beta_{3-}$ (Employed)           | -0.0931  | 0.0188 | -0.0970      | 0.0258 |
| $\beta_{4-}$ (Diploma/higher)     | -0.1865  | 0.0215 | -0.3180      | 0.0347 |
| $\beta_{5-}$ (Age_YCHILD)         | -0.0197  | 0.0022 | -0.0334      | 0.0035 |
| $\beta_{6-}$ Log (HH_dispoincome) | 0.0365   | 0.0146 | 0.0433       | 0.0204 |
|                                   |          |        |              |        |
| $\sigma^2$                        | 0.0900   | 0.0055 | 0.3195       | 0.0184 |
| $\gamma_1$                        |          |        | 2.4446       | 0.1034 |
| -2 Log Likelihood                 | 28,797   |        | 25,270       |        |
| AICC (smaller is better)          | 28,813   |        | 25,288       |        |
| BIC (smaller is better)           | 28,858   |        | 25,339       |        |

In both the fitted final Poisson GLMM and the Zero-altered Poisson models all predictors except time had a highly significant main effect on the number of children born to a woman. The reduction in the log likelihood in the Zero-altered random effect Poisson model when compared to the Poisson GLMM suggests that the Zero-altered Poisson random model fits the data better. The likelihood ratio test of  $H_0: \gamma_1=0$  has a  $\chi^2$  test statistic=559 with 1 degree of freedom 1 is highly significant, showing strong evidence of zero inflation. Though the within-subject- variance is small ( $\sigma^2=0.32$ ) it is highly significant. The intercept is not significant.

The estimated parameters affecting individual fertility change from the zero-altered random effect Poisson model are (Table 6, column 4).

- Time had a significant positive effect when fitted as the only covariate. However, when age and age-squared are added to the model, time had an insignificant effect. Thus time is dropped from the final model.
- Age squared had a highly significant negative effect reflecting the non-linear relationship of age with fertility. The non-significance of the temporal predictor time in the presence of age and age-squared (which are time-varying predictors as well), could be that age and age-squared are proxies the effect of time.
- The positive significance of being married or in a de facto relationship disappeared in the presence of all the covariates in the final model, and is thus dropped.
- Being employed full-time/ part-time had a significant negative effect on fertility. Full-time employment (full-time employed=1, 0= otherwise) had a much larger significant negative effect than that of the employed (table not shown).

- Having a diploma or higher degree had a strong negative effect on fertility.
- Age of the youngest child had a significant negative impact on the number of children born to a woman over the period. A younger age of the youngest child is associated with a woman having a birth over the period. The age of the youngest child had a negative correlation with age and being employed and a positive correlation with having a diploma or higher degrees.
- The logarithm of annual household disposable income had a positive effect on fertility. Higher household disposable income was associated with higher fertility. Alternative codification of household annual disposable income, namely coding household income above the bottom quartile (\$38,200) as coded 1 or otherwise 0, showed a significant positive effect on individual fertility change.

## Conclusion

The analysis of the marital status trajectories showed that most women who were married in 2001 remained married over the four-year period. The widowed showed no change. However, there was a substantial change in the other categories of marital status. In particular the separated and the de facto underwent massive changes. While the majority of those who were in de facto relationships in 2001 who changed their status were married, the majority of the separated were divorced.

Substantial progression to higher parities than the number of children women had in 2001 primarily occurred to women with one child or without a child. The proportions of women who had two or more children in 2001 that proceeded to have more children over the period than what they had in 2001 were small.

Irrespective of the age group and number of children women had in 2001, there was a consistent decline over time in the desire to have children and the likelihood of having children in the future. A general decline was also observed in the mean number of intended number of children in the future. While women without a child in 2001 showed a consistent decline in their mean number of intended children, there was an apparent small increase for those with one child and no clear trend for those with two or more children.

The findings from the analytical modelling of individual fertility change show a number of factors were important. As expected, age had a significant positive effect while age squared had a significant negative effect. Having a diploma or higher degrees is negatively associated with fertility change. Being in employment, particularly full-time had a depressing effect on fertility. The age of the youngest child affects woman's fertility negatively. Household disposable income had a significant positive effect on fertility.

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## Appendix:

**Table 1 Year-to-Year-marital status transitions of women aged 15-49 years in 2001: 2001-05 HILDA**

| Year/Marital status | Married | De facto | Separated | Divorced | Widowed | Never M | No. of women | Share of Total |
|---------------------|---------|----------|-----------|----------|---------|---------|--------------|----------------|
| 2001                |         |          |           | 2002     |         |         |              |                |
| Married             | 97.2    | 0.0      | 2.7       | 0.0      | 0.1     | 0.0     | 2,230,887    | 48.7           |
| De facto            | 12.4    | 78.4     | 0.7       | 1.8      | 0.0     | 6.7     | 551,838      | 12.1           |
| Separated           | 4.2     | 5.9      | 75.1      | 14.1     | 0.7     | 0.0     | 177,458      | 3.9            |
| Divorced            | 1.9     | 6.5      | 1.1       | 89.7     | 0.9     | 0.0     | 215,223      | 4.7            |
| Widowed             | 0.0     | 0.0      | 0.0       | 0.0      | 100.0   | 0.0     | 20,809       | 0.4            |
| Never M             | 2.0     | 9.9      | 0.0       | 0.0      | 0.0     | 88.2    | 1,381,053    | 30.2           |
| Total               | 49.7    | 13.0     | 4.3       | 5.0      | 0.6     | 27.4    | 4,577,268    | 100.0          |
| 2002                |         |          |           | 2003     |         |         |              |                |
| Married             | 97.9    | 0.1      | 1.6       | 0.0      | 0.4     | 0.0     | 2,274,528    | 49.7           |
| De facto            | 9.1     | 79.8     | 0.7       | 1.8      | 0.0     | 8.7     | 594,017      | 13.0           |
| Separated           | 4.1     | 6.7      | 71.4      | 17.8     | 0.0     | 0.0     | 199,232      | 4.3            |
| Divorced            | 1.9     | 6.4      | 0.0       | 91.7     | 0.0     | 0.0     | 227,893      | 5.0            |
| Widowed             | 0.0     | 0.0      | 0.0       | 4.9      | 95.1    | 0.0     | 26,649       | 0.6            |
| Never M             | 0.9     | 9.2      | 0.0       | 0.0      | 0.0     | 89.9    | 1,254,949    | 27.4           |
| Total               | 50.4    | 13.5     | 4.0       | 5.6      | 0.7     | 25.8    | 4,577,268    | 100.0          |
| 2003                |         |          |           | 2004     |         |         |              |                |
| Married             | 98.1    | 0.1      | 1.7       | 0.2      | 0.0     | 0.0     | 2,304,821    | 50.4           |
| De facto            | 11.9    | 79.0     | 0.3       | 3.1      | 0.0     | 5.6     | 620,065      | 13.5           |
| Separated           | 5.2     | 7.6      | 71.3      | 15.9     | 0.0     | 0.0     | 183,538      | 4.0            |
| Divorced            | 0.0     | 3.9      | 1.6       | 94.0     | 0.5     | 0.0     | 256,501      | 5.6            |
| Widowed             | 0.0     | 3.9      | 0.0       | 0.0      | 96.1    | 0.0     | 33,374       | 0.7            |
| Never M             | 2.2     | 6.4      | 0.4       | 0.0      | 0.0     | 91.0    | 1,178,970    | 25.8           |
| Total               | 51.8    | 12.9     | 4.0       | 6.4      | 0.7     | 24.2    | 4,577,268    | 100.0          |
| 2004                |         |          |           | 2005     |         |         |              |                |
| Married             | 97.8    | 0.3      | 1.5       | 0.1      | 0.3     | 0.0     | 2,369,885    | 51.8           |
| De facto            | 13.7    | 74.3     | 0.2       | 1.7      | 0.0     | 10.2    | 592,217      | 12.9           |
| Separated           | 4.0     | 6.7      | 63.3      | 22.3     | 0.3     | 3.4     | 181,471      | 4.0            |
| Divorced            | 3.0     | 4.5      | 1.2       | 87.8     | 0.0     | 3.5     | 293,325      | 6.4            |
| Widowed             | 0.0     | 6.0      | 0.0       | 3.8      | 90.2    | 0.0     | 33,344       | 0.7            |
| Never M             | 2.4     | 7.0      | 0.4       | 0.0      | 0.0     | 90.2    | 1,107,027    | 24.2           |
| Total               | 53.4    | 12.0     | 3.5       | 6.8      | 0.7     | 23.6    | 4,577,268    | 100.0          |
| 2001                |         |          |           | 2005     |         |         |              |                |
| Married             | 92.9    | 1.2      | 3.0       | 2.4      | 0.5     | 0.0     | 2,230,887    | 48.7           |
| De facto            | 30.0    | 52.1     | 2.2       | 4.2      | 0.0     | 11.5    | 551,838      | 12.1           |
| Separated           | 9.1     | 11.3     | 41.7      | 35.1     | 0.0     | 2.8     | 177,458      | 3.9            |
| Divorced            | 9.4     | 6.5      | 0.8       | 78.7     | 0.9     | 3.7     | 215,223      | 4.7            |
| Widowed             | 0.0     | 0.0      | 0.0       | 0.0      | 100.0   | 0.0     | 20,809       | 0.4            |
| Never M             | 12.1    | 14.7     | 0.4       | 0.2      | 0.0     | 72.6    | 1,381,053    | 30.2           |
| Total               | 53.4    | 12.0     | 3.5       | 6.8      | 0.7     | 23.6    | 4,577,268    | 100.0          |

**Note:**

Population weighted analysis (weighted number of women= 4,577,268)

Row percentages add up to 100 per cent except for rounding.

\*= The divorced includes widowed women (15.1 % in 2002, 17.8 % in 2003 and 9.6 % in 2004).

<sup>i</sup> HILDA version 4.1.

<sup>ii</sup> The HILDA Survey collected the following relevant information for the study.



- Would you like to have a child of your own/more children in the future?
- And how likely are you to have child/more children in the future?
- How many more children do you intend to have?
- In which year do you intend to have (a/your next) child? (Wave 2 only)