Determinants of Maternal Leave Duration in Australia: Evidence from the HILDA Survey

Cahit Guven

Deakin University

Aydogan Ulker *

Deakin University

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Abstract

We use the first five waves of the HILDA survey to examine the determinants of maternity leave taken (both paid and unpaid) by pre-birth employed mothers in Australia. We find that the difficulties faced by mothers of newborn babies in finding the appropriate child-care in terms of both cost and quality hinder their ability to return to labour market on time following a childbirth. Maternity leave rights, by inducing workplace or labour market attachments, cause sooner return to labour market relative to those who have no leave rights at all. Those mothers who had higher hourly wage rates in their pre-birth employments tend to return to labour market quicker than their lower wage counterparts. Thus, these results suggest that higher pre-birth wage levels also induce workplace or labour market attachments. The flexibility of pre-birth jobs in terms of day or hour arrangements or special leave entitlements seems facilitate mothers' return to work earlier than average. On the other hand, household wealth seems to play a facilitating role to take a longer maternal leave for looking after the newborn child. That is, those mothers who have higher wealth levels can "afford" to stay on maternal leave longer to better nourish and look after their children. We believe that the findings of this paper provide strong insights on the current policy debate regarding universally paid maternity leave.

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*Corresponding author, mailing address: School of Accounting, Economics, and Finance, Deakin University. 221 Burwood Highway, Burwood, Victoria, 3125 Australia, tel: +61 3 924 43040, fax: +61 03 924 46283, e-mail: ulker@deakin.edu.au.

1 Introduction

As in most developed countries there is an increasing rate of maternal employment in Australia, however, we only know little about the factors which influence employment transitions of Australian mothers following the birth of a child. Australian employment policies in terms of parental leave rights differ significantly from the other developed OECD countries in many dimensions (see Ray (2008) for a detailed discussion). The current Australian practice is that new parents may use 52 weeks of unpaid family leave. A new mother may choose to either use all 52 weeks as maternity leave or to transfer one week to the child's father as paternity leave. Adoptive couples may divide the yearlong leave between the parents however they wish, including assigning all 52 weeks to one parent. Family leave is available to nearly all employees including "casual" employees, who are exempt from most employment standards, if they have at least a tenure of 12 months (Ray, 2008). This practice is likely to change as the current government proposed in its 2009-10 budget a means tested scheme of 18 weeks paid leave for mothers at the minimum wage. The scheme, however, will only be implemented from January 2011. To be eligible for the scheme, a mother in paid work (i) must have worked continuously with one or more employers for at least 10 of the 13 months before the expected date of birth or adoption; (ii) must have worked at least 330 hours in those 10 months (equivalent to around one full day of work each week); and (iii) must have an adjusted taxable income of 150 000 (Australian Dollars) or less in the financial year prior to the date of birth or adoption of the child (Commonwealth Budget 2009-2010).

James Heckman, 2000 Nobel laureate in Economics, stresses in his recent work

that early years of a child's life are important for prospects in later life. Heckman (2006), for example, provides scientific evidence that investing in early childhood well-being creates a persistent pattern of strong positive effects throughout the life cycle. Significantly these substantial long-term benefits are not necessarily limited to intellectual gains, but are most clearly seen by measures of 'social performance' and 'lifetime achievement'. The development of social, motivational and other emotional skills affects performance in school and the workplace. People who are in enriched early childhood environments are more likely to complete school and much less likely to require welfare benefits, become teen parents, or participate in criminal activities.

But it's not just for emotional and cognitive development that the early years are important. Physical health in later life is profoundly affected by experiences in the early years - even before birth. Barker (1998) has now compiled evidence from many countries showing that risks for many adult physical disorders - such as hypertension, coronary artery disease, some kinds of renal disease and 'adult-onset' diabetes - can be traced to a pattern of lower than average birth-weight followed by above average weight gain during later childhood.

Related to early childhood environments, length of maternity leave taken has been found to influence the well-being of working mothers and their newborn children through factors such as the quality of mother-infant interactions,the incidence and duration of breastfeeding, and immunisations (Barker et al. 2009; Berger et al. 2005; Brooks-Gunn et al. 2002; Klein et al. 1998). As the quality of family life is impacted by the quality of work life (and vice versa), maternity leave duration has also direct implications for pre-birth employed mothers' future labour market

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prospects in terms of labour force participation, wages, and working hour schedules (Arun et al. 2004; Beggs and Chapman 1988; Breusch and Gray 2004).

This paper investigates the determinants of maternity leave duration in Australia using a recent sample of pre-birth employed mothers constructed from the longitudinal Household Income and Labour Dynamics in Australia (HILDA) survey. Specifically, we examine the roles of household wealth, child-care accessibility, pre-birth job characteristics such as maternity leave entitlements, hours flexibility, and wage levels as well as the roles of household structures, education levels, and attitudes towards family and employment situations in determining the length of maternity leave taken by pre-birth employed mothers after having a newborn child. Addressing these issues are crucial in designing public policies which will, on the one hand, improve the well-being of mothers, their new born children and potentially their families as a whole and, on the other hand, will enable pre-birth employed mothers to successfully return to the labour market.

There has only been limited research on this topic in Australia due to mainly the unavailability of data. In the past, analyses of maternal employment transitions have been presented based on older, mainly cross-sectional data (Glezer 1988) and only recently Baxter (2005 and 2008) have looked at the impact of maternal leave use on the timing of return to work using data from the Longitudinal Study of Australian Children (LSAC). Along the lines of Baxter (2008), the paper utilizes the the rich information on the socio-demographic and economic characteristics of mothers from the HILDA survey.

The paper significantly contributes to the literature in several aspects. First, this analysis provides more detailed insights into maternal employment decisions

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following childbirth than is possible from conventional studies of cross-sectional data. Given a cross-sectional data set one is usually not able to derive, for example, the dynamics of socio-economic conditions such as the transitions in labour market status. By examining these dynamics in a longitudinal framework, we better identify the factors which influence maternal leave duration. In this regard, the HILDA survey provides an excellent opportunity as it has much detailed information on many variables such as household wealth, maternity leave entitlements (both paid and unpaid), and child-care accessibility which are crucial to have in examining the timing of mothers' return to work decisions.

Thus, among the rare longitudinal studies of maternity leave within the Australian literature, this study adds to Baxter (2008) which uses the LSAC. The analysis here, however, differs from Baxter (2008) in several important ways. The LSAC is, for example, limited by the availability of data on the use of leave, rather than the entitlements to leave and it is problematic to draw conclusions about how improved access to maternity leave might result in changes to the timing of return to work due to the potential endogeneity problem between leave use and return to work. In regards to this limitation of the LSAC, the HILDA fortunately provides information on both the paid and unpaid maternity leave entitlements in pre-birth jobs of mothers. [1]

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[1]One needs to acknowledge, however, that even for the maternal leave entitlements the found relationship between legal rights and the length of maternal leave taken may not be purely casual if women who would use longer maternal leave for some unobserved underlying reason without the rights anyway self-select themselves into those jobs with entitlements. We , however, are unaware of such documented evidence for the Australian labour market. Some recent work in the international literature have used "natural experiments" such as the exogenous expansion of governmental maternal leave programs in Canada, the U.K, or Germany to identify the causal impact of maternal leave rights on the return to work decisions of mothers (Baker and Milligan 2008; Burgess et. al 2008; Ludsteck and Schoenberg 2007). The current Australian government

The advantage of using the HILDA survey is not limited by this. The LSAC also lacks information on the most important variables such as household wealth and child-care accessibility which are also available in the HILDA survey. Moreover, the LSAC sample is biased towards those more connected to the labour market, however, the HILDA survey is representative of the entire population of Australia. Last but not least, as opposed to 18 months in the LSAC, the HILDA survey allows to identify employment transitions within 5 years following the birth of a child and it also has detailed information on the leave taken before the birth of a child so that the total maternal leave taken from the labour market can be calculated in a more accurate way. Thus, given these advantages of using the HILDA survey, this paper provides a more complete picture of the determinants of maternity leave duration within the Australian labour market.

2 Related Literature

Women face a tradeoff between social benefits and economic costs when making decisions about how long time to take off from the labour market following the birth of a child. On the social side, they need to, for example, consider the importance of being home with their children during their primary developmental months and the quality of care that their children receive. On the economic side, however, they might take into account employment related factors such as the households' "abil-

proposal in this regard would serve as a natural experiment when it is implemented in 2011, however there is still some time before the appropriate data would be available. As we will further describe later in the paper, in order to tackle this issue, we consider a Weibull-Gamma Mixture duration model which accounts for the unobserved heterogeneity. Moreover, we believe that our control of some attitudinal variables pertaining to work and family importance helps us to proxy some of those unobserved heterogeneity.

ity" or wealth in affording to stay at home longer, the need for female income in supporting the households' living expenses in the immediate period after the birth, the opportunity cost of taking care of children at home rather than participating in the labour market, and the expectations regarding the effects of staying home longer for their future labour market attachments and wage levels.

While there is little Australian research on the employment transitions of mothers after giving a birth, some of the factors associated with return to work decisions and their timings have been examined for several developed countries and presented in the international literature. A recent study by Burgess et al. (2008), for example, uses a cohort of 12,000 births from the U.K. to examine the effect of maternity rights on mothers' post-birth return to employment decisions. They find that mothers with rights have an underlying (but unobserved) stronger attachment to the labour market that prompts earlier return than on average. However, using data from Canada, Baker and Milligan (2008) find that modest leave entitlements of 17-18 weeks do not change the amount of time mothers spend away from work. In contrast, longer leaves do have a substantive impact on behavior, leading to more time spent at home. They also find that entitlements increase job continuity with the pre-birth employer. The results of this study could be particularly relevant for the Australian case as the current government proposal only gives 18 weeks of paid maternity leave entitlements. Similarly, Ludsteck and Schoenberg (2007) use data from the Germany to analyse the impact of expansion in the leave coverage on mothers' labour market outcomes after childbirth. They find strong evidence that each expansion induced women to delay their return to work. They also find that most of these effects were short term in the sense that the expansions

had little impact on women's labour supply in the long run.

Berger and Waldfogel (2004) provide a good summary of the literature on post-birth employment decisions of the U.S. mothers. In this literature, the consensus is that women who worked during pregnancy are more likely to work after birth and return more quickly than women who did not work during pregnancy (Smith, Downs and OConnell, 2001). With regard to the effects of maternity leave entitlements in the U.S., there is evidence that leave policies indeed influence the return to work decisions of new mothers. Waldfogel (1999) finds that the legislation of the 1993 Family and Medical Leave Act in the US (which guaranteed 12 weeks of job-protected maternity leave for qualifying women) led to increased leave-taking among the newly-covered. Similarly, Ross (1998) estimates that leave durations for those who gained coverage rose significantly after the introduction of the act.

Gutierrez-Domenech (2005) compares women's transitions from employment to nonemployment after first birth in Belgium, Germany, Italy, Spain and Sweden. She shows that Spain and Germany are the countries with the lowest staying-on rates in the labour market after childbearing. Over time, Spanish mothers increased their probability of post-birth employment, but the opposite occurred in Germany. She argues that the shift towards a separate taxation system, the increase in education and part-time employment are potential explanations for these trends in post-birth employment. Other similar comparative studies include, for example, Pylkkanen and Smith (2003) for Denmark and Sweden, Ronsen and Sundstrom (2002) for Scandinavian countries such as Finland, Norway and Sweden, and Waldfogel et. al (1999) for the U.S., the U.K. and Japan. Of course these international studies might be informative in terms of policy perspectives, however,

they may not directly apply given the Australian employment policies and maternal leave rights significantly differ from those developed countries mentioned above.

In addition to maternal leave entitlements,another important factor in making return to work decisions of mothers following childbirth can be the accessibility of child-care in terms of both cost and quality. In the international literature there is now a huge of body of empirical research examining the joint decisions of child-care use and labour supply of women. Anderson and Levine (1999) survey the existing evidence prior to 1999 regarding the responsiveness of female labour supply to child care cost and then investigate the variation in the response to child-care cost across different skill levels by implementing models similar to those used in the past literature. They find that while the overall elasticity of labour force participation with respect to the market price of child care is between -0.05 and -0.35, this elasticity is larger for the least skilled women and declines with skill. Among relatively more recent examples of such studies from the international literature, Powell (2002) and Michalopoulos and Robins (2000, 2002) still identify a negative influence of child-care costs on female labour market participation for the U.S. and Canada. The negative relationship between female labour force participation and child care cost has also been found in the Australian studies. Doiron and Kalb (2002, 2005), for example, find this negative impact and they also find that the effects are larger for lone parents and those women facing limited labour market opportunities in the form of low wages. Given these close connections between child care and maternal labour force participation suggested by the existing evidence, one can imagine that affordable and accessible quality child care might significantly impact the duration of leave mothers take after giving a birth.

As mentioned above when making return to work decisions, mothers might also be concerned about the implications of their labour force participation for the physical, cognitive and emotional developments of their children because maternity leave duration has been found to influence the well-being of not only the young children but also their mothers. Among such studies, Klein et al. (1997) find a negative association between a shorter leave and the quality of maternal interactions with the infants. Mothers who either reported more depressive symptoms or who perceived their infant as having a more difficult temperament and who had shorter leaves, compared with mothers who had longer leaves, were observed to express less affect, sensitivity, and responsiveness in interactions with their infants. Baker and Milligan (2008) also find very large increases in mothers time away from work post-birth and in the attainment of critical breastfeeding duration thresholds in Canada. Essex et al. (2006) find a relationship between the length of maternal leave and the children's mental health. Scott et al. (2006) suggest that improved maternity leave provisions and more flexible working conditions may help women to remain at home with their infants longer and to combine successfully breastfeeding with employment outside the home.

Moreover, Berger et al. (2005) find considerable associations between early returns to work and childrens health outcomes suggesting causal relationships between early returns to work and reductions in breastfeeding and immunisations, as well as increases in externalising behaviour problems. These results are generally stronger for mothers who return to work full-time within 12 weeks of giving birth.

Considering the aggregate effects of parental leave policies on child health outcomes, Tanaka (2005) shows the effects of both job-protected paid leave and other

leave- including non-job-protected paid leave and unpaid leave- on child health outcomes, more specifically, infant mortality rates, low birth weight and child immunisation coverage using data from 18 OECD countries from 1969-2000.

There is a strong relationship found (Klein et al. 1998; Chatterji and Markowitz 2000) between the mental health of the women after birth and the maternity leave duration. Distress was associated with job overload, role restriction, and infant distress. Depression was greatest among women relatively high in work salience when leaves were long. Anxiety and anger were greatest among women whose employment status was not congruent with their preferences. These interactions underscore the importance of individual differences in responses to leave and work.

In our data, although mothers' concerns regarding these well-being roles of maternal leave are not directly measured we believe that some of our explanatory variables such as wealth, education levels, cultural backgrounds and attitudes towards work and family will help us proxying those concerns to some degree. Education, for example, might proxy them in terms of "awareness" but wealth or income might proxy the "affordability" of them. Although those mothers with higher household wealth or income might afford to take time off from the labour market for longer as a well-being measure, those with lower wealth or those who are liquidity constrained in terms of income levels may not be able to do so.

3 Data Description

The paper uses the first five waves of the HILDA survey. The HILDA survey is a household-based panel study which began in 2001. It collects information on eco-

nomic and subjective well-being, labour market and family dynamics. Especially from the perspective of the this paper, it has detailed information on household wealth, perceived difficulties in child-care access, job characteristics including paid and unpaid maternity leave entitlements and flexibility of jobs in terms of hours and other arrangements, and the duration of leave taken from the labour market both before and after the birth of a child. The wave 1 of the panel consisted of 7682 households and 19,914 individuals. Interviews are conducted annually with all adult members of each household.

Although currently seven waves of the HILDA survey are available, only in the fifth wave each mother is specifically asked regarding the exact duration of leave taken from the labour market both before and after the most recent birth she has given. Thus, our sample includes all pre-birth employed mothers whose most recent children were born during the first five waves of the survey. We did not include the births after the fifth wave as we do not know the exact duration of maternal leave for those children. We also exclude births before the first year of the data as our study required information on mothers' pre-birth employment characteristics which are not available for those births.

There are 401 such women in the HILDA who gave birth during the first five years of the survey and were also employed before birth. As mentioned, the HILDA survey provides information not only on the leave following the birth of a child but also the leave taken in the immediate period before the birth. Thus, in our empirical analysis one definition of leave that we use simply involves the leave taken after birth whereas our second definition considers the total leave duration which sums both the before and after leave durations. In the survey while some

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respondents reported their leave in weeks the others reported in months. In terms of consistency across all mothers we re-calculated durations in months for those who reported in weeks. Considering leave before birth, average leave duration is 3.3 months. After birth, 268 out of 401 mothers have completed their leave spells and returned to work with an average leave length of 7.6 months. The remaining 133 mothers, however, are still on maternal leave and treated as censored observations in the empirical analysis which will follow. Including all mothers, both censored and completed spells, average total length of maternity leave is calculated as 11.5 months. Figure 1 below presents the overall frequency distribution of maternal leave duration across the sample in terms of both the leave taken after birth and total leave definitions. The distributions for both cases suggest that there is a great deal of heterogeneity in mothers' maternal leave durations. While a significant share of women are away from the labour market for a short time only such as 3 months, still a fair number of women take a much longer time off such as 20 months or more.

As stressed in the previous sections, in terms of explaining the variation in mothers' maternal leave duration our empirical focus will be on factors such as household wealth, child-care accessibility, pre-birth job characteristics pertaining to maternity leave rights and hours flexibility as well as other demographic and economic variables such as education levels, marital status, and attitudes towards family and employment situations.

In this regard, we use household wealth data available from the wave 2 to proxy for mothers ability to financially "afford" taking longer leaves to nourish their newborns during their primary developmental stages. Ideally, one would like

to use a pre-birth household net worth measure to avoid any potential reverse causation problem between wealth and leave duration after birth. However, this is not possible for all observations due to the fact that during the first five waves of the HILDA only wave 2 collected wealth data. For the births given after wave 2 (a majority of 401 births), nevertheless, the available wealth measures are indeed the pre-birth net worths of the corresponding households. Although we keep in mind this potential problem for births given in the first or the second wave, we still think that it is likely to be a minor issue as household net worth usually do not change drastically within one or two years unless there is a huge wealth shock.

With respect to the role of child-care accessibility on mothers' timings of return to work decisions, the HILDA includes in each wave several questions on different aspects of perceived difficulty in finding child-care. Some of these questions are, for example, related to the cost of child care, some are related to its quality, and some others are related to its flexibility. [2] Fortunately, each parent who has at least one child aged 0-17 is asked these perception questions even when he or she has not even actually used any formal or informal child-care. If, on the other hand, these self-reported measures of child-care accessibility were reported only for those who actually used the child-care we would face a selection problem. [3]

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[2]The full list of these questions is provided in the Appendix. Their answers are categorial variables taking values 0-10 where 0 is very easy and 10 is very difficult

[3]One might think that self-reported difficulty measures may not ideally reflect the "objective" child-care accessibility. To overcome this issue, some studies such as Yamauchi (2009) use the number of accredited child-care centers in the parents' neighborhood to proxy the "objective" measure of child-care accessibility. However, one can clearly criticize this measure as well, because many parents might, rather than choosing the child-care centres in their own neighborhoods, use a nearby centre in another neighborhood or they might want to be at a closer distance to their children during working hours and choose a centre near their workplace. Thus, it is not really clear which number of centres to use to proxy the actual child-care accessibility unless the parents live and work in the same neighborhood or we know their both the working place zip codes and

Using the eleven perceived difficulty measures, we create an overall child-care accessibility index of each mother for the first year following the birth of her child which is simply equal to the sum of those difficulty indicators. Creating the accessibility index in this way is justified by showing, in table 1, that these measures are not highly correlated with each other and it is sensible to sum their values to take the mean.

Among other major explanatory factors of maternal leave duration, we consider mothers' pre-birth job characteristics with regards to maternity leave rights or flexibility. Given the current Australian practice, some mothers are able to use both paid and unpaid leave whereas others are eligible for either paid or unpaid leave only and the remaining ones whose job tenure with their pre-birth employers will be generally less than twelve months are not entitled with any leave rights. Fortunately, each female adult in the HILDA is asked about their maternity leave entitlements with their current employers in each wave. Thus, we are able to extract the pre-birth leave entitlements for our sample of 401 mothers who gave a birth during the first five years of the HILDA survey. Out of those 401 mothers, 124 are eligible for both paid and unpaid leave, 18 are able to use paid leave only, 107 can use unpaid leave when they wanted and the remaining 152 are not entitled with any leave rights. [4]

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the living address zip codes which are unlikely to be available in almost all surveys. Indeed, self perceptions of difficulty in finding the appropriate child care might be more relevant than the actual child-care accessibility when making decisions regarding self-employment decisions in terms of the duration of maternal leave.

[4]In the HILDA survey, although we are able to identify whether a mother is covered by paid or unpaid maternity leave rights, we are unable to ascertain the "coverage intensity" in terms of length of those entitlements. Thus, in the present study we cannot investigate the coverage intensity effects on the duration of mothers' actual leave from the labour market.

For the measurement of job flexibility, we use information on mothers' ability to use (i) flexible finish and start times, (ii) permanent-part time work arrangements, (iii) home based work arrangements, and (iv) special leave for caring family members. Using the dummy indicators for each of these job features, we create an index similar to that was done for the case of child-care accessibility. This time, however, the index is simply the sum of these four dummy indicators. The higher the value of the index, the more flexible the job is. The justification of the index is again done by looking at the correlation matrix of these four dummy variables in table 2.

Among other potential factors in explaining the variation in maternal leave durations, we also include information on other pre-job characteristics such as tenure in the occupation, occupational status, wage levels and job satisfactions.

Following the birth of the child, we think that variables on household structures in terms of marital status, number of current children and future child expectations, parenting responsibilities, and health status might be relevant and thus, include them in the empirical analysis. These variables are measured for the first year following the birth of the child.

We also include some general variables such as education levels, age, birth of country, and attitudes towards work and family. The full list of these independent variables and their descriptive statistics are provided in table 3 .

4   Empirical Framework

Because we examine the length of mothers' maternal leave from the labour market following the birth of a child, our estimation strategy involves implementing duration models in two different specifications. In our first specification, we estimate a Weibull-Gamma Mixture duration model whereas we perform a Cox Proportional Hazard model in our second estimation method. [5] Of course, each model has its own advantages and disadvantages. In this regard, while Cox Proportional Hazard model is a semi-parametric method which is less restrictive in the sense that it does not make any parametric assumption regarding the baseline hazard rate, with the Weibull-Gamma Mixture model, we are easily able to control for unobserved heterogeneity although it has more parametric assumptions. Given the tradeoff, thus, we present the results from both models.

As we briefly discussed previously, controlling for unobserved heterogeneity can be crucially important within the context of maternal leave duration if there are some unobservable characteristics of women that are correlated with maternal leave entitlements. Thus, although we impose distributional restrictions on the form of heterogeneity by using the Weibull-Gamma Mixture method, we believe that it is an easy and useful way of "netting out" their influence in identifying the impact of maternal leave rights on mothers' duration of leave from working following the childbirth. To release some of the distributional assumptions, on the other hand, we use the Cox Proportional Hazard model to see if our results are

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[5]Due to the overriding concern of keeping the paper as short and focused as possible, here we only describe our empirical strategy. For a nice and simple theoretical framework with respect to how maternity leave rights or other factors might influence mothers' timing of return work to decisions, see Burgess et al. (2008).

robust to both specifications, recognizing the fact that we do not control for the unobserved factors in this case.

In mathematical terms, each model can be represented as follows:

Cox Proportional Hazards Model:

The proportional hazards model developed by Cox (1972) is a flexible model that does not assume a specific from for the baseline hazard. The absence of a need to parameterize time dependency is a significant advantage in most applications, since our theories might often not allow us to specify a priori what specification should be used, and the parameterizations chosen can have a large impact on the substantive conclusions drawn. The hazard rate for the proportional model is:

$$h_i(t|X_i) = h_0(t)e^{(\beta' X_i)} \ ,$$

where $h_0(t)$ is the (unspecified) baseline hazard function and X_i are covariates for individual i. Such models are typically estimated via a quasi or partial-likelihood procedure in which the term for the baseline hazard is treated as a nuisance parameter and integrated out of the likelihood. Thus, the model assumes that the hazard functions of any two individuals with different values on one or more covariates differ only by a factor of proportionality. The baseline hazard rate varies with time but not across individuals so that the ratio of the hazards for individuals i and j are independent of t and are constant for all t:

$$\frac{h_i(t)}{h_j(t)} = e^{\beta(X_j - X_i)} \ ,$$

In terms of deriving the likelihood function to be maximized, one needs to

use the hazard rate which captures the relationship between failure times and the survival function, $h_i(t) = [\frac{f_i(t)}{S_i(t)}]$. Failure in our case means return to work and survival function gives the probability of no failure beyond time t. Because $f_i(t) = -[\frac{\partial S_i(t)}{\partial t}]$, one can derive the probability density of failure $f_i(t)$ and the survival function $S_i(t)$ by solving

$$h_i(t) = -[\frac{[\frac{\partial S_i(t)}{\partial t}]}{S_i(t)}] = -[\frac{\partial ln S_i(t)}{\partial t}] \ ,$$

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Given the density functions of the failure time $f_i(t)$ and the survival function $S_i(t)$, one can then write the general likelihood function as

$$L = \prod_{i=1}^{n} \{f_i(t)\}^{\delta_i} \{S_i(t)\}^{(1-\delta_i)} \ ,$$

the term δ_i censoring indicator where the value is zero if the observation is right censored and one if the observation is uncensored.

Due to the proportionality assumption of the model, one can re-arrange this general likelihood function and integrate the baseline hazard rate out of the likelihood in order to partially maximize its remaining portion and estimate the unknown parameters of β.

Weibull-Gamma Mixture Model:

The Weibull model is also a proportional hazard model where the baseline hazard rate is parameterized as $h_0(t) = pt^{p-1}e^{\beta_0}$ where p is the shape parameter estimated from the data and it implies a monotonically increasing hazard function

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when $p > 1$ or a monotonically decreasing hazard function when $p < 1$. In the Weibull-Gamma Mixture model, the Weibull specification is used together with a random unobserved heterogeneity component v_i which has a gamma distribution with mean 1 and variance θ.

The general form of a Weibull-Gamma Mixture model hazard rate for each individual i (or women i in our case) can be represented as

$$h_i(t|X_i, v_i) = h_0(t)v_i e^{(\beta' X_i)}, \quad v_i \sim (1, \theta) \ and \ v_i > 0 \ ,$$

By substituting $h_0(t) = pt^{p-1}e^{\beta_0}$ into the above equation, we can re-write the hazard rate of the Weibull-Gamma Mixture model as

$$h_i(t|X_i, v_i) = pt^{p-1}e^{\beta_0}v_i e^{(\beta' X_i)} \ ,$$

To derive the likelihood function, one can follow the same steps we have mentioned for the Cox Proportional Hazards model and then estimate the unknown parameters of p and β using a Maximum Likelihood Estimation method. Only difference in this case, however, is that, rather than using a partial maximization, the full likelihood function can easily be maximized due to the parametrization of the baseline hazard rate. [6]

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[6]For further details of implementing Weibull-Gamma Mixture model, see, for example, Cameron and Trivedi (2005) and Cleves et al. (2002).

5 Empirical Results

First we estimate the Weibull-Gamma Mixture model to look at the impact of our control variables on the total maternity leave (sum of both before and after birth leave) duration. We also estimate the same model for after birth duration only to see if our results change because one might think that motivations for leave taking before and after birth might be different due to the fact that while there would be a newborn baby for after birth period who needs to be looked after the same issue does not arise for before birth period. Both sets of results are presented in table 4. Because the impacts of independent variables are reported in hazard ratios, for a given covariate, a ratio which is less than one means that the independent variable is associated with increased maternal leave duration as it decreases the hazard rate of returning to work. An hazard ratio which is greater than one, on the other hand, implies that the corresponding independent variable increases the probability of returning to work thereby decreasing the survival rate of being on maternal leave.

Given the interpretation of an hazard ratio, we now focus on the results for our main explanatory variables of interest which are child-care accessibility index, pre-birth job characteristics in terms of maternity leave entitlements, job flexibility and wage levels, and household wealth.

Looking at the results for total leave duration, with a highly significant hazard ratio which is smaller than one, the estimate for child-care accessibility index suggests that the difficulties faced by mothers of newborn babies in finding the appropriate child-care in terms of both cost and quality hinder their ability to return to labour market on time following a childbirth. On the contrary, however,

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the flexibility of pre-birth jobs in terms of day or hour arrangements or special leave entitlements seems facilitate mothers' return to work earlier than average as the estimated hazard ratio for job flexibility index is greater than one, although statistically not significant. Household wealth which has a statistically significant hazard ratio of 0.998 also, however, seems to play a facilitating role to take a longer maternal leave for looking after the newborn child. That is, those mothers who have higher wealth levels can "afford" to stay on maternal leave longer to better nourish and look after their children. Thus, we interpret the wealth hazard ratio as mothers' concern and "ability" for both own and child welfare. In regards to the influence of maternity leave entitlements and pre-birth wage levels we notice some interesting results as well. We find that relative to the base group of mothers with both paid and unpaid maternity leave rights, hazard ratios for maternal leave entitlements for paid only, unpaid only and no entitlement mothers are all smaller than one and monotonically decreasing for the respective three categories of mothers. Especially, the hazard ratio of the mothers with no leave entitlements, whether paid or unpaid, turns out to be statistically significant. These findings suggest that maternity leave rights, by inducing workplace or labour market attachments, cause sooner return to labour market following the birth of a child relative to those who have no leave rights. This finding is especially important as the current Australian government is proposing to introduce a paid leave scheme up to 18 weeks. One needs to keep in mind however that our results, although shed some light on the issue, might not directly apply to the proposed policy changes as the source of funding for the leave entitlements might matter. In the current system the firms have a discretion and they might have been paying maternal leave from their own

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budget. The proposed leave entitlements however will be paid from government funding so that the implications for workplace attachments could be different.

Pre-birth wage levels has also a similar impact to that of maternity leave entitlements on the leave duration. For the wage control variable, a statistically significant hazard ratio which is greater than one implies that those mothers who had higher hourly wage rates in their pre-birth employments tend to return to labour market quicker than their lower wage counterparts. Thus, these results suggest that higher pre-birth wage levels also induce workplace or labour market attachments.

In addition to these main variables of interest, we have included several other control variables in our estimation such as basic demographic characteristics (age, marital status, education, total number of children, country of birth), parenting responsibility, and some attitudinal variables such as importance of family, importance of work/employment situations and future child expectations. To highlight some of the significant results related to those variables, we find that, relative to single mothers, married mothers are more likely to return to work earlier. Potential explanations for this finding might include a higher likelihood of dependence on government welfare programs among single mothers, hence taking longer durations to return to labour market or in some cases no return at all. With regards to the level of education, we find that more educated mothers, potentially due to better awareness of well-being implications maternal leave length, keeping everything else constant take a longer time to return to work and spend more time with their children during their primary developmental months. As one would expect, the attitudinal variables (importance of work and family) have opposite impacts

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on maternal leave duration. While those who perceive that family is the most important thing take a longer leave, those who believe that work or career situations are the most important take a shorter leave and hence return to work earlier. These results for attitudinal variables are of interest as they consistent with our hypothesis that they proxy to some extent the unobserved attitudes towards work and family. Remaining control variables such as future child expectations or being Australian born turn out to be, however, insignificant in explaining the variations in the maternal leave durations of Australian mothers.

In terms of the robustness of our results, one can see from the table 4 that the estimation results for after birth durations yield pretty much the same implications with regards to the associations between the independent variables and the dependent variable of maternal leave durations.

Remembering that one of the major reasons of using the Weibull-Gamma Mixture model was being easily able to control for the unobserved heterogeneity through the random component v_i which had a gamma distribution with mean 1 and variance θ. Thus, in table 4, we also report the hazard ratios of the parameter θ along with the Likelihood Ratio (LR) test statistics of θ being equal to zero. As one can see, for both after birth and total duration specifications, we reject the null hypothesis of no unobserved heterogeneity. Thus, the overall results suggest that, although we find evidence in favor of unobserved heterogeneity, there are still significant associations between the observed independent variables and maternity leave duration beyond the control of the unobserved heterogeneity. As explained previously, this result is particularly relevant for the influence of maternity leave entitlements on maternal leave durations.

Although the Weibull-Gamma Mixture model allows us to maximize the full likelihood function and controls for the unobserved heterogeneity easily, it is more restrictive compared to a Cox Proportional Hazard model due to additional distributional assumptions. With Cox Proportional Hazard model one, for example, does not need to specify a baseline hazard rate. Thus, to see how robust our results are to this parametric assumption, we repeat the above exercise with the Cox Proportinal Hazard model and report the results in table 5 for both after birth and total maternal leave durations . We find basically the same substantive results with respect to our main variables of interest. That is, maternity leave entitlements, job flexibility and higher wage rates at pre-birth workplace increase the probability of returning to work quicker while difficulties in child-care accessibility and a higher wealth seem to cause a delay in returning to work.

In our final step of sensitivity check of the previously reported results, we include some additional pre-birth job variables which were not included in the initial regressions. Those variables include self-reported job satisfaction, occupational tenure, and occupational status scale.[7]The results are presented in table 6.[8] They show that our basic results with respect to the previously used variables stand and the added variables imply a quicker return to labour market but the magnitudes of the implied effects for those added variables are statistically insignificant.

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[7]Given the current Australian policy, tenure with the pre-birth employer will be highly correlated with maternity leave right dummies, thus it is not included in the regressions.

[8]Because it did not matter whether we used the Weibull-Gamma Mixture model or the Cox Proportional Hazard model, we only report the results using the former rather than the latter.

6   Conclusion

We examine the determinants of maternity leave taken (both paid and unpaid) by pre-birth employed mothers in Australia using the first five waves the HILDA survey. Our empirical analysis has led to the following main conclusions.

We find that the difficulties faced by mothers of newborn babies in finding the appropriate child-care in terms of both cost and quality hinder their ability to return to labour market on time following a childbirth. Maternity leave rights, by inducing workplace or labour market attachments, cause sooner return to labour market following the birth of a child relative to those who have no leave rights at all. Those mothers who had higher hourly wage rates in their pre-birth employments tend to return to labour market quicker than their lower wage counterparts. Thus, these results suggest that higher pre-birth wage levels also induce workplace or labour market attachments. The flexibility of pre-birth jobs in terms of day or hour arrangements or special leave entitlements seems facilitate mothers' return to work earlier than average. On the other hand, household wealth seems to play a facilitating role to take a longer maternal leave for looking after the newborn child. That is, those mothers who have higher wealth levels can "afford" to stay on maternal leave longer to better nourish and look after their children.

Among our secondary results, we find that relative to single mothers, married mothers are more likely to return to work earlier. With regards to the level of education, we find that more educated mothers, potentially due to better awareness of well-being implications maternal leave length,take a longer time to return to work and spend more time with their children during their primary developmental months. Finally, while those who perceive that family is the most important thing

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take a longer leave, those who believe that work or career situations are the most important take a shorter leave and hence return to work earlier.

Given the fact that maternal leave length has close ties to mothers' employment decisions and hours of work, and significant impacts on mothers' and children's well-being, the results have important implications for the Australian public policy. Thus, the findings of this paper provide strong insights on the way that the mothers will respond to a given regime of maternity rights and the likely consequences of the Australian policy change which will be implemented staring from 2011.

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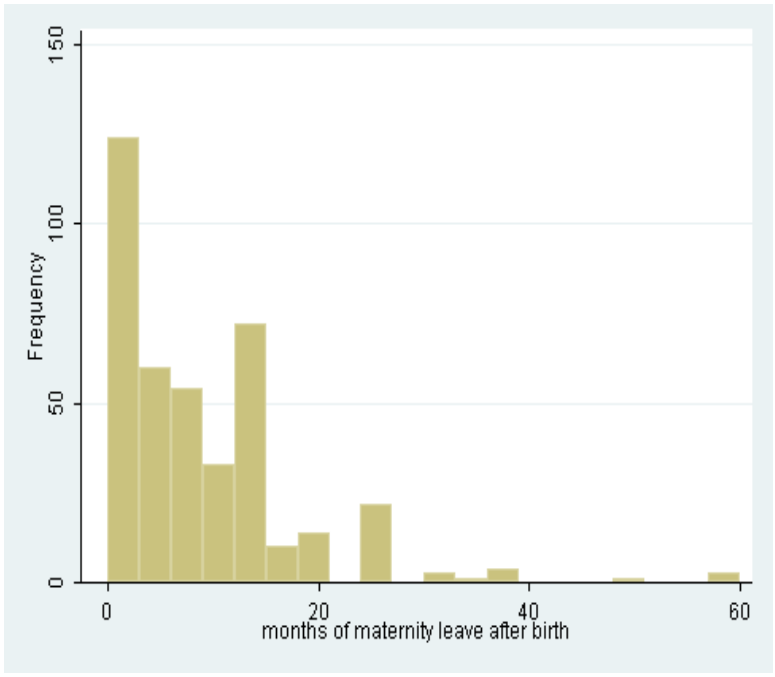
(a) months of maternity leave after-birth
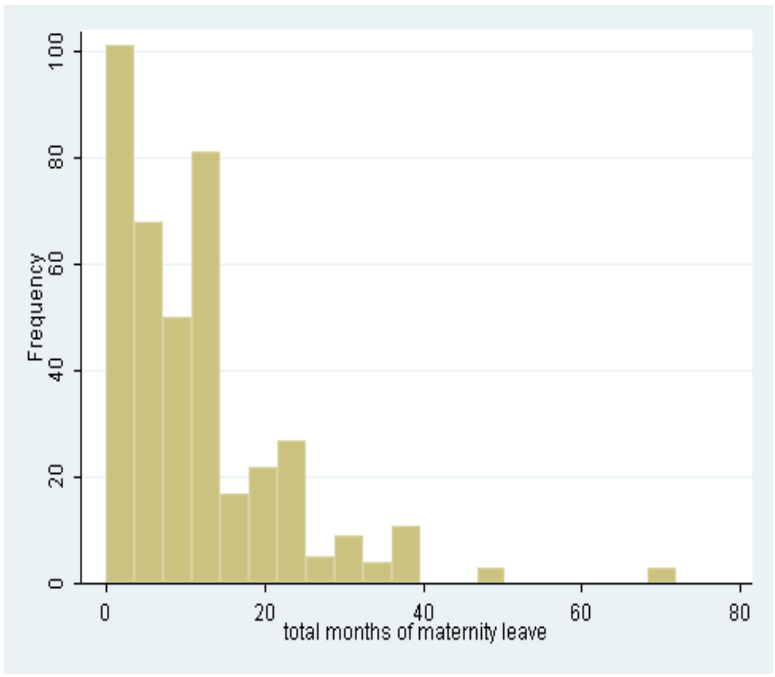
(b) total months of maternity leave

Figure 1: Length of maternity leave in Australia

Table 1: **Correlation matrix: Measures of perceived difficulty in finding child-care**

	dif1	dif2	dif3	dif4	dif5	dif6	dif7	dif8	dif9	dif10	dif11
dif1	1.0										
dif2	0.7	1.0									
dif3	0.6	0.7	1.0								
dif4	0.3	0.4	0.4	1.0							
dif5	0.2	0.2	0.1	0.1	1.0						
dif6	0.8	0.7	0.6	0.3	0.2	1.0					
dif7	0.7	0.6	0.6	0.4	0.1	0.8	1.0				
dif8	0.5	0.5	0.5	0.4	0.1	0.5	0.5	1.0			
dif9	0.8	0.7	0.6	0.4	0.2	0.8	0.7	0.5	1.0		
dif10	0.7	0.7	0.6	0.4	0.1	0.8	0.9	0.5	0.7	1.0	
dif11	0.5	0.5	0.6	0.5	0.1	0.5	0.6	0.5	0.6	0.6	1.0

Notes: The table presents the correlations among 11 different measures of perceived difficulty in finding child-care which take values 0-10. These are in order: Difficulty in last 12 months- 1) finding a place at the child-care centre of choice. 2) finding care my children are happy with. 3) with the cost of child care. 4) finding care during the school holidays. 5) finding care for a difficult or special needs child. 6) finding good quality child-care. 7) getting care for the hours needed. 8) juggling multiple child-care arrangements. 9) finding a child care centre in the right location. 10) finding the right person to take care of my child. 11) finding care for a sick child.

Table 2: **The correlation matrix: Measures of job flexibility**

	flexibility1	flexibility2	flexibility3	flexibility4
flexibility1	1.0			
flexibility2	0.5	1.0		
flexibility3	0.2	0.2	1.0	
flexibility4	0.3	0.3	0.5	1.0

Notes: The table presents the correlations among 4 different measures of job flexibility which take values 0-1. The variables in order are: Able to use: 1) special leave for caring family members? 2) permanent part-time work in current job? 3) home based work in current job? 4) flexible finish and start times?

Table 3: Independent variables' means, proportions, and standard deviations (in parentheses)

Variable	mean	stdev
Australian born	82.5	0.02
non-Australian born	17.5	0.02
number of children	1.9	0.97
age	33.2	5.46
married	92.3	0.13
not married	7.7	0.13
<university	41.8	0.03
university	24.9	0.02
>university	33.2	0.02
wealth	290944.2	417660.10
good health	61.1	0.02
bad health	38.9	0.02
child-care accessibility index	20.8	25.5
job flexibility index	2.1	1.3
both paid and unpaid maternity leave rights	30.9	0.02
paid maternity leave rights only	4.5	0.02
unpaid maternity leave rights only	26.7	0.03
no leave rights at all	37.9	0.03
job satisfaction	7.7	1.9
hourly wage	34.6	48.8
occupational tenure	5.9	5.2
occupational status scale	52.1	23.1
parenting responsibility:		
more than fair share	31.7	0.02
a bit more than fair share	36.4	0.03
fair share	31.9	0.02
future child expectation	3.9	3.92
importance of family	9.6	0.88
importance of work	7.6	1.91

Notes: This table shows the summary statistics of the variables used in the paper for 401 mothers who gave birth during the first five waves of HILDA and are employed pre-birth. Means are reported for the continuous variables and proportions (for instance, 41.1 equals to the number of people with less than university degree divided by the sum of people with less than university degree, university degree, and higher than university degree) are reported for categorical variables.

Table 4: **Weibull-Gamma Mixture Duration Model: Determinants of Maternity Leave Duration in Australia**

Dependent Variable:	Total duration		After birth duration	
Regressors:	Hazard ratio	t	Hazard ratio	t
child-care accessibility index	0.963	-3.6	0.971	-3.5
maternity leave entitlements:				
paid but no unpaid leave	0.944	-0.9	0.984	-0.8
unpaid but no paid leave	0.889	-1.6	0.967	-0.9
neither paid nor unpaid leave	0.696	-2.9	0.742	-2.5
wealth	0.998	-2.4	0.999	-2.1
job flexibility index	1.065	1.4	1.073	1.7
wage	1.001	2.7	1.001	3.2
married	2.301	2.3	2.193	2.1
age	0.989	-0.7	0.976	-1.5
education:				
university	0.953	-1.4	0.861	-1.5
more than university	0.676	-2.8	0.765	-1.9
good health	0.943	-0.4	0.926	-0.6
number of children	0.938	-0.8	1.014	0.2
Australian born	1.116	0.7	1.057	0.3
parenting responsibility:				
a bit more than fair share	0.920	-0.5	0.996	-0.1
fair share	1.115	0.9	1.254	1.4
importance of family	0.915	-1.5	0.883	-1.7
importance of work	1.074	2.0	1.055	1.7
future child expectation	1.000	0.1	0.997	-0.1
Unobserved heterogeneity parameter (θ)	hazard ratio=0.40		hazard ratio=0.43	
Std. error of (θ)	0.23		0.22	
LR test of $\theta=0$	$\chi2(01) = 4.25$		$\chi2(01) = 5.59$	
Number of observations	401		401	
LR statistic	96.5		62.3	

Notes: The table reports estimates for two different regressions. Total duration is the sum of months of maternity leave before birth and months of maternity leave after the birth. After birth duration is the months of maternity leave after the birth. Age is the age of the respondent before the birth in years. Maternity leave entitlements is whether the respondent had maternity rights at her job or not: 1) both paid and unpaid leave 2) paid leave without unpaid leave 3) unpaid leave without paid leave 4) no maternity leave. Child-care accessibility index is the sum of 11 different variables which are the answers to the following questions: From 0 to 10 how much difficulty have you met in last 12 months: 1) finding a place at the child-care centre of choice. 2) finding care my children are happy with. 3) with the cost of child care. 4) finding care during the school holidays. 5) finding care for a difficult or special needs child. 6) finding good quality child-care. 7) getting care for the hours needed. 8) juggling multiple child-care arrangements. 9) finding a child care centre in the right location. 10) finding the right person to take care of my child. 11) finding care for a sick child.

Table 5: Cox Duration Model: Determinants of Maternity Leave Duration in Australia

Dependent Variable:	Total duration		After birth duration	
Regressors:	Hazard ratio	t	Hazard ratio	t
child-care accessibility index	0.952	-3.7	0.968	-3.5
maternity leave entitlements:				
paid but no unpaid leave	0.949	-1.0	0.967	-1.0
unpaid but no paid leave	0.896	-1.6	0.938	-1.4
neither paid nor unpaid leave	0.711	-2.1	0.755	-1.9
wealth	0.999	-2.3	0.999	-2.4
job flexibility index	1.079	1.3	1.094	1.6
wage	1.001	2.6	1.001	2.7
married	2.294	2.4	2.162	2.1
age	0.998	-0.1	0.987	-0.8
education:				
university	0.849	-1.4	0.875	-0.7
more than university	0.727	-2.1	0.711	-2.3
good health	0.972	-0.2	0.973	-0.2
number of children	0.962	-0.6	1.018	0.1
Australian born	1.131	0.7	1.103	0.6
parenting responsibility:				
a bit more than fair share	0.905	-0.6	0.929	-0.5
fair share	1.148	1.1	1.299	1.7
importance of family	0.925	-1.4	0.896	-1.7
importance of work	1.059	1.8	1.042	1.7
future child expectation	0.998	-0.1	0.996	-0.3
Number of observations		401		401
LR statistic		81.5		52.6

Notes: The table reports estimates for two different regressions. The regressions are estimated with Cox Proportional Hazard model. Total duration is the sum of months of maternity leave before the birth and months of maternity leave after the birth. After birth duration is the months of maternity leave after the birth. Age is respondent's age before the birth in years. Maternity leave entitlements is whether the respondent had maternity rights at her job or not: 1) both paid and unpaid leave 2) paid leave without unpaid leave 3) unpaid leave without paid leave 4) no maternity leave. Difficulty in finding child-care index is the sum of 11 different variables which are the answers to the following questions: From 0 to 10 how much difficulty have you met in last 12 months: 1) finding a place at the child-care centre of choice. 2) finding care my children are happy with. 3) with the cost of child care. 4) finding care during the school holidays. 5) finding care for a difficult or special needs child. 6) finding good quality child-care. 7) getting care for the hours needed. 8) juggling multiple child-care arrangements. 9) finding a child care centre in the right location. 10) finding the right person to take care of my child. 11) finding care for a sick child.

Table 6: **Robustness: Additional pre-birth job characteristics**

Dependent Variable:	Total duration		After birth duration	
Regressors:	Hazard ratio	t	Hazard ratio	t
child-care accessibility index	0.969	-3.5	0.979	-3.3
maternity leave entitlements:				
paid but no unpaid leave	0.944	-0.7	0.983	-0.9
unpaid but no paid leave	0.917	-1.4	0.934	-1.1
neither paid nor unpaid leave	0.735	-2.8	0.743	-2.7
wealth	0.999	-2.3	0.999	-2.2
job flexibility index	1.067	1.3	1.071	1.6
wage	1.001	2.6	1.001	2.9
job satisfaction	1.024	0.3	1.002	0.4
occupational tenure	1.024	1.6	1.012	0.7
occupational status scale	1.004	0.8	1.002	0.4
Number of observations	401		401	
LR statistic	106.2		69.1	

Notes: The table reports estimates for two different regressions. The regressions are estimated with Weibull-Gamma Mixture duration model. The dependent variables are the total maternity leave duration and the after birth maternity leave duration. Job satisfaction is the job satisfaction for the respondent before the birth on a scale between 0 to 10 where 0 is totally unsatisfied and 10 is totally satisfied. Occupational tenure is the years of tenure in the occupation before the birth. Occupational status is the ANU4 occupational status scale. Additional control variables in every regression are: marital status, age, education, health status, number of children, country of origin, parenting responsibility, importance of family, importance of work. In both regressions, the LR test statistics of the unobserved heterogeneity parameter (θ) rejects the null hypothesis of no heterogeneity.

7 DATA APPENDIX

DEFINITIONS OF VARIABLES USED IN THE PAPER:

Education: Dummy variables indicating whether the respondent had an education level which is equivalent to less than a university degree, a university degree or higher than a university degree.

Wealth: The second wave total household net worth in 2001 dollars.

Health status: Excellent, good, fair, poor and very poor are the categories for self-reported general health status during the first year following the birth. We recode these categories as follows: bad health if the reported health status is fair, poor, or very poor, and good health if the health status is good or excellent.

Children: Number of own children the mother ever had.

Total maternity leave duration: The sum of months of maternity leave taken before and after the birth.

After-birth maternity leave duration: Months of maternity leave after the birth.

Age: Age of the respondent at the time of birth.

Maternity leave entitlements: Whether the respondent had maternity rights at her pre-birth job: 1. both paid and unpaid leave rights 2. paid leave rights only 3. unpaid leave rights only 4. no maternity leave rights at all.

Married: A binary variable taking the value 1 if the respondent was married during the first year following the birth, 0 otherwise.

Child-care accessibility index: The sum of 11 different variables which are the answers to the following questions: From 0 to 10 how much difficulty have you met in: 1) finding a place at the child-care centre of choice. 2) finding care my

children are happy with. 3) with the cost of child care. 4) finding care during the school holidays. 5) finding care for a difficult or special needs child. 6) finding good quality child-care. 7) getting care for the hours needed. 8) juggling multiple child-care arrangements. 9) finding a child care centre in the right location. 10) finding the right person to take care of my child. 11) finding care for a sick child.

Job flexibility index: The sum of 4 dummy variables which in order are: 1) Able to use special leave for caring family members? 2) Able to use permanent part-time work in current job? 3) Able to use home based work in current job? 4) Able to use flexible finish and start times?

Parenting responsibility: Dummy variables created from the answer to the following question: Do you have fair share of looking after children? (during the first year following the birth) 1. Does much more than fair share, 2. does a bit more than fair share, 3. does fair share.

Future child expectation: Answer to the following question: How likely you will have a child or children in the future? (0-10, 0=very unlikely 10=very likely)

Job satisfaction: Job satisfaction of the respondent from her pre-birth workplace on a scale between 0 to 10 where 0 is totally unsatisfied and 10 is totally satisfied.

wage: Hourly wage of the mother at her pre-birth job.

Occupational tenure: Tenure in the pre-birth occupation.

Occupational status scale: ANU4 occupational status index for the pre-birth occupation which takes a value 0-100 (See Australian Standard Classification of Occupations, Second Edition for more information).

Importance of family: The importance of family in life which is only avail-

able in the first wave of HILDA and takes values 0-10 where 0 is least important and 10 is most important.

Importance of work: The importance of work in life which is only available in the first wave of HILDA and takes values 0-10 where 0 is least important and 10 is most important.