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

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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. 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.

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). 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 utlility 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).

Besides, our results contribute to various policy-related debates. Papers connected to the questions we examine are Adda et al. (2011) 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.

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 below a partial equilibrium model of labor supply, childcare and consumption choices of individuals in two-partner households. 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. In order to keep the model reasonably tractable and parsimonious, we will keep both the divorce and fertility hazards 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 will however endeavour to estimate the matching patterns in terms of education and preferences regarding (private) consumption, leisure and home childcare.

The environment is one of dynamic choice set in discrete time, where the (common) discount factor is denoted β. The dynamic dimension of choices resides only in the fact that participation in the labour market and the intensity of this participation have an impact (in expectation) on future earnings. We rule out saving and borrowing behaviour as well as the concept of home childcare being an investment in the 'qualiy' of the child later on. In some specifications of the model, however, current choices may affect future household bargaining, thereby involving another dynamic consideration in current decision making. The unit time period is one year. 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.[1] We also ignore informal childcare carried out by e.g. grandparents.

2.1 Family structure and childcare need

We follow households that are all initially composed of at least two adults. The event of divorce may occur at an exogenous rate and we describe this arrival rate and the resulting outcomes for each partner in section

[1] This is counterfactual for some subset of the population. In xxx, xx% of couples in the BHPS reported working staggered working days to accomodate childcare needs. It however comes at the cost of time spent together out of work. Hamermesh xxx estimates that couples put some value xxx on this togetherness. 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.

2.2 below. Fertility events are also exogenous and may depend on observables such as parents' education and the number and ages of existing children in the household. 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 contraints a need for childcare which is explicitly formulated in terms of the age composition of the children population.

We denote by K the number of children in the household. Without much loss of generality, we limit K to 4 as very few families in our sample have more than four children. In the rare instances where households have more than four children, the ages of the youngest four children are used. The vector $\kappa = (a_k)_{k=1..4}$ represents the age (at next birthday) structure of the children in the household where $a_k = 0$ if there are less than k children (i.e. the k-th child is unborn). Just as adults, children age by one year every period. As mentioned above, fertility is assumed to be an exogenous process and the arrival rate of a new baby, π_b depends on the age of the household a, the age structure of the existing children population, κ and the education levels of the parents, ed_m and ed_f:

$$\pi_b = \pi_b \left(a, \kappa, ed_m, ed_f\right). \tag{1}$$

The event of a birth is denoted $b = 1$. So for example, a family with two children aged 4.5 and 6.2 is represented by $(7, 5, 0, 0)$. The evolution of the age structure of the children population is represented by: $(8, 6, 1, 0)$ in the following period in the event of a new birth $b = 1$ and by $(8, 6, 0, 0)$ in the absence of new birth $b = 0$. These 'dynamics' are denoted: $\kappa_{\text{next}}(\kappa, b)$.

There are 4 age categories, characterized by the amount of childcare that they require: under 5 years old, 5-11, 11-16, 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. 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. 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: $\max\{CC_k\}_{k=1..4}$. This expression reflects the fact that, when devoting one hour of time to childcare, the adult may look after one to four children.[2] 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[3] the possibility that childcare times performed by

[2] 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. Note that, the time required for childcare within working hours can only take 4 values: $\{\gamma_1, \gamma_2, \gamma_3, \gamma_4\}$.

[3] It is in fact a dominated strategy.

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:

$$p_{CC} \cdot \sum_{k=1}^{4} \max\{CC_k - (dom_m + dom_f), 0\}, \tag{2}$$

where $p_{CC} = p_{CC}(ed_m, ed_f)$ is the unit (hour/child) price of childcare services and is allowed to depend on parents' education levels to capture the fact that better-off households are likely to use childcare services at higher prices on average than less well-off households. The expression (2) reflects the fact that, contrasting with home-produced childcare, one hour of childcare services needs to be bought for each child 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.

The decision to carry out childcare domestically or to buy childcare services from the market is at the centre of our analysis. 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[4] 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. Second, individuals both value home-produced childcare. Indeed, it is a household public good as will be detailed in section 2.4. We assume away any dynamic consequence of children being looked after by a parent versus a market provider in that the household utility is not affected by past childcare choices, at least as far as children's well-being or outcomes may be affected in the long run. Besides, we rule out any (parental) gender gap in the productivity of home childcare. Thirdly, any parent's decision to take time off the labour market to produce home childcare does have consequences on his or her wage progression. By wage, we mean labour market value or human capital, which will depend on the individual's market value and the individual labour market choice in the previous period. As will be detailed in section 2.5, potential wages will be modelled as a first-order Markov process, the parameters of which will depend on labour market participation and hours. Post-divorce asset values will also be affected by these labour market values in a manner detailed in section 2.7. 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. This will be discussed in section 2.6.2. These last two components of the trade-off yield the dynamic dimension of the labour supply versus home production of childcare decision in our framework.

[4]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.

2.2 Household formation and dissolution

As stated above, we follow trajectories of couples whose initial status is a marriage or partnership. Thus we do not model household formation. We consider the event of divorce as exogenous, the determinants of which will be estimated in an auxiliary regression. The occurrence of partnership dissolution is approximated as a Poisson process. The hazard of divorce, π_d depends on the age of the household a, the age structure of the existing children population κ and the education levels of the two parents, ed_m and ed_f:

$$\pi_d = \pi_d \left(a, \kappa, ed_m, ed_f\right) \tag{3}$$

The event of divorce will be denoted D in the following, with $D = 1$ when divorce occurs and zero otherwise.

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. To represent the average case in a simple (but crude) way, 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:

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

The main objective of this model is to analyze labor market 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. The assumptions we make with regards to these will be detailed in section 2.7. Note that, although the individual asset value in a state of being divorced are relevant in the household bargaining over labor supply choices, the endogenous decision to divorce never arises as we assume that the event of divorce is always the result of a large exogenous shock unrelated to household decisions about labour supply and childcare. Formally, this can be accomodated by assuming a large transition cost to the state of divorce.

2.3 Time use

We only analyze decisions with respect to hours in the range of the usual working hours. We assume that there are 40 of these and that 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:

$$40 = 20 \cdot lm_g + L_g + dom_g \tag{5}$$

2.4 Individual preferences

One specificity of our approach is that we consider that households have a preference for home-produced childcare relative to childcare services from the market (nursery, childminder). In our framework, individuals do not derive utility from carrying out childcare *per se*, but from the fact that a high proportion of the household childcare need is being carried out within the home, by whatever parent. This proportion Π_h is formally defined as follows:

$$\Phi_h = \frac{dom_0 + dom_f + dom_m}{dom_0 + \max_k\{CC_k\}}, \tag{6}$$

where dom_0 is a constant to be calibrated illustrating the amount of childcare carried out before and after normal working hours. For simplicity, this is assumed to be constant across household. Φ_h equals 1 for households without children and households who opt to carry out all their childcare domestically. This fraction Φ_h of total childcare time need carried out within the home is a **public good** within the household.

We denote the flow utility of individual g, where $g = m, f$ stands for the individual gender, as $\mathcal{U}_g$. The quantities relevant to the instantaneous utility of the individual leaving in a couple are the individual consumption of private goods, C_g and leisure, L_g and the fraction of childcare needed by the household and that is produced domestically, Π_h. We will use a CES utility function as follows:

$$\mathcal{U}_g = \left[\alpha_g^C \cdot (C_g)^r + \alpha_g^L \cdot (L_g)^r + \alpha^\Phi \cdot \Phi_h^r\right]^{1/r} \tag{7}$$

Whilst α^C and α^L are individual-specific, the coefficient α^Φ is household-specific. We allow individuals and households to be heterogeneous with regard to their relative preferences for these. 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).

In the event of divorce, the female partner inherits the childcare needs of the couple (see section 2.2). Her subsequent choice as to whether to buy childcare services or to produce them domestically is assumed to be an individual choice, but she inherits the household preference in terms of substitution between the two types of childcare –the α^Φ parameter–.

2.5 Wage processes and labor supply choices

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 the household choice in terms of their labour market participation. Part-time and full-time employment 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 Harkness (1996)). 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 3.3.

We model wage dynamics as a first-order Markov process. We categorise all wages into quintiles of the overall wage distribution and consider the probabilities of earning a wage in a given quintile p' next year, given the quintile p where the current wage belongs, the labour market choice, lm and the individual's gender, g. We denote these probabilities $a^g_{lm}(p, p')$. 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. These are the only shocks to market value, so, under our assumptions, part-time work does not carry an instantaneous penalty, i.e. there is no 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 $a^g_{lm}(p, p')$.

The two partners (potential) wage levels are denoted w_m and w_f. Each can take one of five values corresponding to the quintiles of the overall wage distribution: w_p, $p = 1..5$. The transition rates between wage distribution quintiles, which will be key in the household dynamic choices, are summarised in 6 matrices –for two genders and three labour market states– denoted $\mathbf{A}^g_{lm}$. The elements of these matrices will be estimated in section 3.3. At equilibrium, the distribution of wages at age 25 and the transition matrices are such that the sum of individuals over all ages, genders and (active) labour market status in each wage decile comes to 20% of the active population.

2.6 Household decision making

2.6.1 Variables and constraints

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 wage quintiles, denoted respectively p and q to which the market values of the male and the female partners belong, the household non-labour income z,[5] and the marital status, D.

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 constraint, and a joint constraint in childcare need imposed by the age structure of the children population in the household.

[5] We will ignore non-labour income for married couples below retirement age, this variable only serves to accommodate pension income and alimony in the case of divorce

Formally:

$$\begin{aligned} 40 &= 20 \cdot lm_g + L_g + dom_g \text{ for } g = m, f, \\ 20(w_m \cdot lm_m + w_f \cdot lm_f) + z &= C_m + C_f + p_{CC} \cdot \sum_{k=1}^{4} \max\{CC_k - (dom_m + dom_f), 0\} \\ 0 \leq dom_g &\leq \max\{CC_k\} \text{ for } g = m, f, \\ dom_m + dom_f &\leq \max\{CC_k\}. \end{aligned} \tag{8}$$

2.6.2 Decision making

Denote s the vector of state variables:

$$s = \{a, \kappa, w_m, w_f, z, D\}, \tag{9}$$

and S the set of possible values for this vector. The process followed by s is governed by the fertility hazard described in 2.1, the wage progression hazard described in 2.5 and the hazard of divorce described in 2.2. The ageing process of the household is deterministic. Note that, whilst the birth rate and the hazard of divorce are assumed not to depend on choices made within the window of analysis (we follow individuals who have completed their education), the evolution of market values depend on labour market choices. We denote lm the vector of labour market choices:

$$lm = (lm_m, lm_f). \tag{10}$$

We will capture the transition rates for s as $\pi(s'|s, lm)$, which define the probability distribution of state variables next period s' given state variables and labour market choices today. Indeed, since all components of s are first-order Markov processes, the dynamics of s are first-order too. We assume innovations to these processes, i.e. fertility, divorce and wage shocks, to be independent. Thus, starting from a married state, a children population κ and potential wages on the p-th and q-th quintiles respectively for the male and the female partners, the transition rates can be expressed as the following product:

$$\pi(s'|s, lm) = [\pi_b * b + (1 - \pi_b)(1 - b)] \cdot [\pi_d * D + (1 - \pi_d)(1 - D)] \, \mathbf{a}^{\mathbf{m}}_{\mathbf{lm_m}}(p, p') \, \mathbf{a}^{\mathbf{f}}_{\mathbf{lm_f}}(q, q') \tag{11}$$

where $s = \{a, \kappa, w^p_m, w^q_f, z, 0\}$ and $s' = \{a + 1, \kappa_{\text{next}}(\kappa, b), w^{p'}_m, w^{q'}_f, z, D\}$ and zero otherwise.

As seen above the flow utilities for each partner are $\mathcal{U}_g(C_g, L_g, \Phi_h)$. 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' expected utilities. The weight μ is the relative bargaining weight of the female partner in household decision. We will experiment with different assumptions regarding the determinants of Pareto weights. The simplest specification assumes that μ may only be affected by the partners' relative education levels. In this case, weights are constant and exogenous to decisions made. Other possible assumptions regarding determinants of μ include the current age strucure of the household children population κ and/or relative wage levels. The former implies a changing bargaining weight, but in a way that is unrelated to labour market choices. The latter implies that today's labour supply decisions impact on tomorrow's weight

in the household utility function. Both assumptions may affect the efficiency of outcomes, see Browning et al. (2006). The impact of such assumptions in terms of efficiency of the decisions made is discussed in section 2.8.

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:

$$\max_{(C_m,C_f,L_m,L_f,dom_m,dom_f)} \left[\mathcal{U}_m\left(C_m,L_m,\Phi_h\right)+\mu\mathcal{U}_f\left(C_f,L_f,\Phi_h\right)\right] \tag{12}$$

given the choice lm, the value of the state variables s and the resulting constraints (8). The optimal level of household instantaneous utility thus achieved is denoted $\tilde{\mathcal{U}}_h\left(lm,s\right)$.

Now turning to labour market choices, recall from section 2.5 that these choices will have an impact on future periods through the hazard rates of wage progression which depend on labour market status. A household of age a and state variables s_a will thus face the dynamic problem of choosing the sequence $\{lm_t\}_{t=a..R}$ to maximise the lifetime household utility:

$$\tilde{\mathcal{U}}_h\left(lm_a,s_a\right)+\sum_{t=a+1..R-1}\beta^{t-a}\sum_{s_t\in S}\pi\left(s_t|s_{t-1},lm_{t-1}\right)\tilde{\mathcal{U}}_h\left(lm_t,s_t\right)+\beta^{R-a}\sum_{s_R\in S}\pi\left(s_R|s_{R-1},lm_{R-1}\right)V_h^R\left(s_R\right) \tag{13}$$

where we assume that retirement is taken by all at age R. The value of retirement is denoted $V_h^R\left(\cdot\right)$ and the specific assumptions regarding its derivation will be detailed in section 2.7. At each point in time and for each value of the vector of state variables, the optimal lifetime household utility achieved is denoted $\mathcal{V}_h\left(a,s\right)$. So the dynamic programming problem faced by the household at any age $a<R$ is:

$$\max_{lm}\left[\tilde{\mathcal{U}}_h\left(lm,s\right)+\beta\sum_{s'\in S}\pi\left(s'|s,lm\right)\mathcal{V}_h\left(a+1,s'\right)\right], \tag{14}$$

where $\mathcal{V}_h\left(R,s\right)=V_h^R\left(s\right)$. The assumptions regarding $\mathcal{V}_h\left(a,s\right)$ in the state of divorce will be described in section 2.7. Here (as opposed to the static problem above where choices were continuous), the choice of lm is discrete and can only take 9 values, whereby each spouse can either be out of the labour force, working part-time or working full-time. This problem will be solved by backward iterations from retirement.

2.7 Divorce and retirement

2.7.1 Retirement

Retirement occurs at age R for the household and remaining life expectancy is denoted T. By definition, labour market choices are now irrelevant and $lm=(0,0)$, but the household still receives a pension income, which, for simplicity, will be based on labour market values in the last period before retirement only, with a replacement rate of ρ. The (constant) household non-labour income between age R and age $R+T$ is thus:

$$z^R=20\cdot\rho\cdot\left(w_{m,R-1}+w_{f,R-1}\right) \tag{15}$$

We assume post-retirement divorce and fertility hazard to be zero, so that, throughout retirement, the vector of state variables will have simplified dynamics, with transition probabilities as:

$$\pi^R\left(s'|s\right)=1 \tag{16}$$

where $s=\{a,\kappa,w_m^p,w_f^q,z^R,0\}$ and $s'=\{a+1,\kappa_{\text{next}}(\kappa,0),w_m^p,w_f^q,z^R,0\}$ and zero otherwise, which reflects the ageing of the partners and of the children population.

The optimal level of instantaneous utility reached by the household is the same as above with two partners out of the labour force: $\tilde{\mathcal{U}}_h\left[(0,0),s\right]$, so that the asset value of retirement at age R is the following expression:

$$V_h^R\left(s_R\right)=\tilde{\mathcal{U}}_h\left[(0,0),s_R\right]+\sum_{t=1..T}\beta^t\sum_{s_{R+t}\in S}\pi^R\left(s_{R+t}|s_{R+t-1}\right)\tilde{\mathcal{U}}_h\left[(0,0),s_{R+t}\right] \tag{17}$$

2.7.2 Divorce

Now turning to the decision problem faced by each individual post-divorce. As stated in section 2.2, the very simplified picture of divorce we adopt is that the female partner has custody of the children population and the attached childcare needs while the male partner does not have any childcare need within normal working hours any more, but has to pay an alimony $y\left(\kappa,w_m^D\right)$ to the female partner. Note that the alimony does not depend on the female partner's labour market value or past labour market choices. We also assume that divorce is an absorbing state and that fertility post-divorce is zero. The dynamics of the asset values post divorce are thus the following:

$$\pi^D\left(s'|s,lm\right)=\mathbf{a}^{\mathbf{m}}_{\mathbf{lm_m}}\left(p,p'\right)\mathbf{a}^{\mathbf{f}}_{\mathbf{lm_f}}\left(q,q'\right) \tag{18}$$

where $s=\{a,\kappa,w_m^p,w_f^q,z,1\}$ and $s'=\{a+1,\kappa_{\text{next}}(\kappa,0),w_m^{p'},w_f^{q'},z,1\}$ and zero otherwise. Recall that p and q denote the quintiles of the overall wage distribution to which the male and the female labour market values belong, respectively. Note, however, that since the amount of the alimony is set according to the male partner's wage at the time of divorce, the dynamics (and the level from then on) of the male labour market value cease to matter in the female decision problem.

The constraints now facing the female ex-partner are the following:

$$\begin{aligned}
40 &= 20lm_f+L_f+dom_f\\
20w_f\cdot lm_f+y\left(\kappa,w_m^D\right) &= C_f+p_{CC}\cdot\sum_{k=1}^{4}\max\{CC_k-dom_f,0\}\\
0\leq dom_f &\leq \max\{CC_k\}
\end{aligned} \tag{19}$$

As before, for a given labour market state, lm_f, and state variables s the choices of C_f, L_f and dom_f do not have any intertemporal consequences and are made in order to maximise $\mathcal{U}_f\left(C_f,L_f,\Phi_h\right)$ subject to the constraints (19). The optimal level of instantaneous utility thus achieved by the female ex-partner is denoted $\tilde{\mathcal{U}}_f^D\left(lm_f,s\right)$. The optimal amount of time that she devotes to home-produced childcare, dom_f now determines the level of public good Φ_h. We are still calling the fraction of childcare needs carried out

domestically a public good because, even though the two partners are not living as a couple any more, they do both still care for Φ_h as before.

As for her choice of labour market participation, lm_f, the female ex-partner of age a will choose it (between the three available choices) so as to maximise:

$$\begin{aligned}\tilde{\mathcal{U}}_f^D\left(lm_{f,a}, s_a\right) &+ \sum_{t=a+1..R-1} \beta^{t-a} \sum_{s_t \in S} \pi^D\left(s_t | s_{t-1}, lm_{f,t-1}\right) \tilde{\mathcal{U}}_f^D\left(lm_{f,t}, s_t\right) \\ &+ \beta^{R-a} \sum_{s_R \in S} \pi^D\left(s_R | s_{R-1}, lm_{f,R-1}\right) V_f^R\left(s_R\right), \end{aligned} \tag{20}$$

yielding an optimal lifetime utility for the divorced female partner of $\mathcal{V}_f^D(a, s)$.

On the other hand, the male ex-partner faces a standard individual labour supply problem of discrete labour market participation choice $lm_{m,t}$ in order to solve the following problem, given the level of public good $\Phi_{h,t}$ at this period resulting from the female ex-partner's choice:

$$\begin{aligned}\mathcal{U}_f\left(C_{m,t}, L_{m,t}, \Phi_{h,t}\right) &+ \beta \sum_{s_{t+1} \in S} \pi^D\left(s_{t+1} | s_t, lm_{m,t}\right) \mathcal{V}_m^D\left(t+1, s_{t+1}\right) \\ \text{subject to} &\quad L_{m,t} = 40 - 20 lm_{m,t} \\ \text{and} &\quad C_{m,t} = 20 w_{m,t} \cdot lm_{m,t} - y\left(\kappa_t, w_m^D\right), \end{aligned} \tag{21}$$

where $\mathcal{V}_m^D(t, s)$ is the optimal value function reached by solving this problem by backward iteration from the retirement period where: $\mathcal{V}_m^D(R, s) = \mathcal{V}_m^R(s)$. Individual asset values in retirement are obtained in a way similar to above and detailed in the Appendix.

2.8 Efficiency

In our dynamic framework and with household production of the public good, there are several possible sources of inefficiencies. First of all, if we allow individual weights in the household utility function to vary with relative wages and thus to be affected by past decisions, Pareto-efficient outcomes are compromised by the fact that agents take into consideration the impact of their labour market decision today on their bargaining power tomorrow. This has been discussed for example by Mazzocco (2007) who rejects the full efficiency model with US data and finds evidence of variations over time of the relative bargaining power of spouses. Aura (2005) also examines 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. Finally, Duflo and Udry (2004) present evidence that expenditure patterns in households in Cote d'Ivoire are not consistent with a Pareto efficient allocation of household resources. Basu (2006) shows that, even when we use a collective approach to household decision making, whereby the household's preferences are represented by a composite entity in the shape of a weighted sum of the two spouses' utilities, we donot necessarily obtain efficient allocations. Although this collective approach delivers efficient outcomes in static models or when Pareto weights are unrelated to current choices, efficiency may be lost when we have both a dynamic framework and endogenous Pareto weights. Indeed, when current choices affect future Pareto weights and are made

in the anticipation of these changed Pareto weights, strategic considerations will compromise efficiency of these choices (see Basu (2006), p. 566). This built-in time inconsistency is modelled as a game between the current household and the future household, where the current decision-making entity anticipates the decisions of the future decision-maker and assesses the consequences of these in terms of its own preferences. This is illustrated and discussed by Sally (2000).

Another source of inefficiency lies in the fact that any agent cutting on labour market participation to supply the public good bears an expected loss in the event of divorce which cannot always be compensated for. First, divorce regulations do not usually allow for compensation for loss of labour market value and private contracts would be difficult to enforce. Second, the extent to which that agent can be offered compensation in the current period in the form of leisure or private consumption is limited by the amount of current earnings, which in many cases will be lower than the expected cost of lower future wages to the individual. 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 and increasing the quantity of public good in the household. For this type of inefficiency to arise we need a combination of a strong enough taste for home-produced childcare within the household, large enough childcare needs, a large enough loss in future labour market value by the childcare provider when working part-time or not at all, and divorce laws that do not internalise this loss.

3 Descriptive statistics

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 25 to 55. The survey provides detailed information on the number and ages of the children present in the household. The summary statistics of our sample are shown in Table 1.

	mean	sd
Household age	39.077	8.084
Age gap	1.839	5.515
Children under 5	0.244	0.430
Children aged 5-11	0.346	0.476
Children aged 12-18	0.215	0.411
Male educ. high	0.208	0.406
Male educ. medium	0.227	0.419
Male educ. low	0.565	0.496
Female educ. high	0.174	0.379
Female educ. medium	0.170	0.375
Female educ. low	0.657	0.475
N	29314	

Table 1: Descriptive Statistics

3.1 Fertility

Since we wish to maintain the assumption of exogenous fertility rates but recognise the evidence of a gradient in fertility across socio-economic groups, we allow the hazard of fertility to depend on the parents' education but not on the current potential wages. Though our exogeneity assumption does deprive our analysis from a feedback channel of labour supply choices on future fertility via their effect on wages, we still capture variations in fertility present in the data via the inclusion of education variables. 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. Our estimates of the fertility hazard, $\pi_b(a, \kappa, ed_m, ed_f)$ are reported in Table 2. 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. Education effects are not found to be significant.

	b/se
New birth	
Ed. Male low	-0.012
	(0.03)
Ed. Female low	-0.028
	(0.03)
Household age	0.194***
	(0.03)
Household age squared	-0.003***
	(0.00)
Age gap	0.041***
	(0.00)
Children under 5	0.239***
	(0.03)
Children aged 5-11	-0.280***
	(0.03)
Children aged 12-18	-0.520***
	(0.05)
Constant	-3.848***
	(0.45)
Observations	25438

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2: Fertility hazard

3.2 Childcare costs

Evidence on childcare expenditure in the UK is reported in Robinson (2015), where xxx.

Guner et al. (2013) use U.S. data from the Survey of Income and Program Participation (SIPP) and find childcare costs to amount to 10% of average household income in 2005 for children under 5 and to 7.7% for children aged 5 to 14. They also find sizeable heterogeneity in childcare costs across different education groups, whereby more educated households tend to pay higher childcare costs than less educated households, by as much as twofold.

3.3 Wage processes, part-time and full-time

Table 3 displays our estimates of transition matrices $\mathbf{A}_{lm}^{g}$ between wage quintiles by gender and initial labour market status across all age groups. The size of our data set precludes us from estimating reliably the wage quintile transition probabilities of individuals dropping temporarily out of the labour force so we will assume for now that these individuals retain their pre-career break wage quintile when they return to the labour force. This is not very satisfactory since it is to be expected that a long career break leads to a drop in earning power. This assumption will be reviewed in the future. Besides, our specification implies a first-order Markov process, which rules out longer-memory wage processes. Relaxing this assumption would however complicate the model considerably.

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 in terms of earnings dynamics, 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 women 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 will help the identification of the model in our estimation below.

	Males					Females					
	earnings quintile at t					earnings quintile at t					
earnings quintile at $t-1$	59.2	23.4	9.1	3.7	4.3	71.9	18.2	5.1	2.4	2.2	Full time
	21.5	48.6	19.2	6.5	3.9	22.1	57.9	14.6	3.4	1.7	
	5.6	22.7	49.5	16.5	5.4	6.2	24.2	51.3	15.0	3.0	
	2.5	5.1	21.7	55.8	14.6	1.7	5.7	25.8	54.6	12.0	
	1.5	2.2	4.0	18.9	73.1	1.5	2.3	4.5	26.0	65.5	
earnings quintile at $t-1$	54.7	16.9	10.3	9.4	8.4	76.7	14.2	4.3	2.3	2.4	Part time
	25.8	43.1	12.0	8.6	10.3	31.0	50.5	11.0	4.5	2.8	
	21.2	23.4	34.0	2.1	19.1	15.1	26.5	42.3	12.3	3.6	
	12.1	1.5	12.1	37.8	36.3	10.3	9.9	19.3	45.9	14.4	
	6.3	8.6	12.9	19.2	52.9	7.5	6.5	10.1	19.2	56.5	

Note: earnings quintiles from the unconditional sample distribution.

Table 3: Wage quintile transition matrices

3.4 Labor 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. We capture a summary of these effects by matching average labour market status and labour market transitions by age range and gender. We consider 6 age ranges within our sample, characterising different stages in households' childbearing experience, splitting the age interval between 25 and 55 in 5-year age groups. Tables 4 and 5 show these moments. A lifecycle pattern is apparent both in static labour market

choices and in labour market transitions, particularly for females.

	Males				Females			
	N	NP	PT	FT	N	NP	PT	FT
Age								
1	5560	9.4	2.9	87.7	5744	24.2	15.7	60.1
2	6500	7.6	2.9	89.9	6988	27.1	25.6	47.3
3	6599	6.6	3.0	90.4	7092	24.4	32.7	42.8
4	5820	6.5	2.9	90.6	6095	21.1	34.7	44.2
5	4839	7.4	2.8	89.8	5223	20.7	30.0	49.3
6	4188	11.9	3.8	84.3	4655	23.5	27.2	49.3

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

Table 4: Labour market status

	Males			Females			
	labour market status at t			labour market status at t			
labour market status $t-1$	60.76	4.56	34.68	76.94	11.13	11.94	Age 1
	20.29	30.43	49.28	21.00	58.85	20.15	
	3.62	1.83	94.55	2.94	4.14	92.92	
labour market status $t-1$	56.96	4.38	38.66	78.31	12.40	9.29	Age 2
	15.38	37.87	46.75	16.96	69.34	13.70	
	3.09	1.46	95.46	2.66	6.80	90.53	
labour market status $t-1$	54.55	4.83	40.63	79.36	11.96	8.68	Age 3
	15.08	44.13	40.78	12.33	76.93	10.74	
	2.59	1.44	95.97	3.57	9.49	86.95	
labour market status $t-1$	57.63	5.42	36.95	78.01	12.62	9.37	Age 4
	16.46	36.71	46.84	10.82	78.36	10.82	
	2.42	1.55	96.03	3.86	11.75	84.39	
labour market status $t-1$	55.15	5.32	39.53	79.31	11.55	9.14	Age 5
	15.32	37.90	46.77	10.38	79.48	10.15	
	2.77	1.48	95.75	2.43	9.22	88.35	
labour market status $t-1$	63.34	3.52	33.14	78.97	10.45	10.58	Age 6
	15.69	34.31	50.00	7.75	78.70	13.54	
	2.90	1.95	95.15	2.37	7.53	90.10	

Table 5: Labour market status transition matrices

3.5 Divorce hazard

Anticipating the possibility of divorce and the fact that post-divorce asset values are affected by own labour market value as well as total household labour market earnings is key in the cost-benefit analysis of reducing labour market hours to provide domestic childcare for the household. As for the fertility process, in a concern of parsimony, we assume the divorce hazard to be exogenous to labour market choices. Our estimates reported in Table 6 show that female education and the ages of children present in the household both influence the probability of divorce.

	b/se
Divorce	
Ed. Male low	0.086*
	(0.04)
Ed. Female low	0.147***
	(0.04)
Household age	-0.025***
	(0.00)
Age gap	0.018***
	(0.00)
Children under 5	-0.075
	(0.04)
Children aged 5-11	0.160***
	(0.04)
Children aged 12-18	-0.038
	(0.05)
Constant	-1.369***
	(0.11)
Observations	25686

Table 6: Divorce hazard

4 Estimation procedure

Given the auxiliary processes estimated above for fertility, wage processes and divorce, we are able to simulate couples' labour supply decisions within a collective framework at different points of their childbearing experience and at different points of the wage distribution. The parameters of interest are the distribution of individual preferences for consumption and leisure, α_C and α_L, the distribution of households' taste for domestic childcare α_Φ and the distribution of the relative Pareto weight μ. We proceed by using the method of simulated moments, where the moments to be matched are the labour market choices by age decade and gender (24 moments), labour market transitions by age and gender (72 moments) and moments of the wage distributions by age range and gender, i.e. the fraction of each group present in each wage quintile of the overall wage distribution (48 moments).

The main assumptions underlying our estimation strategy are the following. As mentioned above, we keep both the fertility and the divorce exogenous, we calibrate the parameters of childcare need, childcare market price and of the divorce settlements. We also make a parametric assumption on the specification of instantaneous utility as detailed in (7). Then, allowing for heterogeneity of these preferences, we make parametric assumptions about the distribution of relative preferences regarding private consumption, leisure and domestic childcare.

With regards to Pareto weights, we assume a simple functional form and make alternative choices about the factors influencing the spouses' Pareto weights. In one specification we will restrict these factors to the spouses' education levels and unobserved heterogeneity. In this specification we thus rule out any feedback effect from labour market choices to Pareto weights, thereby ignoring the possible strategic consequences of such feedback, as discussed in section 2.6.2. In the alternative specification, we allow the spouses relative

location in the wage distribution, i.e. their relative wage quintile, to affect the Pareto weights. Given that current labour market choices affect expected wage growth, this creates a feedback channel between today's choice and future Pareto weights, hence household preferences. The potential multiple equilibria emerging from the strategic considerations in the presence of changing bargaining power make the identification less clear-cut than when choices are exogenous to Pareto weights.

We do not have a formal proof of identification of our parameter estimates. Intuitively, the fact that we have panel data on households' composition and labour market experience will provide us with two sources of variations of the shadow prices of leisure and of domestic childcare. Indeed, time variation of the spouses' market wages and age structure of children population in the household will yield variations in the relative shadow prices of different uses of time.

5 Results

Work in progress.

6 Conclusion

In this work we aim to reevaluate the tradeoffs 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 tradeoff 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.

Finally, 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.

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