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Abstract

Norwegian parents of preschool children make their care choices from a completely different choice set compared to what their predecessor did, say, two decades ago. Now, there is essentially only one type of nonparental care, center-based care, and at the parental side fathers take a more pivotal role in the early childhood care. In the present paper we develop a joint labor supply and child care choice model that accounts for these new characteristics of the family choice set – only one nonparental care option and both mothers and fathers contributing to the production of nonparental care. Even though Norway may be seen as a frontrunner in terms of both publicly subsidized care and gender equality, we believe that the model points to current and future modeling directions for several other economies too. The model is estimated on data on working hours and families' use of child care. We find that parents are not responsive to the price on center-based care, but respond more strongly to changes in wages. The average wage elasticity for mothers is in the range 0.25–0.30.

JEL-Codes: J130, J220, C250.

Keywords: family policy, child care, structural labor supply model.

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1 Introduction

Norwegian family policy has gone through major changes in the last couple of decades, which implies that the conditions under which families with preschool children make their choices have been substantially altered. Most importantly, we have witnessed a massive expansion in the coverage rate of center-based care, in combination with considerable reductions in parental fees. Norwegian policy-makers formalized this through the so-called "child care compromise" (approved by the Parliament in spring 2003), which was a plan for termination of queues at child care centers in combination with a maximum monthly parental fee. By 2009, the policy initiative had resulted in a market for center-based care from which the Government could guarantee all families of children older than 1 year access to a slot at a center. Further, the maximum payment for 2017 is set to 2,730 Norwegian kroner ($320 and €300)[1] per month, which means that less than 25 percent of the costs are paid by the parents. As expected, this combination has efficaciously terminated other nonparental care alternatives, such as paid care by childminders.

At the same time, and perhaps not entirely unrelated to the policy changes,[2] parents' preferences appear to have shifted towards a more gender-equal division of nonparental care. There are various indications of this. Firstly, the gap between mothers and fathers working hours has been clearly reduced over the last decades (Statistics Norway, 2016b). Secondly, evidence presented in Kitterød and Rønsen (2013) suggest that Norwegian fathers are taking a greater role in the physical and emotional care of children than before. For example, fathers with small children spent much more time on household work in 2010 than in 2000. This happens in a society, in which, according to Hook and Wolfe (2012), the involvement of fathers already (around the time of the turn of the century) was substantially higher than in Britain, Germany and the U.S. Thus, we assert that the negligence of fathers as alternative caregivers to nonparental care in the modeling of parents' decisions, can no longer be justified.

These characteristics form the background for development a new joint labor supply and child care choice model,[3] which we believe represents a modeling option for several other economies too. In the new model, the care involvement of fathers is accounted for by letting the choice of nonparental child care being determined by the working time of both mothers and fathers. This means that we leave the

[1] Exchange rates as of January 2017.

[2] See Ellingsæter (2003) on the existence and implications of family policy feedback effects.

[3] See recent reviews of the joint labor supply and child care choice literature in Blau and Currie (2006), Kalb (2009), Del Boca (2015), and Morrissey (2017).

standard approach of treating only mothers' care as the alternative to paid care.[4] When both parents' working hours are endogenously determined, and when there is flexibility in terms of work schedules, parents' working hours may not overlap, and there is no longer necessarily a fixed link between working time and the child's time in care outside the home.[5] The so-called "fixed link assumption" between working hours and hours in nonparental care (Ilmakunnas, 1993), which is often enforced in the joint labor supply and child care choice literature, can then be abandoned. Along this line, ultimately, parents may choose to work shift, which may enable them to handle two (full time) jobs, in combination with little or no nonparental care.[6] We assert that a realistic decision model should allow for the possibility that parents reduce the time in nonparental care by choosing jobs with non-overlapping working hours.

Time inputs as determinants of care quality is a common approach in the structural joint labor supply and child care choice literature,[7] see for example Blau and Robins (1988), Michalopoulos et al. (1992), Ribar (1995), Wrohlich (2011), Apps et al. (2016), and Gong and Breunig (2017).[8] Given that the present institutional setting only involves one type of nonparental care, it follows that a mix of parental time and time in center-based care is a key factor of the care quality. These inputs are imperfect substitutes, and we believe that perceived relationships between care alternatives and outcomes, such as cognitive and non-cognitive skills,[9] are important for parents' perceptions of preferred care combinations.

Similar to Lokshin (2004), Kornstad and Thoresen (2007), Tekin (2007), Apps et al. (2016), and Gong and Breunig (2017) we employ a discrete choice framework in the estimation of the model. We exploit Norwegian micro data from a survey of families' child care preferences and work choices, obtained from the Child Care Survey 2010 (Wilhelmsen and Löfgren, 2011; Moafi and Bjørkli, 2011). The survey includes detailed information on family composition, parents' main activity and

[4]Blundell et al. (2000), Doiron and Kalb (2005) and Mumford et al. (2015) are other studies that account for effects on male labor supply too.

[5]Non-overlapping working hours might explain the finding that reported hours in nonparental care are often fewer than the time each parent spends at work (Blix and Gulbrandsen, 1993).

[6]Implications of nonstandard work for care choices are discussed by Kimmel and Powell (2006) and Connelly and Kimmel (2007).

[7]Another line of research accounts for child care by letting the fee enter into the budget constraint of a standard labor supply model, see Blundell et al. (2000) and Doiron and Kalb (2005).

[8]Several studies, as Blau and Robins (1988) and Powell (2002), seek to account for existence of a unpaid nonparental care alternative, as care by grandparents. As we shall return to, we argue that this care option can be neglected in the present context. See also Blau and Hagy (1998) on choices between specific modes of child care.

[9]As discussed by Todd and Wolpin (2003), Bernal (2008), Cunha et al. (2010), Bernal and Keane (2011), Del Boca et al. (2014), Black et al. (2014), and Havnes and Mogstad (2015).

labor market status, socioeconomic background, and mode and intensity of child care. Information on income (wages, transfers, etc.) and taxation are obtained from the Income Statistics for Persons and Families (Statistics Norway, 2005), and linked to the survey by using unique personal identification numbers. The estimated model is in turn applied to simulate responses to policy changes on labor supply and demand for nonparental care. Effects of several policy changes are discussed, as increase in the parental fee and the abolishment of the home care allowance (cash-for-care) schedule.

Even though the Nordic countries seem to take the lead with respect to equal parenting and support for center-based care (Gupta et al., 2008), we believe that our modeling framework is relevant for other economies too, and increasingly in the years to come. For example, in Germany (since 2013) every family has a legal claim to a slot in a publicly subsidized child care institution, and the parental scheme includes a "daddy quota" (Geyer et al., 2015; Müller and Wrohlich, 2016), which we believe signals ambitions with respect to gender equality. We also note that subsidies to child care centers recently have been increased in several other countries, as in Canada (Quebec) (Baker et al., 2008), France (Givord and Marbot, 2015), the Netherlands (Bettendorf et al., 2015), and Spain (Nollenberger and Rodríguez-Planas, 2015). In the US, even though child care subsidy programs are very different from typical European programs, and public provision of care in centers is the exception rather than the rule (Blau and Tekin, 2007), one sees signs of a more active policy. When the Child Care and Development Block Grant was reauthorized in 2014 (for the first time since 1996), the goals of the program was adjusted, asserting that a main ambition is to strengthen the focus on the quality of care, which implies more center-based care (Krafft et al., 2017).

The paper proceeds in the following way. In Section 2 we refer to empirical evidence to substantiate our two main assertions behind our modeling framework: the increased coverage of center-based care and the high gender equality among Norwegian parents. Section 3 presents a discrete choice model that builds on the new choice set of Norwegian parents. In Section 4 we present the data and the estimation results, whereas results of an out-of-sample model validation is presented in Section 5. In Section 6 we discuss the model properties further by using the model in various policy simulations, including providing elasticity estimates. Section 7 summarizes the main findings.

2 Changes in choice sets and preferences

Norwegian family policy has been an arena of substantial political controversy the last couple of decades. In particular, the cash-for-care reform, which was introduced in 1998, generated a heated debate on the rationalizations and directions of family policies. The reform introduced a monetary compensation for *not* using subsidized care at child care centers, for parents of children aged 1 or 2. The three main aims of the reform were that parents should be provided with more time to care for their own children, to give families freedom of choice of care provider, and to equalize public support to families, independent of care alternative (Ellingsæter, 2003). The support equalization argument was strengthen by the fact that access to care in centers at that time (late nineties) was severely constrained.

However, since then, there has been massive expansion in the child care center participation rate in Norway, particularly for children under 3 years of age, se Figure 1. Policy-makers formalized their efforts to increase the supply of center-based care through the so-called "child care compromise", approved by the Parliament in spring 2003. The agreement included a plan for termination of queues for care at child care centers, and introduced a substantial reduction in child care fees, regulated by a maximum monthly parental pay. For 2017, the maximum monthly fee is set to 2,730 Norwegian kroner ($320, €300), which implies that the parental fee covers approximately 14 percent of the costs for children under 3, and approximately 25 percent for children aged 3–5 (Lunder, 2015).[10] It follows that gross child care fees, measured as percentage of the average wage, are very low in Norway compared to most other countries (OECD, 2014).

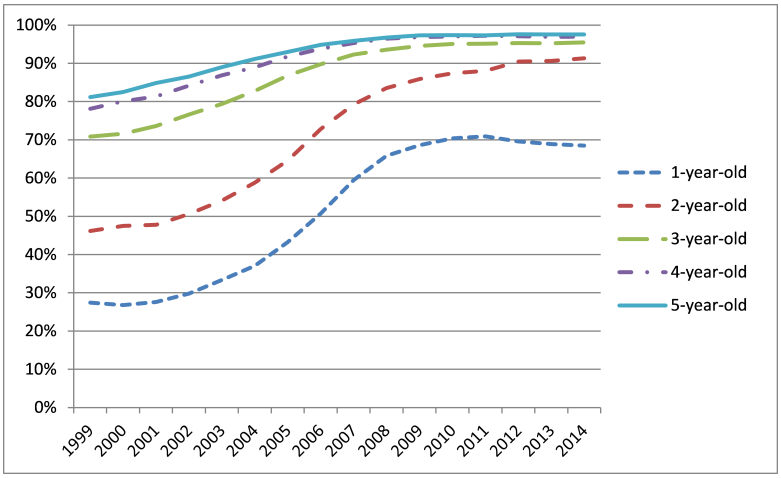
Figure 1 shows that the participation in center-based care is close to 100 percent for children aged 3–5, and also among the youngest children (1 and 2 year olds) the majority attend child care centers.[11] These developments have implications for the design of modeling tools to guide the policy-making in this field.[12] Unpaid care alternatives (for the working parents), typically care by grandparents or other relatives, are not important in the Norwegian setting, also reflected in the data

[10]The cost difference reflects that the care for small children involves a higher staff-to-child ratio.

[11]Parents are usually on paid parental leave until the child is 1 year of age. Note also that the home care allowance is still in place, but only for parents of children that are 1 year. At the time of the introduction of this scheme (in 1998), the plan was to let the support follow the child care subsidies, but that is currently not the case. In 2017, parents who do not use care in centers, receive 7500 Norwegian kroner ($890, €830) per month for the 1 year old child.

[12]For example, the model presented in Kornstad and Thoresen (2007), with two types of nonparental care and a focus on choice set restrictions (because of queues in the market for center-based care), obviously does not provide a good description of the decision-making of Norwegian families anymore.

Figure 1. Share of 1-5 year old children in child care centers, 1999–2014



Source: Kindergarten statistics, Statistics Norway, based on "Annual reports for kindergardens as of 15 December". All approved kindergartens under the Day Care Institutions Act that receive subsidies are in the sample.

utilized in the present study (from 2010).

With respect to the parental part of the care, we instead suggest that the choice set should be expanded, now letting care by fathers be an alternative. We argue that a model without any time inputs from fathers is misleading in the present Norwegian context. Firstly, the working pattern of Norwegian mothers are moving closer to the labor supply of their male counterparts (Statistics Norway, 2016b). This has, according to Miranda (2011), contributed to less difference in unpaid work across gender. Secondly, Hook and Wolfe (2012) find that Norwegian males, around the turn of the century, took a greater role in the physical and emotional care of children, and have more egalitarian relationships with their partners, compared to fathers in other countries. They can therefore be described as examples of "new fathers", to use the terminology of Hook and Wolfe.[13] Moreover, according to Kitterød and Rønsen (2013) this process continues: Norwegian fathers are more involved in the care of children in 2010 than in 2000.[14] This is also supported by the evidence reported in Miranda (2011), showing that the gap in hours of unpaid work between males and females has been reduced over the period from 1998 to 2009.

We interpret the pattern seen in Figure 2 as corroborative evidence of the

[13]The central role of Norwegian fathers in caregiving is also reflected by the so-called "daddy quota" of the parental leave scheme. The parental leave scheme is gender neutral, in the sense that the schedule allots the minimum weeks to each parent: for 2017, it says that out of 49 weeks (full coverage), each parent's share is at least 10 weeks; otherwise families lose the weeks. It is this minimum share that is often referred to as the "daddy quota".

[14]Also, one may expect that policy changes themselves have contributed to this – for example, that the introduction of the father's quota in the parental leave scheme could have influenced attitudes. However, according to Cools et al. (2015), no such traces can be found in data.

Figure 2. Observed relationships between the working time of mothers and fathers and the use of care in centers

Source: Own calculations based on sample (described in Section 4) of households participating in the Child care survey in 2010 (Wilhelmsen and Löfgren, 2011; Moafi and Bjørkli, 2011).

importance of Norwegian fathers as caregivers. The table suggests that there is rather strong dependency between mothers' working time and use of nonparental care, but most importantly, given the present context, we also see a relationship between working hours of fathers and the use of center-based care. Although there are relatively few males in the nonparticipation and part time alternatives, the table indicates that there is a positive relationship between working hours of fathers and the use of nonparental care by the family.[15] Further, in Figure 2 (panels to the right) we show how shift work relate to the use of center-based care for mothers and fathers, respectively. As expected, we see that parents with nonstandard work are less inclined to let their children be in full time care, and again we observe a correlation between care choices and work choices of fathers, but not as clear as for mothers.

Thus, an up-to-date joint labor supply and child care choice model for the decision-making of Norwegian couples should let both parents' working hours be endogenously determined, jointly with care choice. As both parents contribute to the parental care, we loosen the relationship between the children's time in care and parents' working hours, the so-called fixed link assumption (Ilmakunnas, 1993). In the next section, we shall probe deeper into the specification of the model.

[15]Of course, this is only indicative evidence, as a relationship may exist for other reasons too.

3 A decision model for families with preschoolers

3.1 Discrete choice framework

In the following we further spell out our two-parent model of joint labor supply and child care choice. The model is a unitary household model[16] based on a discrete choice framework, influenced by several studies using the discrete choice framework, both in analysis of standard labor supply (Dagsvik, 1994; Aaberge et al., 1995; van Soest, 1995; Dagsvik and Strøm, 2006; Dagsvik et al., 2014; Dagsvik and Jia, 2016) and in the joint labor supply and child care choice setting (Kornstad and Thoresen, 2007; Apps et al., 2016; Gong and Breunig, 2017).

We depart from a modeling approach that shares similarities with Kornstad and Thoresen (2007). Parents are assumed to be influenced by a number of pecuniary as well as non-pecuniary variables, when choosing among job and child care alternatives. Each job opportunity is characterized by a whole range of latent non-pecuniary attributes, reflecting factors related to job satisfaction, in addition to observed variables, such as wage and working hours. Similarly, the opportunities in the market for center-based child care are characterized by fees and opening hours and attributes associated with quality of care. However, several attributes of both jobs and care alternatives are unobserved to the researcher.[17]

It is argued that parents' choice of labor supply and child care realistically can be viewed as a discrete choice problem, where the choice is made from a set of combinations of jobs in the labor market and slots in child care centers. The household is assumed to have preferences over consumption, hours spent at work, job types, time the children stay in nonparental child care facilities and quality of child care. Let C denote consumption, h_m and h_f hours of work for the mother and the father, respectively, and q the hours spent in nonparental child care. Furthermore, let s_m and s_f be dummy variables which indicate whether the jobs are shift jobs or ordinary day time jobs; i.e., s_m is equal to 1 if a job considered by the mother is a shift job, and zero otherwise. s_f is defined similarly. The corresponding utility function is denoted by $U(C, h_m, h_f, s_m, s_f, q, z)$ where $z\,(z = 1, 2, ..)$ indexes the (triple) combinations of child care alternative and job pairs (for the mother and the father) that the family faces. It is implicit that a given triple, z, is characterized by both non-pecuniary job and attributes of the nonparental care alternative.

The household makes choices conditioned on a number of observable and un-

[16] An alternative, accentuated by addressing behavior of both parents, would be to adopt a collective model approach, as seen in Apps and Rees (1988).

[17] In fact, it may be unclear to what extent the agents themselves have good perceptions of the care quality.

observable restrictions. We shall soon return to how this framework accounts for unobservable constraints, but let us first define the economic budget constraint. Consumption for a given job and child care combination is defined by disposable income, $C = f(w_m h_m, w_f h_f, p, I)$, where $f(.)$ is a function which transforms income from work, $w_k h_k \, (k = m, f)$, costs of child care, p, and nonlabor income, I, into disposable income, given that w_m and w_f are the offered wage rates for the mother and father, respectively. p is the child care fee of a child care slot.

Furthermore, choices are restricted by mother's and father's time constraints. We cannot distinguish between parents' "real leisure" time and the time they spend with their children – recall that we only observe working hours and hours in nonparental care. However, we assume that the preference for leisure is highly influenced by the preference for spending time with children. Given that both parents are considered as taking care of the child, there is not necessarily a fixed link (Ilmakunnas, 1993) between the working hours of parents and the child's time in nonparental care. Parents can (at least to some extent) reduce children's time outside home by exploiting the flexibility in working hours and work non-overlapping hours. The time restriction is further loosened by opening up for the parents choosing jobs with nonstandard working hours (shift work). Then, ultimately, parents may be able to handle two (full time) jobs in combination with little or no nonparental care.

It follows from this that hours of parental care and hours in center-based care are viewed as key determinants of overall care quality. Using time inputs as determinants of care quality is a common approach in the structural joint labor supply and child care choice literature (Blau and Robins, 1988; Michalopoulos et al., 1992; Ribar, 1995; Wrohlich, 2011; Apps et al., 2016; Gong and Breunig, 2017). Since we argue that there is only one type of nonparental care, an essential part of the choice problem of the parents involves finding the preferred mix between own care and care in centers.

Next, we take into account that parents face a number of restrictions on their choice among jobs and child care center slots. These restrictions may vary across households. Let $B(h_m, h_f, s_m, s_f, q)$ be the set of triples, z, with working hours, job type (shift work or not) and care hours equal to (h_m, h_f, s_m, s_f, q) that are available to the household, and let $b(h_m, h_f, s_m, s_f, q)$ be the number of triples in $B(h_m, h_f, s_m, s_f, q)$. These are not observable, but we follow Dagsvik et al. (2014) and Dagsvik and Jia (2016), who discuss how the probability of an observed combination of hours of work can be specified in the absence of detailed information about the latent non-pecuniary aspects of the alternatives in $B(h_m, h_f, s_m, s_f, q)$.

The utility function is assumed to have the following structure

$$U(C, h_m, h_f, s_m, s_f, q, z) = v(C, h_m, h_f, s_m, s_f, q) + \varepsilon(z), \tag{1}$$

where $v(.)$ is the deterministic part, which will be discussed further below, whereas $\varepsilon(z)$, $z = 1, 2, ...$, are iid random terms with c.d.f. $exp(-exp(-x))$. When the economic budget restriction, $f(.)$, is taken into account, the utility function can be expressed as

$$\begin{aligned} &\tilde{U}(f(h_m, h_f, s_m, s_f, q, I), h_m, h_f, s_m, s_f, q, z) \\ &= \tilde{v}(f(h_m, h_f, s_m, s_f, q, I), h_m, h_f, s_m, s_f, q) + \varepsilon(z). \end{aligned} \tag{2}$$

It then follows that the probability that the household shall choose jobs and care nonparental care alternatives with corresponding hours equal to (h_m, h_f, s_m, s_f, q) is given by

$$P(h_m, h_f, s_m, s_f, q) = \frac{exp(v(f(.), h_m, h_f, s_m, s_f, q) + \log\, b(h_m, h_f, s_m, s_f, q))}{\sum_d \sum_j \sum_u \sum_x \sum_y exp(v(f(.), d, j, u, x, y) + \log\, b(d, j, u, x, y))}. \tag{3}$$

Note that the choice probability in Equation 3 differs from the standard multinomial logit formulation, as for example in the labor supply model of van Soest (1995), in that the systematic part of the utility function is modified by the term $b(h_m, h_f, s_m, s_f, q)$. As already seen, the term $b(h_m, h_f, s_m, s_f, q)$ accounts for a key feature of the choice problem, namely that the household faces latent choice restrictions and that there are more alternatives with specific observable attributes. For example, in the labor market, there are more jobs characterized by full time working hours. The specification of b is further explained in the next subsection.

3.2 Econometric specification

In this section we further specify the functional form of preferences, $v(C, h_m, h_f, s_m, s_f, q)$, and opportunities, $b(h_m, h_f, s_m, s_f, q)$. With respect to the systematic part of the utility function, $v(C, h_m, h_f, s_m, s_f, q)$, we assume that it can be separated into four different parts, as

$$\begin{aligned} v(C, h_m, h_f, s_m, s_f, q) &= v_1(C) + v_2(h_m, h_f, s_m, s_f) \\ &+ v_3(q) + v_4(h_m, h_f, s_m, s_f, q). \end{aligned} \tag{4}$$

Thus, in addition to consumption, v_1, and leisure (non-work), v_2, we let the "quality of care part" be represented by two components, care in centers, v_3, and an interaction term, v_4, capturing the relationship between care in centers and work (or leisure).

The components will be further explained in the following.

When C_0 is a (set) subsistence level of consumption, $v_1(C)$, is further specified as

$$v_1(C) = \alpha_0(f(w_m h_m, w_f h_f, p, I) - C_0) + \alpha_1(f(w_m h_m, w_f h_f, p, I) - C_0)^2. \quad (5)$$

The subsistence level of disposable income, C_0, is controlled for in the specification of the consumption, given by a fixed amount ($60,000\sqrt{2}$ NOK), and then normalized by dividing by $10,000\sqrt{2}$.[18] Note also that we assume that the offered wage rates, w_m and w_f, do not vary across jobs (also not across shift or daytime jobs), but only across individuals.

Further, we operationalize the preferences for leisure (or non-market time), $v_2(h_m, h_f, s_m, s_f)$, as

$$\begin{aligned} v_2(h_m, h_f, s_m, s_f) = \beta_1 \log l_m + \beta_2 \log l_f + \beta_3 \log l_f \log l_m \\ + \beta_4(1 - s_f)(1 - s_m) \log l_f \log l_m, \end{aligned} \quad (6)$$

where l_m and l_f for both are specified by $l_k = \frac{\bar{l} - h_k}{\bar{l}}$, $k = m, f$, given that $\bar{l}$ is the maximum number of hours available, set to 80 hours. In practice, we let the choice set of working hours for both parents consist of four alternatives, $h_k = [0, 20, 37.5, 45]$, $k = m, f$. It follows from Equation 6 that β_1 and β_2 reflect the mother's and father's preference for leisure, respectively, whereas β_3 and β_4 measure interactions between the spouses' preferences for leisure, i.e., that there may be additional utility from leisure when the spouse or partner also enjoys a substantial amount of leisure. Note also that we open up for differences in interaction of leisure between spouses, dependent on one of the spouses working shift time (β_3) and both holding jobs with a standard work schedule ($\beta_3 + \beta_4$). Thus, we allow for a possible joint utility of "not working" for the spouses – one reason may simply be that the spouses want to spend time together when taking care of children. This raises the question if parents' consumption of leisure are substitutes or complements in the family demand for care quality, as discussed by Hallberg and Klevmarken (2003), Connelly and Kimmel (2009), and Bloemen and Stancanelli (2014). Both Hallberg and Klevmarken (2003) and Connelly and Kimmel (2009) find evidence of complementarity in parental time use.[19] We return to this issue in Section 6,

[18] This normalization does not affect results, but is helpful in order to obtain convergence in the estimation of the model.

[19] This raises the question of bargaining within the household more fundamentally, as discussed by Chiappori (1992), Apps and Rees (1997) and Browning and Gørtz (2012). The model presented here detracts from such complications.

when we discuss the cross-wage elasticity estimates. Taste modifying characteristics in the specification of preference for leisure are included, for mothers and fathers, respectively, such that $\beta_1 = \beta_{10} + \beta_{11}\mathbf{X}_m$ and $\beta_2 = \beta_{20} + \beta_{21}\mathbf{X}_f$, where β_{10} and β_{20} are constants. $\mathbf{X}_k\,(k = m, f)$ include age, immigrant status, an indicator variable of low/high education, and the number of preschool children in the household.

The specification of preferences for nonparental care, $v_3(q)$, is based on time spent in center-based care, given by a quadratic function,

$$v_3(q) = (\gamma_{00} + \gamma_{01}age)q + (\gamma_{10} + \gamma_{11}age)q^2, \tag{7}$$

where the choice alternatives over actual hours in center-based care are given by $q = [0, 30, 40]$, normalized to $[0, 0.75, 1]$.[20] These discretizations are influenced by the observed distributions, see Figure A.1. We let preferences vary with respect to the age of the child (age), by defining two parameters, $\gamma_0 = \gamma_{00} + \gamma_{01}age$ and $\gamma_1 = \gamma_{10} + \gamma_{11}age$, where γ_{00} and γ_{10} are constants. As most parents prefer a combination of parental and nonparental care, we expect that there are positive and decreasing returns to time spent in centers.

As already discussed, we expect that there is a relationship between parents' choice of leisure and their preferences for care quality. To incorporate this element in the modeling framework, an interaction term between preferences for leisure and preferences for care in centers is specified, given by $v_4(h_m, h_f, s_m, s_f, q)$:

$$\begin{aligned} v_4(h_m, h_f, s_m, s_f, q) = (\delta_{11}\log l_m + \delta_{21}\log l_f + \delta_{31}s_m + \delta_{41}s_f)q \\ +(\delta_{12}\log l_m + \delta_{22}\log l_f + \delta_{32}s_m + \delta_{42}s_f)q^2. \end{aligned} \tag{8}$$

After rearringing and defining $\delta_i = \delta_{i1} + \delta_{i2}q,\ i = \{1, 2, 3, 4\}$, we get

$$v_4(h_m, h_f, s_m, s_f, q) = \delta_1 q\log l_m + \delta_2 q\log l_f + \delta_3 q s_m + \delta_4 q s_f. \tag{9}$$

This specification, thus, relates to several studies highlighting the effects of parents' time use in the child development. Both Todd and Wolpin (2003) and Bernal (2008) let time inputs of mothers influence child outcomes. More importantly, given the "gender equal society" point of departure, both mothers and fathers are accounted for in Equation 8. In the care production process of Del Boca et al. (2014) *both* parents contribute to the outcome.

Recall that an idiosyncrasy of the present approach is that we also specify and

[20]Note that the fee does not depend on whether child care is used in 30 or 40 hours per week. Recall that the part time care choice is characterized by 30 hours of care per week, whereas half time care is a 20 hours service per week. However, as we do not observe any half time child care choices in the data, this alternative is not included in the choice set.

estimate the choice set, $b(h_m, h_f, s_m, s_f, q)$. As $b(.)$ is not observed, it is estimated simultaneously with the systematic part of the utility function. But we assume that the estimation can be further facilitated by assuming that the choice set is made up of three components, as

$$log\, b(h_m, h_f, s_m, s_f, q) = b_1(h_m, h_f) + b_2(s_m, s_f) + b_3(h_m, h_f, s_m, s_f, q). \tag{10}$$

b_1 accounts for characteristics of the standard job market, b_2 is included to further characterize shift work opportunities, whereas the last term, b_3, is meant to capture restrictions in the market for center-based care.

First, we let number of jobs with full time working hours ($full$), and the number of options in nonparticipation (no) differ in the following way,[21]

$$b_1(h_m, h_f) = \begin{cases} g_{no,k} & if\ h_k = 0,\ k = m, f \\ g_{full,k} & if\ h_k = 37.5,\ k = m, f \\ 0 & else \end{cases} \tag{11}$$

Thus, we open up for differences in the number of job alternatives in nonparticipation and in full time, represented by the latent variables $g_{no,k}$ and $g_{full,k}$, respectively. Further, we allow the available number of "shift jobs", relative to the number of regular daytime jobs, to vary by the individuals' field of education ($edufield$), seen as

$$b_2(s_m, s_f) = \varsigma_1(s_m \times edufield_m) + \varsigma_2(s_f \times edufield_f). \tag{12}$$

It is expected that there are relatively more shift work opportunities for some types of educational background. For example, it is well-known that there are more part time jobs in the health sector than in other areas, which is assumed to be picked up by the type of education.

Finally, we expect that there are fewer job/care combinations that allow parents to combine two full time jobs and and less than full time center-based care. The last term of Equation 10, $b_3(h_m, h_f, s_m, s_f, q)$, accounts for this possibility by defining an indicator variable, κ, as

[21]Note that it is not perfectly clear what the number of options in the nonparticipation/home care alternative in reality represents.

$$b_3(h_m, h_f, s_m, s_f, q) = \begin{cases} \kappa & if\ q < min(h_m, h_f)\ and\ min(s_m, s_f) = 0 \\ & or\ if\ q = 0\ and\ (h_m + h_f)/2 \geq 30)\ and\ min(s_m, s_f) = 1 \\ 0 & otherwise \end{cases} \tag{13}$$

Thus, κ reflects that we assume that there are limitations with respect to combinations that involve fewer hours in center-based care than parents' working hours (upper line of Equation 13). Further, if at least one parent holds a shift work job, we expect that there are fewer options which allow for full time work of both parents (or close to full time: ≥ 30 on average) in combination with no nonparental care (second line of Equation 13).

The separation of effects into preferences and opportunities is based on assumptions and functional form, and we can therefore not rule out that the opportunity parameters partly reflect (systematic) differences in preferences across choices – for example, preferences for spending time with preschool children at home. Correspondingly, estimates of preferences may also capture "opportunity patterns" in the economy. However, as long as preferences and opportunities are not affected by the policy changes we study, the simulation results are not likely affected by these ambiguities.

4 Estimation results

4.1 Description of data

In the estimation of the model we use data from the Child Care Survey 2010, which maps child care preferences for about 3000 households (Wilhelmsen and Löfgren, 2011; Moafi and Bjørkli, 2011). The survey includes detailed information on family composition, main activity/labor market status of parents, socioeconomic background, and mode/intensity of child care. Information on reported income (wages, transfers, etc.) and tax payments are obtained from the Income Statistics for Persons and Families Statistics Norway (2005), and linked to the Child Care Survey by using personal identification numbers.

We limit the dataset to couples with at least one child in the age group 1–5 years. After excluding couples in which one parent is either student, unemployed, self-employed, or recipient of parental leave payments,[22] we are left with 1,176

[22]Recall that parents normally are on parental leave in the first year after birth, and children are therefore usually older than 1 year when entering into center-based care.

households. Low income families and immigrants are oversampled, but this is not critical with respect to the estimation of the model. However, when results are used for simulations of policy changes, representativity is achieved through the use of weights. Table 1 provides summary statistics for the main variables used in the estimation of the model.

As described in Section 3, we assume that the families choose among four working hours alternatives and two work time schedules (daytime or shift), for both the mother and the father. Further, recall that we assume that they choose among three nonparental care alternatives: no participation, part time and full time.[23] Figure 3 describe how mothers and fathers in our sample distribute on categories of working time, working time arrangements and use of center-based care (for the youngest child). Figure A.1 in the Appendix provides further details on how these discretization relate to the observed choices. A tax-benefit model is utilized to derive after-tax income for each alternative state.[24]

Table 1 shows that most parents pay for a full time center-based care service, as the average contractual hours is approximately 42 hours, but on average use it fewer hours, approximately 33 hours. This has previously been found by Blix and Gulbrandsen (1993). We take this as corroborative evidence of parents having strong preferences for spending leisure time with their children, although the price for nonparental care in centers is 0 at the margin. Some parents reduce their working hours to achieve this, but a main presumption of the present analysis is that it is possible to exploit the flexibility in the labor market to reduce hours in nonparental care, and instead increase the parental care time. Individual wages, reported in Table 1, are obtained from OLS wage regressions, for mothers and fathers, see estimation results in Table A.1 in the Appendix.

[23] In total we end up with 147 combinations in the choice set.

[24] The calculation takes into account that child care expenses are tax deductible up to a threshold. In effect, it means (in the year of 2010) that the government pays 28 percent of the expenses, limited by an upper expenditure threshold.

Table 1. Descriptive statistics for the sample used in the estimation of the model

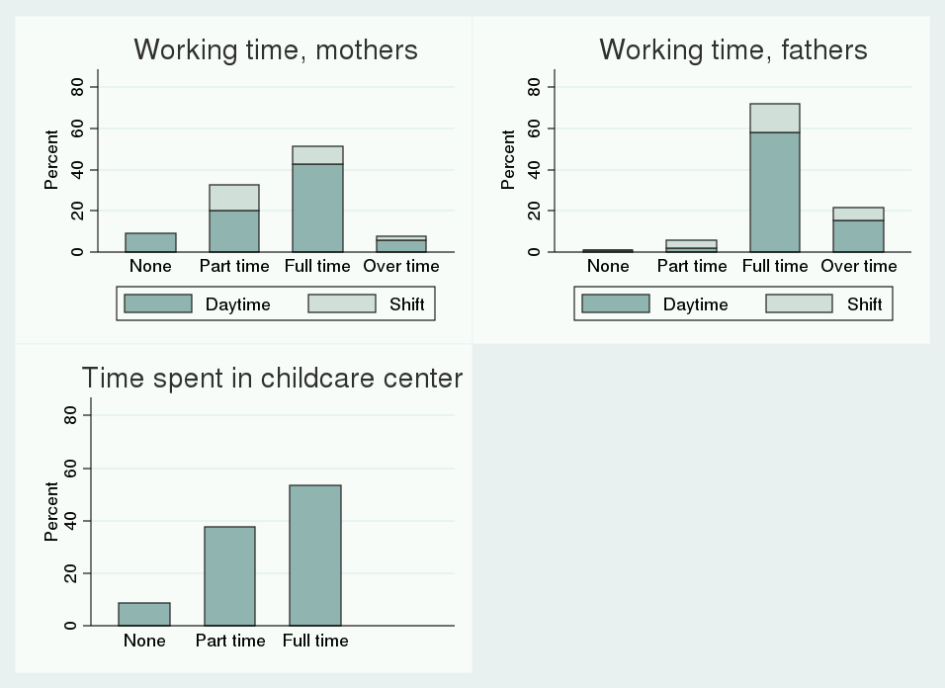
	Mother		Father	
	Mean	Std. Dev.	Mean	Std. Dev.
Age	34.1	4.80	36.8	5.50
Years of education	13.3	2.70	13.4	2.55
Immigrant dummy	0.25	0.43	0.22	0.42
Working hours per week	31.1	12.5	39.4	7.44
Hourly (estimated) wage rate (1EUR = 9NOK)	211.1	48.3	289.5	53.7
Shift dummy	0.22	0.42	0.23	0.42

	Youngest child (1–5 years)			
	Mean	Std. Dev.	Min.	Max.
Age	2.54	1.29	1	5
Actual time in child care per week (hours)	32.6	12.2	0	50
Contractual time in child care per week (hours)	41.9	14.8	0	62.5

	Household			
	Mean	Std. Dev.	Min.	Max.
Number of children 1–5 years	1.40	0.54	1	3
Non-labor income (1EUR = 9NOK)	67,493	137,920	-147,250	2,926,443

Number of household observations	1,176

Figure 3. Observed labor market and child care choices



4.2 Parameter estimates and model fit

The model is estimated by maximum likelihood, where we summarize the likelihood contribution over individuals, given by Equations 5, 6, 7, and 9. This essentially means that the parameters of the utility function and the opportunity measure, given by Equations 11, 12, and 13, are estimated simultaneously, in order to maximize the probability of the observed labor market decisions and child care choices. Table 2 reports the estimates of the parameters. First, we note that not all parameters are statistically significant. When the model is employed to simulate effects of alternative policies, we use the parameter point estimates, allthough not all of them are strictly significant (in a statistical sense).

The utility function behaves well, as preferences for both consumption and leisure are positive, and the estimate of α_1 suggests decreasing returns with respect to consumption. Given that leisure to a large extent is spent on giving care to children, it is worth noting that the valuation of leisure is higher for mothers than for fathers. Thus, even though the Norwegian males are found taking an important role in the upbringing of children, this suggests that there still are gender differences among Norwegian parents. We will come back to this issue when discussing how nonparental care varies with respect to the labor market choices of parents.

Recall that the modeling framework opens up for the couple having preferences for joint parental care, represented by an interaction term in leisure, see Equation 6. The estimation results show that the common interaction term is clearly insignificant (β_3), but that there is positive valuation from both parents having standard working time schedules (β_4). Further, with respect to the preferences for child care, estimates of γ_0 and γ_1 imply that parents attain positive utility of having their children in nonparental care, but at a decreasing rate. This is expected since we observe that parents tend to underutilize nonparental care, even though they have already paid for it. With respect to the interaction of preferences for nonparental care and leisure, the estimation results suggest a negative relationship, which fits with a story where parents use their leisure time caring for their kids. We note that there is positive interaction between mother's working hours and preferences for nonparental care, see estimate of δ_1, whereas the other interaction estimates, δ_2, δ_3, andδ_4, are clearly insignificant.

The estimates of the opportunity parameters are more difficult to interpret. It follows from the model specification that the estimates of job opportunities with standard working hours, $g_{no,k=m,f}$ and $g_{full,k=m,f}$, are assessed against the left out alternatives, part time and over time work, both set to 1. Given this, the estimates reported in Table 2 signify that there are more jobs with full time work schedules,

as expected. Similarly, the estimates for shift work, ς_0 and ς_1, seem to be reasonable, as they are both negative, suggesting that there are less job alternatives in this job category. Of course, the "opportunity" estimates in the nonparticipation alternative are especially hard to interpret. However, we note that they are negative and close to 0, for mothers and fathers, respectively. The last component of the choice set specification is a dummy variable, κ, representing limitations in the possibilities to combine full time work and less than full time care, see Equation 13. In Table 2 this is referred to as "decoupling". We see that the estimate of κ is close to 0 and statistically insignificant.

To further discuss the performance of the model, Table 3 describes valuations of nonparental care for different labor market choices and with respect to the age of the youngest child. We do this by using Equation 7 and Equation 8, and the accompanying parameter estimates. With respect to the age of the child, Table 3 shows that the valuation of center-based care increases with age, as expected. We also find that on average the assessment of center-based care increases with use, see difference between the valuation of part time and full time care. Thus, the parents are still on the increasing part of the concave (nonparental) care function.

More noteworthy, and as already brought up in relation to the results of Table 2, there are preference differences between mothers and fathers. Although, in the motivation for the present work, we have stated that Norwegian males are well underway to take up a gender-equal position, the results in Table 3 indicate that there are still some differences. We use the results of Table 3 for mothers' and fathers' valuation of care for shift work and part time work choices as indicative evidence: whereas for mothers, full time center-based care is valued below part time care for other choices than full time work, valuations of part time and full time center-based care are identical when fathers' choices deviate from standard full time work. Given that we let nonparental care quality perceptions vary according to the leisure of fathers and mothers, see Equation 8, we interpret these results as being generated by higher valuations of mothers' care than fathers' care. The fathers are not unaffected, as the full time care option is lower valued than as seen by average figures (upper line of Table 3), but whereas valuations go down in the switch from part time to full time care for mothers, there is no change in the case of fathers. This suggests that the preferences for nonparental care are still more connected to mothers' than fathers' working time decisions. Thus, we may ponder over that Norwegian fathers still have a way to go before they are involved in caretaking at the same level as their female counterparts.

Table 2. Results of the estimation of the decision model

Variables	Parameter	Estimate	Std. error
Preferences,			
$v(C, h_m, h_f, s_m, s_f, q)$			
Consumption, $v_1(C)$			
Intercept	α_0	0.1462***	(0.0319)
Squared term	α_1	-0.0002	(0.0001)
Leisure, $v_2(h_m, h_f, s_m, s_f)$			
Leisure of mother	β_1	11.9354***	(1.7752)
Leisure of father	β_2	3.4543	(1.8071)
Interaction	β_3	-0.2739	(1.0996)
Interaction, standard schedules	β_4	1.7512***	(0.3871)
Nonparental child care, $v_3(q)$			
Intercept	γ_0	4.1333	(2.1744)
Squared term	γ_1	-5.9967*	(2.0562)
Care int., $v_4(h_m, h_f, s_m, s_f, q)$			
Leisure of mother	δ_1	-5.8906*	(2.2930)
Leisure of father	δ_2	-2.5697	(3.1319)
Shift mother	δ_3	-0.2442	(1.1075)
Shift father	δ_4	0.2718	(1.0651)
Opportunity, $b(h_m, h_f, s_m, s_f, q)$			
Nonparticipation, mother	$g_{no,m}$	-1.6315***	(0.2127)
Nonparticipation, father	$g_{no,f}$	-0.1307	(0.3877)
Full time, mother	$g_{full,m}$	1.4244***	(0.0883)
Full time, father	$g_{full,f}$	1.5965***	(0.0794)
Shift work, mother (mean)	ς_1	-0.5247	(0.5438)
Shift work, father (mean)	ς_2	-0.9806*	(0.4221)
Decoupling work/care	κ	-0.1687	(0.1644)
Number of observations		1176	

The leisure of mothers and fathers are interacted with the individual's age, immigrant status, education and number of preschool children. Nonparental child care are interacted with the age of the child to capture that (perceived) child care quality at home, compared to nonparental care, may depend on the age of the child. The shift work opportunity measure is interacted with field of education.

Table 3. Estimated (deterministic) preferences for nonparental child care, dependent on labor market choices and age of youngest child. Standard errors in parantheses.

	Preferences for center-based care				
	None	Part time		Full time	
Average	0.00	2.92	(0.24)	3.14	(0.24)
Mother and father choose full daytime work	0.00	3.46	(0.31)	4.49	(0.34)
Mother chooses shift work	0.00	2.90	(0.25)	2.48	(0.27)
Father chooses shift work	0.00	3.13	(0.35)	3.13	(0.35)
Mother chooses not to work	0.00	1.04	(0.16)	-0.40	(0.17)
Mother chooses part time work	0.00	2.18	(0.18)	1.75	(0.17)
Father chooses part time work	0.00	2.22	(0.26)	2.22	(0.36)
Age of youngest child					
1 year	0.00	1.74	(0.22)	1.87	(0.25)
5 years	0.00	4.80	(0.39)	5.15	(0.33)
Number of observations	1176				

4.3 Robustness checks - accounting for unobserved heterogeneity in preferences for nonparental care

So far, individuals with identical observed characteristics are assumed to have the same preferences for child care, leisure and consumption. It is generally acknowledged that it is challenging to account for unobserved heterogeneity in discrete choice models, see for example Haan (2006) and Train (2009). Since preference for child care is especially important in our model set-up, we have, in a robustness check, assessed to what extent results are sensitive to an alternative specification, addressing unobserved heterogeneity in preferences for formal child care. This is done by letting the parameters γ_{00} and γ_{10}, see equations 7 and 8, differ according to two latent types of families. The model parameters for each group and the probability of belonging to each type are obtained simultaneously. Two types of families are identified – a majority, with a share of 95 %, and a minority, which consists of only 5 % of the families. Parents in the smallest group have positive preferences for nonparental care, but negative preferences for longer hours in child care, whereas the estimates based on the majority of families are in line with the estimated parameters in the benchmark model, see Table 2. Thus, a majority of parents have more positive preferences for nonparental care than what the main model estimates signify. Most importantly,

Table 4. Estimated preferences for nonparental child care, dependent on labor market choices and age of youngest child, when model is estimated with two unobserved types of families

Two unobserved		Preferences for center-based care				
types of families	Probability	None	Part time		Full time	
Type 1	0.946	0	2.83	(0.51)	3.10	(0.18)
Type 2	0.054	0	23.15	(0.86)	22.60	(0.88)
Number of observations			1176			

when using this alternative specification in simulations of alternative policies, which we will return to in Section 6 for the benchmark model, we find that results are not sensitive to this alternative specification. We take this as corroborative evidence for the model performing well without introducing unobserved heterogeneity in child care preferences.

5 Validation of model against quasi-experimental evidence

In this section we discuss to what extent the predictions given by the model is supported by results from other information sources. Results from quasi-experimental analyses can be used to validate structural models (Blundell, 2012), see for example Todd and Wolpin (2006), Hansen and Liu (2015), and Thoresen and Vattø (2015). Here, we validate the performance of the model by using a reform in the schedule for the home care allowance (cash-for-care) in 2012. Responses are measured in terms of changes in income and in the use of center-based care.

The reform is presented in Table 5. Recall that the home care allowance (cash-for-care) schedule is a monetary compensation for *not* using subsidized care at child care centers, for parents of children aged 1 or 2. Here, we use a reform of the schedule in 2012 in the model validation. Before 2012, families received approximately 3300 NOK ($390, €370) per child per month, whereas the 2012-change implied that children aged 13–18 months and 19–23 months received 5000 NOK ($590, €560) and 3300 NOK ($390, €370), respectively;[25] thus eliminating this type of support for the oldest age group (2 years old).

The model simulation results of this change are presented in Table 6, where we decompose results into effects on families with 1 and 2 years old children. The table shows that the qualitative results are as expected – fathers and mothers of

[25] After this change the schedule has been adjusted again, such that there (in 2017) is only one rate, 7 500 NOK, for 1 year old children.

Table 5. Cash-for-care regulations, pre- and post-reform

Monthly cash-for-care rates (nominal NOK)			
	Age 13–18 months	Age 19–23 months	Age 24–35 months
Pre-reform	3303	3303	3303
Post-reform	5000	3303	0

Table 6. Model simulations. Effects of the 2012-changes in the cash-for-care schedule on working hours and care participation rates. Standard errors in parantheses

	Mothers, work	Fathers, work	Participation, care in centers
YOUNGEST CHILD 1 YEAR OLD (N=288)			
Baseline, working hours/use of care	27.08	37.46	0.806
	(0.35)	(0.19)	(0.014)
Effect of reform, working hours/use of care	-0.26	-0.04	-0.016
	(0.05)	(0.01)	(0.003)
Effect of reform, earnings (NOK)	-1127	-217	
	(221)	(67)	
YOUNGEST CHILD 2 YEARS OLD (N=313)			
Baseline working hours/use of care	28.68	37.78	0.894
	(0.25)	(0.17)	(0.008)
Effect of reform, working hours/use of care	0.49	0.08	0.030
	(0.07)	(0.02)	(0.004)
Effect of reform, earnings (NOK)	2123	433	
	(326)	(107)	

the youngest children reduce their labor supply and the use of center-based care, whereas opposite effects are seen for parents of the 2 years old children. As we validate the model results against responses in labor income, we recalculate the labor supply effects into corresponding effects on earnings. This is straightforwardly done by using the individual-specific wage rates, derived from the wage equation estimations.[26]

A major challenge in validity tests is to obtain clear and reliable results from the empirical studies that are used in the model validation.[27] Even though families may respond along several margins because of a change in the budget constraint, as argued by Feldstein (1995), we assert that responses in labor earnings, in the

[26]The individual wage rates are kept fixed in the simulations.

[27]We largely replicate an approach presented in Weierud (2015).

short run, primarily pick up adjustments in working hours. We have access to income information for the whole population, derived from administrative registers (Statistics Norway, 2005), which alleviates detailed studies of income developments for relatively small groups of families, for couples with children aged 1 and 2. We use similar figures of income developments of parents with 4 years old children as the benchmark (common trend representation). With respect to the use of center-based care, we do not have individual information that can be used in the present context. We therefore validate against measures of aggregate coverage rates over the time period, derived from the yearly reports for child care institutions (Statistics Norway, 2016a). Since average rates are used directly, we cannot compute confidence intervals for the these measures.

Figure A.2 in the Appendix presents mean earnings for the time period 2008–2013, comparing developments for parents of 1 year and 2 years old children with developments for parents of older children (aged 3 and 4). We see no clear indications of behavioral responses by visual inspection of the graphs, but when turning to results of difference-in-differences regressions,[28] on the same data material, we find that income of parents of the 2 years old children increases, see Table 7. More importantly, the results are close to the results of the model simulations, presented in Table 6. Table 7 shows that no significant effects are obtained for the mothers of the 1 year old children. However, the standard errors are large, and we note that the 95 percent confidence interval includes the effect predicted by the model simulation. The table also confirms that fathers do not respond to the change in the cash-for-care schedule, as also predicted by the model simulations. Thus, we find it reassuring that the predictions of the labor supply model are not far from the results of the quasi-experimental data analysis. Of course, this implies that the model has been not rejected through the validation exercise – it does not mean that the model has been approved.

The simulated effects of the use of child care centers after the reform are also close to what we see in data. Figure A.2 (in the Appendix) shows an increase in the child care coverage rate for the 2-year-olds and a decrease for the 1-year-olds in 2012, as also described by the average figures (from the same data source) reported in Table 8. The participation rate of the youngest children goes down by 1.2 percentage points, whereas it increases by 2.6 percentage points for children aged 2. Moreover, both estimates are very close to the model predictions (Table 6), which means that this evidence is supportive of the model performance too.

[28]Regressions are based on standard difference-in-differences technology, letting the parents of the 4 years old children representing the common trend.

Table 7. Effects on labor earnings from change in the cash-for-care scheme in 2012. Results of difference-in-differences regressions, based on income data for 2011 and 2012

	Estimate	95 % confidence interval	Observations
Mothers, 1-year-olds	677.8	[-1475,2830]	175 639
Mothers, 2-year-olds	3143.8**	[1022, 5266]	178 457
Fathers, 1-year-olds	-204.0	[-5847,5439]	101 159
Fathers, 2-year-olds	108.7	[-5491,5709]	106 248

Figures for families of 4 years old children used as benchmark. Individual control variables included are: age of parents, age of parents squared, education level, immigrant-background, labor income three years prior to the reform, and a dummy variable for siblings.

Table 8. Effects on the use of center-based care from change in the cash-for-care scheme in 2012. Care coverage rates derived from aggregate data

	Change, participation care in centers
1-year-olds	-0.012
2-year-olds	0.026

6 Further explorations of model properties

6.1 Simulated elasticities

In this section we shall further examine the performance of the model. First we present simulated labor supply and child care demand elasticities, and, next, model properties are discussed by showing results of various simulations. Estimates of labor supply elasticities and child care demand elasticities are obtained from simulations, where the wage rate and the child care fees are increased by 10 percent from a baseline. The elasticity estimates are reported in Table 9, where the labor supply response is divided into a participation elasticity (extensive margin) and an elasticity conditional on participation (intensive margin). Importantly, and as discussed in detail in Section 3, given that the model holds no fixed link between working hours and hours in care, a change in the price of nonparental care has different implications on parents' labor supply and on the demand for child care. As we have developed a model for couples, we also provide cross-wage elasticity estimates.

Table 9 provides figures for the participation response and the response in hours of work separately; the overall (Marshallian) wage elasticity is obtained by adding the two estimates. One notable result of Table 9 is the small responsiveness of child

care demand with respect to the price of child care. This result is influenced by the modeling, as the time constraint on use of nonparental care is not binding in our case. When the price for nonparental care is not related to hours of use, the marginal price is essentially zero.[29] This means that for all households where the demand for child care is positive, an increase in the child care fee can be seen as a pure income effect. Thus, small income effects is probably the main explanation for the finding that families are rather insensitive to the price of child care, both with respect to the labor supply of parents and the demand for child care.

The previous literature on the price responsiveness is not unanimous. For example, the review in Chaplin et al. (2000) show estimates ranging from large positive values to large negative values. Similarly, previous studies on effects of fees on labor supply are far from consistent, see overviews in Blau and Currie (2006), Kalb (2009), Del Boca (2015), and Morrissey (2017). Relatively small labor supply responses are also found by Kornstad and Thoresen (2007), with Norwegian data from the late nineties, when there were queues for access to care in centers.[30] Another study that finds response estimates close to zero is Lundin et al. (2008), with data for Sweden. They argue that in countries with a well-developed and highly subsidized child care system, further reductions in the price of child care give small effects on mothers' labor supply. Thus, this can explain the low response in the Norwegian case too.

[29]If the demand for nonparental care is larger than the opening hours of center-based care, parents may in reality choose other options of nonparental care in addition, which implies that there is a positive marginal price too.

[30]As there is no rationing in the Norwegian market for child care anymore, one may expect to find higher price responsiveness in the present situation, not less responsiveness, as found.

Table 9. Simulated elasticities (standard errors) of labor supply and child care demand with respect to wage and child care fee

	Labor supply, mother		Labor supply, father		Demand for non-parental care	
	Particip.	Hours[1]	Particip.	Hours[1]	Particip.	Hours[1]
Wage of mother	**0.147**	**0.120**	-0.001	0.004	0.072	0.028
	(0.020)	**(0.018)**	(0.001)	(0.002)	(0.011)	(0.004)
Wage of father	-0.004	-0.002	**0.021**	**0.042**	0.011	0.001
	(0.004)	(0.004)	**(0.005)**	**(0.006)**	(0.003)	(0.001)
Child care price	-0.002	0.004	-0.002	0.002	**-0.016**	**0.002**
	(0.005)	(0.004)	(0.001)	(0.002)	**(0.003)**	**(0.001)**

[1]Calculated conditional on working.
Standard errors are obtained by non-paramteric bootstrap.

Table 9 shows that the parents' labor supply is more responsive with respect to the wage than to the price of care. However, there is clear gender difference – mothers' labor supply is more sensitive to the wage than fathers' work. The overall wage elasticity for mothers is in the range between 0.25–0.30, which is relatively close to what Kornstad and Thoresen (2007) found (0.35) on Norwegian data from the 90s, and somewhat lower than reported by Thoresen and Vattø (2015) for all Norwegian females in couples (0.46). Compared to results of studies of mothers of preschool children from other countries, the response is, for example, higher than one of the estimates seen in Ribar (1995) for the US (0.09), but considerably below what Powell (2002) finds for Canada (0.85). It is worth noting that the increased labor supply following from increased wages of mothers, also give a relatively large increase in the demand for center-based care, allthough smaller than the reponse in working hours. A key characteristic of our modeling approach is that increased labor supply of parents does not necessitate nonparental care in the same scale – parents may exploit the flexibility in the labor market to let children be taken care of by the parents.

Given that there are few studies based on models of the joint labor supply of parents, the literature offers few estimates of the wage responsiveness of fathers of preschool children.[31] However, we note that the elasticities for males reported here are very close to the estimates presented in Thoresen and Vattø (2015) for all males (not restricted to fathers of preschool children).

[31]One exception is Mumford et al. (2015), who find similar wage elasticities for mothers and fathers.

As discussed in Section 3, our modeling approach facilitates deriving cross-wage elasticities, which are influenced by how mothers' and fathers' consumption of leisure interact. Recall that we find estimation results in accordance with parents having preferences for spending time together, as there are stronger preferences for leisure when the partner has more leisure, see the estimate of β_4 in Table 2. Such preferences limit the cross-wage responses, and correspondingly we see cross-wage elasticity estimates that are close to zero in Table 9.

6.2 Closing the gender wage gap

In Table 10 we further elaborate on model properties by discussing to what extent the different labor market adjustment for men and women can be explained by differences in wages. More precisely, we use the model to simulate how mothers' and fathers' labor supply are affected when the gender gap in wages is closed. This can be done in two ways, either by increasing mothers' wages to the level of fathers, or by reducing the wage of fathers down to the level of mothers, see Table 10. Results are measured against a benchmark, denoted "Baseline, 2010".

Firstly, we note that if the mothers obtain "male wages", they increase their participation rate by 3.9 percentage points. As the difference between participation between mothers and fathers is approximately 7.8 percent (see the baseline simulation), this means that about half of the difference is explained by higher wages for males. The rest of the gap in the participation are then explained by other differences, as deviating preferences and unequal possibilities in the labor market. If we instead decrease the fathers' wage, the reduction in the participation rate for fathers is only 1.1 perecent, and the participation of mothers increases by only 0.2 percent. The asymmetry in results follows from higher elasticities among mothers than fathers, in addition to low cross-elasticities, as seen in Table 10. This imbalance is also found with respect to the results on the intensive margin. An increase in mothers' wages explain 1.25 hours (1.27-0.02) of the difference in hours of work, whereas an decrease in fathers' wage leads to a smaller change, only 0.54 hours (0.08+0.46).

Table 10. Labor supply effects when the gender wage gap is closed

	Labor supply, mother		Labor supply, father		Demand for non-parental care	
	Particip.	Hours[1]	Particip.	Hours[1]	Particip.	Hours[1]
Baseline, 2010	0.912	31.91	0.990	38.17	0.913	35.89
	(0.006)	(0.23)	(0.002)	(0.16)	(0.007)	(0.14)
Increase wage of mother	0.039	1.27	-0.000	0.02	0.019	0.32
	(0.004)	(0.20)	(0.000)	(0.02)	(0.003)	(0.05)
Decrease wage of father	0.002	0.08	-0.011	-0.46	-0.003	0.01
	(0.002)	(0.07)	(0.003)	(0.08)	(0.001)	(0.02)

[1]Calculated conditional on working

6.3 More on effects of parental fees

Recent family policy discussions in Norway have centred on whether to make child care services cheaper or to strengthen cash benefits schedules. Given this, and given that the elasticity estimates suggest that parents' labor supply is rather insensitive to child care fees, we take a closer look at the effects of changes in payments for center-based care. In Table 11 we report the simulated effects of alternative pricing schemes for nonparental care, both letting the price be doubled and making the service free. Moreover, in order to further look into the heterogeneity of responses, simulation results for specific groups of households are presented – for families where both parents are immigrants and for families where mothers are low-educated or have low predicted wage rate.

The results of Table 11 signify that the relationship between the price of non-parental care and the labor supply of mothers follows a nonlinear pattern. Although Table 9 shows that labor supply is very insensitive to the price of care, close to 0, we see clearer effects when introducing larger changes, as a doubling of the parental fee (from the level of 2010).[32] As expected, mothers decrease their labor supply. Correspondingly, they increase their labor supply when they are offered full time center-based care free of charge. The labor supply of fathers are not affected by these changes.

With respect to the selected subgroups, the most distinct devation from the responses of the overall population is seen for the category of families whose mothers are low paid. For the simulation alternative where they experience a doubled price

[32]In 2010 the maximum price was 2330 NOK, or approx. $280 and €260 (when using exchange rates as of January, 2017).

for nonparental care, the average reduction in hours of labor supply is 0.1. This is not a large response, for example compared to what other studies find, but clearly higher than for the whole population. It should also be acknowledged that many of the cofidence intervals are relatively wide.

6.4 Abolishment of the cash-for-care scheme

In the validation of the model we used a change in the cash-for-care scheme in 2012. However, the removal of the program is an ever returning question in the Norwegian policy debate, for instance recently suggested by a governmentally appointed expert group (Ministry of Children and Equality, 2017). In Table 12 we report the simulated effects of abolishing the scheme altogether. Again the responses are very small on average for all individuals. Effects are larger when restricting to the target population of the schedule, but even in that group effects are small: labor supply participation increases by 1.4 percentage points and participation in center-based care increases by 4.1 percentage points.

Table 11. Simulated effects of alternative child care fee schemes. All households and population subgroups

	Labor supply mother[1]		Labor supply, father[1]		Demand, non-parental care[1]	
ALL HOUSEHOLDS (N=1,176)						
Baseline (2010)	29.16	(0.25)	37.79	(0.16)	32.77	(0.28)
Change from baseline schedule						
2 x maximum price	-0.16	(0.08)	-0.03	(0.02)	-0.53	(0.09)
Free part time care	-0.19	(0.03)	-0.01	(0.01)	-0.16	(0.03)
Free full time care	0.14	(0.03)	0.02	(0.01)	0.35	(0.04)
MOTHER WITH NON-NORWEGIAN BACKGROUND (N=297)						
Baseline (2010)	27.67	(0.63)	37.41	(0.23)	32.24	(0.57)
Change from baseline schedule						
2 x maximum price	-0.20	(0.07)	-0.05	(0.03)	-0.55	(0.73)
Free part time care	-0.19	(0.04)	-0.01	(0.01)	-0.14	(0.67)
Free full time care	0.15	(0.03)	0.02	(0.01)	0.35	(0.67)
MOTHERS WITH LOW EDUCATION (N=182)						
Baseline (2010)	26.59	(0.80)	37.21	(0.23)	31.82	(0.41)
Change from baseline schedule						
2 x maximum price	-0.21	(0.06)	-0.05	(0.02)	-0.57	(0.52)
Free part time care	-0.21	(0.04)	-0.01	(0.01)	-0.14	(0.48)
Free full time care	0.16	(0.02)	0.03	(0.01)	0.37	(0.50)
MOTHERS WITH LOW PREDICTED WAGE RATE (N=150)						
Baseline (2010)	25.30	(0.55)	37.20	(0.24)	30.69	(0.59)
Change from baseline schedule						
2 x maximum price	-0.38	(0.10)	-0.11	(0.04)	-0.88	(0.69)
Free part time care	-0.20	(0.04)	-0.01	(0.01)	-0.07	(0.56)
Free full time care	0.25	(0.04)	0.04	(0.01)	0.53	(0.54)

[1] Hours, unconditional on participation (capture both extensive and intensive margin effects).

Table 12. Simulated effects of abolishing the "cash-for-care" schedule

	Labor supply mother		Labor supply, father		Demand for non-parental care	
	Particip.	Hours[1]	Particip.	Hours[1]	Particip.	Hours[1]
All households (N=1,176)						
Baseline (2010)	0.912	31.91	0.990	38.17	0.913	35.89
	(0.006)	(0.23)	(0.002)	(0.16)	(0.007)	(0.14)
No "cash-for-care"	0.007	0.13	0.000	0.04	0.020	0.00
	(0.001)	(0.02)	(0.000)	(0.01)	(0.003)	(0.00)
"Cash-for-care" eligible households (N=601)						
Baseline (2010)	0.888	31.35	0.988	38.07	0.851	35.72
	(0.008)	(0.26)	(0.002)	(0.16)	(0.011)	(0.18)
No "cash-for-care"	0.014	0.26	0.001	0.07	0.041	0.00
	(0.002)	(0.03)	(0.000)	(0.01)	(0.005)	(0.00)

[1] Calculated conditional on working

7 Concluding remarks

Developments in Norway and several other countries imply that there are reasons to question the design of the typical structural model for joint labor supply and child care choice. In particular, we assert that the negligence of fathers as caregivers no longer can be justified with reference to the decision-making of Norwegian families. Even though Norway and other Nordic countries are considered as taking the lead with respect to equal parenting and support for center-based care, we expect that the model presented here represents a relevant approach for other economies too. At least, we conjecture that future developments will enhance its relevance.

Two new characteristics are in particular attended to in the design of the updated model. Firstly, the choice set of nonparental care has been simplified – in effect, now, parents choose between own care and center-based care. Secondly, in contrast, the decision-making at the parental side has become more complicated. It is asserted that Norwegian couples move towards more gender equality in family life, which implies that care by fathers also should be accounted for in the nonparental care choice set. When both parents are assumed to take part in the care, and parents' working hours may not overlap, a model is developed that accounts for the possibility that parents may exploit the labor market flexibility to reduce time in nonparental care.

The estimation results give support for the basic premise of this modeling framework, i.e., that fathers' care should be accounted for. We find results that are affirmative of fathers being involved in the care, although most likely not in the same scale as their partners. Our estimation results may suggest that Norwegian fathers still have a way to go before they are involved in caretaking at the same level as their female counterparts. Nevertheless, we maintain that fathers' care should not be neglected. One implication of the involvement of fathers is that the "fixed link assumption" between nonparental care and the labor supply of mothers, which is often used in the joint labor supply and child care choice literature, should be questioned and probably abandoned.

The simulation results suggest that parents' labor supply are insensitive to the price of child care. This finding is supported, or at least not rejected, by validations against other information sources. Model simulation results are relatively close to findings derived from quasi-experimental data analysis, using a reform in the cash-for-care scheme as an out-of-sample validation.

Further, even though simulation results suggest that parents are not responding to changes in the price of center-based care, they show more responsiveness with respect to changes in wages. The model predicts that mothers more than fathers increase their labor supply to an increase in the wage. The average wage elasticity for mothers is 0.27, whereas fathers are much less responsive, the elasticity is around 0.06. The cross-wage elasticity estimates are small. The labor supply effects generated by increased wages of mothers give increased demand for center-based care, but not in the same range as given by the response in the labor supply. This reflects the key characteristic of our model: we let parents exploit the flexibility in the labor market to spend more time with their children at home, and, in particular, we allow the fathers to contribute to this caretaking.

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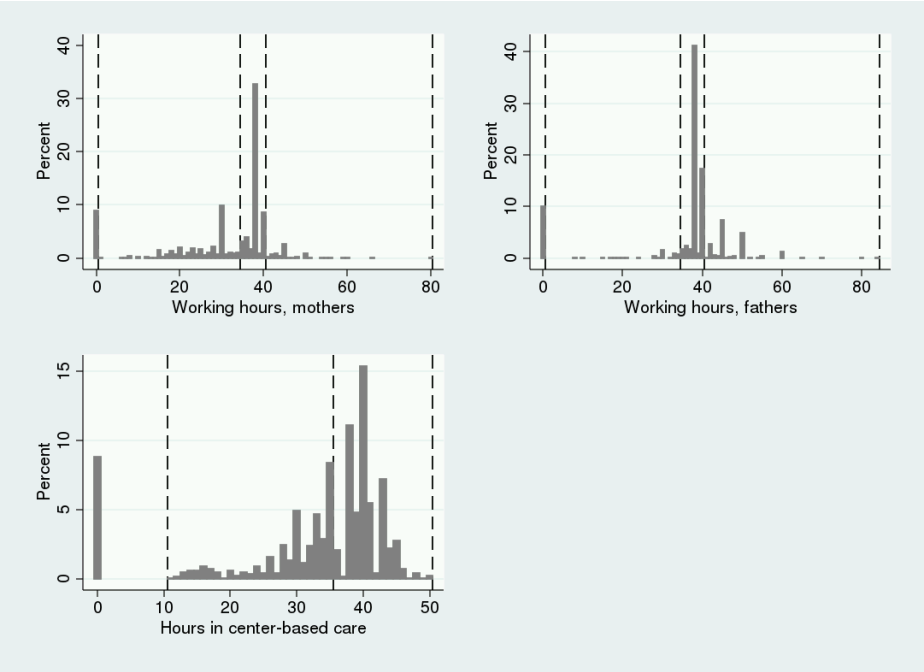
Appendix

Table A.1. OLS wage regressions

	Mothers		Fathers	
Experience	0.0688***	(0.0150)	0.0202	(0.0040)
Experience squared	-0.0017**	(0.0005)	-0.0005	(0.0001)
Low education	-0.3323***	(0.0781)	-0.2121*	(0.0921)
High education	0.2296***	(0.0486)	0.2672***	(0.0471)
Education category (base: "unknown")				
General	0.4833***	(0.0886)	0.2570**	(0.0969)
Human, Art	0.3057**	(0.0999)	-0.0999	(0.1185)
Education	0.2943**	(0.0909)	0.0085	(0.1165)
Social, Law	0.5078***	(0.1051)	0.0206	(0.1167)
Business	0.4942***	(0.0844)	0.3180**	(0.0892)
Technology	0.6091***	(0.0930)	0.2616**	(0.0691)
Health	0.4319***	(0.0782)	0.1475	(0.1011)
Primary	0.4504*	(0.2035)	-0.1384	(0.1368)
Service	0.4203**	(0.1622)	0.2780**	(0.1006)
Constant	4.1004***	(0.1274)	4.9824***	(0.1279)
Number of non-missing observations	1144		1176	
Number of missing observations	86		54	

Standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure A.1. Distribution of observed working hours and hours in center-based care



The dashed lines illustrate the chosen cut-offs points when discretizing the observed choices into none (0), part time (20), full time (37.5) and over time (45) for mothers' and fathers' working time, and none (0), part time (30) and full time (40) for center-based care.

Figure A.2. Observed earnings (1000 NOK) and child care center coverage rates by age of the children