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A Discrete Choice Model for Labor Supply and Child Care

Abstract:
A discrete choice model for labor supply and child care for mothers of preschoolers is presented. The mothers are assumed to make choices from a finite set of job possibilities and from a finite set of child care options. The options in the markets for child care are characterized by opening hours, fees and a number of quality attributes, such as mode of care. Similarly, jobs are characterized by a (fixed) wage rate, working hours and a number of variables related to job satisfaction. In the estimation of the model we take into account that the number of options available might vary across work/care combinations, and that some mothers are rationed in the market for care at day care centers. The model is employed to simulate the female labor supply effects of the Norwegian home care allowance reform.

Keywords: female labor supply, child care, discrete choice, microsimulation

JEL classification: J13, C25

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1. Introduction

The last decades have brought about a drastic change in the role of women in the labor market. The labor market participation rate for Norwegian females (25–59 years) has increased from about 50 percent in 1972 to well above 80 percent in 1997 (Stølen and Svendsen 1999). The entry-rate has been particularly high among females of fertile age, 25–40 years. Simultaneously, the ratio of preschool children attending state subsidized day care centers has increased from below 20 percent in the seventies to more than 60 percent in 2000.[1]

As in many other countries, cf. e.g. discussions around the Family Credit and the succeeding working families tax credit in the UK (Duncan and Giles 1996; Blundell et al. 2000) and the earned income tax credit in the US (Scholz 1996; Eissa and Liebman 1996), the policy-makers in Norway aim at improving work incentives for parents. However, they opted for a different approach when a "home care allowance" was introduced in 1998 that strengthen incentives to parents to provide care at home for their young preschoolers. The "home care allowance" gives parents of preschool children aged 1–2 years a transfer in cash, that depends on utilization of public or private day care centers: non-users are eligible to 36,000 Norwegian kroner (about 4,000 U.S. dollars) per year and per child in support, while provisions are scaled down to nil for users of full-time center-based care.[2] In effect, this means a substantial price increase of center-based care relative to the costs of other modes of care, i.e., other paid care and parental care. We expect that this policy change will reduce female labor supply. The total effect on labor supply is, however, not easily assessed since it depends, among other things, on the extent to which parents consider other paid care alternatives as an acceptable substitute for care at centers.

The purpose of this paper is to develop and estimate a decision model for female labor supply and child care choices in order to predict the female labor supply responses of this policy change. We focus on mothers since they are assumed to be the primary caregiver and since results from empirical studies suggest that females are more responsive to changes in taxes and transfers than men.[3]

While traditional models of labor supply focus on the adjustment of hours spent at work and leisure, the literature on child care choices and labor supply emphasises that market work for

[1] These figures apply to children 1–5 years old. Thanks to a generous maternity leave provisions, very few children attend day care centers in their first year. Children start school in their sixth year.

[2] The term "home care allowance" is in accordance with the terminology used in Ilmakunnas (1997). However, the transfer might rather be characterised as an "out-of-child care center allowance".

[3] There are, however, signs of convergence of opinions between the sexes in Norway regarding child care and outside work, which could mean that male income should also be treated as endogenous in future model proposals.

parents of preschoolers also implies a demand for non-parental child care, which entails (pecuniary) costs and affects the well-being of children. Labor supply analyses that encompass child care choices in the decision-making framework include, e.g., Blau and Robins (1988); Ermisch (1989); Hofferth and Wissoker (1992); Connelly (1992); Michalopoulos, Robins and Garfinkel (1992); Gustafsson and Stafford (1992); Ribar (1992, 1995); Averett, Peters and Waldman (1997); Kimmel (1998); Powell (1998); Blau and Hagy (1998).

Our modeling approach is based on the assumption that jobs and various care alternatives are characterized by a number of pecuniary and non-pecuniary attributes. Parents' choice of job is influenced not only by working hours and wage rates, the two variables that are the main focus of traditional labor supply studies, but also by job location, type of work and other factors related to job satisfaction. Similarly, child care options vary with regard to facilities, quality of staff etc., as well as opening hours and fees. Many of these attributes are fixed for a given job or child care option. For instance, opening hours are fixed at child care centers, as frequently are hours of work and job satisfaction factors. A desire to alter features such as these would most likely imply a job change or a change of care provider. Hence, we assume that labor supply and choice of child care are outcomes of discrete choices from finite sets of jobs and child care arrangements, where each job is assumed to have fixed working hours, a wage rate and a number of non-pecuniary characteristics, and each care alternative has fixed opening hours, a care fee and specific quality attributes.

Variables related to job satisfaction and quality of child care are often latent to the researcher. In the approach presented here, the effects of these variables on choices are integrated in the stochastic specification of the model. The approach is related to Aaberge, Dagsvik and Strøm (1995).

The assumption that each mother faces the same choice set irrespective of her own characteristics and characteristics of the job/care options might not be realistic. For instance, we argue that there are more full-time jobs and more full-time places at child care centers than part-time. In the empirical specification of the model we allow choice probabilities to vary according to variations in number of opportunities across states. Since some parents report that they are rationed in the market for places at centers, we also take this into account by restricting their choice set when estimating the model. Model estimations are based on micro data for about 770 families with preschool children in 1998, derived from the Norwegian Home Care Allowance Survey 1998. The data contains detailed information on families' labor supply and child care choices.

When model estimates are used to predict the effects of the home care allowance reform on labor supply, we find that the mothers in the target group reduce market work by approximately 16 percent. We interpret this estimate as representing the long-term predicted effect of the reform.

The paper is organized as follows: in Section 2 we present the institutional setting from which Norwegian parents make their choices, while Section 3 presents the labor supply model and estimation results. Section 4 discusses the labor supply effects of the home care allowance reform, and Section 5 compares our elasticity estimates with estimates from the literature. Section 6 concludes the paper.

2. Institutional setting

Markets for care

The increase in labor supply for all groups of females witnessed over the past few decades has enhanced the demand for non-parental care of preschoolers. Side by side two markets have existed for child care in Norway: a market for care at day care centers and a market for other types of paid care, dominated by childminders.

Day care centers are run by local public authorities, private organizations, firms and, to some extent, also by individuals. Relatively strict regulations apply to group size, child–staff ratio, staff qualifications, facilities, etc. On the other hand, the centers receive state subsidies dependent on number and age of children. On average the subsidies cover about 35–40 percent of total costs of the centers. Parental fees are the other most important source of financing, while centers owned by the municipalities also receive support from local governments. More than 60 percent of all children aged 1–5 years attended child care centers in 1998.

In spite of a substantial increase in the number of places at centers, there is another market for paid care. This category – "other paid care" – includes types of non-parental care that are ineligible for public financial support, such as care by childminders, au pairs, etc. There are no special public arrangements regulating these types of child care in Norway. The lack of public control in this market finds expression in the large number of childminders that do not report incomes to the tax authorities. As will be shown below, the prices are on average lower in this part of the market for non-parental care.

According to the Home Care Allowance Survey 1998 unpaid (non-parental) care options are available, most typically by close relatives of family, i.e., grandparents. Families enjoying child care from unpaid grandparents are considered to be in a very fortunate situation, receiving high-quality care[4] while parents are out working. However, unpaid care by grandparents is not a real option for most families since it requires able and motivated grandparents living in the "neighbourhood" of their

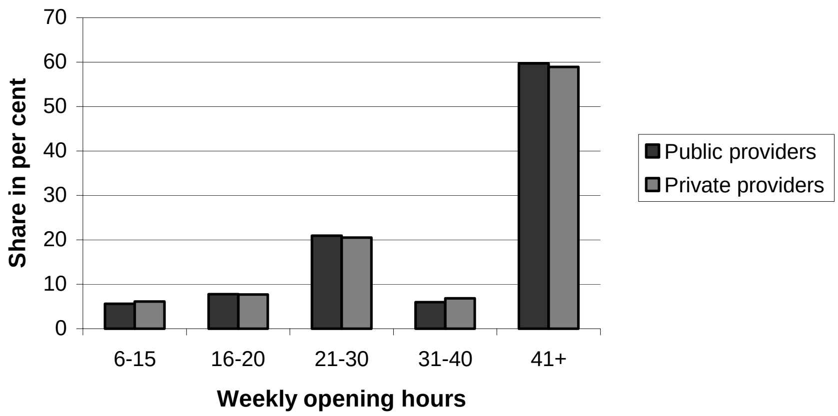
[4] This is an a priori assumption about grandparents.

children. Hence, in what follows, we categorize options into two types of non-parental care: care at child care centers and other paid care. The latter category includes both childminders and au pairs. Some authors, cf. e.g. Michalopoulos, Robins and Garfinkel (1992), argue that free care is available for all mothers since one always can choose to leave the children alone while working, but this possibility is ignored here.

Another important feature of non-parental care markets is the constraints (other than prices) preventing individuals from purchasing care at centers. Two important constraints are queues and the lack of flexibility in opening hours. A vast majority of child care centers offer services restricted to a fixed number of hours per day. According to Figure 1 both the public and the private part of the market offer primarily either half or full-time care. About 20 percent of the children have half-time care and about 60 percent full-time. "Underutilisation" has been reported, which means that parents are paying for a full-time service, while using it less. The peak in opening hours around full-time might result from institutional features on the supply side and/or from past demand patterns. Whatever the reason, the distribution in Figure 1 indicates that the number of child care options should be allowed to vary across opening hours.

We assume that the distribution in Figure 1 represents the supply of care at child care centers as perceived by the households in our sample, and allow the choice probabilities to vary according to this variation in the empirical specification of the choice model.

Figure 1. Opening hours distribution for child care centers, public and private, 1998



Source: Statistics Norway (2000)

With respect to opening hours for other paid care, we employ information on utilization as reported by parents to the Home Care Allowance Survey 1998. These data reflect actual utilization rather than formal opening hours, and Figure 2 shows that the peak is around 35 hours per week rather than 41+.

We assume that the distribution in Figure 2 (at least to some extent) reflects arrangements made by parents and care providers jointly, and hence, we do not treat this distribution as representing market opportunities for the parents in the decision model.

Figure 2. "Opening hours" distribution for other paid care, 1998

Source: Home Care Allowance Survey 1998

Moreover, families might be rationed in the markets for non-parental care. This means that the choice set for child care arrangements is limited relative to what it would have been if the family was unconstrained. There are reasons to believe that this type of rationing is most significant in the child care center market. Although if there has been a substantial increase in number of places at day care centers over the past few decades, there are still queues, at least in some municipalities. At the national level 61.1 percent of children aged 1–5 attended child care centers in 1998 (Statistics Norway 2000). However, in the municipality with the lowest coverage only about 34 percent had a place at a center, while other municipalities have close to 100 percent coverage. The Home Care Allowance Survey, the data source used in the estimation, yields information on mothers' access to care at centers. This information is applied in the determination of choice sets.

The home care allowance reform

The home care allowance reform was introduced in the fall of 1998,[5] and provides families with children aged 1–2 a tax-free cash transfer that depends on the utilization of care at centers, as shown in Table 1.[6] The table shows that care exceeding 32 hours per week at day care centers makes the family non-eligible to the cash transfer. The maximum transfer is NOK 36,000 or about 4,000 U.S. dollars

[5] It is fair to say that the reform gave rise to a fierce exchange of views on the direction of the modern welfare state.

[6] There have been some minor adjustments in the transfer system since it was introduced. The system for 2000 is presented here, which costed about 2.8 billion NOK in total expenditure.

per year per child with no center-based care at all. Instead of supporting care at centers only, the reform means that all modes of care are supported equally.[7] Families using child care centers are supported by the subsidized services, while the others receive a transfer in cash, which they in turn can use to pay a childminder, an au pair or to finance own care.

Table 1. The rate system for the home care allowance. Yearly rates per child in Norwegian kroner (NOK)* in 2000

	Weekly hours of care at child care centers					
	0	1–8	9–16	17–24	25–32	32+
Yearly rate	36,000 (100 pct)	28,800 (80 pct)	21,600 (60 pct)	14,400 (40 pct)	7,200 (20 pct)	0 (0 pct)

*36,000 NOK ≈ 4,000 USD

Incentives were radically changed by the reform. Parental care and care by childminders have become relatively cheaper than care at centers. Now, the costs of employing full-time care at centers are not only the parental fee, but also an additional cost in terms of lost cash transfers. Correspondingly, applying parental care not only means that expenses such as fees to centers are avoided, but the family receives an additional NOK 36,000 (per year/child) in cash support for looking after the child or children.

Whether this fundamental change in the economic implications of various choices leads to substantial reductions in female labor supply depends on the direction and the strength of the mothers' movements. A key factor is their assessment of the quality of the various modes of care. If users of child care centers consider care by childminders and au pairs as satisfying substitutes for care in centers, they will use these alternatives as a response to the reform, and fewer mothers will withdraw from the labor market to care for children at home. Moreover, the more care by mothers is considered superior to non-parental care alternatives[8], the more we expect the reform to impact on labor supply. The "quality-of-care" issue will be further discussed in Section 3.

For families that used other paid care alternatives before the reform, we expect the new cash support to be spent on various goods, improvements in child care quality included. Thus, if care by mothers represents the best quality, more time will be spent providing it at home, rather than taking part in market work. In the next section we probe deeper into a modeling framework that enables us to assess the labor supply effects of this reform.

[7] At least, equal support was the initial intention. State budgets in recent years show that this is not strictly the case, as subsidies to centers are separated from the home care allowance rate system.

[8] Since the reform applies to parents of very small pre-school children, mothers might consider our case as representing a unique input to the well-being of the child.

3. The model

As already discussed in the previous section, care quality is one of the key variables in the decision-making when households maximize their preferences. It is not apparent how quality of child care should be measured and views may differ across households and societies, cf. the survey in Blau (1991).

Child care quality is often taken into account in analyses by relying on a "production function approach" (Ilmakunnas 1997), where hours of parental and non-parental care are considered as key production factors in addition to other variables. Various specifications to make this approach operational can be seen in the literature: Connelly (1992) refers to a vector of characteristics that affect the production of child quality. Similarly, Ribar (1995) assumes that quality is increasing in maternal care and market goods and a number of conditioning factors such as number and age of children, parents' education, etc. Blau and Hagy (1998) let the quality of non-parental care be represented by quality-related attributes of the arrangement, as group size, staff-child ratio and provider training. They conclude that "the discrete choice analysis indicates that the parents do care about some features of child care that we do not observe and that are associated with the discrete outcomes" (p. 135). This might indicate that parents do not believe that group size, staff-child ratio and provider training are associated with care quality, or that supply-side constraints might prevent parents from carrying out their preferred decisions.

A basic assumption underlying the present modeling approach, is that we do not observe all variables and choice opportunities that are relevant for decisions by families with regard to labor supply and choice of child care arrangement. We argue that the mothers are influenced by several pecuniary as well as non-pecuniary variables, quality of care attributes included, when choosing among job and child care alternatives. Each job opportunity is characterized by a whole range of latent, non-pecuniary attributes, reflecting the actual work, location and other factors related to job satisfaction, in addition to observed variables, such as wage and working hours. Similarly, the opportunities in the market for non-parental care are characterized by factors regarding fees and opening hours, but also latent, non-pecuniary attributes associated with the quality of care, as discussed above. The effects from non-pecuniary attributes on preferences, quality of care included, will be treated as latent variables, captured by the stochastic error term, in the following. Moreover, it is also assumed that the set of feasible opportunities is partially unobserved by the researcher. The effects of these latent variables are important for understanding the labor supply behavior and the choice of care alternatives.

We assume that many of the non-pecuniary benefits are fixed for a particular job and for a particular child care arrangement. In many jobs, work activities and working hours are given, and if the worker wants to adjust these attributes, it often means finding a new job entirely. Similarly, with respect to the consumption of care, a desire to change hours of non-parental care or to purchase higher quality of care will often imply a change of care provider. Thus, we argue that mothers' choice of labor supply and child care realistically can be treated as a discrete choice problem.

Let us go into a more detailed exposition of the model. Let *B* denote the choice set of jobs that are feasible for the mother and *S* the choice set of child care arrangements. Both choice sets are assumed finite. The mother is assumed to choose a job, *k*, from *B*, and child care, *r*, from *S*. All jobs are characterized by fixed hours of work, a wage rate, and a set of non-pecuniary job attributes that are latent to the analyst. Similarly, each child care arrangement is characterized by fixed hours of care, a specific child care fee and a set of (latent) quality attributes.

The household aims at maximizing preferences subject to the budget constraint. Let $U(C_{kr}, H_k, k, r)$ denote the utility of choosing job *k* and child care arrangement *r*, where C_{kr} is consumption/disposable income corresponding to job *k* and child care arrangement *r* and H_k is hours of work in job *k*. It is assumed that preferences can be specified as

$$(1) \qquad U\left(C_{kr}, H_k, k, r\right) = v\left(C_{kr}, H_k\right) + \varepsilon^*\left(C_{kr}, H_k, k, r\right), \; k \in B, \; r \in S,$$

where $v(C_{kr}, H_k)$ is the deterministic part of the utility function and $\varepsilon^*\left(C_{kr}, H_k, k, r\right)$ is a stochastic error term, which is supposed to account for the effects of latent non-pecuniary variables. The analysis assumes a "fixed link" (Ilmakunnas 1997) between hours of work and hours in care, which means that the child needs care for as many hours as the mother works in the market, but this is suppressed in the notation. Note also that "leisure" is assumed to contribute to the well-being of preschoolers since mothers typically spend their time with children when not working in the market.

The consumption corresponding to the choice *k* and *r* is given by the budget constraint

$$(2) \qquad C_{kr} = wH_k + I - Q_r - T\left(wH_k, I, Q_r\right),$$

where *I* is family income other than the mother's own earnings, Q_r is the price of non-maternal child care in choice *r* and *T* is the tax function. The wage rate (*w*) is assumed to be person-specific, but independent of hours of work.

Further, we assume that the alternative-specific error terms, $\varepsilon^*_{kr} \equiv \varepsilon^*\left(C_{kr}, H_k, k, r\right)$, are i.i.d. according to the standard type I extreme value distribution,

$$(3) \qquad P\left(\varepsilon^*_{kr} < x\right) = \exp\left(-\exp(-x)\right), \qquad x \in R.$$

In what follows we divide all child care arrangements into three different modes of care: care at centers $(m=1)$, care by other paid providers $(m=2)$ and own/parental care $(m=3)$. Similarly, the jobs available in the market are divided into groups according to working hours. We distinguish between non-participation $(j=1)$, three types of part-time work, corresponding to 1-16 hours per week $(j=2)$, 17-24 hours per week $(j=3)$, 25-32 hours per week $(j=4)$, and full-time work 32+ hours per week $(j=5)$. Let S_{jm} denote the set of child care arrangements of mode m, $m=1,2,3$, with opening hours in interval j, $j=1,2,...,5$, and let B_j denote the set of jobs with hours of work in interval j.

Table 2 summarizes our categorization of working hours and care alternatives. Note that since we want to elaborate the point that market work for mothers must imply some sort of non-parental care, there is a fixed link between hours of market work and hours of non-parental care for $j>1$. This means that the male is not providing care during the working day.[9] However, we do not exclude the possibility of home-working mothers to employ non-parental care alternatives. Thus, $j=1$ does not imply $m=3$. The combinations $j=1$ and $m=1$ or $m=2$ are found in the data, which means that non-parental care is seen as a sole contributor to child care quality, not only as a means of custody, or, alternatively, home-working mothers consume "real" leisure.

Table 2. Classification of jobs and child care arrangements

	Weekly working hours / weekly child care hours (j)				
Mode of care (m)	0	1-16	17-24	25-32	32+
Day care center	$m=1,\ j=1$	$m=1, j=2$	$m=1,\ j=3$	$m=1,\ j=4$	$m=1,\ j=5$
Other paid care	$m=2,\ j=1$	$m=2,\ j=2$	$m=2,\ j=3$	$m=2,\ j=4$	$m=2,\ j=5$
Parental care	$m=3,\ j=1$	-	-	-	-

It can be demonstrated that (1) and (3) imply that

$$(4) \qquad U^*_{jm} \equiv \max_{k\in B_j, r\in S_{jm}} U\left(C_{kr}, H_k, k, r\right) \overset{d}{=} \log\left(\sum_{k\in B_j}\sum_{r\in S_{jm}} \exp\left(v\left(C_{kr}, H_k\right)\right)\right) + \varepsilon_{jm},$$

[9] As a consequence we only incorporate families with a full-time working male in the estimations. Nevertheless, families that manage to combine two careers with parental care are observed in data. However, it is difficult to find a good representation of the costs involved in such arrangements.

where *d* denotes equality with respect to distribution, and ε_{jm} has the same distributional property as $\varepsilon^*(C_{kr}, H_k, k, r)$.[10] This equation yields the distribution of the preferred job/child care arrangement in hours of work group *j* and child care mode *m*. Moreover, we assume that the following approximation is close:

$$(5) \qquad \frac{1}{n_{jm}} \sum_{k\in B_j} \sum_{r\in S_{jm}} \exp\left(v(C_{kr}, H_k)\right) \approx \exp\left(v\left(\tilde{C}_{jm}, \tilde{H}_j\right)\right),$$

where n_{jm} is the number of opportunities in $B_j \times S_{jm}$, $\tilde{H}_j$ is the average working time in hours of work group *j*, and $\tilde{C}_{jm}$ is consumption, corresponding to working time, $\tilde{H}_j$, and the price of non-parental care, Q_{jm}.

Substituting (5) into equation (4), gives

$$(6) \qquad U^*_{jm} = \log n_{jm} + v\left(\tilde{C}_{jm}, \tilde{H}_j\right) + \varepsilon_{jm}.$$

The term $\log \eta_{jm}$ reflects that the more jobs and child care alternatives there are within hours of work group *j* and child care mode *m*, the larger is the utility of the preferred job/child care arrangement.

In the estimation of the model we employ information from respondents on their access to care at centers. Mothers that report unsuccessful applications for center-based care (about 16 percent of all mothers in the sample) have a more limited choice set, since we assume that they are effectively denied access to care at centers. We also consider that preferences vary across households by introducing a vector of household characteristics characteristics (X_h) in the specification of the preference function.[11] Then it follows from equation (6) that the choice probabilities corresponding to table 2, are given by

$$(7) \qquad P_{hjm} = \frac{\exp\left(v\left(\tilde{C}_{hjm}, \tilde{H}_j, X_h\right) + \log\left(n_{jm}\right)\right)}{\exp\left(v\left(\tilde{C}_{h13}, \tilde{H}_1, X_h\right) + \log n_{13}\right) + \sum_{i=1}^{5} \sum_{l\in\Omega_h} \exp\left(v\left(\tilde{C}_{hil}, \tilde{H}_i, X_h\right) + \log n_{il}\right)},$$

where

$$(8) \qquad \Omega_h = \begin{cases} \{1\} & \text{if household } h \text{ is constrained in the market for care at centers} \\ \{1,2\} & \text{otherwise.} \end{cases}$$

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[10] Dagsvik (2001) discusses this issue.

[11] We ignore that the *v*-function is changed by the introduction of the taste modifier variables (X_h).

P_{hjm} is the probability that household *h* chooses a job with hours of work in group *j* and a child care arrangement in mode *m*.

According to equation (7), there are two types of rationing in this model. Households are rationed in the sense that the number of opportunities in $B_j \times S_{jm}$ (n_{jm}) is finite. As discussed in Section 2, a majority of places at day care centers are full-time places. Similarly, there might be more full-time jobs than part-time jobs, for instance due to economies of scale in production. These market features can be considered in the estimation by letting the number of alternatives vary across groups. In addition they might be rationed in the market for child care at centers because of queues. While the latter type of rationing is observed and the information is employed in the analysis, rationing with respect to variations in n_{jm} is treated as a latent variable.

The empirical specification

The deterministic part of preferences is represented by the following "Box-Cox" type utility function,

$$(9) \qquad v\left(\tilde{C}_{hjm}, \tilde{H}_j\right) \equiv \gamma_0 \frac{\tilde{C}_{hjm}^{\alpha_1} - 1}{\alpha_1} + \frac{\left(1 - \frac{\tilde{H}_j}{M}\right)^{\alpha_2} - 1}{\alpha_2} X_h \beta \cdot$$

See, for instance, Heckman and MaCurdy (1980) and Aaberge, Dagsvik and Strøm (1995) for empirical analyses applying this specification. $M = 8760$ is the total number of annual hours, while γ_0, α_1, α_2 and β are parameters. For the utility function to be quasi-concave, we require $\alpha_1 < 1$, and $\alpha_2 < 1$. Note that if $\alpha_1 \to 0$ and $\alpha_2 \to 0$, the utility function converges to a log-linear function.

Our information on fees families have to pay in the markets for non-parental care is limited to the care alternative actually chosen by the parents. We therefore predict expenses in various states for each family. Several studies of labor supply and child care report that information about care utilization is missing for non-working mothers, cf. e.g. Connelly (1992), Ribar (1995). In our data, information on child care utilization is not dependent on employment status.

The child care fees are considered neither as fixed costs of work (cf. Cogan 1980) nor measured as a flat hourly expense, as in Connelly (1992) and in Michalopoulos, Robins and Garfinkel (1992). The approach here yields child care expenses between these two extremes. Child care expenditures increase with hours of utilization, but at a decreasing rate (as in Ribar 1995). The expenditure (i.e. the log of the expenditure) is explained by the number of children 1-5 years old, hours of care, and dummies for modes of care and region. Table A1 in Appendix 1 provides parameter estimates for the expenditure equation.

Similarly, we observe wages only for the mothers that work in the labor market. In order to predict wages for home-working mothers we employ a wage equation, where $\log(w)$ is explained by years of education, experience (measured as age minus years of education minus preschool years) and experience squared.[12] The results are presented in Table A3 in Appendix 1.

Neither do we observe the number of opportunities in the various states. Based on the distribution in Figure 1 and our hypothesis that there is a fixed link between hours of non-parental care and hours of work, we allow varying number of opportunities across states. It is assumed that the number of possibilities within the groups not working/child care center ($j=1, m=1$), long part-time work/child care center ($j=4, m=1$), full-time work/child care center ($j=5, m=1$) and not working/parental care ($j=1, m=3$) differ relative to the other states. For the other states, the number of possibilities is normalized to one.

Comparing these assumptions with equation (7), we see that the terms $\log n_{jm}$ cancel out for the states with n_{jm} =1 possibilities. For the states with different number of opportunities we estimate n_{jm} by introducing dummy variables in the specification of the likelihood function. The estimate of the parameter of the relevant dummy variable can then be considered as an estimate of $\log n_{jm}$.

Description of data

We apply data from the Home Care Allowance Survey 1998. These data were collected through postal interviews before the reform, and they include detailed information on families' connection to work, use of child care and composition of income. Consumption and hours of work is measured annually, and $\tilde{H}_{jm}/52 \in \{0, 8, 20, 28, 38\}$. Consumption, $\tilde{C}_{hjm}$, is defined by disposable income for each family in each of the 11 possible states, derived by employing a tax-benefit model to calculate taxes in each state. The calculations take into account that child care expenses are deductible, up to a threshold. In effect, it means that the government pays 28 per cent of the expenses (limited by the upper limit).

A number of restrictions were imposed on the data set in order to arrive at the data used in the empirical analyses. First, the analysis is restricted to married or cohabiting parents. The main reason is that single parents are eligible to various means-tested transfers, such as support for child care expenses. Since we only have limited information about these special arrangements, we decided to include only married or cohabiting parents in the analysis.

[12] We have considered the possibility of selectivity bias by the method suggested by Heckman (1979) without finding any significant biases.

Second, the model is estimated for families with a full-time working male. This restriction implies that the child is taken care of by the female when the household does not use non-parental care, i.e. it establishes a fixed link between market work and non-parental care for the mother. Another reason for this restriction is that in many municipalities (about 40 percent) the parental fees for publicly run child care centers depend on gross family income. To establish individual budget constraints when prices are income-dependent is cumbersome, especially because there are numerous fee systems around the country. By restricting the analysis to full-time working partners, the impact of income-dependent prices is reduced, as male income often exceeds the first threshold. Income dependency is usually triggered for family incomes below NOK 250,000 in 1998.

Third, families might employ both modes of non-parental care if they have more than one child. Very few parents mix modes of non-parental care, but we exclude the small number of families that do.

After these restrictions the sample used in the estimation consists of 770 families with pre-school children. Table 3 provides summary statistics. Household disposable income refers to post-tax family income in their chosen state. We see that about 16 percent of the mothers report that they do not are restricted with respect to access to care at centers.

Note that model estimates are derived from a sample of families with preschoolers (1-5 years old), while the model simulations are carried out for families with 1 and 2-year-old children.

Table 3. Summary statistics

Variable	*Mean*	*Standard deviation*
Household disposable income (NOK)	326,200	89,628
Mothers' age	32.3	4.87
Mothers' education (years)	13.9	2.67
Mother's weekly hours of work	26.2	13.9
Mother's gross wage rate (NOK)	102.4	17.7
Dummy variable for rationing in the market for care at centers	0.163	0.37
Participation dummy (participation rate)	0.838	0.37
Dummy for work at home and use of day care center	0.021	0.14
Dummy for part-time work 25-32 hours per week and use of day care center	0.162	0.37
Dummy for full-time work and use of day care center	0.373	0.48
Dummy for work at home and parental care	0.136	0.34

Estimation results

Table 4 reports the maximum likelihood estimates of the parameters in the utility function. Both α_1 and α_2 are less than one, which is needed if preferences are quasi-concave. We have tested numerous taste-modifying variables, but have found significant parameter estimates only for the variable representing the age of mothers (i.e. log of age), β_1, in addition to the constant, β_0. There are reasons to believe that the difficulties finding significant taste-shifters arise from the lack of heterogeneity in this group of females. We see that preferences for leisure increase with age.

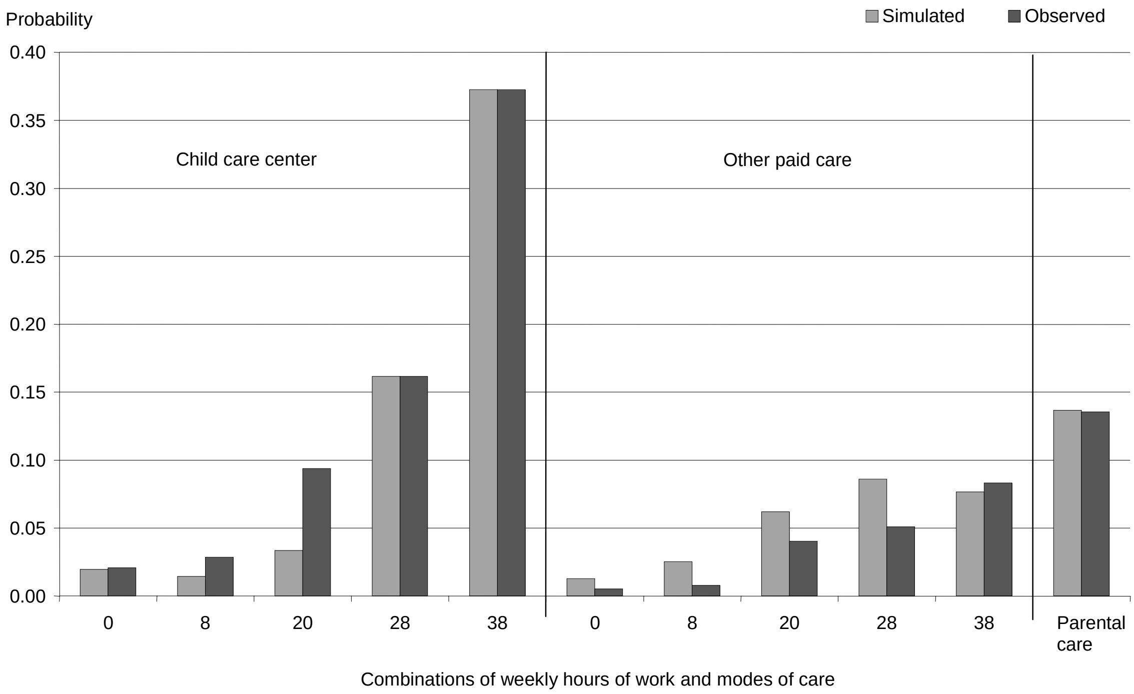
The estimates of $\log n_{11}, \log n_{41}, \log n_{51}$ and $\log n_{13}$, are all statistically significant. As we interpret these parameters as reflecting differences in opportunities across states, the estimates indicate more opportunities in the combination full-time work/child care center $\left(\log n_{51}\right)$ than the combination (long) part-time work/child care center $\left(\log n_{41}\right)$, which is in accordance with expectations. There are about 3 times more opportunities in the full-time alternative, according to parameter estimates. Further, in line with the model reasoning, the dummy for home work also reflects possibilities. We see that there are more opportunities when non-working is combined with own care $\left(\log n_{13}\right)$, relative to the combination non-working and care at center $\left(\log n_{11}\right)$. We interpret this difference as reflecting the exhaustiveness of opportunities in the market for center-based care. Notice, however, that we cannot separate the effect of differences in opportunities across states from the effect on preferences of other latent variables, such as quality attributes related to choices of care. Thus, we cannot rule out that these parameters reflect perceived differences in care quality across states. However, since we assume that parameter estimates are not influenced by the policy changes we study, the results of simulations are not affected by this ambiguity.

Table 4. Estimates of the parameters in the utility function

Variables	*Parameters*	*Estimates*	*t-statistic*
Consumption	γ_0	0.845	1.9
	α_1	0.702	4.8
Leisure	β_0	-4.971	1.9
	β_1	1.914	2.0
	α_2	-9.739	4.2
Home work/child care center opportunity index	$\log n_{11}$	0.927	3.0
Long part-time work/child care center opportunity index	$\log n_{41}$	1.189	10.0
Full-time work/child care center opportunity index	$\log n_{51}$	2.171	15.1
Home work opportunity index	$\log n_{13}$	1.879	11.4

In order to evaluate the model specification, Figure 3 displays the actual frequencies of the different combinations of working time and child care modes and the corresponding probability distribution, based on model simulations. The simulated probabilities are derived by calculating the average probability for each state, based on the individual probabilities from equation (7). Despite the tendency to underestimate the probability of employing care at center for low values of weekly hours of work, the model scores well on this kind of evaluation.

Figure 3. The distribution of observed and simulated choices, 11 states. Families with children 1-5 years old



4. Labor supply responses of the home care allowance reform

Let us consider the labor supply effects of the home care allowance reform, according to this model. The home care allowance reform was introduced for families with 1-year-old children in August 1998 and for 1 and 2-year-old children from 1 January 1999. The short-term labor supply effects have been monitored through various sources of data. The data show that responses from fathers are negligible. A reasonable interpretation of the short-term effect for the mothers in the target group is that the reform brought about a reduction of about 4 000 man-years (Håkonsen et al. 2001).[13] As these mothers supplied about 53 000 man-years before the reform, this result implies a reduction in labor supply of 7-8 percent.

It is well known that people may respond slowly to reforms, so we may well ask if data collected shortly after a reform actually describes the full effect of the policy change. In this perspective, the results from a simulation model based on individuals' preferences will be useful. As discussed in Section 2, the reform introduced drastic changes in the distribution of economic benefits

[13] There are (statistically insignificant) indications in the data that the short-term effect might be somewhat stronger, a reduction around 5–6000 man-years.

of the various alternatives. Choosing states that do not involve care at centers became economically much more advantageous after the reform.

Figure 4 shows the predicted results of the home care allowance reform, when the sample is restricted to families with preschool children aged 1-2, the target group of the reform. As in Figure 3, the probabilities in Figure 4 represent average state probabilities. We see that, in accordance with expectations, there is a substantial reduction in the probability of working full-time and long part-time (28 hours per week) in combination with care at centers. The probabilities for employing other paid caregivers increase for all categories of working hours, and the probability for caring for the preschoolers at home increases substantially. In total, it is predicted that mothers reduce their labor supply by about 16 percent. Converted into man-years, this means that more than 8000 man-years will be withdrawn from market work. Thus, the model simulation predicts stronger (long-term) effects of the reform than the effect seen in data collected shortly after the reform.

Figure 4. Pre-reform and post-reform probabilities. Families with children 1–2 years old

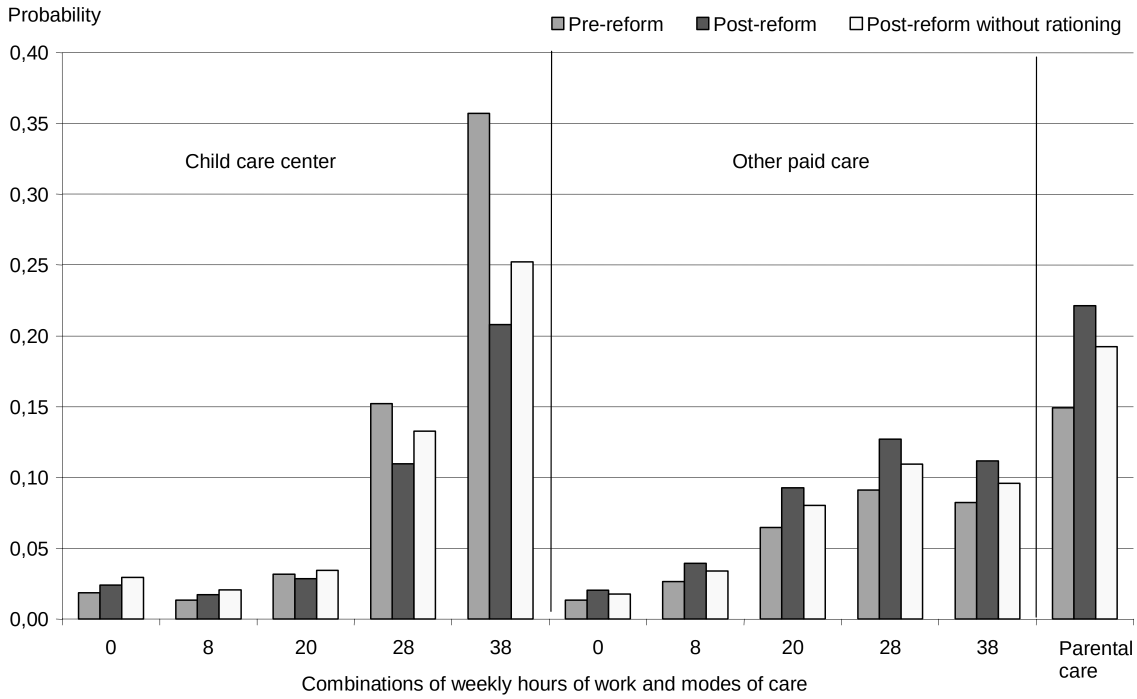


Table 4 also shows the results from a simulation when we have abolished the restriction that some households are rationed in the market for care at centers, cf. equation (8). It can be argued that parents who were denied access to care at centers before the reform will have care at centers included in their choice set after the reform, since total demand for care at centers has been reduced by the reform. Moreover, parallel to the home care allowance reform one has aimed at increasing the number of places at centers, by supporting the establishment of new centers. We doubt that queues at centers have disappeared totally after the reform, but the effect of the reform under the no-rationing assumption should be relevant. The bars in Figure 4 labeled "post-reform without rationing" describe the simultaneous effect of the home care allowance reform and the abolition of rationing. We see that the effect of the reform, as expected, is curbed by the improved access to care at centers. The probability to choose full-time care at centers increases from 0.20 to 0.25, and the reduction in labor supply due to the reform is now less than 12 percent.

5. Comparison with findings in the literature

In order to compare our results with previous studies, we briefly contrast our findings with others' elasticity estimates. As highlighted by the discussion in Kimmel (1998), estimates from various studies are not easily comparable due to differences in specifications and definitions. For instance, Ribar (1992) discusses whether his definition of care costs, expenditures per hour of care utilized per child, impact on the rather strong effect from costs on labor supply that he finds. That the evidence comes from various countries complicates comparisons further, as country-specific factors do generally impact on results.

Of special importance in the interpretation of the elasticity estimates is the effect from rationing with respect to access to care at centers. Gustafsson and Stafford (1992) provide empirical results that indicate a substantial difference in aggregate response measures for rationed and non-rationed households, with the non-rationed much more responsive than the rationed. An explanation for this might be that "those who value the service most are those more likely to clear the rationing hurdle" (Gustafsson and Stafford, p. 214). Our elasticity estimates do not deviate much whether we allow choices to be restricted[14] or if non-rationing is assumed. Thus, with respect to own elasticity estimates, we report the set of results that applies to the current situation, where there is rationing.

In Figure 5 these elasticity estimates are compared with a selection of elasticity estimates found in the literature. Measures for labor supply responses from married mothers to changes in wages, non-labor income and costs of child care are included. We assume that estimates for married mothers are comparable to our own results for married and cohabiting mothers. The presentation is divided into analyses that provide estimates with respect to participation in market work and analyses that focus on effects on (overall) hours of work.

[14] About 16 percent of the mothers report that they are denied access to care at centers.

Our own elasticity estimates are obtained from various simulations, increasing mothers' wage, non-labor income and cost of child care marginally. Non-labor income includes both income from other family members and capital income, while the cost of child care includes both center fees and payments for other paid care alternatives.

Table 5. The effects on labor market participation and hours worked from changes in wages, non-labor income and child care expenses for married mothers. Results reported by elasticity estimates

Labor market decision	Study	Wage	Non-labor income	Cost of child care
Participation	Blau and Robins (1988)[a]			-0.38[a]
	Connelly (1992)			-0.20[b]
	Ribar (1992)			-0.74[b]
	Gustafsson and Stafford (1992)			-0.87[c]
	Ribar (1995)[d]	0.09	-0.18	-0.02
	Powell (1998)	0.85		-0.38
	Kimmel (1998)			-0.92
	Our results	0.44	-0.26	-0.12
Hours worked	Michalopoulos et al. (1992)	0.04	-0.01	
	Averett et al. (1997)[e]	1.6	0.04	-0.78
	Powell (1998)	0.17		-0.32
	Our results	0.59	-0.32	-0.14

[a]This study differs in the sense that it is based on a family labor supply model
[b]Kimmel (1998) replicates Connelly (1992) and Ribar's (1992) studies and finds larger elasticities when changing model specifications, -0.42 and -0.89, respectively.
[c]For all mothers. The measure for non-rationed mothers is -2.68.
[d]Specification (4) in Table 5.
[e]The dual-error term model in Table 6.

Table 5 shows that there is great variation in existing estimates. The child care cost elasticity, which is the most focused measure, varies from -0.02 (Ribar 1995) to -0.92 (Kimmel 1998) with respect to participation, and from -0.32 (Powell 1998) to -0.78 (Averett, Peters and Waldman 1997) with respect to hours worked. Our estimates seem to belong to the "low-response" end of the scale. For a 1 percent increase in child care costs, we predict that the mothers reduce their participation by 0.12 percent, and that hours worked is reduced by 0.14 percent. As already noted, this "inelasticity" might be due to effects of rationing.

We find a wage elasticity with respect to hours worked around 0.6, which is low compared to Averett, Peters and Waldman (1997) on U.S. data, but substantially higher than estimates from the analyses of Canadian data in Powell (1997). However, our estimate for the participation response is lower than Powell's estimate, and higher than estimates in Ribar (1995), based on data from the U.S.[15]

6. Summary

In an era of increased focus on policies to improve work incentives for parents it might be somewhat surprising that one introduces a cash transfer that encourage mothers to withdraw from market work. One main motivation for the reform has been to make it feasible for mothers to spend more time with their young preschoolers at home. Our figures indicate that a non-negligible number of mothers use the new allowance in that manner. It is predicted that mothers' labor supply will be reduced by 16 percent by the home care allowance reform.

We have deliberately renounced to interpret this result in terms of child well-being, gender equality, etc. The main motivation for our work is to present a model that simulates effects of policy changes with respect to families with preschoolers, and to establish that the decision problem can be analyzed as a discrete choice. While discrete choice approaches often seem to be applied for practical reasons, we want to emphasize that both the options in the labor market and possibilities in the markets for care entail characteristics that in fact are discrete.

We argue that a realistic depiction of choices for Norwegian parents needs to take into account that both care and job opportunities are characterized by a number of latent, non-pecuniary attributes in addition to other variables such as wage rates, hours of work, child care fees and hours in care. Since working hours and working activities often are fixed, changing them in many cases will require a job change as well. Similarly, changes in the demand for hours in care or for various care quality attributes will often imply a change of care provider.

[15] Note that specification (3) in Table 5 in Ribar (1995) provides a higher wage elasticity estimate, 0.38.

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Predicted child care costs and predicted wages

Table A1 provides parameter estimates for the child care expenditure equation. The logarithm of the expenditure is explained by the number of children 1-5 years old, hours of care, and dummies for modes of care and region.

Table A1. Estimation results for the child care expenditure function

Variables	*Estimates*	*t-statistic*
Modes of care; Child care center = 1, other paid care = 0	0.165	5.2
Area; 1 = Oslo/Akershus, 0 = rest of the country	0.173	4.9
Hours in care	0.013	10.3
Number of children, 1-5 years	0.456	12.5
Constant	6.798	112.6

Table A2 shows how predicted monthly child care expenses for a family in the Oslo-area in 1998 depends on number of children, utilization and modes of care. The figures reflect the discounts available to families with more than one preschool child. The figure for full-time parental pay at day care centers is close to the (fixed) full-time rate at centers owned by the municipalities in 1998.

Table A2. Predicted monthly parental pay for a family with one or two preschool children in the Oslo-area in 1998, for center-based care and other paid care

Number of children	*Mode of care*	*Part-time care (20 hours per week)*	*Full-time care (38 hours per week)*
One child	Child care center	2,600	3,200
	Other paid care	2,200	2,700
Two children	Child care center	4,000	5,100
	Other paid care	3,400	4,300

Table A3 shows the estimates of the wage equation. log(w) is explained by years of education, experience (measured as age minus years of education minus preschool years) and experience squared.

Table A3. Estimation results for wage regression model

Variables	*Estimates*	*t-statistic*
Education	0.060	11.8
Experience	0.075	6.3
Experience squared	-0.002	4.7
Constant	3.221	28.4