Home production of childcare and labour supply decisions in a collective household model

Work in progress

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Abstract

Childcare costs and the labour supply of mothers is a recurring topic of policy debate. The extent of female part-time work and the consequences of career breaks on future employment and earnings are part of that picture. The decision to leave (partially or not) the labour market is often taken within a couple but, in the event of divorce, the impact of this decision may not be borne by both parties equally, which may render the initial decision inefficient. This paper proposes a dynamic structural model of labour market and childcare choices for couples within a collective model of decision making. We formalise explicitly the need for childcare as a function of the age structure of the children population in the household then examine the determinants of the decision to supply labour. The fraction of home-produced childcare to household childcare needs is considered to be a public good in the household, for which preferences are heterogeneous across households. Spouses' bargaining weight in the decision making will also influence the decision. We include non-participants and model the labour supply decision as a discrete choice between non-participation, part-time work and full-time work. An important feature of our framework, which introduces one of the dynamic dimensions of the decision, is that we take into account the implications of today's labour supply decision on future wage growth and future bargaining power. We examine the efficiency of the childcare/work decision and link it with parameters of divorce regulations. Using data from the BHPS, we then present a structural estimation of our model to quantify these various components of the choice of childcare mode.

Keywords: Household, labour supply, collective model, childcare.

JEL Codes: J12, J13, J22, J31, J38.

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1 Introduction

Childcare costs and the labour supply of mothers is a recurring topic of policy debate and exhibit large variations across countries and over time. The extent of female part-time work and the consequences of career breaks on future employment and earnings are part of that picture. The decision to leave (partially or not) the labour market is often taken within a couple but, in the event of divorce, the impact of this decision may not be borne by both parties equally, which may render the initial decision inefficient xx check xx. This paper proposes a dynamic structural model of labour market and childcare choices for couples within a collective model of decision making. We formalise explicitly the need for childcare as a function of the age structure of the children population in the household then examine the determinants of the decision to supply labour. The fraction of home-produced childcare to household childcare needs is considered to be a public good in the household, for which preferences are heterogeneous across households. Spouses' bargaining weight in the decision making will also influence the decision. We include non-participants and model the labour supply decision as a discrete choice between non-participation, part-time work and full-time work. An important feature of our framework, which introduces one of the dynamic dimensions of the decision, is that we take into account the implications of today's labour supply decision on future wage growth and future bargaining power. We examine the efficiency of the childcare/work decision and link it with parameters of divorce regulations. Using data from the BHPS, we then present a structural estimation of our model to quantify these various components of the choice of childcare mode.

LCM, cost ben analysis, sensitivity to cc policy

Our results contribute to the literature in several ways. First, they reevaluate the household bargaining weights once the assymmetric cost of home childcare across spouses is taken into account. Second, they quantify households' preferences for home-produced childcare and documents evidence of heterogeneity with respect to these. Third, they establish a direct link between divorce regulations, labour supply decisions and the efficiency of the household choice in terms of childcare. Finally, our results are relevant to another policy debate concerned with child poverty. Britain has been documented to have a high incidence of child poverty relative to countries of similar overall economic performance. Descriptive statistics show that many of the children living in 'poor' households do so in single-parent families. Whilst not aiming to propose a comprehensive analysis of this phenomenon, we are able to quantify the role played by the childcare versus labour supply and future earnings mechanism proposed in our framework.

The related literature is plentiful. Ever since the seminal paper by Chiappori (1992), collective models of household decisions have been used to understand household consumption patterns and to estimate the sharing rule, e.g. Browning et al. (2006), sometimes in the presence of children, as in Blundell et al. (2005), sometimes in the presence of a public good, as in Donni (2009). Most of this literature is set in the static context, but a recent branch has introduced a dynamic dimension to household decisions, as in Mazzocco (2007). LCM marcet marrimon, ligon thomas worrall chiapporri mazzocco voena bronson xxx Identification of bargaining weights has been extensively discussed and been shown to depend on various factors and/or assumptions such as distribution factors, excludable goods, parametric specification and separability of utility functions. A recent stream of papers uses the revealed preference approach to identify the model parameters with minimal use of parametric assumptions, led by the work of Cherchye et al. (2010), Cherchye et al. (2011) and Cherchye et al. (2012). xx check these xx

Besides, our results contribute to various policy-related debates. Papers connected to the questions we examine are Adda et al. (2017) on the career costs of children, Guner et al. (2014) on household labour supply and taxation policy or childcare subsidies (Guner et al. (2013)), and Chiappori et al. (2002) on the impact of marriage market and divorce legislation on household labour supply. bick?

The rest of the paper is organised as follows. Next section outlines our model. Section 3 presents descriptive statistics of our dataset and estimates of the auxiliary regressions used later on. In section 4 we detail our estimation procedure before presenting the results in Section 5. Finally, Section 6 concludes.

2 The model

We set out a partial equilibrium model of labour supply, childcare and consumption choices of individuals in two-partner households and of their decision to divorce or remain in the partnership.[1] Our focus is on the decision to carry out childcare at home or to buy childcare services to free up time for labour market work and/or leisure, given a certain population of children in the household and the (potential) wages of the two partners. Individuals value consumption, leisure and home-produced childcare in a manner described in section 2.2. In order to keep the model reasonably tractable and parsimonious, we keep the fertility hazard as exogenous. Couple formation, similarly, is kept out of the picture as we will follow couples already in existence at the beginning of the sample. We model couple decision making within a limited commitment model described in section 2.5, which also predicts endogenous divorce.

The environment is one of dynamic choice set in discrete time, where the (common) discount factor is denoted β. The dynamic dimension of choices is twofold and hinges on the fact that participation in the labour market and the intensity of this participation have an impact (in expectation) on future earnings (see section 2.3) and future bargaining power (see section 2.5). We rule out saving and borrowing behaviour as well as the concept of home childcare being an investment in the 'quality' of the child later on. The unit time period is five years. This is mainly to ease the computational burden but also because we view the choice between domestic and market-bought childcare as being made rather infrequently and kept to for some years. We follow working-age couples and assume for simplicity that both partners have the same age, a. We will only model time use within the standard working time in a week, i.e. 40 hours, as this is the time where the alternative between home-produced and market-bought childcare seems the most relevant. We ignore the possibility of working staggered shifts to combine work and home childcare, that is, if both parents work full-time all childcare needs (within the 40 working hours) must be bought on the market.[2]

[1] We make no distinction between married and cohabiting couples.

[2] This is counterfactual for some subset of the population. In xxx, xx% of couples in the BHPS reported working staggered working days to accommodate childcare needs. It however comes at the cost of time spent together out of work. Hamermesh

We also ignore informal childcare carried out by e.g. grandparents. .. add figure ..

In this framework, a household member g has three possible uses of his/her time, namely work, leisure, L_g and childcare dom_g. We assume that labour market participation lm_g can only take three forms: non-participation, $lm_g = 0$, part-time work $lm_g = 1$ or full-time work, $lm_g = 2$. The individual time constraints are thus the following:

$$40 = 20 \cdot lm_g + L_g + dom_g \tag{1}$$

Given that we have no savings in this framework, the only state variables are the age of two partners, a, the age composition of the children population, κ, and the wages (or potential wages, which we keep track of for individuals out of the labour force) of the male and the female partners, w_m and w_f and the Pareto weights of the two partners.

The control variables are both partners' labour market choices, lm_g, hours of domestic childcare, dom_g, hours of leisure, L_g and private consumption, C_g. Labour market choices are discrete and can only take three values: non-participation ($lm = 0$), part-time ($lm = 1$) or full-time ($lm = 2$), corresponding to 0, 20 and 40 weekly hours of work respectively. The other choices are continuous.

The household faces three types of constraints: a joint budget constraint, individual time constraints, and a joint constraint in childcare need imposed by the age structure of the children population in the household. Two additional constraints are that both spouses must be better off within the couple than in the divorced state. In neither of them is, divorce ensues. If at least one of them is better off within the marriage, an adjustment of the Pareto weight may allow the marriage to continue, as described in section 2.5. These dynamics of the Pareto weights is an interesting outcome of our framework, both for its own sake and for its role in the labour supply decision.

The dynamics of κ, the age structure of the children population in the household, is driven by the (deterministic) ageing of existing children and the stochastic exogenous fertility process. The dynamics of wages are stochastic, driven by independent shocks and by (endogenous) labour market choices.

We will now describe each component of the model in more detail and present the formal equations in section 2.6.

2.1 Childcare need

The children population of the household is described by its age composition and size. Because we are interested in household decisions in terms of domestic production versus market provision of childcare services, we use age categories that determine childcare needs. A contribution of this paper is that we include within the household constraints a need for childcare which is explicitly formulated in terms of the age composition of the children population.

(2002) estimates that couples put some value on this togetherness and synchronise their schedules. The analysis of this tradeoff is beyond the scope of this paper and we ignore it altogether with the assumption that all labour market work has to be carried out within the same 40 hours.

There are 4 age categories, characterized by the amount of childcare that they require: under 5 years old, 5-11, 11-16 and over 16, which correspond, in the UK, to the ages of children who are pre-school, in primary school, in secondary school and above the legal school-leaving age (within our sample). As our focus is on time use decisions within normal working hours, we will define childcare needs only with respect to the subset of these needs that fall within working hours.

Without much loss of generality, we model families as having up to 3 children as very few (1.3%) families in our sample have more than three children.[3] The vector $\kappa = (\kappa_k)_{k=1..3}$ represents the age structure (at next birthday) of the children in the household where $\kappa_k = 0$ if there are less than k children (i.e. the k-th child is unborn). The dynamics of κ are driven by the ageing of existing children and the birth of news ones.

Just as adults, children age by 5 years every period. Fertility events are exogenous and depend on the age structure of the existing children in the household, κ, and on the age of the parents, a. So for example, a family with two children aged 4.5 and 6.2 is represented by $\kappa_t = (7, 5, 0)$. In the following year, we will have either $\kappa_{t+1} = (8, 6, 1)$ in the event of a new birth or $\kappa_{t+1} = (8, 6, 0)$ otherwise.

These dynamics are represented by the matrix A^K of transition probabilities between different values of κ. This matrix only depends on a the age of the two partners in the household.

We denote the number of hours of childcare needed for the aforementioned four age categories as $\{\gamma_j\}_{j=1..4}$. Intuitively, $\gamma_{j+1} \leq \gamma_j$ for $j = 1..3$ since older children require less childcare than younger ones. These γ parameters will be calibrated in the estimation section below to reflect evidence on childcare use for children of different age categories. Note that these hours needed are all nested in one another in that the γ_3 hours weekly childcare that a child aged 11-16 needs are a subset of the γ_2 hours of weekly childcare that a primary school child needs in a timetabling sense. We denote CC_k the number of hours of childcare needed by the child indexed k in the household. The total time needed for childcare if this childcare is carried out by any (or both) adult(s) from the household is: $\max\{CC_k\}_{k=1..3}$. This expression reflects the fact that, when devoting one hour of time to childcare, the adult may look after one to three children.[4]

Adults in the household may decide to carry out some or all of the childcare needed by spending time dom_g $(g = m, f)$ on this activity. We rule out[5] the possibility that childcare times performed by parents within the 40 weekly 'working' hours overlap so that the total time devoted to the home production of childcare within the household is $dom_m + dom_f$. By "working hours" we mean hours that could be used for labour market work. Since childcare needs must be covered either by home production or market-bought childcare services, the household spending on childcare services is:

$$p_{CC} \cdot \sum_{k=1}^{3} \max\{CC_k - (dom_m + dom_f), 0\}, \tag{2}$$

where p_{CC} is the unit (hour/child) price of childcare services.[6] The expression (2) reflects the fact that, contrasting with home-produced childcare, one hour of childcare services needs to be bought for each child

[3] In the rare instances where households have more than three children, the ages of the youngest three children are used.

[4] We abstract from any potential difference in childcare quality depending on the number of children cared for by an adult in the home –or by market-provided childcare.

[5] It is in fact a dominant strategy.

[6] One could argue that this price should vary with parents' education levels to capture the fact that better-off households

needing childcare. This difference between the time required for home-produced childcare and the number of hours of childcare services needed to be bought for a given family structure means that the relative 'price' of one hour devoted to childcare or to work depends on the age structure of the children population in the household κ.

2.2 Taste for home-produced childcare

One specificity of our approach is that we consider that home-produced childcare D enters individuals' preferences as well as consumption C and leisure L. Each spouse's instantaneous utility is denoted $\mathcal{U}_g\left(C_g, L_g, D\right)$ for $g = m, f$. Individuals do not derive utility from carrying out childcare *per se*, but from the fact that a higher proportion of the household childcare need is being carried out within the home, by whatever parent as opposed to a market provider (nursery, childminder). This proportion D is formally defined as follows:

$$D = \frac{dom_m + \lambda \cdot dom_f}{\max_k\{CC_k\}}, \tag{3}$$

D equals 1 for households without children and households who opt to carry out all their childcare domestically. This fraction D of total childcare time need carried out within the home is a **public good** within the household.

We allow households to value the domestic times of the two parents differently via the factor λ. Possible reasons why the domestic times of the parents may not be valued equally are social custom on 'traditional' role of the mother as care-giver, biological comparative advantage in breastfeeding or inherited preference for parent giving care in the early months. We will discuss the role of λ in more depth in section 5.5.

The marginal rate of substitution between D and consumption is one of the driving forces of the choice of childcare mode. A contribution of this paper is our attempt to quantify this 'taste' for home-produced childcare and its heterogeneity across households. Indeed we claim that this is key to an understanding of the response of the population of household to changes in the price of childcare services. Our estimate of the distribution of the sensitivity of households to the unit price of childcare is presented in section 5.4.

The relative 'price' of D depends on both static and dynamic considerations. In the current period, the amount of household consumption lost or gained with a marginal increase in D depends on the number of children needing childcare at the margin, the overall household childcare need, the unit price of childcare and the wage of the parent increasing his/her domestic time. In future periods, other components of the trade-off include the loss of labour market value of the partner working less as well as the impact of this on Pareto weights (see section 5.4). We assume away any dynamic consequence of children being looked after by a parent versus a market provider in terms of children's well-being or outcomes in the long run.

Components of this relative price will be discussed at length below, but we retain from this that it will depend on κ, (w_m, w_f) and the Pareto weights of the two partners.

are likely to use childcare services at higher prices on average than less well-off households. We have ruled this out, though it could easily be included by considering that this price is a fraction of the household potential income.

2.3 Wage processes

We model wage dynamics as a first-order Markov process. We characterise all wages by their quintiles in the overall wage distribution and assume that transition probabilities between quintiles p and p' over the next period depend only the current quintile p and labour market choice, lm. We denote these probabilities $a^{W}_{lm}(p, p')$. Each individual, whether earning an actual wage or not, will be assigned a 'market value' or potential wage, which will carry on evolving over time according to the above process even when the individual is out of the labour force.

As mentioned above, labour supply choices are assumed to be restricted to three states: full-time employment, part-time employment and non-participation. We ignore unemployment and assume that individuals are always able to implement their household choice in terms of their labour market participation. Part-time and full-time employment may differ among three dimensions: the amount of time they take, the hourly wage and the rate of wage growth. Indeed, it is a well-documented fact that part-time jobs tend to pay less and offer less scope for promotion than their full-time equivalent, even when accounting for selection (see Connolly and Gregory (2009), Harkness (1996) and Manning and Petrongolo (2008)). An important feature of these differences is that they are not uniform across the wage distribution: the expected part-time penalty in terms of wage growth is not the same at low and high quantiles of the distribution. Evidence of this in our data will be shown in section 3.2.

Our assumptions are the following: part-time work does not carry an instantaneous penalty, i.e. there is no hourly wage drop in the current period when taking a part-time as opposed to a full-time job. Over time, however, part-time work (and non-participation) deteriorate the labour market value of an individual relative to full-time work, in expectation. New labour market entrants are given a market value distribution that depends solely on education. From then on, wages experience growth spurts or drops which occur at Poisson rates $a^{g}_{lm}(p, p')$. These wage shocks are assumed to be independent between spouses and independent of the household fertility shock.

Admittedly this is a crude representation of income dynamics, which have been documented to be better represented by richer specifications (see for example Meghir and Pistaferri (2004) and Guvenen et al. (2015)). We think nevertheless that our simple process allows us to capture the mechanisms of interest in this paper, one of them being that any parent's decision to take time off the labour market to produce home childcare does have consequences on his or her wage progression. Besides, this expected cost depends on the initial wage of the individual.

2.4 Divorce and retirement

The main objective of this model is to analyze labor market and childcare choices of individuals living as a couple. However, because we also consider the possibility of divorce and the impact that this possibility has on household choices, we need to model preferences and choices of divorced individuals. We follow trajectories of couples whose initial status is a marriage or partnership. Thus we do not model household formation.

2.4.1 Divorce

There is no straightforward way to treat the allocation of time and money resources upon divorce. Our modelling aim in this respect is twofold. First, a concern for parsimony leads us to adopt a very stylised picture of post-divorce outcomes. Second, we wish to capture, even if in a simplified way, how childcare need and individual potential wages are passed on to each individual post divorce. In the related literature, Mazzocco (2007) and Bronson (2014)) assume the divorced state to be equal to the state of being single while Voena (2015) allows for the remarriage probablity of divorcees to differ from that of singles and for a division of assets depending on divorce laws. Since our framework focuses on childcare we need to specify divorce outcomes with respect to custody and child support. We use the government regulations (UK Government (2017)) to set our assumptions on divorce values. As noted by Voena (2015), marriage contracts are rare and difficult to enforce so it seems reasonable to assume that spouses expect to follow government regulations in the event of divorce.[7]

We assume that the female partner receives custody of the children population and the attached childcare needs. She also receives an alimony y from the male partner which depends on the age structure of the children population and on his labour market value at the time of divorce:

$$y = y\left(\kappa, w_m^D\right) \tag{4}$$

Note that the alimony does not depend on the female partner's labour market value or past labour market choices.

Her subsequent choice as to whether to buy childcare services or to produce them domestically is now an individual choice, but she inherits the household taste for home childcare. The male partner inherits this taste too, his utility will therefore be affected by her labour market choices for as long as there is a childcare need for their children. He however does not participate in that choice. When individual utility is separable in D, the decision of the male ex-partner will not be affected by that of the female ex-partner. Also, since the alimony is set according to the male partner's wage at the time of divorce, the dynamics of the male labour market value cease to matter thereafter in the female decision problem. The two decision problems are thus independent post divorce.

We also assume that remarriage and fertility hazards post-divorce are zero.

2.4.2 Retirement

Retirement occurs at age R for the household (both spouses have the same age) and the remaining life expectancy is denoted T. Pension income is based on labour market values in the last period before retirement,

[7] The question of sharing the household's assets is irrelevant in our model since we rule out savings.

with a replacement rate of ρ. The (constant) household budget between age R and age $R+T$ is thus:

$$z^R = 40 \cdot \rho \cdot (w_{m,R-1} + w_{f,R-1}) \tag{5}$$

We assume post-retirement divorce and fertility hazard to be zero, so that the only variations in the state variables in retirement relate to the ageing of children under 16 at the time of retirement.

Similarly, for retired divorcees, the only source of variation in the two ex-spouses environment is the ageing of the remaining children. The fraction of the male pension income allocated to the female ex-spouse is included in the alimony specification (see section 4.1 for our specific assumptions).

2.5 Family decision making

We set our framework within the collective model literature and consider that the household decision making consists in maximising a weighted sum of the two spouses' asset values. The weight μ is the relative bargaining weight of the female partner in the household decision. Given values of the state variables, s (wages, age, ages of the children), the household chooses x (labour supply, domestic times, consumption shares) in order to maximise:

$$\mu \cdot V_m(s,x) + (1-\mu) \cdot V_f(s,x)$$

where μ and $1-\mu$ are the relative bargaining weights of the two spouses, V_i, $i = m, f$ are the asset values of both spouses (more formally defined in section 2.6).

The resulting values of this optimisation for both partners are denoted $V_i^M(\mu, s)$ and depend on the Pareto weights. In addition to this, both partners value their marriage through a 'love' term ϵ, which captures the quality of the match. This term is common to both partners and is subject to shocks. Each partner is content to stay in the marriage if it yields a valuation $V_i^M(s,\mu) + \epsilon$ that is greater than their outside option. We will consider that outside options refer to divorce and are denoted $V_i^D(s)$.

We assume that divorce can be triggered unilaterally so this bargaining weight can be adjusted in the event of one of the partners threatening to dissolve the marriage.[8] With unilateral divorce and forward-looking agents we are in the presence of forward-looking constraints relating to the continuing participation of both spouses in the marriage. Such optimisation problems can be represented as recursive contracts, as developed by Marcet and Marimon (2017), whereby bargaining weights adjust whenever a participation constraint binds and the Lagrange multiplier attached to it is non-zero. This yields a limited commitment model as in Ligon et al. (2002) and Chiappori and Mazzocco (2014) where the partnership may survive after an adverse shock leading to one of the parties desire to leave it through a renegotiation of the bargaining weights.

Note that $V_m^M(s,\mu)$ is increasing in μ and we can define $\mu_m^*(s,\epsilon)$ such that $V_m^M(s,\mu_m^*(s,\epsilon)) + \epsilon = V_m^D(s)$ as the bargaining weight that makes the male partner indifferent between divorce and staying in the marriage with this bargaining power. Of course, there may be no value of $\mu \in (0,1)$ such that in this condition

[8] As shown in Mazzocco (2007) and Voena (2015), when divorce is not an option or can only be legally initiated when both spouses agree to it, bargaining weights are fixed over time. This is the full commitment model.

is satisfied, in which case the male partner prefers divorce even if he has all the bargaining power in the marriage, i.e. $\mu = 1$. Similarly, we define $\mu_f^*(s,\epsilon)$ such that $V_f^M(s,\mu_f^*(s,\epsilon)) + \epsilon = V_f^D(s)$, the bargaining weight that makes the female partner indifferent between marriage and divorce (if it exists). Since $V_f^M(s,\mu)$ is decreasing in μ, a renegotiation triggered by the female partner will yield an decrease in μ.

Formally, the dynamics of the Pareto weights can be summarised as follows:

$$\mu_t = \mu_{t-1} \text{ if } \begin{cases} V_m^M(s_t,\mu_{t-1}) + \epsilon_t & \geq & V_m^D(s_t) \\ V_f^M(s_t,\mu_{t-1}) + \epsilon_t & \geq & V_f^D(s_t) \end{cases}$$

$$\mu_t = \mu_m^*(s_t,\epsilon_t) \text{ if } \begin{cases} V_m^M(s_t,\mu_{t-1}) + \epsilon_t & < & V_m^D(s_t) \\ V_f^M(s_t,\mu_m^*(s_t,\epsilon_t)) + \epsilon_t & \geq & V_f^D(s_t) \end{cases}$$

$$\mu_t = \mu_f^*(s_t,\epsilon_t) \text{ if } \begin{cases} V_m^M(s_t,\mu_f^*(s_t,\epsilon_t)) + \epsilon_t & \geq & V_m^D(s_t) \\ V_f^M(s_t,\mu_{t-1}) + \epsilon_t & < & V_f^D(s_t) \end{cases}$$

in other cases, divorce happens, with probability $\delta(s_t)$. Note that this probability does not depend on μ_{t-1}.

Both partners anticipate the above dynamics, which are endogenous in that current labour market choices impact on the law of motion of some state variables (wages) which in turn impact on future values of the bargaining power. This feedback effect plays a role in household decisions that we will discuss further in section 2.7.

2.6 Summary and formalisation

We now turn to the formalisation of the model, including the various ingredients described above. We will derive in turn the constraints, the laws of motion of state variables and the objective functions relating to the optimisation problems of the married household, of divorced individuals and of retired households, either married or divorced.

Constraints For the married household pre-retirement, the constraints are:

$$\begin{aligned} 40 &= 20 \cdot lm_g + L_g + dom_g \text{ for } g = m, f, \\ 20(w_m \cdot lm_m + w_f \cdot lm_f) &= C_m + C_f + p_{CC} \cdot \sum_{k=1}^{3} \max\{CC_k - (dom_m + dom_f), 0\} \\ 0 \leq dom_g &\leq \max\{CC_k\} \text{ for } g = m, f, \\ dom_m + dom_f &\leq \max\{CC_k\}. \end{aligned} \tag{6}$$

In retirement, they become:

$$\begin{aligned}
40 &= L_g + dom_g \text{ for } g = m, f, \\
z^R &= C_m + C_f + p_{CC} \cdot \sum_{k=1}^{3} \max\{CC_k - (dom_m + dom_f), 0\} \\
0 \leq dom_g &\leq \max\{CC_k\} \text{ for } g = m, f, \\
dom_m + dom_f &\leq \max\{CC_k\}.
\end{aligned} \tag{7}$$

where z^R is the household pension as defined in section 2.4.

For the male divorcee, the relevant constraints do not include childcare any more since he does not have custody of the children:

$$\begin{aligned}
40 &= 20 \cdot lm_m + L_m \\
20 w_m \cdot lm_m - y(\kappa, w_m^D) &= C_m.
\end{aligned} \tag{8}$$

For the female divorcee, the amount of time devoted to childcare is still relevant:

$$\begin{aligned}
40 &= 20 \cdot lm_f + L_f + dom_f \\
20 w_f \cdot lm_f + y(\kappa, w_m^D) &= C_f + p_{CC} \cdot \sum_{k=1}^{3} \max\{CC_k - dom_f), 0\} \\
dom_f &\leq \max\{CC_k\}.
\end{aligned} \tag{9}$$

Laws of motion Denote s the vector of state variables:

$$s = \{a, \kappa, w_m, w_f\}, \tag{10}$$

Additional state variable μ. mm and S the set of possible values for this vector.

The ageing process of the household is deterministic (we rule out death hazards). The dynamics of κ are exogenous and described by the transition matrix A^K as explained in section 2.1. In both divorce and retirement the fertility rate is zero so that the dynamics of κ boil down to the ageing of the population of existing children and are captured by a transition matrix A_0^K.

The dynamics of each wage quintile is endogenous as it depends on labour market choices and are described by the transition matrices $A^W(lm)$ as described in section 2.3. Finally, the dynamics of the bargaining power, as described in section 2.5, are also endogenous and depend on all other state variables and on the labour market choice. In the empirical section we will discretise the set of values of μ with a set M so that its law of motion can be captured by a transition matrix too, denoted by $A^\mu(s, lm)$, where we denote lm the vector of labour market choices: (lm_m, lm_f).

Since we have assumed that the shocks to the various processes are independent, we can write the law of motion of the vector of state variables (s,μ) as the following products:

$$\begin{aligned}
\pi\left((s',\mu')|s,lm,\mu\right) &= \mathbf{a}^{\mathbf{K}}\left(\kappa,\kappa'\right)\cdot\mathbf{a}^{\mathbf{W}}\left(w_m,w_m'|lm_m\right)\cdot\mathbf{a}^{\mathbf{W}}\left(w_f,w_f'|lm_f\right)\cdot\mathbf{a}^{\mu}\left(\mu,\mu'|s,lm\right)\\
\pi_m^D\left(s'|s,lm\right) &= \mathbf{a}_{\mathbf{0}}^{\mathbf{K}}\left(\kappa,\kappa'\right)\cdot\mathbf{a}^{\mathbf{W}}\left(w_m,w_m'|lm_m\right)\\
\pi_f^D\left(s'|s,lm,\right) &= \mathbf{a}_{\mathbf{0}}^{\mathbf{K}}\left(\kappa,\kappa'\right)\cdot\mathbf{a}^{\mathbf{W}}\left(w_f,w_f'|lm_f\right)\\
\pi^R\left(s'|s\right) &= \mathbf{a}_{\mathbf{0}}^{\mathbf{K}}
\end{aligned} \tag{11}$$

where π denotes the transition probability within a married household pre retirement, π_m^D (respectively π_f^D) the transition probabilities for divorced males (respectively females) before retirement and π^R the transition probabilities for all retired households and divorced individuals.

Optimisation As seen above the flow utilities for each partner are $\mathcal{U}_g\left(C_g,L_g,D\right)$. In the first instance, let us note that, given labour market choices, the decision regarding C_g, L_g and dom_g does not have any future consequences. As a result, we can consider that this decision is made in the static framework where the household maximises the weighted sum of instantaneous utilities:

$$\max_{(C_m,C_f,L_m,L_f,dom_m,dom_f)} \mu\cdot\mathcal{U}_m\left(C_m,L_m,D\right)+(1-\mu)\cdot\mathcal{U}_f\left(C_f,L_f,D\right) \tag{12}$$

given the choice lm, the value of the state variables s and the constraints seen above. The optimal level of household instantaneous utility thus achieved is denoted $\tilde{\mathcal{U}}_h\left(lm,s,\mu\right)$.

In retirement both partners cease participation in the labour market and the only remaining dynamics relate to the ageing of children yet to reach the age of 16. The household asset value at retirement is thus:

$$V^R\left(s_R,\mu_R\right)=\tilde{\mathcal{U}}_h\left((0,0),s_R,\mu_R\right)+\sum_{\tau=R+1}^{R+T}\beta^{\tau-R}E\left[\tilde{\mathcal{U}}_h\left((0,0),s_\tau,\mu_R\right)|s_{\tau-1}\right] \tag{13}$$

Now turning to (discrete) labour market choices, recall from sections 2.3 and 2.5 that these choices will have an impact on future periods through the hazard rates of wage progression and bargaining power dynamics which depend on labour market status. The dynamic problem faced by household h is to choose $lm=(lm_m,lm_f)$ to maximise expected lifetime household utility:

$$\begin{aligned}
\tilde{\mathcal{U}}_h\left(lm_t,s_t,\mu_t\right) &+ \sum_{\tau=t+1}^{R-1}\beta^{\tau-t}E\left[\tilde{\mathcal{U}}_h\left(lm_\tau,s_\tau,\mu_\tau\right)|lm_{\tau-1},s_{\tau-1},\mu_{\tau-1}\right]\\
&+ \beta^{R-t}E\left[V_h^R\left(s_R,\mu_R\right)|lm_{R-1},s_{R-1},\mu_{R-1}\right]
\end{aligned} \tag{14}$$

This yields an optimal labour market choice, $\tilde{lm}$, and the household asset values defined as:

$$V^M(s,\mu)=\mu V_m^M(s,\mu)+(1-\mu)V_f^M(s,\mu) \tag{15}$$

and satisfy the following Bellman equations since we use the Pareto weights as an additional state variable and its law of motion described in section 2.5:[9]

$$V^M(s_t,\mu_t)=\tilde{\mathcal{U}}_h\left(\tilde{lm}_t,s_t,\mu_t\right)+\beta\cdot E\left[V^M(s_{t+1},\mu_{t+1})|\tilde{lm}_t,s_t,\mu_t\right] \tag{16}$$

[9]As in Marcet and Marimon (2017), we are able to formalise household choices in this way after adding the co-state variable μ_t, the dynamics of which embody the forward-looking constraints that both partners are willing to stay in the marriage.

All expectations are taken conditional on state variables and labour market choices in the previous period since all processes are first-order Markov. Specifically:

$$\begin{aligned} E\left[V_h\left(s_\tau,\mu_\tau\right)|lm_{\tau-1},s_{\tau-1},\mu_{\tau-1}\right] &= \sum_{(s_\tau,\mu_\tau)\in SxM} \pi\left((s_\tau,\mu_\tau)|lm_{\tau-1},s_{\tau-1},\mu_{\tau-1}\right)\cdot \\ &\quad \left(\delta(s_\tau)\left[\mu_{\tau-1}V_m^D(s_\tau)+(1-\mu_{\tau-1})V_f^D(s_\tau)\right]+(1-\delta(s_\tau))V_h\left(s_\tau,\mu_\tau\right)\right) \end{aligned} \tag{17}$$

where the asset values in divorce, V_m^D and V_f^D do not depend on the bargaining power at the time of divorce since the post-divorce allocation is governed by regulations as set out in section 2.4 and can be expressed as follows:

$$V_g^D(s_t) = \tilde{\mathcal{U}}_g\left(\tilde{lm}_{g,t},s_t\right) + \beta\cdot E\left[V_g^D(s_{t+1})|\tilde{lm}_{g,t},s_t\right] \tag{18}$$

for $g=m,f$ and where $\tilde{\mathcal{U}}_g\left(lm_g,s\right)$ is the result of ex-spouse g maximising their instantaneous utility given (lm_g,s) subject to the constraints (8) and (9):

$$\begin{aligned} \tilde{\mathcal{U}}_f\left(lm_f,s\right) &= \max_{dom_f}\mathcal{U}_f(C_f,L_f,D) \\ \tilde{\mathcal{U}}_m\left(lm_m,s\right) &= \mathcal{U}_m(C_m,L_m,D) \end{aligned} \tag{19}$$

and $\tilde{lm}_g$ are their optimal individual labour supply. Note that, given his labour supply, the male divorcee does not have any remaining choice since C_m and L_m are both dictated by his budget and time constraints and D is determined by the female divorcee's choice of domestic time dom_f.

2.7 Time inconsistency and inefficiency

The household collective decision-making unit is a hybrid of the preferences of the two partners. It thus has changing preferences over time since Pareto weights may vary, even though the preferences of both partners are constant. Today's household is characterised by the composite preferences determined by μ_t and makes choices in the anticipation that the future household will be guided by different preferences μ_{t+1} while today's choices have an impact on these preferences since labour market choices affect future labour market values, which affect divorce outcomes in asymmetric ways and yield variations in bargaining power (in expectation).

Time inconsistency resides in the fact that $V_m^M(s_{t+1},\mu_{t+1})$ and $V_f^M(s_{t+1},\mu_{t+1})$ are the results of the optimisation problem solved by the household with preferences μ_{t+1} whereas $\mu_t\cdot V_m^M(s_{t+1},\mu_{t+1})+[1-\mu_t]\cdot V_f^M(s_{t+1},\mu_{t+1})$ is the valuation of this result by the household with preferences μ_t. Note that this is not the object that will be maximised by the decision-making entity characterised by μ_{t+1}. Sally (2000) analyses decision making in a context of a forward-looking agent and changing preferences. The agent (Ulysses) makes choices today in the understanding of the impact of these choices on future preferences, and maximising his welfare in terms of today's preferences. Manipulating tomorrow's individual (and preferences) to make choices that are consistent with the preferences of today's decision maker are one of the determinants of today's choices.

Within a marriage, these changing preferences are in the form of variations in the relative bargaining power. Basu (2006) shows the interplay between household decisions and the balance of power within the household in a dynamic setting, where agents are forward looking and anticipate the dynamics of the nature of the 'hybrid', which leads to the possibility of Pareto inefficiencies. Lundberg and Pollak (2003) showed that inefficient outcomes occur in marriages because spouses cannot commit not to exploit a bargaining advantage arising in the future as a result of their partner's investment in the marriage today.[10]

In our framework, the source of inefficiency lies in the fact that any spouse cutting on labour market participation to supply the public good by producing domestic childcare bears an expected loss in the event of divorce which cannot be compensated for, since contracts between spouses within a marriage are difficult to enforce. Indeed, divorce regulations do not usually allow for compensation for loss of labour market value. We can thus be in a situation where Pareto improvements could be achieved if the working spouse could borrow individually to transfer an asset to the spouse providing home-produced childcare.

3 Descriptive statistics

3.1 Data

The data we use comes from the British Household Panel Survey, which covers years from 1991 to 2008. We restrict our attention to observations relating to households with two adults aged 20 to 70 and follow these couples (married or cohabiting) from their entry into the survey if they are married in their first year of observation or their first marriage if they enter the survey as 'never married' until their exit from the survey or their divorce. We will use the 'marriage' denomination for both married and cohabiting couples. This selection leaves us with 4,467 couples whom we follow for 1 to 18 years, 2,660 of these staying in the sample for at least 6 years. The mean number of years in the sample is 8.22 years and we have 36,717 household-year observations.

The survey provides detailed information on the number and ages of the children present in the household. 44% of observations relate to households with no children present (these may have had children who do not live in the same residence anymore). Few households have three children or more (6.9% observations). The summary statistics of our sample are shown in Table 1.

[10]Similar issues abound in the literature. Mazzocco (2007) rejects the full efficiency model with US data and finds evidence of variations over time of the relative bargaining power of spouses. Duflo and Udry (2004) present evidence that expenditure patterns in households in Ivory Coast are not consistent with a Pareto efficient allocation of household resources. Aura (2005) discusses the impact of different divorce laws on consumption and saving of married couples that cannot commit. He focuses on the fact that future behaviour is constrained by the outcome of future renegotiation process and that today's choices affect this process. Stevenson (2007) also finds that divorce laws affect the extent of specialisation within marriage.

across households		
	mean	sd
Household age	38.5	13.6
Age gap	2.5	5.8
N children (max)		
	%	
0	44.1	
1	17.8	
2	25.4	
3 and more	12.8	
N	4,467	
across observations		
	%	
No children present	44.0	
Children under 5 present	18.9	
Children aged 5-11 present	24.0	
Children aged 12-18 present	13.1	
N	36,717	

Table 1: Descriptive Statistics

The age structure of the children population in the household drives the need for childcare as explained in section 2.1 which enters the household optimisation problem. In the model simulations, we will restrict our attention to cases where there are at most two children for two reasons. First, relatively few households (12%) have more than two children in our data. Second, the market price of two nursery places is roughly the same as that of a nanny so that capping the childcare need in terms of time and cost of market services to the need of the two youngest children in the households is a fair representation of actual time/money costs.

We will use the index K to represent the age structure of a children population κ as:

$$K(\kappa) = 100 \sum_{i=1}^{3} \mathbb{1}_{\{11<\kappa_i \leq 16\}} + 10 \sum_{i=1}^{3} \mathbb{1}_{\{5<\kappa_i \leq 11\}} + \sum_{i=1}^{3} \mathbb{1}_{\{\kappa_i \leq 5\}} \tag{20}$$

so that, for example, a household with children aged 4 and 13 will be represented by an index $K = 101$. K can only take ten values to represent households with up to two children. The variations in K that are useful in our identification yield variations in time and money need for childcare. We thus regroup categories that yield similar needs on these two dimensions[11] and focus on the following 7 types of children population, the distribution of which is reported in Table 2.

[11]The categories 100 and 200, 10 and 110, 1 and 101 have been regrouped.

across observations	all ages	ages 21-34	ages 35-44	ages 45-54
K	%			
0	56.00	48.14	24.58	58.47
1	8.93	19.35	8.70	1.25
2	3.72	8.72	4.63	0.52
10	10.21	6.80	20 .59	12.97
11	5.93	10.53	12.27	1.65
20	7.51	5.67	17.46	5.90
100	7.71	0.80	11.77	19.23
N	37,644	10,590	10,073	7,270

Table 2: Children population

The dynamics of K reflect the ageing of the children the household and fertility hazards, which we assume to be driven only by the current κ and the household age. We assume fertility hazards to be exogenous and thus rule out a potential feedback mechanism of current labour supply decisions on future fertility. If fertility hazards were allowed to vary with parents' wages then fertility motives would enter decisions on labour supply since these affect future wages. This would add another mechanism to our analysis and we have excluded it on the grounds that it is likely to be quantitatively minor relative the mechanisms that we focus on. Given the small income elasticities typically found in the literature (for example Schultz (2005)), the size of the fertility changes that we ignore is probably small.[12] Birth rates peak at the age of 28, increases in the presence of children under 5 in the household and decreases sharply in the presence of older children. The first-order Markov process of the dynamics of K is characterised by the $(7, 7)$ transition matrices A_K^{age} reported in the Appendix in Table A-1.

The joint distribution of education levels is reported in Table 3, where 'high' refers to degree level education, 'medium' refers to the completion of A-levels and 'low' refers to a maximum qualification of strictly less than A-levels.

Educ. F	high	medium	low
Educ. M			
high	6.22	2.66	7.97
medium	2.88	3.74	12.88
low	5.06	8.25	50.34
N = 3,953			

Table 3: Education joint distribution

We note some modest degree of assortative matching by education with 60% of the sample on the first diagonal. In 16% of households, the female spouse has a higher level of education than the male spouse. In 24% of households the reverse is true.

[12]Besides, our (unreported) estimates of fertility hazards with additional controls include insignificant coefficients on the education variables.

3.2 Stylised facts

Now turning to the joint distribution of wages, we consider quintiles of hourly labour market values for all individual in our sample. For all individuals in employment this is simply their monthly labour earnings divided by their hours of work. For individuals out of the labour force we use the last hourly wage quintile observed for this individual if they have been observed in employment at some previous date in the sample or the predicted wage quintile at age 21-25 for individuals of the same education and gender. This will allow us to trace all individuals labour market values, which is essential in our framework where these play a role in the household decision. In the following, we will refer to both actual wage quintile and inputted labour market value as 'wage'.

Hourly wages are calculated as the ratio of monthly labour income and the sum of usual hours and overtime hours (with a weight of 1.5 on overtime hours to reflect overtime pay). The mean wage levels in each quintile are $(3.71, 6.47, 7.86, 10.19, 18.67)$. About 10% of wages fall below the official minimum wage. The rate of non-compliance by employers with minimum wage regulation is probably not this large and we expect the bulk of these low wages to come from the fact that, in the BHPS, hours are reported as hours 'normally worked per week' while monthly income is reported for the previous month.

	female wage quintile				
	4.89	4.52	1.60	1.83	1.40
male	4.53	5.09	1.93	1.83	1.07
wage	4.14	7.50	2.05	2.19	1.19
quintile	5.15	6.92	3.80	5.22	2.90
	5.18	6.76	3.97	6.72	7.63

Table 4: Joint distribution of wage quintiles

The joint wage distribution is shown in Table 4 in our sample of 36,717 observations of individuals living in a couple. Consistent with the assortative matching in education observed above, we see some positive association of female and male wage quintiles, with nearly 25% of the joint distribution on the first diagonal. Observations where the female spouse is on higher wage quintile than the male spouse represent 55% of the sample while the reverse is observed in 20% of the sample. The joint distribution of wages is much less equal between genders than the joint distribution of education in a large part because the accumulated labour market experience differs markedly between genders as we will see shortly.

Wage processes, part-time, full-time and non-participation As detailed in section 2.3, we model wage dynamics as a first-order Markov process for wage quintiles, where transition hazards depend on initial labour market choices. Table B-1 in the Appendix displays our estimates of 5-year transition matrices $\mathbf{A}_{lm}$ for $lm = 0, 1, 2$ relating to initial non-participation, part-time and full-time employment. Our sample size and the fact that few men work part-time precludes a reliable estimation of transition matrices for both genders in each labour market state so we have opted to estimate these matrices for both genders together.

This is a limitation since returns to experience have been documented to vary across genders. However, the bulk of this difference stems from the fact that some of the female labour experience is in part-time employment, which we do account for with our transition matrices specific to each labour market choice.

Two facts emerge from these transition matrices that are key to the approach we take in this paper: first, there are substantial costs attached to part-time work and non-participation in terms of earnings dynamics[13], so it is useful to include these in household labour market decisions by using a dynamic framework. Second, these costs vary depending on one's initial position within the wage distribution. For example, it is more costly in terms of expected wage progression to work part-time for individuals initially on the third wage quintile than for those on the first (lowest) wage quintile. This variation in the cost-benefit analysis of opting for part-time work or non-participation with individuals' current wage quintile will help the identification of the model in our estimation below.

3.3 Moments to match

Labour market choices The moments to be matched by our model are labour market choices and labour market transitions. Within our theoretical framework these will be chiefly affected by the age composition of the children population in the household and wages of the two spouses.

The distribution of household labour supply choices is reported in Table 5 by composition of the children composition in the household, embodied by the value of K and by values of each spouse's wage quintile. In our data, few men work less than full-time so we regroup all observations where this is the case into a single category.

[13] Most of the literature on the part-time pay penalty focuses on static differences rather than these differences in dynamics. Its key findings are that much of the raw penalty of part-time work comes from differences in education and occupation, and that occupation downgrading often occurs in transitions from full-time to part-time work (see Connolly and Gregory (2009), Harkness (1996) and Manning and Petrongolo (2008)). We do not account for an instantaneous pay penalty from switching to part-time. This penalty arises over time in the form of a reduced wage growth. Besides, the only way we account for selection is to compute transition rates specific to each initial wage quintile, thus controlling for initial earning capacity.

	$lm_m < FT$	(FT, NP)	(FT, PT)	(FT, FT)
K				
0	0.08	0.09	0.14	0.69
1	0.11	0.27	0.33	0.29
2	0.16	0.41	0.29	0.13
10	0.09	0.18	0.41	0.33
11	0.13	0.35	0.38	0.15
20	0.10	0.21	0.47	0.23
100	0.08	0.11	0.37	0.45
w_m				
1	0.13	0.21	0.24	0.42
2	0.07	0.19	0.27	0.48
3	0.19	0.14	0.24	0.43
4	0.06	0.16	0.28	0.50
5	0.08	0.20	0.33	0.39
w_f				
1	0.10	0.16	0.39	0.35
2	0.14	0.31	0.24	0.31
3	0.07	0.15	0.25	0.53
4	0.07	0.11	0.21	0.60
5	0.08	0.08	0.32	0.51

Note: NP: non-participation, PT: part-time, FT: full-time.

Table 5: Household labour supply (lm_m, lm_f)

The dynamics of household labour supply choices are reported in the Appendix in Table C-1, aggregated over all ages 21-54 and by age category. Within our framework, these dynamics are driven by the dynamics of K (ageing of household's children, fertility events), the dynamics of wages (stochastic wage changes given labour market choices) and shocks to marriage 'quality', ϵ.

Divorce hazard As seen in section 2.4, the possibility of divorce plays a crucial role in the dynamics of the bargaining power within the couple. It also affects labour supply decisions in that post-divorce outcomes are affected by labour market values, which are themselves influenced by labour market status. Five-year divorce hazards for the different wage quintiles of the two spouses are reported in Table 6.

wage gap	-4	-3	-2	-1	0	1	2	3	4
divorce rate	3.92	2.21	2.36	1.89	1.77	1.62	1.90	2.03	2.01

Note: wage gap = male quintile - female quintile.

Table 6: Divorce rates

We observe that divorce rates are at their highest when the magnitude of the gap between the wage quintiles of the two spouses is large.

4 Estimation procedure

We present here the estimation method and the assumptions we make. We will use estimated processes presented above of the dynamics of the age structure of the children population (section 3.1) and the dynamics of wage quintiles (section 2.3). These two processes are assumed to be exogenous and are both key in labour supply decisions of forward looking households.

Besides, we make a number of assumptions described below regarding preferences, divorce arrangements and retirement (section 4.1), childcare needs by child age and the initial distribution of power (section 4.2).

We are then able to solve the model by backward induction from retirement and predict household labour market choices for each (w_m, w_f, K). We proceed to estimate structural model parameters using the simulated method of moments (see Gourieroux et al. (1993)) to be matched with the observed choices estimated above (section 3.3) from our sample. The parameters to estimate are the distribution of individual preferences for consumption and leisure, and the distribution of households' taste for domestic childcare. We also match the dynamics of household labour supply (preference types are assumed constant). Specifically, the moments to be matched are the labour market choices by type of children population K, and by wage quintile of either spouse $(w_m,\ w_f)$ (51 moments) xx update xx, labour market transitions (12 moments).

We also match divorce hazards and their variations with the gap in spouses' wage quintiles to estimate the mean and variance of marriage quality shocks. Identification is dicussed in section 4.3.

4.1 Assumptions

Preferences Individuals derive utility from consumption, leisure and from the public good described in section 2.2, i.e. the fraction of the childcare need carried out domestically, D. We use a CES utility function as follows:

$$\mathcal{U}_g\left(C_g, L_g, D_h\right) = \tag{21}$$

or (as in Bronson):

$$\mathcal{U}_g\left(C_g, L_g, D_h\right) = \frac{\left(C_g^{\alpha_g} L_g^{1-\alpha_g}\right)^{1-\sigma}}{1-\sigma} + \beta_h \log D_h \tag{22}$$

atm in Matlab:

$$\mathcal{U}_g\left(C_g, L_g, D_h\right) = \exp\left[\beta_h\left(\alpha_g \log C_g + \left(1-\alpha_g\right)\log L_g\right) + \left(1-\beta_h\right)\log D_h\right] \tag{23}$$

introduce equivalence scale, see Meghir

Whilst α^g is individual-specific, the coefficient β_h is household-specific. We allow individuals and households to be heterogeneous with regard to their relative preferences for these.[14] Spouses also derive utility from being in a marriage, ϵ_h, which is common to both and subject to shocks every period (5 years). The

[14] The parameter illustrating the household's preference for home-produced childcare is similar to the parameter measuring the dis-utility of joint work in Guner et al. (2014).

mean and variance of these shocks, $(m_\epsilon, s_\epsilon^2)$, are two of the structural parameters that we estimate. The distribution of ϵ is assumed to be normal.

We model the heterogeneity in the parameters $(\alpha_m, \alpha_f, \beta)$ in the form of discrete distributions, with weights ω_m, ω_f and χ respectively. The marginal cumulative distribution functions are thus the following:

$$\begin{aligned} \mathcal{W}_g(\alpha_g^p) &= \sum_{q\leq p} \omega_g^q \text{ for } g = m, f \\ \mathcal{X}(\beta^p) &= \sum_{q\leq p} \chi^q \end{aligned} \tag{24}$$

The distributions of α_m and α_f are allowed to be correlated through a Gaussian copula C_R, with a correlation coefficient of R, which we calibrate at $R = 0.80$. The distribution of β is assumed to be independent of (α_m, α_f). The joint distribution of these parameters can thus be expressed as the following c.d.f:

$$F(\alpha_m^p, \alpha_f^q, \beta^r) = \mathcal{W}_m(\alpha_m^p) \cdot \mathcal{W}_f(\alpha_f^q) \cdot C_R \left[\mathcal{W}_m(\alpha_m^p), \mathcal{W}_f(\alpha_f^q)\right] \cdot \mathcal{X}(\beta^r) \tag{25}$$

with the Gaussian copula:

$$C_R(x, y) = \Phi_2 \left[\Phi^{-1}(x), \Phi^{-1}(y), R\right] \tag{26}$$

where $\Phi_2(.,.,R)$ is the c.d.f. of the bivariate standard normal with correlation coefficient R and Φ the standard normal univariate c.d.f.

In the spirit of Train (2008) we specify a discrete support of values $\{\alpha_g^p\}_{g=m,f;p=1..P}$ and $\{\beta^p\}_{p=1..P}$ for these coefficients and then estimate the attached weights$\{\omega_g^p\}_{g=m,f;p=1..P}$ and $\{\chi^p\}_{p=1..P}$. Relative to estimating both mass points and probabilities, this makes the estimation much quicker and allows for more support points.

Divorce As mentioned in section 2.4, the male ex-spouse transfers an alimony y to the female ex-spouse following their divorce. This alimony varies with the ages of the children and are a fraction of the male spouse's labour earnings at the time of divorce. Our calibration is the following:

$$y(w_m^D, \kappa) = \left[0.025 \sum_{i=1}^{3} \mathbb{1}_{\{11<\kappa_i\leq 16\}} + 0.05 \sum_{i=1}^{3} \mathbb{1}_{\{5<\kappa_i\leq 11\}} + 0.1 \sum_{i=1}^{3} \mathbb{1}_{\{\kappa_i\leq 5\}}\right] 20 \cdot lm_m^D \cdot w_m^D \tag{27}$$

For retired divorcees, the alimony is assumed to be a fixed percentage, 15% of the male ex-spouse's earnings.

Retirement The retirement age is set at 65 for all, with a remaining life expectancy of 20 years. The retirement income replacement ratio is set to 0.50.

4.2 Other calibrated parameters

The childcare needs of each age category are calibrated as follows, bearing in mind that these are time needs within the 40-hour working week: 40 hours for children under 5, 15 hours for children aged 5 to 11 and 5 hours for children aged 11 to 16. The market price for a unit of childcare services (per hour-child) is set to £3.5.[15] Sensitivity of our model predictions to the price of childcare will be assessed in section 5.4.

The limited commitment model described in section 2.5 is informative on the dynamics of Pareto weights in response to shocks to wages, fertility and marriage quality but does not deliver any predictions regarding the Pareto weights at the time of marriage formation, apart from the fact that both parties have to derive a higher asset value from marriage than from being single. Since we do not model marriage formation and consequently not the value of being single pre-marriage, we take a shortcut of assuming an initial distribution of Pareto weights that is uniform over the discrete support of values that we use in the estimation procedure, i.e. $\{0.1, 0.25, 0.5, 0.75, 0.9\}$. We have examined the sensitivity of our results to alternative choices for this initial distribution and found qualitatively similar outcomes.[16]

The annual discount rate is set at 0.95. Since the amount of leisure and domestic childcare decided upon within our framework relate to the time within working hours, we allow for the fact that individuals and household enjoy 'baseline' levels of both of these outside these hours. Thus, the quantities L and D that enter the utility function are the sum of the leisure and domestic childcare chosen within the model and the baselines levels, L_0 and D_0 respectively. We set L_0 t0 25 hours (weekly) and D_0 to 0.2.

Finally, the relative taste for the male domestic time dom_m to the female domestic time dom_f, i.e. the parameter λ in equation 3, is set to 0.7.[17]

4.3 Identification

We do not have a formal proof of identification but can point to several sources of variations that help identifying the parameters of interest. First, as we saw in section 3.2, the cost of working less than full-time, both in the current period and in expectation depends on one's initial wage quintile and age. Second, depending on the number of children needing childcare, one hour of a parent's domestic time may save from 1 to 3 hours of market childcare services. The trade-off between this loss of income, the possible increase in leisure time –since labour supply choices are discrete, in some cases, working part-time to fulfil the childcare need entails increased leisure time too– and the increased amount of the public good (the fraction of needed childcare carried out domestically) depends on the household's preferences on consumption, leisure and home-produced childcare.

Third, working less than full time causes two additional losses for the *individual* concerned: the expected future loss in labour market value will weaken his/her bargaining power, in expectation, as well as his/her asset value post divorce. So if an individual has a high Pareto weight at the time of the decision, they are likely to influence it by leaning against the option of them working less than full time (all other things equal). Indeed, these two costs are not internalised by the spouse not expecting to bear them, which makes each

[15] According to Which? website, childcare costs average 4.6 per hour for a child under 2 in nursery in 2015. The lower figure we use is meant to account for the fact that some households use grandparents' childcare. xxx Figures

[16] These results are available upon request.

[17] This parameter helps to predict that households where the female spouse is on a higher wage quintile still choose for her to work less than full-time to fulfil childcare needs domestically, as often observed in the data.

spouse more likely to push for the other one to drop out of full-time. This, however, may be offset by the fact that the household values the domestic time of the mother more than that of the father (see section 2.2 and the parameter λ). Finally, depending on the initial gap between the spouses' wage quintiles, today's labour supply decision may yield an increase (respectively decrease) of the divorce rate if the spouse earning the least (respectively the most) drops out of full-time employment, since divorce rates are higher when the magnitude of the wage gap is higher.

Now turning to the estimation of the mean and variance of the shock to marriage quality ϵ, the identification will come from the average divorce rate as well as the variations in divorce rate with the relative wage quintiles.

5 Results

work in progress

5.1 Fit

The fit of the model is presented in Tables D-1 to D-3 for the labour supply choices, labour supply transitions and divorce rates. The model offers a reasonably good fit and captures the main stylised facts. *work in progress*

5.2 Coefficient estimates

The coefficient estimates are displayed in Table 7. We note a substantial degree of heterogeneity both in terms of the consumption-leisure trade-off and in terms of households' taste for home-produced childcare. Some households (with a low β) do not derive much utility from the fact that their children are looked after by a parent rather than a market provider of childcare, so take their labour supply versus childcare decision mostly based on its expected financial consequences and its impact on future bargaining power. Some other households, on the other hand, place a large value on domestic childcare and this taste will play a prominent role in their decision to supply labour in the presence of young children. Section 5.3 presents an illustrative example of these contrasting tastes.

mass points	0.02	0.25	0.5	0.75	0.98
α_m	0.161	0.001	0.001	0.004	0.833
α_f	0.203	0.187	0.000	0.203	0.406
Correlation (α_m, α_f)	0.85	(calibrated)			
β	0.241	0.250	0.001	0.007	0.502
		mean	std. dev.		
Marriage quality shocks		xx	xx		

Table 7: Coefficient estimates

Estimates of the mean and variance of the marriage quality shocks give rise to dynamics of the Pareto weights within our limited commitment model which are illustrated by the following transition matrix between the values on the discrete support of μ: $\{0.05, 0.15, 0.25, 0.35, 0.45, 0.55, 0.65, 0.75, 0.85, 0.95\}$, where the current μ's are represented by rows and the μ's in the next period are represented by columns. These transitions[18] are the results of shocks to marriage quality only, keeping wages and children constant.

$$\begin{pmatrix} 0.06 & 0.06 & 0.17 & 0.33 & 0.37 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0.12 & 0.17 & 0.33 & 0.37 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0.30 & 0.33 & 0.37 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.63 & 0.37 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1.00 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1.00 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.31 & 0.69 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.31 & 0.36 & 0.33 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.31 & 0.36 & 0.21 & 0.12 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.31 & 0.36 & 0.21 & 0.07 & 0.05 \end{pmatrix}$$

This transition matrix suggests rather persistent levels of Pareto weights, with infrequent large adjustments in spouses' bargaining powers following shocks to marriage quality. Explain more the shape of transition matrix and link with theory. *work in progress*

On the other hand, the table below shows our predicted[19] average Pareto weights for different values of (w_m, w_f), which demonstrates the influence of relative wages (or labour market values) on bargaining power and justifies the concern for future power in today's choice of labour supply, given its consequences on expected wages.

	female wage quintile				
	4.89	4.52	1.60	1.83	1.40
male	4.53	5.09	1.93	1.83	1.07
wage	4.14	7.50	2.05	2.19	1.19
quintile	5.15	6.92	3.80	5.22	2.90
	5.18	6.76	3.97	6.72	7.63

Table 8: Average Pareto weights by (w_m, w_f)

As a robustness check we have run our estimation with a different value of the discount rate illustrating a scenario where households are much more myopic than in the benchmark estimation. Indeed, households may choose to have one spouse dropping out of full-time work not because they value domestic childcare highly but because they are shortsighted with regards to the future impact of this decision on future wages. Our alternative calibration of the annual discount rate is 0.80. The results we obtain[20] are qualitatively similar but include a distribution of the taste for home-produced childcare that is much more skewed towards 0.

[18] These are calculated for utility parameter values of $\alpha_m = xxx$, $\alpha_f = xxx$ and $\beta = xxx$ and for a household where $(w_m, w_f, K) = (3, 3, 0)$.

[19] Again, these figures are calculated for utility parameter values of $\alpha_m = xxx$, $\alpha_f = xxx$ and $\beta = xxx$.

[20] Available upon request.

work in progress

5.3 Illustration

work in progress

Our coefficient estimates allow us to quantify the various components of the cost-benefit analysis underlying households' labour supply decisions. In this section we provide an illustration of the relative sizes of these components for some values of the coefficients. As detailed in section 2.6, these components are the following:

The components of the trade-off between these two alternatives are the following (and we will return to each of them more specifically in the following sections). First, the home production of childcare entails one of the partners taking time off work[21] and foregoing current labour market income. In terms of monetary budget, this is to be compared with the instantaneous savings in terms of market childcare services.

The fourth and last component of this trade-off is that an individual's labour market value may impact on his/her bargaining power in household decision making. If that is the case, taking time off work in the current period means foregoing bargaining power in future household decisions, in expectation. These last two components of the trade-off yield another dynamic dimension of the labour supply versus home production of childcare decision in our framework.

work in progress: Impact of divorce regulations on μ dynamics (all other things equal). Impact of divorce regulations on labour market choices (all other things equal).

5.4 Households sensitivity to childcare policy

The example above illustrates how the cost-benefit analysis of labour supply versus home childcare depends on the household's preference parameters, current Pareto weights, spouses' wages and children's ages. The only households who are likely to be responsive to a change in childcare prices are those for whom the net cost/benefit of supplying labour is close to zero. All others will value their current choice much more than the alternatives and will not react to a change in the childcare policy. From the policymaker's point of view it is interesting to quantify the mass of households who are marginal in the population in order to predict the effectiveness of a policy change.

Our estimation allows us to compute the predicted household asset values of alternative labour supply choices. In order to represent the distribution of households in terms of their distance to breakeven between

[21] We assume that household do not decide to pay for childcare in normal working hours in order to increase the amount of leisure of an adult in the household, so that the relevant alternative to childcare is work. This seems to us a reasonable assumption in most households and will be checked with our estimated coefficients.

different labour supply choices, we calculate the following quantities:

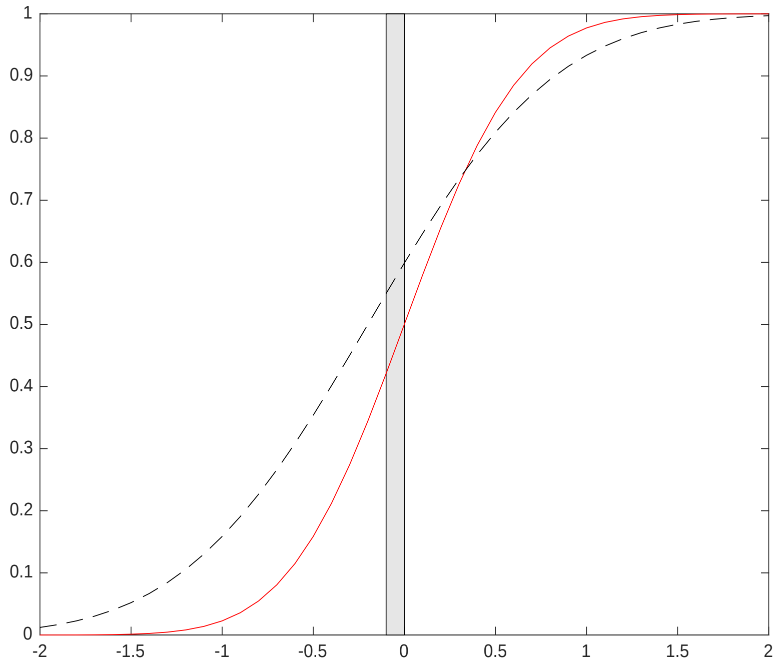
$$\begin{aligned}
\Delta_{FT} &= \frac{V_h(FT,FT) - V_h(FT,PT)}{B_2} \\
\Delta_{PT} &= \frac{V_h(FT,PT) - V_h(FT,NP)}{B_2}.
\end{aligned} \tag{28}$$

These measure the gap in asset values between the labour supply choices (FT, FT) and (FT, PT) and between (FT, PT) and (FT, NP) relative to the cost of childcare services saved from either transition B2 (as defined in section 5.3). If the policy maker is considering a 10% decrease in childcare prices, the marginal households are those for whom our calculated quantities are in the range $(-0.10, 0)$. The households for whom (at least one of) these quantities are positive already supply labour before the policy change and are infra-marginal. The households for whom these quantities are below -0.10 will not be enticed to supply labour by this policy change.

Figure 1 shows the c.d.f of the quantities defined above among our sample of households aged 30 to 35 and with two children under 5 ($K = 2$). The childcare need for these households is 40 units of time and 80 units of childcare services, so that quantity B_2 reflects a saving of 40 units of childcare services for both transitions considered here. As is clear from our framework, these gaps will depend on the households taste parameters $(\alpha_m, \alpha_f, \beta)$. Given these and the initial distribution of Pareto weights that we calibrate (see Section 4.2), we can predict the distribution of μ for each (w_m, w_f, K). The distributions illustrated in Figure 1 are obtained by simulating 10,000 households whose wages are drawn from our empirical joint distribution of wages among households aged 30-35 with two children under 5, taste parameters are drawn from the estimated distributions reported in Table 7, and μ's are drawn from the resulting distribution of Pareto weights.

For the group under consideration, Figure 1 tells us that xxx % of households are infra-marginal, i.e. would benefit from the policy but not alter their labour supply behaviour (xxx check this) while xxx % of households are marginal and would switch from xxx to xxx. Different numbers for PT and FT transitions. Besides, our simulations show that xxx% of this group would still prefer the mother not to participate in the labour market even if childcare costs were cut by 50%. *work in progress*

Figure 1: Estimated distances to breakeven



dashed: Full-time vs Part-time; solid: Part-time vs Non-participation
Not real figures yet

5.5 Policy questions

The ability of our approach to predict the impact of alternative policies is limited by our assumptions of exogenous fertility and partial equilibrium. These preclude any feedback mechanism whereby firms may alter their job creation behaviour in response to changes in female labour supply, or whereby fertility rates or wage determination are affected by these changes. With this caveat in mind, we are discussing here various policy implications of our results.

Incentives to specialisation depend on several features of our model. First, taste for mother time: custom, biology, time persistence (acquired taste). Second, taste for domestic childcare combined with expected loss of income due to part-time work or non-participation. Third, the initial distribution of Pareto weights. Divorce regulations such that partner incurring loss of labour market value from working less than full time is not compensated for this loss post-divorce. This implies that this partner not only has a lower post-divorce continuation value but also looses bargaining power within the marriage. This means that, all other things equal, the spouse with a high bargaining power initially is less likely to push the household labour supply decision where he/she works less than full-time. A policy that would compensate any partner who has lost potential labour market earnings by providing the household's domestic childcare would thus have an impact on both post-divorce values and the balance of power in continuing marriages. The impact of such a policy on specialisation depends on the distribution of bargaining power at the time of the domestic childcare versus labour supply decision. For example, in a situation where the male spouse has most of the bargaining power and the household decision is for the mother to specialise in childcare while the father specialises in labour supply, the above policy would lessen the incentive to specialisation as the male partner (and thus the household, in which decisions he weighs heavily) now internalises the expected cost of domestic childcare. On the other hand, in a situation where the female partner has most of the bargaining power, the above policy lowers the expected cost of specialisation and increases the incentive for this household to specialise. In other words, this policy would shift some of the expected costs of working less than full-time from the parent providing childcare to the other parent. This would thus entice a household where the childcare provider has most of the power to specialise more and a household where the parent staying in the labour force has most of the power to specialise less. Both the policy itself and these responses would then lead to a more balanced division of power within households. The direct effect results from the fact that both partner's outside options are affected more equally by the decision to produce childcare domestically. The indirect effect comes from the fact that households where the mother has more power have more incentives to adopt a choice (specialisation) that will reduce her power whereas households where the father has more power have less incentives to specialise, so less incentive to decide that the mother produces domestic childcare and looses bargaining power.

The crucial role of divorce laws on the dynamics of bargaining and on investments within marriages have been pointed out by Stevenson (2007). She shows that changes in divorce laws affect both the likelihood of divorce and the incentive to invest in the marriage. In our framework, since we ignore any long-term effect of domestic childcare on children outcomes that may enter the parents' utility, the time taken off labour market supply to look after children is a reverse investment in that benefits are reaped off in the current period while costs are spread over future periods.

One could take the view that if households choose to specialise because they value domestic childcare highly then there is no need for the policy maker to interfere with these decisions. However, the policy maker may find the long-term effects of specialisation undesirable for two reasons. First, since the childcare provider is often the woman and since working less than full-time damages future earnings, specialisation leads to greater future gender gaps in labour market value. Second, specialisation may produce higher numbers of children living in poor households. Indeed, when divorce occurs in the presence of children, custody is mostly given to the mother, who, in specialised households, has lost potential labour market value. The post-divorce household in which the children live is thus poorer when the pre-divorce household was specialised. Since gender gaps and child poverty are both items of the political agenda, the specialisation of households is indeed of interest to the policy maker.

Our model proposes a coherent set of behaviour that leads to xx% of children under 11 to live in households (married or single) in the lowest quintile of household incomes, and xx% of children under 11 to live under the 'poverty line' defined as 40% of median income. Our analysis falls short of a prediction within a general equilibrium model of a response to policy changes, but we can nevertheless conjecture that policies aiming to increase the quality of market childcare (thereby shifting the preference distribution for home-produced childcare), to decrease the price of these services, to sustain human capital and labour market skills of childcare home providers, or to include larger compensation for loss of market earnings into divorce settlements, would all reduce the extent of child poverty.

Finally, a compelling reason for policy intervention is the presence of inefficiency. In this context, as we saw in section 2.7, the fact that today's decisions alter future bargaining power is a source of inefficiency, arising mainly from the fact that future outside options are affected in an asymmetric manner by today's decisions, i.e. the post-divorce outcome of the spouse providing childcare is more affected than that of the other spouse. A policy to subsidise childcare would have no direct impact on these dynamics and hence the source of inefficiency, while a policy that would account for past investments in household public good in post-divorce settlements would reduce the scope for such inefficiency to arise.

6 Conclusion

In this work we aim to reevaluate the trade-offs faced by households when making labour supply decisions in the presence of children. We model the need for childcare in terms of parental time or in units of bought childcare services according to the age structure of the children population within the household. A novel feature of the model specification is that home-produced childcare is a public good within the household. The taste for the fraction of required childcare being carried out within the home is the same for both spouses within a married household but is heterogeneous across households. The presence of children and their ages will thus affect the time and the budget constraint of households as well as the trade-off between the different uses of time, i.e. leisure, childcare and work. Besides, labour market choice has an impact on future labour market earnings, the size of which depends on the initial location of the individual earnings in the wage distribution. Indeed, our data show that the expected cost of working part-time relative to full-time is larger at the higher wage quintiles.

An interesting component of the model is that this cost of working less than full time to carry out home childcare cannot be fully internalised by the household because of the hazard of divorce and because divorce settlements do not compensate (fully) for past labour market choices and public good provision. The inability to compensate the partner providing home-produced childcare and thus the household public good in the current period or in future settlements gives rise to a market failure within the household and to inefficiency of labour supply decisions. Besides, the fact that the cost of working less is borne by the spouse doing so more than by the household as a whole helps us to identify the Pareto weights of both partners in the collective decision process. Clearly, considering both the provision of home childcare as a household public good and part-time work or non-participation as bearing long-term costs in labour market value leads to revise downwards our estimates of the bargaining power of the spouse providing childcare, typically the woman.

We also produce estimates of households' preference for home-produced childcare and the heterogeneity of this preference. We find that households are on average prepared to give up xxx of consumption for a 10% increase in the fraction of childcare being carried out by a parent. This is, to the best of our knowledge, a slightly different angle of labour supply choices in the presence of children from the existing literature. Our estimates of the taste for home-produced childcare is relevant for policy design since this taste is bound to affect the response of households to childcare subsidies. Indeed, households with a strong preference for home-produced childcare will be expensive to entice into labour market participation from a policy maker point of view. Our results allow us to compute a structural estimate of labour supply elasticity to the price of childcare. Our simulations show that, for households aged xxx with xxx children, a 10% decrease in the price of childcare would induce xx% of households to participate in the labour market, while xx% of households would not participate in the labour market even if childcare prices were cut by half.

The figures we obtain are informative for policy design. Our structural approach allows us to predict the fractions of households that are not likely to respond to any childcare policy change of reducing childcare costs by up to half as well as the fraction of households who are at the margin, i.e. would alter their labour market choice following a small (10%) change in the price of childcare. (repeat)

Further research ... (?)

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APPENDIX

A Dynamics of K

Five-year transition matrices between the K categories $\{0, 1, 2, 10, 11, 20, 100\}$

All ages						
0.82	0.09	0.04	0.02	0.02	0.00	0.00
0.04	0.01	0.05	0.35	0.39	0.16	0.01
0.03	0.00	0.03	0.02	0.22	0.69	0.00
0.17	0.03	0.01	0.22	0.03	0.05	0.49
0.03	0.00	0.01	0.29	0.09	0.56	0.02
0.04	0.01	0.01	0.41	0.01	0.07	0.46
0.91	0.01	0.00	0.01	0.00	0.00	0.07
Ages 21-34						
0.46	0.31	0.15	0.02	0.06	0.00	0
0.05	0.02	0.08	0.28	0.48	0.10	0.00
0.07	0.01	0.02	0.03	0.32	0.54	0.01
0.05	0.14	0.03	0.25	0.21	0.11	0.21
0.04	0.01	0.02	0.18	0.24	0.52	0.00
0.03	0.06	0.00	0.56	0.00	0.15	0.21
0.50	0.00	0.00	0.50	0.00	0.00	0.00
Ages 35-44						
0.55	0.21	0.09	0.05	0.08	0.01	0.01
0.02	0.01	0.04	0.36	0.39	0.18	0.00
0.02	0.00	0.03	0.01	0.21	0.72	0.00
0.08	0.04	0.02	0.29	0.04	0.10	0.44
0.03	0.01	0.01	0.28	0.08	0.58	0.02
0.02	0.01	0.01	0.47	0.01	0.08	0.40
0.74	0.01	0.01	0.07	0.00	0.00	0.17
Ages 45-54						
0.93	0.02	0.00	0.03	0.01	0.00	0.00
0.05	0.00	0.01	0.52	0.17	0.20	0.03
0.01	0.00	0.00	0.02	0.07	0.90	0
0.22	0.00	0.00	0.19	0.01	0.02	0.56
0.03	0.00	0.00	0.36	0.05	0.52	0.04
0.03	0.00	0.00	0.36	0.01	0.05	0.55
0.91	0.01	0.00	0.01	0.00	0.00	0.07

Table A-1: Transition matrices between K values

Note that some of these transitions are estimated on small samples: in the age range 21-34, the transitions from categories 20 and 100 (two children 5-11 and one child 11-16, respectively) are calculated with denominators lower than 100. In the age range 35-44, the transitions from category 7, and in the age range 45-54, the transitions from category 20 (two children under 5) are also computed with small denominators.

The ergodic distribution of the transition matrix corresponding to all ages is fairly close to the distribution of the sample population across categories of K reported in Table 2, which makes sense since households mostly enter and exit the sample with no children under 16, i.e. the 0 category.

B Dynamics of wage quintiles

Five-year transition matrices between wage quintiles.

Full time				
0.34	0.29	0.15	0.14	0.08
0.14	0.27	0.24	0.25	0.09
0.08	0.14	0.21	0.40	0.17
0.05	0.05	0.09	0.39	0.41
0.06	0.04	0.04	0.13	0.74
Part time				
0.39	0.30	0.11	0.10	0.11
0.30	0.33	0.14	0.12	0.11
0.17	0.19	0.20	0.24	0.19
0.13	0.14	0.11	0.25	0.38
0.10	0.08	0.07	0.12	0.64
Non-participation				
0.77	0.13	0.04	0.03	0.03
0.11	0.80	0.04	0.03	0.02
0.08	0.08	0.70	0.10	0.04
0.05	0.05	0.06	0.70	0.13
0.08	0.04	0.03	0.07	0.79

Table B-1: Wage quintile transition matrices

C Dynamics of household labour supply

Five-year transition matrices between the household labour market choices $\{(lm_m < FT), (FT, NP), (FT, PT), (FT, FT)\}$.

All ages			
0.31	0.20	0.21	0.28
0.06	0.46	0.36	0.12
0.05	0.12	0.56	0.27
0.05	0.11	0.21	0.64
Ages 21-34			
0.29	0.23	0.23	0.26
0.08	0.47	0.33	0.13
0.04	0.23	0.52	0.20
0.03	0.16	0.27	0.53
Ages 35-44			
0.29	0.21	0.24	0.27
0.05	0.43	0.41	0.10
0.03	0.11	0.61	0.25
0.04	0.10	0.24	0.61
Ages 45-54			
0.36	0.15	0.17	0.32
0.07	0.50	0.28	0.14
0.08	0.09	0.51	0.32
0.06	0.06	0.11	0.77

Table C-1: Household labour supply transition matrices

D Model fit

	(FT,NP)		(FT,PT)		(FT,FT)	
K	Data	Model	Data	Model	Data	Model
0	0.09		0.14		0.69	
1	0.27		0.33		0.29	
2	0.41		0.29		0.13	
10	0.18		0.41		0.33	
11	0.35		0.38		0.15	
20	0.21		0.47		0.23	
100	0.11		0.37		0.45	
w_m						
1	0.21		0.24		0.42	
2	0.19		0.27		0.48	
3	0.14		0.24		0.43	
4	0.16		0.28		0.50	
5	0.20		0.33		0.39	
w_f						
1	0.16		0.39		0.35	
2	0.31		0.24		0.31	
3	0.15		0.25		0.53	
4	0.11		0.21		0.60	
5	0.08		0.32		0.51	

Note: NP: non-participation, PT: part-time, FT: full-time.

Table D-1: Fit of labour supply choices

Data			
0.31	0.20	0.21	0.28
0.06	0.46	0.36	0.12
0.05	0.12	0.56	0.27
0.05	0.11	0.21	0.64
Model			

Table D-2: Fit of labour supply transitions (all ages)

wage gap divorce rates	-4	-3	-2	-1	0	1	2	3	4
Data	3.92	2.21	2.36	1.89	1.77	1.62	1.90	2.03	2.01
Model									

Note: wage gap = male quintile - female quintile.

Table D-3: Fit of divorce rates