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Family life events and mothers’ employment transitions

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**Justine Gibbings & Carole Heyworth¹
Research and Analysis Branch
Australian Government
Department of Family and Community Services**

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1 Introduction

This paper uses data from the first three waves of HILDA² to examine the employment patterns of women with dependent children. Further, the paper explores how various life transitions and events affect whether women are employed or not and where they are employed, the number of hours they work. This 'work-in-progress' is being carried out by Justine Gibbings and Carole Heyworth of the Research and Analysis Branch, Australian Government Department of Family & Community Services.

Employment patterns of women have long been of interest to governments and academics. The large volume of literature on this topic shows that a range of social, psychological and economic factors may be important influences upon women's participation in paid employment. These factors include attitudes towards work and family; the role of paid work in the socio-economic status of individuals, and the marginal tax rates experienced by individuals when they enter or re-enter the workforce.

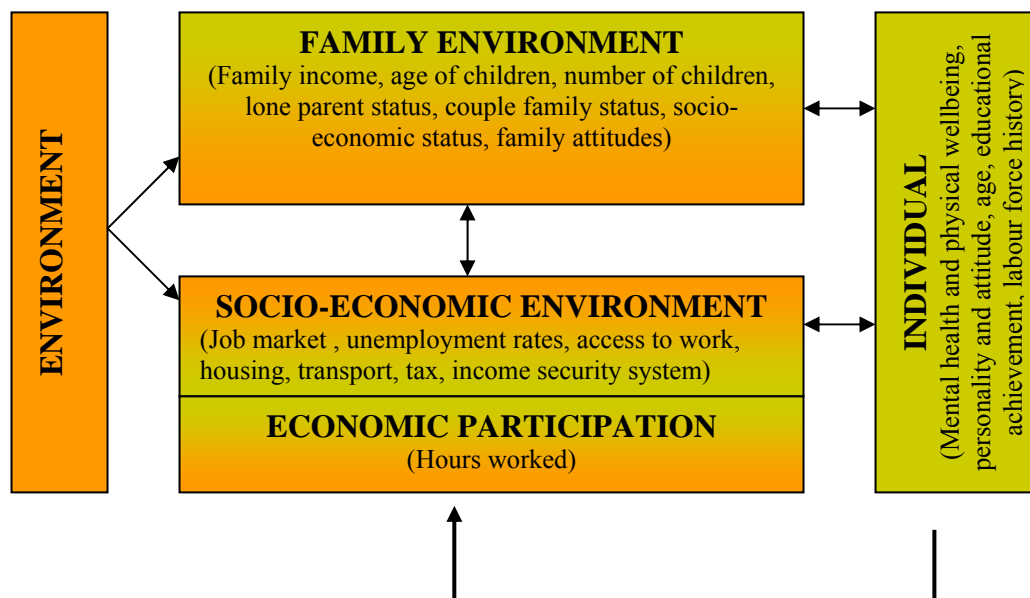
The Australian Institute of Family Studies (AIFS) conducted the Families and Work Decisions (FAWD) survey in 2002³ and this survey was cross-sectional in design. With this dataset it is possible to explore the relative importance of economic, psychological and social/environmental factors and how they interact in women's decisions about participation in the labour force. Early work reported by Michael Alexander and others at the AIFS Conference in February 2005 indicates that a range of factors are indeed important in the employment decision.

While it is possible to conceptualise women's participation in paid employment as the result of a linear process, the fact that women's lives are dynamic rather than static entities means that a life-course approach which models employment participation over a period of time may provide greater insights into this issue. This approach also takes into account the fact that women do not make decisions about employment in isolation but in the context of the households and societies in which they live and that their circumstances change over time.

Figure 1 below identifies possible factors and processes which may influence women's participation in paid employment.

² Household, Income and Labour Dynamics in Australia, release 3.0

³ Details at www.aifs.gov.au/institute/research/progC.html



In Australia, until recently, in the absence of longitudinal datasets, the capacity of researchers to test such a model has been limited, with most research based on cross-sectional data. One exception has been The Negotiating the Life Course (NLC) project, which has also collected longitudinal data⁴. The NLC project has collected three waves of data from 1997 each three years apart, the interviews were conducted by telephone and the sample size for the first wave was 2,231. Thus the nature of the sample is very different from HILDA.

However one constraint on longitudinal methods is the length of time required for data to accumulate. To counter this problem, the analysis reported here selects groups of women at different stages of child bearing and rearing as a way of capturing a life-course perspective and assess their participation in paid employment over the three waves of HILDA. The women are categorised as belonging to various family types: they may have children aged under 15 years for the entire three waves, or they may move from being childless to having care of children. Conversely women with older children may have the care of children at earlier waves of the study but not at later waves.

It is also recognised that over time women may also encounter and experience other life events and transitions, which may also influence their employment. For example, as their children grow and enter full-time education the type of childcare needed will also change. Likewise over time women's marital status and household composition may vary and there may also be changes in physical location.

⁴ Details about this project are available from <http://lifecourse.anu.edu.au/>.

At this stage in our research, it has not been possible to consider all these types of events and we concentrate on changes in the number and ages of children. Associated with these changes, women may move between different employment states (full-time, part-time and not employed). The paper also attends to the issue identified by Chalmers, Campbell and Charlesworth (2005) which shows that the intensity of the work, usually characterised as either part-time or full-time, is also an important characteristic of Australian women's employment experience, with Australia having one of the highest rates of part-time work. Using the number of hours worked per week as a measure of intensity, a multilevel model enables us to describe changes in the intensity of work over time.⁵

2 Structure of this Paper

We first provide details about the sample selected from HILDA, then the derivation of the major classification variable *family structure* is described and using this variable we provide summary results from our exploratory data analysis. The detailed descriptive analysis of the relationship between the structure of the family in terms of the presence of dependent children and the employment status of the woman in the family is given next.

Two categories of family structure are then selected and cases belonging to these two groups chosen. Using these two groups, an exploratory multilevel model is estimated with *hours worked per week* used as the outcome or dependent variable. The paper concludes with a summary of results and a discussion of future analysis.

3 Selecting the sample

Since this HILDA conference is partly about methods for conducting research using the survey data, set out below are the details of how the records were chosen.

Selection of records

The identification number of records was selected from the 'responding person' file for each wave of the HILDA data that met the criteria of

- Sex = 2 (female) and;
- `_hhrih` = 1 or 5. That is *relationship in household*⁶ describes a woman who was a member of a couple with dependent children under 15, or a sole parent with dependent children under 15.

The variable *xwaveid* was the id variable selected as it remains with the person for all waves of HILDA.

⁵ Multilevel modelling is also known as hierarchical linear modelling, random coefficient regression and mixed modelling.

⁶ Relationship in household is a concept defined by the ABS. For a full explanation see Standards for Statistics on the Family ABS Catalogue No. 1286.0 For our purposes it is sufficient to note that a member of a couple includes both married people and those in defacto relationships (including same sex relationships), and that dependent children are natural, adopted, step or foster children who usually reside in the household. By definition all children under 15 are dependent. Further, a household can contain one or more families and hence it is possible that more than one woman from the same household has been selected. This is a rare situation.

This selection produced 2362 records from wave 1, 2115 records from wave 2 and 2047 records from wave 3. These records were merged by *xwaveid* to obtain the set of all women who were caring for dependent children under 15 for at least one of the waves. There were 2678 such women in the merged file. Of the women, 64% had records in each of the three waves, 16% had records in two waves and 20% had a record in only one of the waves.

A record could be missing because the person did not respond in that wave or because they were out of scope for that wave. Reasons for being out of scope include having not yet joined the survey or being overseas for the interview period. Where a record existed for the wave, the woman could have been caring for a dependent child under 15 or not.

Variables chosen

The information we wanted to analyse about the women was both personal information (such as highest level of education) and household or family information (such as the income of the household and whether they were renting or buying a house). We therefore selected our information from the combined file which is an amalgamation of the responding person file and the household file. A list of the variables selected from each of the waves is at Appendix 1.

The subsets of the combined file for each wave were merged with the file of 2,678 ids to keep only those records for women who were part of our sample.

Creating wide, long and balanced files

The files from each wave were merged by *xwaveid* to create a *wide file*⁷. This file was the easiest to use for the preliminary analysis. Factors such as number of children in the household and labour force status, could easily be cross tabulated from this file to analyse how these attributes changed over time.

To create a *long file*⁸ which is necessary for longitudinal modelling, the prefixes a, b, and c first had to be dropped from all variable names. The SAS macro supplied in the HILDA User Guide⁹ was used to achieve this. The files for each wave were then combined into a single file and sorted by *xwaveid* and wave. This file of 8034 records had one to three records for each id.

For the purposes of this study, we decided to restrict the sample to only those women who provided an interview (and therefore had a record) in each wave. A balanced file removes the need to consider missing data in any longitudinal modelling. The balanced wide file contained 2038 women (and records), and the balanced long file 6284 records, one for each wave for each woman.

⁷ A wide file is a longitudinal file which has one record per person and the information for waves is displayed across the 'page'. Also called a person-person dataset.

⁸ A long file is a longitudinal file with multiple records per person following one after the other. Also called a person-period dataset.

⁹ www.melbourneinstitute.com/hilda/manual/user_manual.html

Creation of derived variables

Variables which were created for each wave were: number of children under 15, number of people in the household, employment status (three levels), relationship in household (four levels) and hours currently worked per week (where those not working were set to zero). A variable which drew on information at each wave was also created to define the family type. This is described in the section 5 Types of family.

4 Relationships in Household

The women of interest in this study are a subset of all women aged 15 and over in HILDA. Table 1 gives the distribution of all women in HILDA by the derived variable of *relationship in household*.

Table 1 Estimated population distribution of relationship in household for all women aged 15 and over at Wave 1

Relationship in household	Frequency	Percent
Couple with child<15	1,716,780	22.4
Couple with dependent student (no child<15)	339,032	4.4
Couple with non depchld (no child<15 or depst)	430,303	5.6
Couple without child	2,094,363	27.3
Lone parent with child<15	437,012	5.7
Lone parent with dependent student (no child<15)	88,164	1.2
Lone parent with non depchld (no child<15 or depst)	176,523	2.3
Dependent student	504,898	6.6
Non-dependent child	413,085	5.4
Other family member	190,964	2.5
Lone person	1,042,885	13.6
Unrelated to all HH members	227,159	3.0
Total	7,661,166	100.0

Weighted data, n=7334

Notes: "Child" includes one or more children

"Student" includes one or more student

"dep" means "dependent"

The most common category (27.3 per cent) for all women is as a member of a couple with no children, either dependent or independent, present in the household. Women who are members of "couples with dependent children under 15" represent 22.4 per cent of women. These couples may also have students or independent children present and are not necessarily (but normally are) the biological parents of the children. The most common type of sole parent is a woman with dependent children under 15 (5.7 per cent of all women), living in a household which may also include students or independent children.

As noted, for this study we selected all women who had a child under 15 in at least one of the waves of HILDA. Since some of these women did not have these children at wave one there are a variety of relationships present at this wave. This is shown in Table 2 where the 13 levels in Table 1 have been reduced to four levels because of the small

numbers in some groups. The group *Other relationship* combines the last seven categories in Table 1.

Table 2 Estimated population distribution of relationship in household at wave 1 for women with a child under 15 for at least one wave

Relationship in household	Frequency	Percent
Couple with child<15	1,716,275	73.0
Other couple	171,874	7.3
Lone parent with child<15	423,723	18.0
Other relationship	40,218	1.8
Total	2,352,090	100.0

Weighted data, n=2038

Since much previous research (see for example Gray ,Qu, de Vaus and Millward, 2003) shows that employment rates vary between partnered women as opposed to lone parents it is of interest to determine the stability of relationships over the three waves. The relationships for the women over this period are shown in Table 3.

This table shows that across three waves of data, women’s relationships are mostly stable. For the total sample of women, 74.1 per cent [61.0+2.6+3.5+3.1+3.9] are always part of a couple either as a couple with children under 15 years or another type of couple and a further 15.6 per cent [13.4+ 0.7+0.9+0.4+0.2] are always a lone parent with or without children under 15 years. There is some movement from *Couple, child < 15* to *Lone parent, child < 15* [1.9 + 2.3=4.3 per cent] and from *Lone parent* to *Couple* [1.5 + 0.9=2.4 per cent] but these changes are represented by very few cases. This indicates that more waves of data will be required to undertake a detailed analysis of the effect that a change in marital status from Couple to Lone parent or vice versa has on employment. Such an analysis will be undertaken in the future and will in addition examine other differences between couple and lone parents in terms of their employment.

Table 3 Percentage distribution of relationship type for women across three waves

		Relationship in Household Wave 3			
Relationship in Household Wave 1	Relationship in Household Wave 2	Couple, child <15 Per cent	Other couple, Per cent	Lone parent, child<15 Per cent	Other relationship Per cent
Couple, child <15	Couple, child <15	61.0	2.6	1.9	0.5
	Other couple	0.1	3.5	-	0.1
	Lone parent, child<15	0.3	-	2.3	0.1
	Other relationship	0.1	0.1	0.1	0.2
Other couple	Couple, child <15	3.1	0.1	-	-
	Other couple	3.9	-	-	-
	Lone parent, child<15	-	-	-	-
	Other relationship	-	-	0.2	-
Lone parent, child<15	Couple, child <15	1.5	0.1	0.4	-
	Other couple	-	-	-	-
	Lone parent, child<15	0.9	0.1	13.4	0.7
	Other relationship	-	0.1	-	0.9
Other relationship	Couple, child <15	0.3	0.1	0.1	0.5
	Other couple	0.4	-	0.1	-
	Lone parent, child<15	-	-	0.4	-
	Other relationship	0.2	-	0.2	-

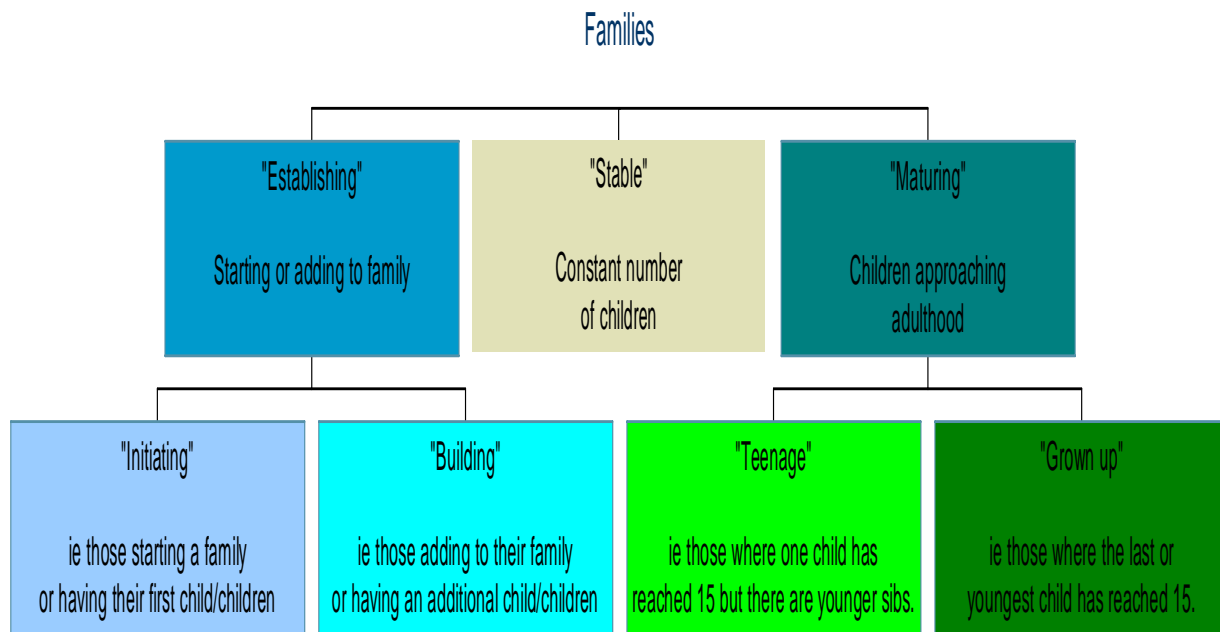
Weighted data¹⁰, Percentages in table add to 100%

5 Types of family

The three waves of HILDA provide many different patterns of households where there are children who are under 15 years of age. A woman may have within her family unit such children at each wave of HILDA or she may have them at Wave 1 but they may not be present at either Wave 2 or 3. Conversely such children may not be present at Wave 1 but are there in either or both Wave 2 and 3. The number of such children may also vary across the waves.

¹⁰ Unless otherwise specified the responding person longitudinal weight (clnwtrp) was used.

We have constructed a categorical variable *family structure* which summarises these different patterns across the three years¹¹. The families are divided into three broad groups: Establishing – those starting or adding to a family; Stable – those with a constant number of children; and Maturing – those who children are approaching adulthood. The Establishing and Maturing groups are then divided into two groups. Establishing is divided into: Initiating – those having their first child¹²; and Building – those adding to their family. Maturing is divided into: Teenage – those where one child has reached 15 but there are younger siblings; and Grown-up – those where the youngest or last child has reached 15 years. “Child/Children” refers to children less than 15 years old. The details of the groups are shown in the following household topology Figure 2:



Initiating Group

No children under 15 present at wave 1, but in wave 2 or 3 at least one present. If present at wave 2 also present at wave 3.

Building Group

At least one child present at wave 1, with at least one additional child present at wave 2 and/or 3.

Stable Group

Same number of children under 15 present at each wave.

¹¹ The number of children counted are actually the number in the household rather than the family. Generally a household contains only one family and so the two measures are equivalent. This was the case in our sample where no households contained 2 or more families.

¹² Mostly the children are biological children but may also be foster or adopted. At this stage we have not distinguished babies from children of other ages.

Teenage Group

Two or more children present at wave 1, but (at least) one less child under 15 at wave 2 and/or 3. If one less child under 15 at wave 2 then no more than this number or less at wave 3.

Grown-up Group

At least one child under 15 present at wave 1, in either wave 2 or 3 number reduces to zero. In most cases when the children turn 15 they stay in the family as dependent students.

Group 6

Patterns not elsewhere classified. Small residual group [n=22] not analysed further.

6 Characteristics of the family groups

Characteristics of the sample cross-classified by this 5 level classification are examined and the summary results presented in Table 4. Except where otherwise specified the women's characteristics reported are as they were at Wave 1. The Stable Group is substantially larger [n=1026] than the other groups and contains families where the children are for example, a variety of ages. It would be possible to divide this group into subsets depending, for example, on the age of the youngest or eldest child. This will be considered for future analyses.

The mean *age last birthday at date of interview* is consistent with expectations that those with younger children would themselves be younger than those whose children are older. Those having a first child (*Initiating*) are younger (28 years) than those having an additional child (*Building*, age=30 years). Those where the numbers of children stay constant over the three waves (*Stable*) have probably completed their families and are older (36 years) than those with additions to the family. Those whose children are turning 15 or more (*Teenage*) are older (40 years) but those with the last child turning 15 (*Grown-up*) are the oldest (43 years).

The women's labour force history is summarised by three variables. *Years since leaving FT education for the first time*, measured to the nearest year, records how long it is since someone has left school or full-time tertiary education. *Proportion time spent working* is the proportion of those years spent in either full-time or part-time employment. Similarly *proportion of time spent time spent not in the labour force (NILF)* is the proportion of time spent not employed or looking for work. The remainder of the time is the *proportion of time spent unemployed* but this is very small, only 1 to 4 per cent.

Table 4 Characteristics of women with dependent children less than 15 years by family structure

		Initiating	Building	Stable	Teenage	Grown-up
Characteristics at wave 1		n=146	n=214	n=1206	n=278	n=172
Age	Mean years	28	30	36	40	43
Years since left FT educatn 1 st time	Mean years	11	13	19	23	27
Proportion time spent working	Mean Per cent	79	69	67	55	62
Proportion time NILF	Mean Per cent	17	28	30	44	35
Household financial year disposable income	Median \$s per year	\$52,573	\$42,744	\$44,120	\$49,718	\$50,302
Presence of long-term health condition	Percentage yes	14	10	12	12	17
Current smoker	Percentage yes	31	27	24	24	23
Age of youngest in HH over 3 waves	Mean years	1	0	5	7	13
Housing	Percentage Owning /mortgage	50	58	70	73	82

Weighted data, n=2016

At wave 1 the *Initiating* Group have the greatest mean *proportion of time spent working since leaving education* (79 per cent). Once the women have children (the other Groups) the mean proportion of time spent working is lower on average by at least 10 per cent; for example the mean for the *Building* Group is 69 per cent. This reflects the fact many women withdraw at least temporarily from the labour force when children are added to the family.

As the age of the children increases, more women return to the labour force and so the mean proportion of time spent working increases once more. Thus the proportion of time spent working increases from 55 per cent for the *Teenage* group to 62 per cent for the

Grown-up group. This movement towards more employment is also reflected in the employment histories shown in more detail in Tables 11 and 12.

The mean income is for the household for the financial year preceding the wave 1 interview, with imputed values included. The distributions, as is commonly the case with income, are positively skewed¹³ so the median rather than the mean has been reported. The *Initiating* Group where at wave 1 there were no dependent children less than 15 has the highest median income of \$52,600. In the other groups there is a positive relationship between the mean age of the youngest child and the median income of that group. The *Building* Group where there are already dependent children and another will be added has the lowest median income of \$42,700.

In the health related variables, the *Grown-up* Group which is on average the oldest (43 years) has the highest proportion (17 per cent) reporting a long term health condition. However it is the youngest group (*Initiating*, age = 28 years) that has the highest proportion (31 per cent) of current smokers. Although the percentage does decrease slightly with age, the lowest proportion is still 23 per cent of the oldest group (*Grown-up*). Previous research (reported in Hsu, Gibbings & Morrison, 2004) has shown a negative association between smoking and employment. The proportion of women still smoking while they have young children (approximately 25 per cent) is of significant concern for public health.

The proportion of women, who own or are buying their own homes again increases with age. The youngest group (*Initiating*) has the lowest proportion (50 per cent) and the proportion increases across the groups until the group with ‘grown-up’ children, which has 82 per cent owning or buying.

Table 5 Highest level of education achieved by family group

	Initiating	Building	Stable	Teenage	Grown-up
Advanced diploma & above	34.2	33.8	31.4	27.3	28.9
Certificates including trades	24.9	27.9	25.8	23.3	23.5
Year 12	22.4	14.3	13.6	13.7	5.8
Year 11 & below	18.6	24.0	29.1	35.8	41.9
Total	100.0	100.0	100.0	100.0	100.0

Weighted data, n=2016

The highest level of education achieved (Table 5) shows clear differences with age, with younger cohorts having higher educational achievement. The *Initiating* Group (mean age=28) has the highest proportion (34 per cent) with degrees and advanced diplomas and

¹³ The peak of each distribution is displaced more towards lower values of income

the *Grown-up* Group (mean age=43) has the highest proportion (42 per cent) with Year 11 or below. This indicates that there is a cohort effect, with younger women gaining more formal education. Spending longer in education will delay entry into full-time employment and may also result in delaying the birth of the first child. This will be investigated further in later work.

Work by McDonald, Bradley and Guthrie (2005) shows that the attitude of a woman towards having other people care for her children and the value of work to her are important influences in whether a woman is in paid employment and whether she works full-time or part-time. In HILDA wave 1, a number of attitudinal questions covering various aspects of work were asked. The results of these questions are given in Table 6.1 to 6.3 which show the percentage distribution for each group¹⁴.

Table 6.1 Mothers who don't really need the money shouldn't work

	Initiating	Building	Stable	Teenage	Grown-up
Disagree	62.2	48.5	50.1	52.3	50.9
Neutral	19.9	15.2	17.2	15.9	14.4
Agree	17.9	36.2	32.7	31.8	34.7
Total	100.0	100.0	100.0	100.0	100.0

The *Initiating* Group contrasts with the *Building* Group and other women with children with only 18 per cent agreeing with the statement that 'mothers who don't really need the money shouldn't work'. Although there is never a majority of women agreeing with this statement, the percentage in *Building* Group (36 per cent) is double that of the *Initiating* Group.

Table 6.2 Work-family balance: Having both work and family responsibilities makes me a more well-rounded person

	Initiating	Building	Stable	Teenage	Grown-up
Disagree	70.8	15.3	9.9	8.5	10.9
Neutral	6.9	20.9	23.0	25.5	20.3
Agree	22.3	63.8	67.1	66.0	68.8
Total	100.0	100.0	100.0	100.0	100.0

There is an even greater difference between the *Initiating* Group and the other women to the question 'having both work and family responsibilities makes me a more rounded person' with two-thirds of women with children agreeing with this statement. Of interest is the fact that over 20 per cent of the women with children chose not to express an opinion.

¹⁴ The seven levels of each variable have been summarised as follows: 1-3 Disagree, 4 Neutral, 5-7 Agree.

Table 6.3 Work-family balance: Working leaves me with too little time or energy to be the kind of parent I want to be

	Initiating	Building	Stable	Teenage	Grown-up
Disagree	82.7	54.6	49.2	44.3	48.6
Neutral	-	16.8	12.0	17.2	19.7
Agree	17.3	28.6	38.8	38.5	31.8
Total	100.0	100.0	100.0	100.0	100.0

Weighted data

Again there is a contrast between the *Initiating* Group and the others in their answers to ‘Working leaves me with too little time or energy to be the kind of parent I want to be’. The question was answered when the *Initiating* group had no children. The presence of children is associated with much greater support for the idea that there is little time or energy to be an enthusiastic parent.

Our future work will examine the relationship between attitudes such as these and women’s employment experience particularly when they have young children.

7 Changes in Employment States Across HILDA

Since this paper focuses on the effect of family life events on employment we will consider two measures of employment. The first is a categorical variable which measures employment status at each wave. Since few women in our sample are unemployed (in wave 1 there are only 58 cases across all family groups), this group has been combined with *Not in the Labour Force (NILF)*. In addition because of the importance of part-time work for women with children, those employed are divided into two categories namely *employed full-time*¹⁵ and *employed part-time*. The distribution of employment status for the women in our sample is shown in Table 7. The proportions in each category are very similar but as will be demonstrated in Tables 8-12, these cross-sectional estimates do not show the movement between employment states of individual women.

Table 7 Percentage distribution of employment status for each HILDA wave

Employment Status	Hilda Wave		
	Wave 1	Wave 2	Wave 3
Employed F/T	24.3	23.5	23.9
Employed P/T	34.5	36.6	35.1
Unemployed/NILF	41.3	40.0	41.0
Total	100.0	100.0	100.0

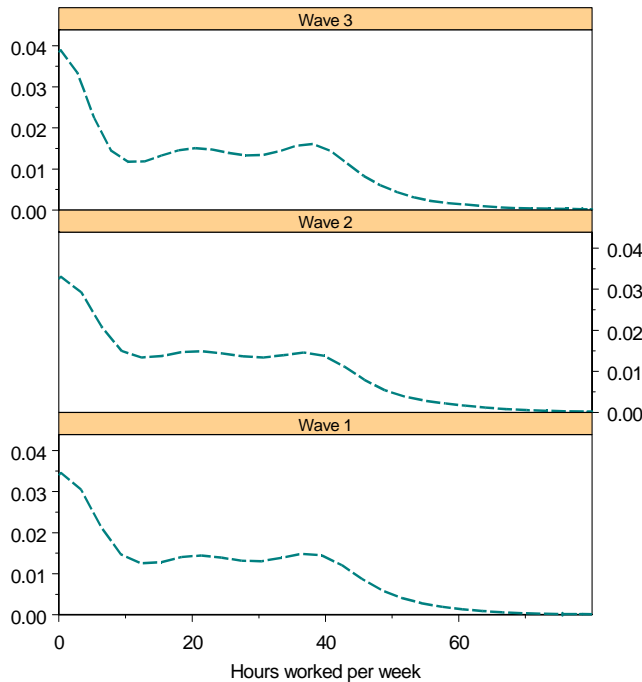
Weighted data, n=2038

The other variable is measured on an integer scale and is the *number of hours currently worked*. Individuals not currently employed are recorded as working zero hours. The probability density distribution of this variable over the three waves is shown in Figure 3.

¹⁵ In HILDA, *full-time* is defined as working 35 hours or more per week

The distribution of the variable is similar across waves and is positively skewed because of the proportion of women with zero hours worked. The median hours of women working part-time is 20 hours per week and 40 hours for those working full-time. These medians are shown in these graphs as slight peaks at 20 and 40 hours. This variable is used in the multilevel model fitted in the later analysis and this skewness needs to be considered in the fit of the model.

Fig 3 Probability density distributions¹⁶ of hours worked per week by wave



Results of women's employment transitions

The next five tables provide details of the employment status of women over the three waves categorised by the household typology described in Fig 2. In each of the tables, the dark grey boxes highlight women who did not change employment status over the three waves.

Members of the *Stable* Group have the same number of children < 15 for the three waves of HILDA. The Group is characterised by stability in employment status as well: nearly two thirds of the group [64.9 per cent] did not change employment status over the three waves. Thirty-seven per cent [13.8 per cent full-time and 23.1 per cent part-time] stay employed and 28 per cent were unemployed/NILF for all three waves.

¹⁶ These distributions have to smoothed to make the comparison of their shape easier.

Table 8 Employment status of women at each wave for *Stable* Group

		Wave 3 status		
		Employed F/T	Employed P/T	Unemployed/NILF
		Per cent	Per cent	Per cent
Wave 1 status	Wave 2 status			
Employed F/T	Employed F/T	13.8	1.5	0.9
	Employed P/T	1.1	1.7	0.2
	Unemployed/NILF	0.1	0.5	0.1
Employed P/T	Employed F/T	3.0	1.3	0.2
	Employed P/T	3.2	23.1	2.5
	Unemployed/NILF	0.3	1.4	2.2
Unemployed/NILF	Employed F/T	1.3	0.3	-
	Employed P/T	0.8	5.5	1.5
	Unemployed/NILF	0.6	4.7	28.0

Weighted data, percentages add to 100%, n = 1206

The other cells represent movement between employment states over at least one wave. The largest groups are the 10 per cent [5.5+4.7] of women who move from unemployed/NILF to part-time employment at either wave 2 or 3. Smaller proportions, (6 per cent [3.0+3.2]), moved from part-time to full-time and from unemployed/NILF to full-time, (5 per cent) over the period. On the other hand, another 5 per cent [2.5+2.2+0.2] moved the other way to unemployed/NILF. It has been suggested (Blank, 1994) that women use part-time work as a stepping stone from unemployed/NILF to full-time work. This question of stepping up and stepping down will be investigated more closely in future analysis.

Table 9 Employment status of women at each wave for *Initiating* Group

		Wave 3 status		
		Employed F/T	Employed P/T	Unemployed/NILF
		Per cent	Per cent	Per cent
Wave 1 status	Wave 2 status			
Employed F/T	Employed F/T	9.6	5.9	16.9
	Employed P/T	-	6.9	4.3
	Unemployed/NILF	1.7	5.5	11.5
Employed P/T	Employed F/T	-	-	1.6
	Employed P/T	-	2.2	4.8
	Unemployed/NILF	1.0	1.1	5.8
Unemployed/NILF	Employed F/T	-	-	0.9
	Employed P/T	-	-	2.2
	Unemployed/NILF	-	0.6	17.7

Weighted data, percentages add to 100%, n = 149

Women in the *Initiating* Group had no children < 15 at wave 1 but had at least one child by wave 2 or 3. In wave 1, 62 per cent [32.4+11.2+18.7] were working full-time, 16 per cent [1.6+6.9+7.9] part-time and 21 per cent [0.9+2.2+18.3] were unemployed/NILF. At wave 3 these proportions are almost reversed with 12 per cent working full-time, 22 per cent part-time and 66 per cent unemployed/NILF. Only 30 per cent did not change employment status most of whom (18 per cent) were already unemployed/NILF.

This clearly shows that on average, the presence of the first child < 15 (largely babies) is associated with a large reduction in full-time work and this translates, over a two year period, mainly into movement out of employment. However it is of interest that those who are employed part-time at wave 3, (18.3 per cent [5.9+6.9+5.5]) have mainly come from full-time work rather than having worked part-time in wave 1 [2.2 per cent]. Those who were part-time in wave 1 had mainly moved to unemployed/NILF, 12.2 per cent [1.6+4.8+5.8] by wave 3.

Of interest is the 18 per cent who were unemployed/NILF across the entire three waves ie were not employed even when they did not have any children < 15. Analysis of the characteristics of this group show that they have greater levels of long term disability than other women in the group. At wave 1, 25 per cent had a long term health condition/impairment or disability compared with only 12 per cent of the remainder of this group. Of those in the unemployed/NILF group who identified as having such a long-term condition, 79 per cent said that it limited the type or amount of work they could do. This compared with only 45 per cent of those with a long-term health condition in the remainder of the group. Later analysis will consider the women across all groups who remain unemployed/NILF across all waves.

Table 10 Employment status of women at each wave for *Building* Group

		Wave 3 status		
		Employed F/T	Employed P/T	Unemployed/NILF
		Per cent	Per cent	Per cent
Wave 1 status	Wave 2 status			
Employed F/T	Employed F/T	3.1	0.6	2.5
	Employed P/T	0.9	1.2	0.4
	Unemployed/NILF	-	0.2	2.1
Employed P/T	Employed F/T	0.5	1.0	0.8
	Employed P/T	0.4	12.7	5.9
	Unemployed/NILF	1.3	4.0	6.0
Unemployed/NILF	Employed F/T	0.4	-	0.4
	Employed P/T	2.2	2.2	1.8
	Unemployed/NILF	0.9	3.4	45.2

Weighted data, percentages add to 100%, n = 129

The *Building* group had at least one child < 15 at wave 1 and at least one additional child in waves 2 and/or 3. Very few of this group [10.9 per cent] were working full-time at wave 1 and only 4 per cent of the total were still working full-time at wave 3. The others

had moved to either part-time [2.0 per cent] or unemployed/NILF [5.0 per cent]. There was a general movement in this group away from part-time work towards unemployment/NILF. At wave 3, overall 10 per cent of the group were employed full-time, 25 per cent part-time [33 per cent wave 1] and 65 per cent were unemployed/NILF [57 per cent wave 1].

Similarly to the *Initiating* Group, the presence of an additional child results in a reduction in employment although the reduction is not as dramatic as for those with a first child. This reduction is investigated further by the fitting of a model in Section 9.

The final two groups are those where the children were growing up and turning 15. In the *Teenage* Group one child turned 15 in wave 2 or 3 but there were still younger siblings and in the *Grown-up* Group the last child turned 15 leaving no children < 15 in the household in waves 2 and/or 3.

Table 11 Employment status of women at each wave for *Teenage* Group

		Wave 3 status		
		Employed F/T	Employed P/T	Unemployed/NILF
		Per cent	Per cent	Per cent
Wave 1 status	Wave 2 status			
Employed F/T	Employed F/T	14.9	1.2	0.3
	Employed P/T	3.0	1.8	-
	Unemployed/NILF	-	-	0.6
Employed P/T	Employed F/T	3.3	1.0	0.4
	Employed P/T	2.4	24.9	1.4
	Unemployed/NILF	-	0.8	2.0
Unemployed/NILF	Employed F/T	1.9	0.3	-
	Employed P/T	0.5	4.8	3.8
	Unemployed/NILF	1.6	2.0	27.1

Weighted data, percentages in table add to 100%, n = 278

This *Teenage* group shows patterns, which are similar to the *Stable* group. Forty per cent [14.9+24.9] were employed full-time or part-time at every wave which is a little higher than the 37 per cent or so employed in the *Stable* Group. Likewise 27 per cent of the *Teenage* Group were unemployed/NILF at each wave compared with 28 per cent for *Stable* Group. There was also movement between states and overall this is a movement to **more** employment: 20 per cent part-time to full-time or unemployed/NILF to {part-time or full-time} compared with 12 per cent {part-time or full-time} to unemployed/NILF or full-time to part-time .

At wave 3, a greater proportion of the *Teenage* Group were employed part-time [37 per cent] than full-time [28 per cent].

Table 12 Employment status of women at each wave for the *Grown-up* Group

		Wave 3 status		
		Employed F/T	Employed P/T	Unemployed/NILF
		Per cent	Per cent	Per cent
Wave 1 status	Wave 2 status			
Employed F/T	Employed F/T	27.4	0.5	0.5
	Employed P/T	3.0	1.5	0.6
	Unemployed/NILF	-	-	-
Employed P/T	Employed F/T	3.9	0.5	0.4
	Employed P/T	6.5	18.3	1.4
	Unemployed/NILF	-	0.8	1.1
Unemployed/NILF	Employed F/T	1.3	1.7	1.3
	Employed P/T	1.2	1.2	2.0
	Unemployed/NILF	0.5	3.9	20.3

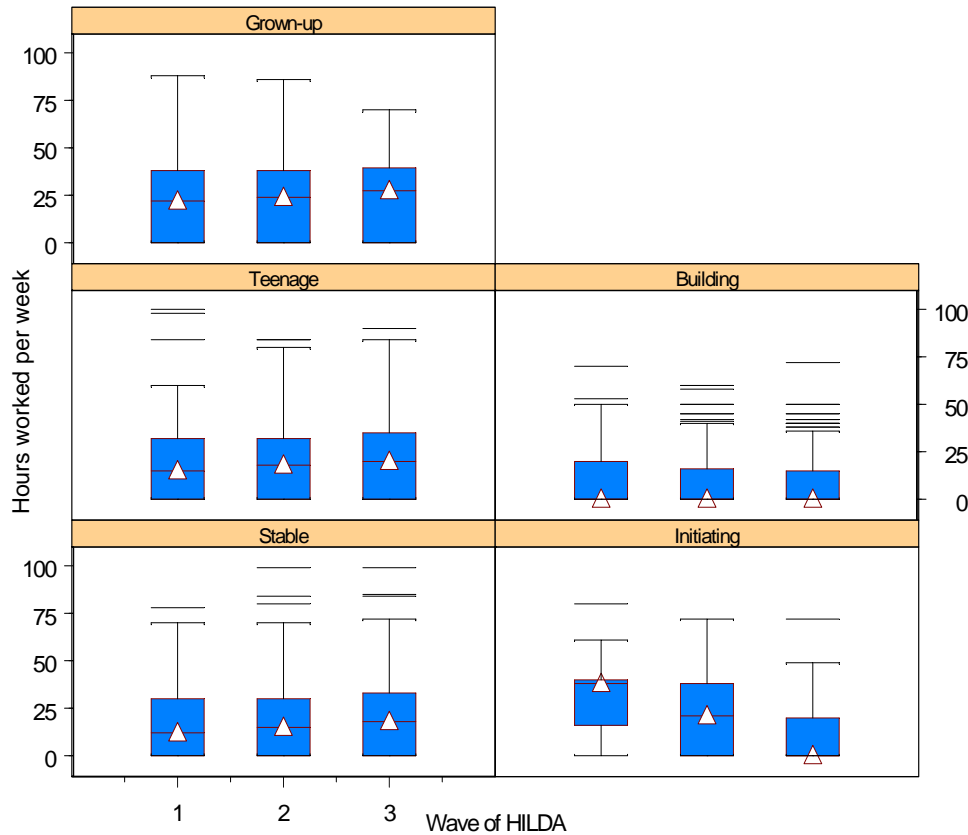
Weighted data, percentages add to 100%, n = 172

In the *Grown-up* Group, most people did not change employment status but this Group did have, of all the groups, the greatest proportion employed at wave 3 with 72 per cent working [43.9 per cent F/T and 28.5 per cent P/T]. The largest movements were from part-time to full-time work, 13.4 per cent [3.0+3.9+6.5]. It is of interest that at wave 3, a relatively high proportion of 28 per cent were unemployed/NILF: 20 per cent have had this status for all three waves but 8 per cent were recorded as employed at one of the waves.

8 Number of hours worked

Of the groups examined in the previous section, the biggest changes were seen in the *Initiating* Group where the addition of a first child resulted in a dramatic reduction of the number women working full or part-time. Rather than looking at employment simply in terms of full-time or part-time, it is useful to look at the actual number hours worked. In Fig 4, the integer variable *number of hours worked per week* is plotted by wave for each of the five groups.

Fig 4 Boxplots¹⁷ showing the distribution of number of hours worked per week by Wave for each of the family groups



The decline in the median number of hours worked (shown by the white triangle) by the *Initiating* Group from 38 to zero hours per week over the three waves is clearly visible. The mean also declines from 30 to 10 hours. The other group in which further children are being added is the *Building* Group. Here the median stays constant at zero hours for the three waves but the mean declines from 11 to 9 hours.

In the last three groups the average age of the children increases from the *Stable* Group to the *Grown-up* Group and the children also increase in age across the waves. The median and mean of the number of hours worked increases both across the groups but also within the groups across waves. Notice that the median for the *Grown-up* Group, in wave 3 (where there is no child < 15) is 28 hours per week. This is 10 hours below the median of 38 hours for *Initiating* Group, in wave 1 (where there were no children).

Since the differences within and between the *Initiating* and *Building* groups are clearly visible over the three waves, it was decided to select them in order to construct an exploratory multilevel model, which will examine change over time in the number of hours worked per week.

¹⁷ Details of the features of a boxplot are given in Cleveland (1993) and many other statistics texts.

9 Multilevel Model of Number of Hours Worked per Week

We saw in the boxplots above, that in the two groups *Initiating* and *Building* where new children were being added to the families, the number of hours worked was either declining or stable but low. This compared with the other three groups where there was an increase in hours worked both with age of the children and over time. We are interested in using statistical models, in this case the multilevel model for change, to investigate the processes in the population that generated these patterns of work over time.

The first limitation is that there are only three waves of data suggesting that a linear model of some sort is the only realistic option. In addition, in this exploratory stage, we will model the combined data from the *Initiating* and *Building* Groups to simplify the analysis. Using a methodology suggested by Singer and Willet (2003) we proceed to fit a series of models to our data where the outcome (or dependent) variable is *number of hours currently worked per week*. The two additional explanatory variables are *family structure* two levels: *Initiating & Building* and *highest education level achieved* reduced to two levels. The variables have been recoded as dummy (or indicator) variables as follows:

Variable name	Recoded to zero	Recoded to one
Family structure	Initiating group	Building group
Highest education achieved before wave 1	Other including trades	Advanced diploma & above including degrees

A table of equations for each model is given in Appendix 2. The estimated parameters for these models are presented in Table 13 with the standard errors given in brackets beneath the estimates. The probability of rejecting the null hypothesis that the coefficient = 0, is summarised below this.

A summary of the interpretation of each model follows.

Model A

This model can be known as the unconditional means model. It has one parameter $\hat{\gamma}_{00}$, that estimates the grand mean of hours worked across all occasions and individuals. It is significantly different from zero and is estimated as 13.9 hours per week. This model also allows us to estimate the amount of variation which is attributable to differences between women. The interclass correlation coefficient $\rho = 0.42$ and indicates that approximately 42 per cent of the variation in hours worked is due to differences between women. In this model, the coefficient also measures the average correlation between any pair of composite residuals and at 0.42 indicates that it is much higher than the zero residual autocorrelation that an OLS¹⁸ analysis would require.

¹⁸ Ordinary Least Squares – the most commonly used technique for linear regression

Table 13 Results of fitting a series of multilevel models for change to the women with dependent children in Initiating and Building Groups
 Linear mixed-effects model fitted using Maximum Likelihood¹⁹

		Parameter	Model A	Model B	Model C	Model D	Model E
Fixed effects							
Initial status, φ_{0i}	Intercept	γ_{00}	13.95 (0.72) ***	18.81 (0.98) ***	30.02 (1.34) ***	26.41 (1.46) ***	27.25 (1.40) ***
	Family structure	γ_{01}			-18.87 (1.74) ***	-18.57 (1.67) ***	-18.64 (1.67) ***
	Education achieved	γ_{02}				8.74 (1.67) ***	6.72 (1.28) ***
Rate of change, φ_{1i}	Intercept	γ_{10}		-4.86 (0.49) ***	-9.92 (0.69) ***	-9.30 (0.79) ***	-10.02 (0.69) ***
	Family structure	γ_{11}			8.52 (0.90) ***	8.54 (0.90) ***	8.61 (0.90) ***
	Education achieved	γ_{12}				-1.71 (0.90) NS	
Variance components							
Level 1	Within person	σ_{ε}^2	178.46	139.13	135.05	135.60	136.21
Level 2	In initial status	σ_0^2	126.63	229.38	148.63	127.73	128.52
	In rate of change	σ_1^2		15.71	2.28	1.58	1.64
	Covariance	σ_{01}		-6.83	-4.21	-3.7	-3.81
Pseudo R ² statistics							
	R_{ε}^2			0.22	0.22	0.22	0.22
	R_0^2				0.35	0.44	0.44
	R_1^2				0.86	0.90	0.90
Goodness of fit							
	Deviance		9072.46	8934.73	8822.81	8793.15	8796.73
	AIC		9078.46	8946.73	8838.81	8813.15	8814.73
	BIC		9093.41	8976.63	8878.69	8863.00	8859.59

N= 275, *** p < .001, ** p < .01, * p < .05, NS not significant

¹⁹ Details about how linear mixed effects models are implemented in S-Plus can be found in Venables and Ripley (2002).

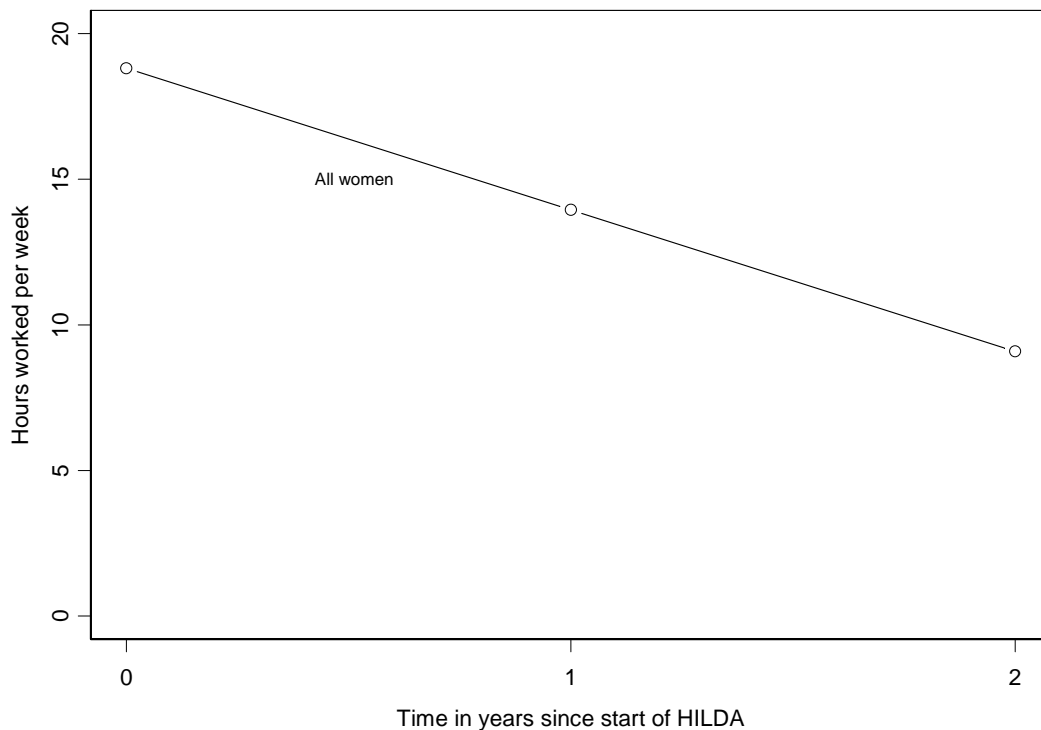
Model B

This model can be known as the unconditional growth model and introduces the predictor *Time* into the model. In HILDA the passage of time starts at an arbitrary point and so in order for the intercept of the model to be meaningful, we recode the Wave variable to Time ie

$$\text{Time} = \text{Wave} - 1$$

The fixed effects $\hat{\gamma}_{00}$ & $\hat{\gamma}_{10}$ estimate the starting point and slope of the population average change path (or trajectory) for hours worked. Since we can reject the null hypothesis ($p < 0.001$) for both estimates, we conclude that overall *hours worked* has a non-zero intercept of 18.8 and a non-zero slope of -4.9 . This path is plotted in Fig 5 and shows that it starts at 18.8 hours worked and declines over the three waves.

Fig 5 Number of hours worked by time for all women in Initiating & Building Groups combined



We compare the variance component $\hat{\sigma}_{\epsilon}^2$ in Model B with Model A. This declines from 178.5 to 139.1 (ie by 22 per cent) and we conclude that this is the amount of within person variation in hours worked that is systematically associated with Time.

Model C

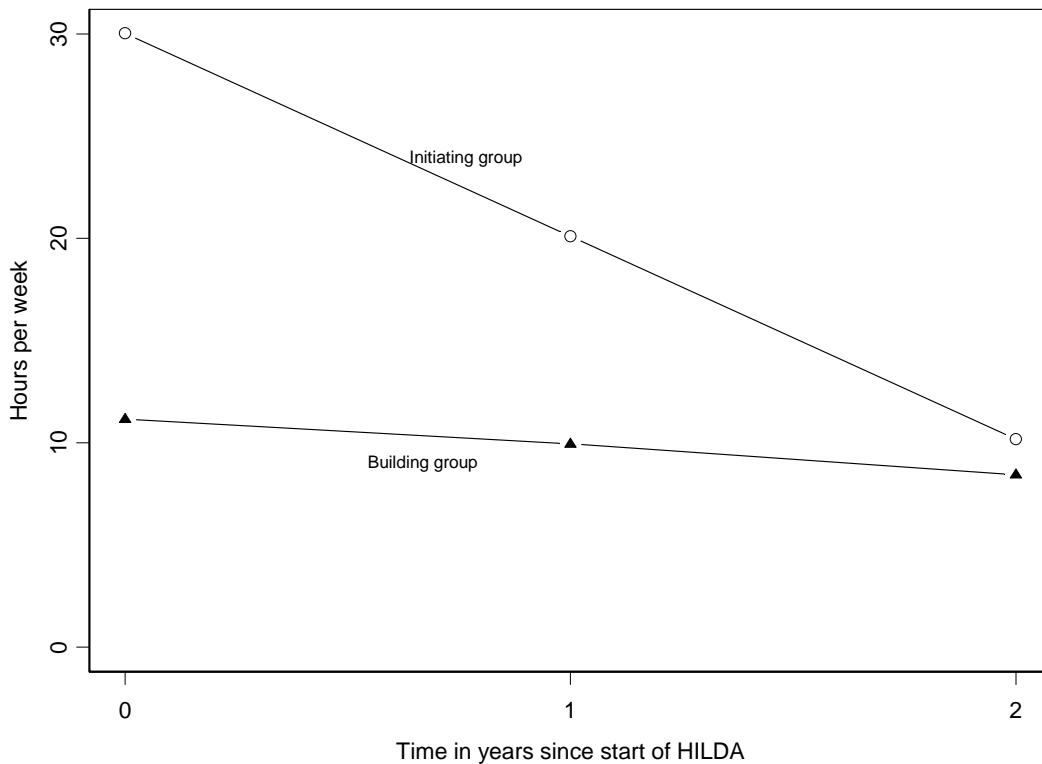
In the next three models we investigate whether the hours worked varies systematically by family structure and education level achieved. The chief interest in these exploratory models is to examine the effect of the two types of family structure. It is known that higher levels of education increase women's probability of employment and the number of hours they work so in these models we will evaluate the effects of family structure while controlling for the effects of education.

Family structure is included in Model C as a predictor both of initial status and change. It has four fixed effects which, reading down the column for Model C, may be interpreted in the following manner.

1. The estimated initial hours worked per week for *Initiating* group is 30.0 hours ($p < .001$)
2. The estimated difference in initial number of hours between *Initiating* and *Building* groups is -18.9 hours ($p < .001$) ie *Building* group works initially 11.1 hours per week
3. The estimated rate of change over time for women in the *Initiating* Group is -9.9 ($p < .001$)
4. The estimated differential in the rate of change between women in the *Initiating* and *Building* group is 8.5 ($p < .001$)

This model suggests that the women who have no children in Wave 1 (*Initiating*), work on average 30.0 hours a week and 18.9 hours more than those who already have at least one child (*Building*). Over the waves of HILDA the rate of work by the *Initiating* group declines by 9.9 hours per time period and the rate for the *Building* group also declines but much more slowly at $(9.9 - 8.5)$ 1.4 hours per time period. The effect of education level achieved has not been taken into account. A graph showing typical change paths (or trajectories) for this model is given in Fig 6.

Fig 6 Number of hours worked by women with young children by family type over three waves



The following characteristics of the variance components are noted:

The level-2 variance components both change. $\hat{\sigma}_0^2$ declines by 35 per cent from Model B and potentially still contains explainable residual variation in initial status. $\hat{\sigma}_1^2$ also declines but by 86 per cent and probably has little residual variation left to explain. We now want to include our other level-2 predictor *highest education* which may help explain some of the remaining variation.

Model D

This model evaluates the effects of family structure on both initial status and rates of change in the hours worked, while controlling for the effects of education on initial status and rate of change. The interpretation of the six fixed effects reading down the column for Model D should be interpreted as follows.

1. The estimated initial number of hours worked for the *Initiating* group whose members have the lower level of education is 26.4 ($p < .001$).
2. The estimated initial difference between the *Initiating* group whose members have the lower level of education and members of the *Building* group whose members are similarly qualified is -18.6 hours ($p < .001$)
3. The estimated initial increase in hours worked by those with the higher level of education is 8.7 hours ($p < .001$)
4. The estimated rate of change over time for women of the *Initiating* group is -9.3 ($p < .001$)
5. The estimated differential in the rate of change between women of the *Initiating* and *Building* group is 8.5 ($p < .001$)
6. The estimated differential in the rate of change between women of higher education and lower is -1.7 ($p > .05$ NS).

This model suggests that the women who have no children in wave 1 (*Initiating*) and have the higher level of education, initially work on average 35.1 [$26.4+8.7$] hours, that is 8.7 hours more than women in the *Initiating* Group with the lower level of education, who work 26.4 hours. Women in the *Building* group with the lower level of education, initially work on average 7.8 [$26.4-18.6$] hours and those with the higher level of education 16.5 [$7.8+8.7$] hours a difference of 8.7 hours.

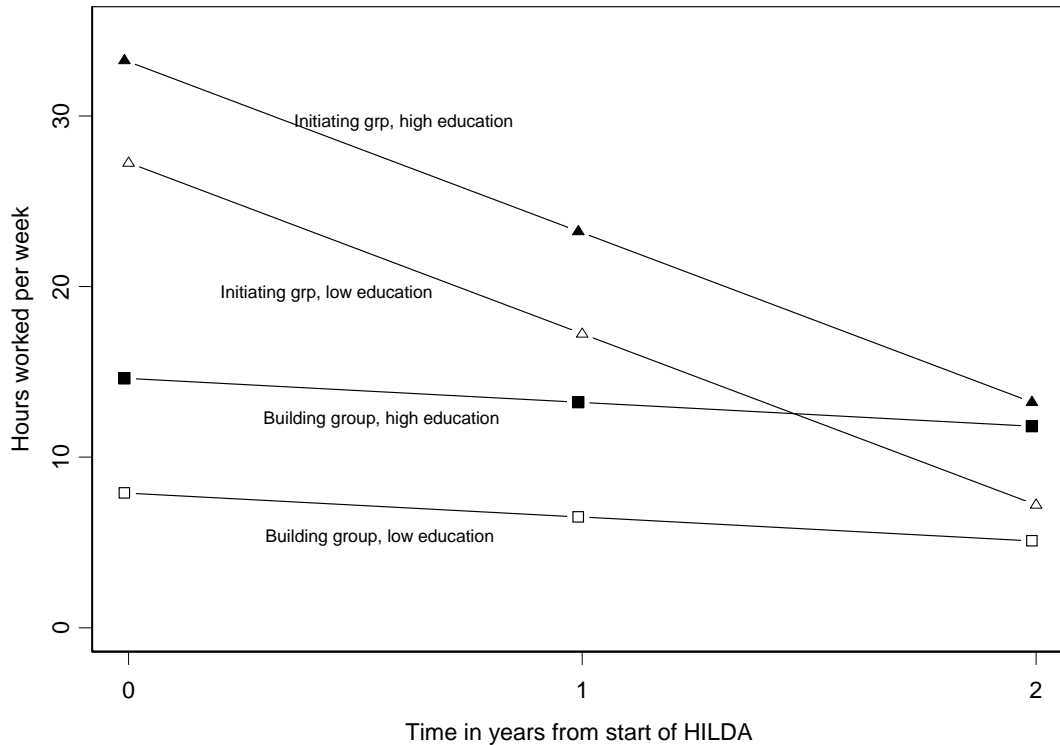
In relation to the rate of change, the coefficient for family structure is significant, so over the waves of HILDA the rate of work by the *Initiating* group declines by 9.3 hours per time period and the rate for the *Building* group also declines but much more slowly at ($9.3 - 8.5$) 0.8 hours per time period. The effect of education on rate of change is not significant and so we could drop this term to produce a more parsimonious model.

Model E – A Model for the Controlled Effects of Family Structure on Number of Hours Worked

Model E contains *family structure* as a predictor of both initial status and rate of change for our outcome variable *hours worked*, but *highest education* is included only as a predictor of initial status. The interpretation of the five fixed effects is identical to those in Model D. This model suggests that although the level of education affects a woman's number of hours worked at an initial point in time (time=0), with women with higher education working more hours on average, the rate at which the number of hours declines

after the birth of a child is influenced by family structure but not by education level. A graph showing typical change paths for this model is given in Fig 7.

Fig 7 Number of hours worked per week by women with young children by family type and education level, over three waves



The model estimates the mean number of hours worked across the waves as follows.

Table 14 Estimated mean number of hours worked at wave 1 and wave 3

Group	Highest education	Wave 1	Wave 3
Initiating	High	35.1	16.5
	Low	26.4	7.8
Building	High	16.5	14.9
	low	7.8	6.2

From both Figure 7 and Table 14 it is clear that although the rates of decline are very different, the number of hours worked for a particular level of education at wave 3 is very similar, in fact only 1.5 hours apart. At wave 3, the Initiating group have only one child, which the majority of the Building group had at wave one. It is therefore of interest that at wave 3 the Initiating group is working the same mean number of hours, 16.5 and 7.8, that the Building group was at wave 1. The relationship between age and number of children will be investigated further in future research.

The variance components $\hat{\sigma}_\varepsilon^2$, $\hat{\sigma}_0^2$ and $\hat{\sigma}_1^2$ change little between Model E and Model D suggesting that little is lost by removing the effect of highest education on the rate of

change. This change can be assessed more systematically by the use of a deviance-based hypothesis test.

We wish to test what happens as we move from Model D to Model E where we remove the fixed effect of rate of change for education by setting $\gamma_{12} = 0$. From the deviance statistics in Table 13, $\Delta D = (8796.7 - 8793.2) = 3.5$

We compare this with a χ^2 distribution on 1 d.f.. Since this does not exceed the .05 critical value of 3.84 we accept the null hypothesis and conclude that we can safely remove γ_{12} from Model E, as we have done.

In Appendix 3, additional information concerning goodness of fit of Model E is provided.

10 Summary of Results

Employment patterns of women are of interest to both government and academics. The literature on this topic shows that a range of social, psychological and economic factors are important influences upon women's participation in paid employment.

Using three waves of HILDA data, this paper examines the employment patterns of women with dependent children and explores how various transitions and events affect whether women are employed or not and where they are employed the number of hours worked.

To facilitate this analysis a typology of different family structures for those with children was devised. Further to maximise the usefulness of this data a multi-level model was fitted. This technique enables assessment of change over time.

Results of the analyses conducted identified that:

- The women were classified into five different family types. Women in different family types differed in terms of their employment status.
- An important grouping of women were those who were 'Establishing' their families, having either their first (Initiating) or additional (Building) children. At wave 1, women in the Initiating group (ie those who had yet to start a family) were most likely to be working.
- Women in the Building group (those adding to their family) were the least likely to be working at wave 1 with 11 per cent working full-time and 33 per cent part-time. This dropped to 10 per cent full-time and 25 per cent part-time after the addition of another child.
- Once women had started their families, if they were employed, they were much more likely to be employed part-time rather than full-time.
- In contrast, in the family type groups where the children were mainly teenagers, the proportions of women working full-time increased over the waves. By the time the children were all aged 15 years or more, 44 per cent of women were working full-time, an increase of 10 per cent over two years. In the same time

- period, the proportion working part-time had declined slightly from 33 per cent to 28 per cent part-time.
- It is noteworthy, that a substantial number of women across all family types were either out of the labour force or unemployed at all three waves.
 - o The preliminary modelling task concentrated on examining the employment patterns of women in two family types ie those in the Initiating and Building groups.
 - o Two things were of interest, how many hours women worked initially (that is at wave 1, Time = zero), and secondly how this changed with the addition of children over time.
 - o Given the evidence that women's employment status and the intensity of their work is highly related to their educational achievements, the analyses conducted sort to control for, or take into account, the effect of education on hours worked.
 - o As noted, women in the Initiating group had a higher initial work intensity, ie they worked more hours than women in the Building group. Within both groups however women with higher educational levels worked more hours.
 - o Over time and with the addition of children, women of both groups decreased their working hours. At wave 3 (time=2) women in both groups reported working similar hours each week. Hence women in the Building group decreased their working hours slightly but women in the Initiating group reduced their hours dramatically.
 - o Across both groups, despite reducing their hours, women with higher education remained working longer hours than did women with lower education.

The findings presented in this paper therefore highlight the challenges faced by women initiating and building their families and maintaining their links to the labour force. The paper also identifies that education may be an important buffering or moderating factor in that women with higher education may have greater choice when it comes to hours worked.

11 Future work

The strength of the analyses presented in this paper lies both in its use of longitudinal data and in the techniques used to maximise this valuable resource. The preliminary nature of the paper must be stressed. A limited number of predictor variables were modelled and the small number of waves of data meant the capacity to assess real change was also limited.

Future work will build upon the analyses presented here and examine the effects of other family transitions, such as change in marital status and physical location upon hours worked. We also plan to include work that we have recently started in which we are considering the derivation of a measure, for an individual, of socio-economic status. Any new work will also incorporate further waves of data.

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Appendix 1
Variable list

Category	Description	Variable name in Wave1	Wave 2	Wave 3
Personal identifiers & characteristics	Cross wave id	xwaveid		
	Household id	ahhrhid		
	Age at interview	ahhiage		
	Sex	ahgsex		
	Relationship in household	ahhrih		
Children - total & derived	Persons aged 0-4 at 30 June in HH	ahh0_4		
	Persons aged 5-9 at 30 June in HH	Ahh5_9		
	Persons aged 10-14 at...	Ahh10_14		
	Adults in HH at...	ahhadult		
	Age youngest in HH	ahhyng		
Education	Highest edu level achieved	aedhigh		
Housing	R1 own, rent or rent free	ahstenur	Not available	Not available
Lifestyle and living situation	Do you smoke	alssmoke	Not available	Not available
Health-longterm cond	K2 longterm health cond	ahelth		
	K3 impact on work limits	ahelthwk		
Employment status	Labour force status -broad	aesbrd		
	Labour force status -detail	aesdtl		
Time since left education	Time since left FT education - yrs	aehtse		
	Time in paid work - yrs	aehtjb		
	Time unemployed and looking for work - yrs	aehtuj		
	Time not working and not looking for work	aehto		
Current job	DV Hours per week usually worked all jobs worked (if varies this is av per week over last 4 weeks)	ajbhru	bjbhruc	cjbhruc
Not working	Main reason not looking for work	anlmrsn	bnlmrea	cnlmrea

HH Income	HH gross income	ahifefp ahifefn ahifeff		
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Parenting and work	SCQ F4a having both work and family responsibilities makes me a more rounded person	apawkmrp		
	SCQ F4l working leaves me with too little time or energy to be the kind of parent I want to be	apawklte		
Attitudes and values	SCQ D1h Mothers who don't really need the money shouldn't work	aatwkmsw	Not available	Not available
Weights	Responding person weight	ahhwtrp		
	Responding person longitudinal weight	Not available	Not available	clnwtrp

NOTE: Unless otherwise stated the equivalent variables for waves 2 and 3 exist and were also selected.

Variables created by us

Wave identifiers				
Presence of kids<15 and interview completed	If _hhrih in (1,4) and personal interview completed	W1	W2	W3
Family structure across the 3 waves	Six categories relating to whether number of kids increase, decrease or stay the same	afamstructure	bfamstructure	bfamstructure
Number of kids under 15	Sum of kids0-4, kids5-9, kids10-14	akidsu15	bkidsu15	ckidsu15

Appendix 2

Table 14 Description of multilevel models for change fitted to the *number of hours worked per week* data.

These models predict *hours currently worked per week* as a function of *Time* (at level-1) and various combinations of *family structure* and *highest education* (at level-2).

Level-1/level-2 specification			
Model	Level-1 model	Level-2 model	Composite model
A	$Y_{ij} = \varphi_{0i} + \varepsilon_{ij}$	$\varphi_{0i} = \gamma_{00} + \zeta_{0i}$	$Y_{ij} = \gamma_{00} + (\varepsilon_{ij} + \zeta_{0i})$
B	$Y_{ij} = \varphi_{0i} + \varphi_{1i} \text{time}_{ij} + \varepsilon_{ij}$	$\varphi_{0i} = \gamma_{00} + \zeta_{0i}$ $\varphi_{1i} = \gamma_{10} + \zeta_{1i}$	$Y_{ij} = \gamma_{00} + \gamma_{10} \text{time}_{ij} + (\varepsilon_{ij} + \zeta_{0i} + \zeta_{1i} \text{time}_{ij})$
C	$Y_{ij} = \varphi_{0i} + \varphi_{1i} \text{time}_{ij} + \varepsilon_{ij}$	$\varphi_{0i} = \gamma_{00} + \gamma_{01} \text{fam}_i + \zeta_{0i}$ $\varphi_{1i} = \gamma_{10} + \gamma_{01} \text{fam}_i + \zeta_{1i}$	$Y_{ij} = \gamma_{00} + \gamma_{01} \text{fam}_i + \gamma_{10} \text{time}_{ij} + \gamma_{11} \text{fam}_i \times \text{time}_{ij} + (\varepsilon_{ij} + \zeta_{0i} + \zeta_{1i} \text{time}_{ij})$
D	$Y_{ij} = \varphi_{0i} + \varphi_{1i} \text{time}_{ij} + \varepsilon_{ij}$	$\varphi_{0i} = \gamma_{00} + \gamma_{01} \text{fam}_i + \gamma_{02} \text{edu}_i + \zeta_{0i}$ $\varphi_{1i} = \gamma_{10} + \gamma_{01} \text{fam}_i + \gamma_{12} \text{edu}_i + \zeta_{1i}$	$Y_{ij} = \gamma_{00} + \gamma_{01} \text{fam}_i + \gamma_{02} \text{edu}_i + \gamma_{10} \text{time}_{ij} + \gamma_{11} \text{fam}_i \times \text{time}_{ij} + \gamma_{12} \text{edu}_i \times \text{time}_{ij} + (\varepsilon_{ij} + \zeta_{0i} + \zeta_{1i} \text{time}_{ij})$
E	$Y_{ij} = \varphi_{0i} + \varphi_{1i} \text{time}_{ij} + \varepsilon_{ij}$	$\varphi_{0i} = \gamma_{00} + \gamma_{01} \text{fam}_i + \gamma_{02} \text{edu}_i + \zeta_{0i}$ $\varphi_{1i} = \gamma_{10} + \gamma_{01} \text{fam}_i + \zeta_{1i}$	$Y_{ij} = \gamma_{00} + \gamma_{01} \text{fam}_i + \gamma_{02} \text{edu}_i + \gamma_{10} \text{time}_{ij} + \gamma_{11} \text{fam}_i \times \text{time}_{ij} + (\varepsilon_{ij} + \zeta_{0i} + \zeta_{1i} \text{time}_{ij})$

Y_{ij} number of hours worked per week for the i^{th} individual at j^{th} wave

fam family structure *edu* highest education achieved before wave 1

Appendix 3

In this appendix we present information on our tests for evaluating the assumptions underlying our exploratory Model E.

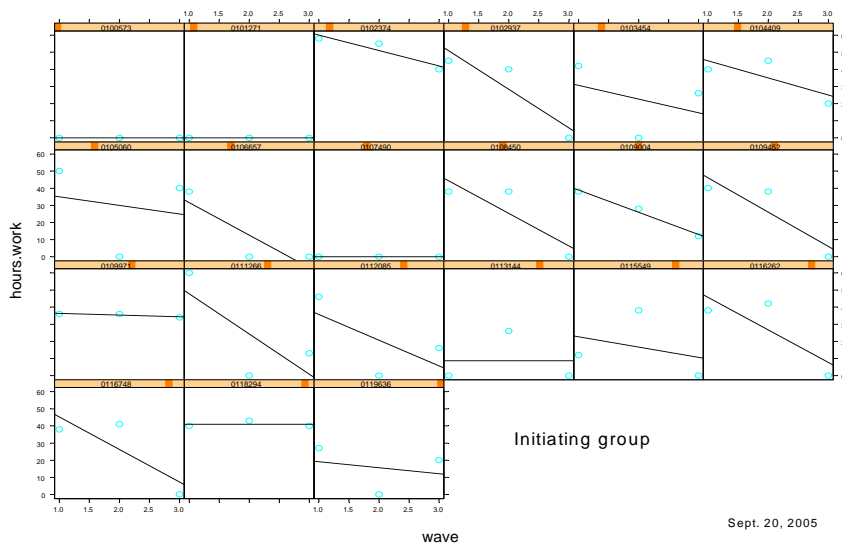
Functional Form

With only three waves of data we have only three data points for each individual so a linear model is the only realistic option. However we plot a sample of individual growth paths (trajectories) for both groups of the family structure variable just to make sure that the assumption is reasonable.

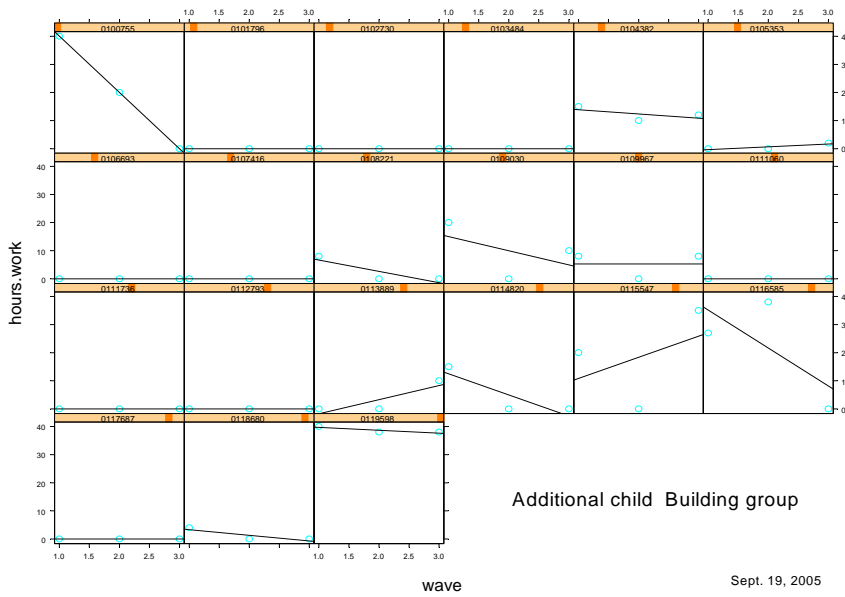
Level 1

For a sample of individuals in the two groups we plot estimated OLS-fitted trajectories

1) Initiating group: Sample of individuals with OLS-fitted trajectories for Hours Worked by Wave of HILDA



2) Building group: Sample of individuals with OLS-fitted trajectories for Hours Worked by Wave of HILDA



The linear functional form seems reasonable although there are two observations in the Building group where slope is positive when the rest are either flat or negative.

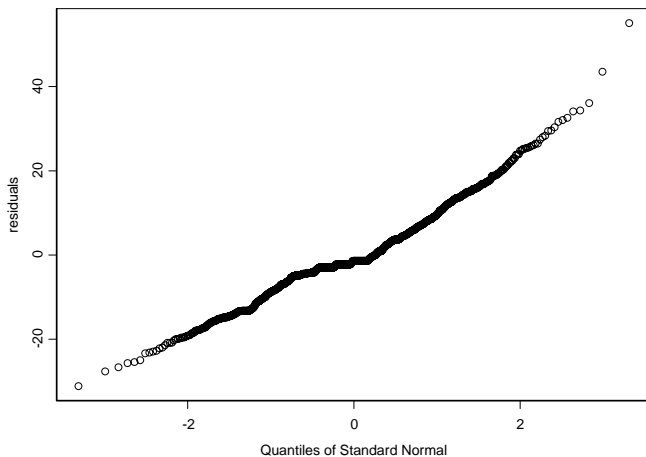
Level 2

Both our level two variables, *family structure* and *highest education achieved*, are dichotomous predictors and a linear model is de facto acceptable for such variables.

Checking normality

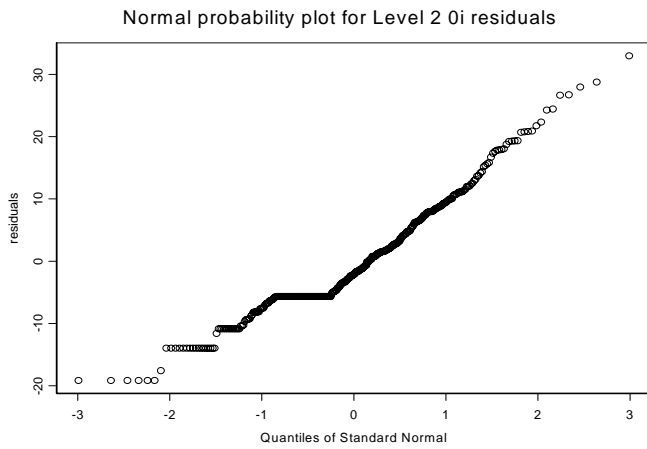
With the estimates of the level 1 residuals ie \mathcal{E}_{ij} we plot them against their associated normal scores to produce a normal probability plot where if the distribution is normal the points will form a straight line. This is shown in the next figure.

Normal probability plot for level 1 residuals



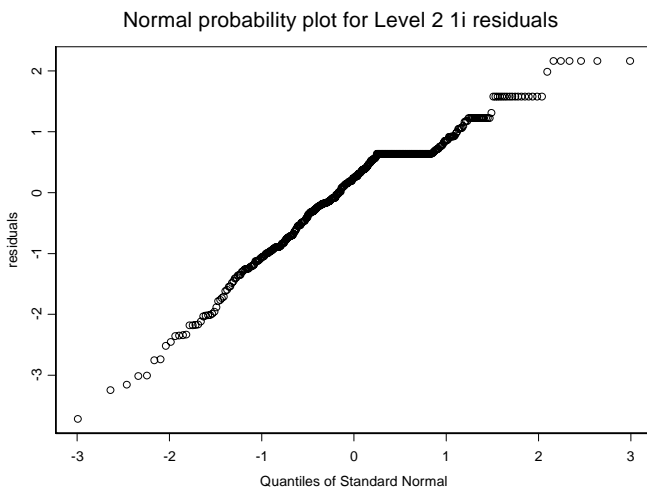
The data appear linear for this plot.

For the Level-2 residuals we examine the ζ_{0i} and ζ_{1i} residuals. The plot for the ζ_{0i} residuals is given first.



This plot has a foreshortened lower tail which falls closer to the centre zero than expected. This may be due to limited variability in the lower tail of the underlying distribution which results from the bounded nature of the *hours worked* variable where the lowest possible value of zero imposes a limit on the initial values.

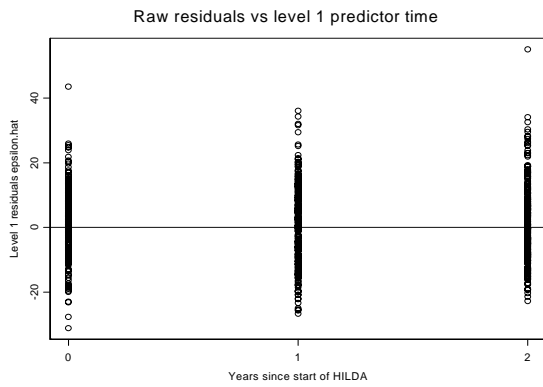
Next the plot for the ζ_{1i} residuals



This graph shows some foreshortening in the right hand end of the line but it is not to the same extent as in the plot for the Level 2 0i residuals.

Homoscedasticity

We evaluate the homoscedasticity assumption by plotting raw residuals against predictors. First the level-1 residuals against the level-1 predictor which is *Time*.

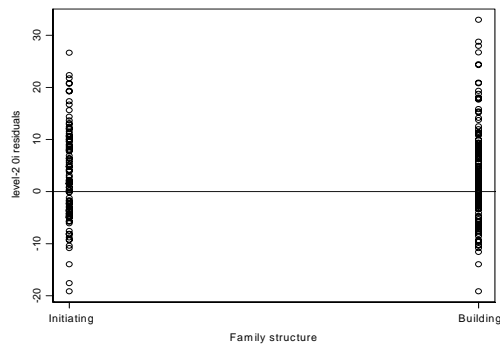


The level-1 residuals have approximately equal range and variability.

For the level-2 residuals there are two plots each for the ζ_{0i} and ζ_{1i} . One for each predictor variable.

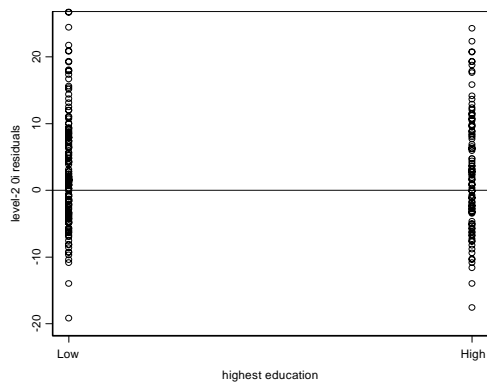
Level-2 ζ_{0i}

First for Family Structure, then Highest education



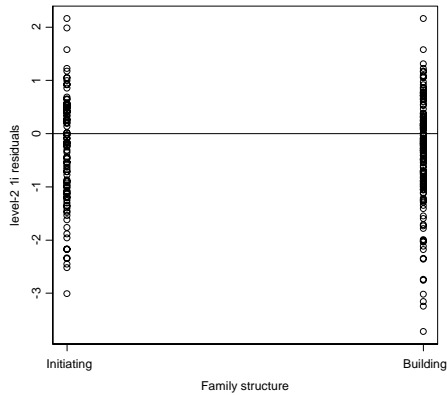
The residuals for *Family structure* have approximately equal range and variability.

Highest education likewise



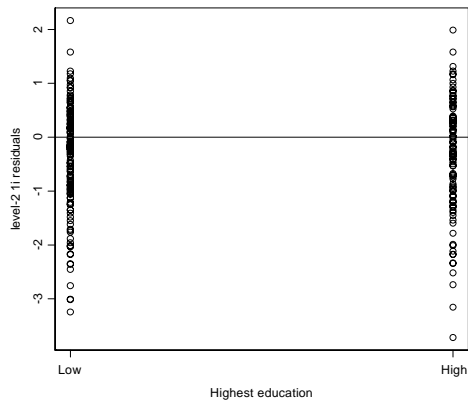
Level-2 ζ_{1i}

First for predictor variable *Family structure*.



The residuals for Building group have slightly greater spread than those for Initiating but it is difficult to reach a conclusive decision.

For predictor variable *Highest education*.



The residuals for *Highest education* have approximately equal range and variability. We conclude for this exploratory model the basic assumptions for the model are met.