Child Care Costs and Mothers' Labor Supply: An Empirical Analysis for Germany

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Abstract: This study analyzes the effect of child care costs on the labor supply of mothers with preschool children in Germany using data from the German Socio-Economic Panel (2002). Child care costs are estimated on the basis of a sample selection model. A structural household utility model, which is embedded in a detailed tax-benefit model, is used for labor supply estimation. In contrast to a previous German study, I find significant effects of child care costs on mother's labor supply. Compared to other countries such as the US, Canada or the UK, the effects are rather small, which can be explained by the fact that child care costs are already heavily subsidized in Germany.

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1 Introduction

The purpose of this study is to shed some light on the effect of child care costs on the labor supply decisions of women with preschool children in Germany. Since policy makers in Germany recently have been emphasizing the importance of child care policies (see, e.g. German Ministry of Families, Seniors, Women and Youth - BMFSFJ 2003), the findings of this study can contribute to the on-going policy debate in Germany.

Compared to other countries, the child care policy in Germany is rather peculiar: On the one hand, child care facilities are highly subsidized, and the share of the costs that parents have to bear is rather small, lying between zero and thirty percent. On the other hand, availability of child care places is relatively limited compared to other European countries, especially in west Germany[1]. In east Germany, where the labor force participation of women is traditionally higher than in the west, availability and utilization of child care is comparable to other countries, such as Finland or France.

From a theoretical point of view, the impact of child care costs on labor supply of mothers is clear-cut: Since child care costs increase the mother's reservation wage, child care costs imply a lower labor force participation of women with small children. This result has also been found in a large number of empirical studies for the US, Canada and the UK. No matter what methodological approach is being used, all studies find a negative impact of child care costs on labor force participation of mothers. For the case of Germany, there is so far only one study on the relationship between maternal employment and child care costs (Merkle 1994). Using data from the German Socio-Economic Panel (GSOEP), wave 1987, Merkle does not find a significant effect of child care costs on maternal labor force participation.

My study aims at analyzing the relationship between child care costs and employment behavior of mothers[2] in Germany on the basis of data from the most recent wave of the GSOEP (2002). I follow the approach most widely used in the literature and estimate child care costs on the basis of a selection model. However, in contrast to most studies, which estimate labor force participation probits only, I will estimate mothers' labor supply on the basis of a structural household utility model embedded in a detailed tax-benefit microsimulation model. Estimation technique is discrete choice which, in combination with the tax-benefit model, makes it possible to account for the highly non-linear budget

[1] In a brochure of the German Ministry of Families, Seniors, Women and Youth, it is stated that as far as availability of child care facilities for preschool children is concerned, west Germany has a "structural lag" of 10 to 15 years compared to other European countries (BMFSFJ 2003).

[2] An explanatory note on the focus of the analysis, namely the mothers' instead of the parents' labor supply decisions might be appropriate: According to a study by Friedl and Kannicht (1997) about child care patterns in Germany, mothers still bear the major part of time and responsibility of education and care of children.

constraints faced by German households due to the tax and benefit system. This approach allows me to identify effects of child care costs on labor force participation *and* working hours decision of mothers with preschool children. I will capture the labor supply effects of child care costs by two measures – the participation and hours elasticities with respect to a one percentage change in the costs of child care and the labor supply changes that result from a policy simulation which gives a hundred percent subsidy on formal child care expenditures to all households with preschool children.

In contrast to the previous German study by Merkle (1994), I do find a significant effect of child care costs on the labor supply of mothers. The labor supply elasticities with respect to a one percentage increase in the hourly price of child care are small (participation declines by 0.01 to 0.03 precentage points and hours decline by 0.03 to 0.09 percent, varying by region) though significant. Simulations show that in case of a hundred percent subsidy of child care costs, participation rate of women with preschool children would rise by 3 percentage points in west and 1.5 in east Germany. Total working hours in that case would rise by about 3.5 percent in east and by 9 percent in west Germany.

2 Institutional Background and Some Stylized Facts

Patterns of availability and utilization of child care facilities differ significantly in east and west Germany. While in east Germany utilization of child care facility is traditionally high, the share of preschool children in child care facilities in west Germany is among the lowest of all countries of the European Union (see tables 1 and 2). The difference in child care utilization between east and west Germany is particularly striking for children under the age of three. In 1998, there were only 2.8 child care places available per hundred children under the age of three in west Germany – compared to the east, where there were 36.3 places per hundred children of the same age group. For children between three and school age (usually six years), part-time care is available in all parts of Germany (86.8 places for hundred children in the west, 111.8[3] in the east). Since 1996, parents even have a legal claim for part-time care for each child between 3 and 6. However, availability of full-time care facilities is limited in most parts of western Germany (of all child care places for children in this age group, only 18.8 percent are full-time care places in west Germany; in east Germany, this percentage is as high as 97.7 percent).

[3] Due to the sharp decline in the fertility rate in east Germany after 1989/90, there is considerable excess supply of child care facilities in some regions (see DJI 2002).

Table 1: Share of children attending child care facilities in countries of the European Union (in percent)

	Children aged 0-3	Children aged 4-6
Austria**	3	75
Belgium*	27	95
Denmark**	48	82
Germany**	6	91
Finland**	21	53
France*	23	99
Great Britain*	2	60
Greece*	2	64
Ireland*	2	55
Italy***	6	91
Luxembourg***	6	91
Netherlands*	8	71
Portugal*	12	48
Spain*	2	84
Sweden**	33	72

Source: BMUJF (Österreichisches Bundesministerium f. Umwelt, Jugend, und Famile) 1999.
* Data from the year 1993
** Data from the year 1994
*** Data from the year 1991

Table 2: Availability* of child care facilities in Germany by age group and region

Age Group	Year	east Germany	west Germany
0 - 3	1990	54.2	1.8
	1994	41.6	2.2
	1998	36.3	2.8
4 - 6	1990	114.3	78.3
	1994	96.2	73.0
	1998	111.8	86.8

Source: DJI (Deutsches Jugendinstitut) 2002.
*Definition of availability according to DJI: Places in child care facilities per 100 children.

Most carriers of child care facilities in Germany are either the communities themselves or private (mostly confessional) institutions that are highly subsidized by communities (according to the Statistisches Bundesamt, total subsidies of child care facilities were as high as 10.4 billion Euro in 2001). All carriers, either public or private, can - within certain limits - decide autonomously about the fees they charge. There are regulations, however, which force child care facility carriers to charge fees according to the parents' income. Further, costs also depend on the number of children from one family in the same facility (siblings' reduction). On average, parents' fees amount to between zero to 30 percent of the total costs of child care facilities (DJI 2002). As a comparison, in the US the share of total child care costs that has to be borne by the parents amounts to 70 percent (Blau 2003).

In the German Socio-Economic Panel (GSOEP)[4], which is the databasis for this analysis, there are questions on the monthly expenses on child care for each child in the household. There is also information on utilization, type and hours of child care for each child per household. Expenses are reported for formal child care facilities and for paid nannies who look after the children on a regular basis. GSOEP data show that for children under the age of three, parents pay about 70 € per month for part-time care in the east and about 110 € in the west. For full time care, average monthly fees lie between 100 and 220 €. For children above three years, child care is much cheaper: for this age group, parents pay about 65 € on average for part-time care and about 100 € for full-time care.

Table 3: Average monthly child care expenses by child (in € per month)

	Part-time care		Full-time care	
Age	east	West	East	West
0-3	72	110	100	218
4 - 6	55	67	88	103

Source: GSOEP, wave 2002.

Traditionally, the link between mothers' employment and the use of child care (at least part-time care for pre-schoolers) is not very strong in west Germany. According to the GSOEP, in west Germany about 50% of all children in part-time care facilities have mothers who are not employed and are not engaged in education or training (see table 4). Part-time care is seen as preschool education, not so much as a means to provide the possibilities for mothers to work. Further, since part-time care facilities do not provide enough hours of care, mothers often have to rely on informal child care arrangements (either relying on paid babysitters or unpaid care by relatives) even to be able to take up a part-time job. (For utilization patterns of informal, unpaid care arrangements see table 5.) Because of these (west) German institutional peculiarities, in particular the combination of low availability of child care facilities and the low (since highly subsidized) price of child care, it has been argued, that it is not so much the costs of child care but the availability that influences mothers' employment behavior (e.g. Kreyenfeld and Hank 1999, Spieß and Büchel 2003)[5].

[4] For detailed information of the German Socio-Economic Panel see (Haisken-DeNew and Frick 2001).

[5] There are some studies on the impact of availability of child care facilities on maternal employment, however, they report different results. While Kreyenfeld and Hank (1999) do not find a significant effect of availability of child care on maternal employment, the study by Spieß and Büchel (2003) shows that there is a significant effect for mothers with children aged three to six in west Germany.

Table 4: Employment status of mother and age of child / "child care status" of child, by age group and region (in percent)

	Age of child 0 - 3		Age of child 4 - 6			
	East	West	East	West		
Full-time employment	24	8	30	10		
Part-time employment	17	18	26	30		
Marginal employment	5	11	3	10		
Education/Training	2	0	2	1		
Not employed	53	66	38	49		
Sum	100	100	100	100		
	Child not in child care facility		Child in part-time care		Child in full-time care	
	East	West	East	West	East	West
Full-time employment	8	4	20	7	41	25
Part-time employment	3	14	23	32	30	38
Marginal employment	3	11	7	11	2	7
Education/Training	0	0	5	0	1	2
Not employed	86	71	45	50	25	28
Sum	100	100	100	100	100	100

Source: GSOEP, wave 2002.

Table 5: Utilization of informal care arrangements by age of child / mother's employment status (in perccent)

	Care by relatives*		Care by friends*	
Age of child	East	West	East	West
0 – 3	40	30	6	5
4 – 6	44	35	9	9
Employment status of mother				
Full-time employment	47	44	4	13
Part-time employment	46	45	14	11
Marginal employment	80	34	10	6
Education/Training	20	1	0	0
Not employed	36	25	8	6

Source: GSOEP, wave 2002.

* Both categories possible. Question in the questionnaire: *"Are there additionally (to the utilization of child care facilities and paid nannies) other persons outside the household who regularly watch or take care of your children?"* Unfortunately, there is no information on hours and frequency of these care arrangements in the GSOEP.

3 Literature Review

A large body of literature deals with the question of whether and how much child care costs influence mothers' labor supply in various countries (for a detailed literature review see Anderson and Levine 1999, or Viitanen 2004a). The vast majority of the literature is about the US (see, among others Connelly 1992, Ribar 1992 and 1995, Anderson and Levine 1999), Canada (see Cleveland et.al. 1996, or Powell 1997) and the UK (see, e.g., Viitanen 2004a). The different methodological approaches vary with respect to (i) the variation in the costs of child care and (ii) the modeling of labor supply. The variation in child care costs is either captured by the variation in prices of child care facilities by region or by making use of the differences in child care expenses across households. In the latter case, child care costs have to be predicted for households who are not using child care. This problem is similar to the one of prediction of wage rates for people who are not employed in a labor supply estimation. However, in the case of child care costs, the underlying selection problem is even more complicated than in the case of wages: Child care costs are only observed for households who use formal child care, and the decision of utilization of child care is strongly related to the mother's employment decision. Therefore, the method used in most studies is to estimate a bivariate probit model on the probability of the mother being employed and the probability of the utilization of child care. On the basis of these probit models, inverse Mill's ratios are calculated and used as regressors in an OLS regression on child care costs based on the selected sample only. The labor supply decision is modeled as a binary choice labor force participation estimation in most studies. There are a few studies that estimate a structural model (Ribar 1995, Michalopoulos et.al. 1992). In these cases, the parameters of a utility function (based on assumptions of functional forms) are estimated.[6]

No matter what methodology employed, all studies using data from North America and the UK find a negative impact of child care costs on maternal employment. However, the size of this effect varies widely: the reported employment elasticities of mothers with respect to a change in child care costs lie between just above zero and almost one. As Anderson and Levine (1999) point out in their literature review, the studies using structural models to estimate the effects report lower elasticities than the others.

For Germany, the only study on the relationship between child care costs and maternal labor supply that employs a similar approach to the above-cited studies is by

[6] In addition, there are some studies that analyze the effect of child care costs on mothers' labor supply by evaluating the outcomes of "natural experiments" (see for example Viitanen 2004b). These studies employ a methodological approach that makes use of an exogenous policy shift affecting only one group of households.

Merkle (1994). She uses data from the German Socio-Economic Panel from the year 1987, where monthly child care expenses were reported by households for each child. She estimates monthly child care prices using different specifications and various sample selection models. Labor supply is estimated by a probit model on participation status and by a bivariate probit on utilization of formal child care and participation status. Merkle does not find a significant effect of child care costs on the participation decision of mothers with children aged three to eight[7]. She tries to explain this result with the peculiar child care situation in Germany, where opening hours of child care facilities are not long and flexible enough to meet the demands of working mothers. Therefore, she concludes that participation depends primarily on the availability of informal caregivers as a complement to the possibilities of formal child care, and not so much on the price of the latter.

4 Econometric Methodology

In this section, I will describe my approach of estimating labor supply of women and identifying the participation and hours elasticities with respect to changes in child care costs. After the description of the labor supply model I will outline the econometric methodology of estimating child care costs, taking into account some peculiarities of the German situation. Unfortunately, I can only evaluate the labor supply effects of mothers living in (married or unmarried) couples, since there are not enough observations of single mothers with preschool children.

4.1 Specification of the Labor Supply Model

Following the approach introduced by van Soest (1995), labor supply of women is modeled in the household context according to the household utility model. This model is based on the assumption that both spouses jointly maximize a utility function in the arguments of leisure of both spouses and net household income. Hours of work are assumed to be a categorical rather than a metric variable. This form of modeling takes into account the fact that hours of work are heavily concentrated at particular hours. The most important reason for this kind of modeling, however, is that the specification of a relatively small number of hours categories leads to a substantial reduction in computational burden, as the budget set of a household has to be computed for a few selected points only. Therefore, this simplification is in fact a prerequisite for an adequate specification of the budget constraints given the complexities of the German tax-benefit system. This is of special importance for

[7] In one specification, Merkle does actually find a significant effect of child care costs on mother's labor force participation, but the sign of coefficient is positive.

the purpose of female labor supply, since the joint income taxation of married couples may result in high marginal tax rates for women from low working hours on, and therefore labor supply estimations that base on net wages only might lead to biased results.

In the style of van Soest (1995) and Steiner (2000), I specify a household utility function depending on the leisure time of the household members and net household income. It is assumed that the household's utility index for a particular hours category k can be modelled by the following translog function:

$$(1) \qquad U_k(x_k) = x_k' A x_k + \beta' x_k + \varepsilon_k$$

where $x = (y, lm, lf)'$. The components of x are the natural logs of net household income (y), leisure of the husband (l_m) and leisure of the wife (l_f). These components enter the utility function in linear, quadratic and cross terms. The matrix A, with elements α_{ij}, $i,j = (1,2,3)$, contains the coefficient of the quadratic and the cross terms, the vector β_j, $j = (1,2,3)$, the coefficients of the linear terms. ε_k is a stochastic error term accounting for unobserved factors that affect household utility, its distribution is specified below.

Given the assumption of joint maximization of household utility, the household will choose hours category k if, in probability terms, the associated utility index, U_k, exceeds the utility index in any other possible alternative l, i.e.:

$$(2) \qquad P(U_k > U_l) = P\left[\left(x_k' A x_k + \beta' x_k\right) - \left(x_l' A x_l + \beta' x_l\right) > \varepsilon_l - \varepsilon_k\right].$$

Assuming that ε_k is distributed identically across all hours categories according to an extreme-value distribution[8], the difference of the utility index between any two hours categories follows a logistic distribution. Under this distributional assumption the probability of choosing alternative k relative to alternative l can be described by a Conditional Logit Model as introduced by McFadden (1973):

$$(3) \qquad P(U_k > U_l) = \frac{\exp(x_k' A x_k + \beta' x_k)}{\sum_m \exp(x_m' A x_m + \beta' x_m)}, \forall l \neq k,$$

[8] The assumption that the error terms follow an extreme value distribution is rather restrictive and results in the property of the independence of irrelevant alternatives. Random coefficient models, as opposed to the conditional logit model used here, allow for unobserved heterogeneity and therefore circumvent this 'IIA-assumption'. However, Haan (2003), who estimated several labor supply models with the same data set I do, showed that the results (in terms of labor supply elasticities) from a random coefficient model do not differ significantly from the results obtained from a conditional logit model.

where the summation sign is defined over all possible alternatives, i.e. hours categories. I control for observed heterogeneity by accounting for household characteristics such as age and health status of both spouses, number and age of children in the household, regional and nationality variables. Because variables with no variation across alternatives drop out of the estimation in the conditional logit model, the household-specific variables are interacted with household income and leisure times, which vary across hours categories.

4.2 Data and Variables

As already mentioned above, estimation of the labor supply model is based on data from the most recent wave (year 2002) of the German Socio-Economic Panel (GSOEP). The GSOEP is a representative sample of private households living in Germany with detailed information on household incomes, working hours and household structure. Although I am only interested in the labor supply behavior of households with children under the age of six years, I estimate the parameters of the utility function based on a sample of all households. However, I restrict the sample to heads of the households and spouses who are between 25 and 60 years old, who are not pensioners and not in any sort of schooling, training or university any more. Also self-employed people and civil servants are excluded, since these groups might differ in their labor supply behavior.

Hours Categories

In the GSOEP, information on the number of weekly hours actually worked (thus including overtime) in the month before the interview is given. The definition of the hours categories is motivated by both, economic considerations and the actual distribution of hours in the sample. Although a relatively fine aggregation of hours into categories seems desirable in order to realistically approximate the household's budget constraint, the actual distribution of hours in the previously defined sample severely restricts the number of possible categories. In particular, men in the restricted sample typically do not work part-time and their actual working hours are heavily concentrated between 35 and 40 hours per week. However, for women I allow for six hours categories: non-employment, three part-time categories, full time and overtime[9]. Table 6 shows the distribution of households across hours categories.

The specification of the econometric model is based on the assumption that each household compares the expected utility obtained from net income and two spouses' leisure associated with the choice of a particular hours category. Here, it is assumed that this

[9] As a sensitivity check, I have also run an estimation based on five hours categories for women, which did not lead to significantly differing results.

comparison is based on the average number of hours worked in a particular hours category, where leisure is calculated by subtracting the working hours from an assumed total time budget of 80 hours per week.

Table 6: Distribution of couple households among hours categories

<table>
<tr><td></td><td></td><td colspan="4">Men</td></tr>
<tr><td rowspan="9">Women</td><td>Weekly Hours*</td><td>0</td><td>1-40 (37)</td><td>> 40 (48)</td><td>Sum</td></tr>
<tr><td>0</td><td>200 (5.7)**</td><td>526 (14.9)</td><td>409 (11.6)</td><td>1135 (32.2)</td></tr>
<tr><td>1-12 (8.5)</td><td rowspan="3">88 (2.5)</td><td>211 (6.0)</td><td>131 (3.7)</td><td rowspan="3">1328 (37.6)</td></tr>
<tr><td>13-20 (18)</td><td>239 (6.8)</td><td>159 (4.5)</td></tr>
<tr><td>21-34 (27)</td><td>294 (8.3)</td><td>206 (5.8)</td></tr>
<tr><td>35-40 (38.5)</td><td rowspan="2">108 (3.1)</td><td>490 (13.9)</td><td>250 (7.1)</td><td rowspan="2">1074 (30.5)</td></tr>
<tr><td>>40 (45)</td><td>101 (2.9)</td><td>125 (3.5)</td></tr>
<tr><td>Sum</td><td>396 (11.3)</td><td>1861 (52.8)</td><td>1280 (36.2)</td><td>3537</td></tr>
</table>

* Average of weekly working hours in parentheses.
** Relative share in parentheses.
Source: GSOEP, wave 2002.

Net Household Income

Net household incomes for all hours categories are calculated by applying a detailed tax-benefit simulation model, which contains the main features of the German tax, and transfer system[10]. The calculation of taxable income is based on information on earnings from dependent employment, income from capital, property rents and other income. For most households, earnings from dependent employment is the most important source of income. These earnings are calculated by multiplying gross hourly wages by the respective working hours in each hours category. For non-working individuals, wages are estimated by applying a two-stage estimation with a Heckman (1979) sample selection correction[11]. Estimation results for the wage equations are available from the author upon request.

Gross household income is calculated by adding all income components of all household members (weekly working hours are only varied by category for the head of the household and the spouse). Taxable income is calculated by deducting certain expenses from gross household income. The income tax is computed by applying the income tax formula to taxable income of each person in the household or of the spouses' joint income, depending on marital status. Then, the income tax and employee's social security contribution rates are deducted from gross income, and social transfers are added to get net household income. Social transfers include child benefits / allowances, child-rearing

[10] The same microsimulation model has already been used in, among others, Steiner 2000 and Steiner and Wrohlich 2003 and 2004. A detailed description of the model can be obtained from the author upon request.
[11] In order to increase the variance of predicted wages to make it comparable to that of observed wages, I adjust the predicted wages by adding the normalized error term distribution of the regression of the observed wages.

benefits, education benefits for students (BAfoeG), unemployment compensation, housing benefits and social assistance.

Child care costs also enter the model through the net household income variable. Hourly child care costs (in case of more than one child under six years: the sum of all hourly child care costs) are subtracted from the simulated net household income in each hours category according to the working hours of the mother. However, child care costs are not subtracted linearly increasing with working hours of the mother: I assume that less than part-time care (that is, a minimum of 3.5 hours per day) cannot be purchased for a child, thereby implementing a fixed costs part of child care costs. In the following section, I will describe what measure of child care costs is deducted from simulated net household income.

4.3 Estimating Child Care Costs

The information on child care expenses for child care facilities such as kindergartens or crèches and paid nannies are available in the GSOEP on a monthly basis. Further, there is information on whether the child is in a facility or cared for by a nanny part-time (with or without lunch) or full-time. To get an approximation for hourly child care costs, I divide the monthly expenses by 21.5 (average weekdays per month) and by 3.5 if the child is reported to be in part-time care without lunch, 5 if the child is in part-time care with lunch and 8 if the child is in full-time care.

For the estimation of child care costs, I follow an approach widely used in the literature: Hourly child care costs are estimated on the basis of a regression model corrected for sample selection bias. The selection bias might appear because child care costs are only observed for households who use formal child care. Selection into this sample might not be completely random, since households using formal child care might have access to cheaper child care due to unobservable characteristics. Therefore, the regression of child care costs has to be corrected for this possible sample selection bias. It should be mentioned at this point, that most studies using North-American or UK data employ a double selection model. Most authors argue that child care costs are only observed for households where the mother is employed. Therefore, in addition to the selection regarding utilization, also the selection regarding employment of the mother should be controlled for. In Germany, however, the link between utilization and employment is not very strong, especially not for children between three and six years[12]. Thus, for the case of Germany, I model the equation that determines selection into the sample of the children using formal child care as follows:

[12] As a control, I also run labor supply estimations including estimated child care costs based on a double selection model. The labor supply effects do not differ significantly.

(4) $Z_i = W_i'\gamma + u_i$ where $Z_i = 1$ if the child is in formal child care and $Z_i = 0$ otherwise.

The subscript *i* represents a child, the vector W_i contains the explaining variables such as age of the child, number of siblings in different age groups, household income other than the mother's wage income, the mother's education and health status, other adult in household, other female adult, other unemployed adult, a dummy variable if the mother is not German and a set of regional variables. u_i captures unobservable characteristics. The equation of interest, namely the hourly price of child care (Y_i), is given in equation (5):

(5) $Y_i = X_i'\beta + \varepsilon_i$

where X_i contains the determinants of the hourly child care price, including the age of the child, number of children in the household under the age of three, number of children per household between three and six years, net household income, mother's years of schooling as well as regional variables. The sample rule says that Y_i is only observed if $Z_i = 1$. The error terms u_i and ε_i follow a bivariate normal distribution with means 0 and covariance ρ. The expected value of hourly child care costs, given utilization of child care, is

(6) $$E[Y_i \mid Z_i = 1] = E[Y_i \mid u_i > -W_i'\gamma\ ] = X_i'\beta + \beta_\lambda \lambda_{1i},$$

where λ_{1i} is the inverse Mill's ratio,

(7) $$\lambda_{1i} = \frac{\phi(W_i'\gamma)}{\Phi(W_i'\gamma)},$$

$\phi(.)$ being the normal probability density function and $\Phi(.)$ the normal cumulative distribution function. Estimation could therefore be based on the two-step procedure introduced by Heckman (1979), where equation (4) is estimated by probit and equation (5) with OLS. The exclusion restrictions which identify equation (5) are number of siblings aged 6-10 and number of siblings aged 10-14, number of siblings older than 14, health status and of the mother, presence of another female adult in the household, presence of another unemployed adult in the household as well as a dummy if the mother is not German. These variables are assumed to influence the probability of utilization of formal child care but not the amount of the hourly costs of child care.

Since a considerable share (about 10 percent) of households using formal child care do not have to pay for it, i.e. face zero costs, estimation of equation (5) with OLS might lead to negative predictions. Therefore, equation (5) will be estimated with a Tobit model. The expected value of Y_i (hourly child care costs) has to be rewritten as:

(8) $$E[Y_i \mid X_i] = \Phi\left(\frac{X_i'\beta}{\sigma}\right) \cdot \left(X_i'\beta + \sigma\lambda_{2i}\right),$$

where X_i contains the variables from equation (5) and the inverse Mill's ratio λ_{1i} from equation (7). σ is the standard error from the linear part of the likelihood function and λ_{2i} is the inverse Mill's Ratio from the Tobit estimation, namely

(9) $$\lambda_{2i} = \frac{\phi\left(\frac{X_i'\beta}{\sigma}\right)}{\Phi\left(\frac{X_i'\beta}{\sigma}\right)}.$$

5 Estimation Results

In this section, I will first report the results from the child care costs estimation and then the results from the labor supply estimation, i.e. the labor supply elasticities with respect to a one percentage change of the gross wage rate and a one percentage change of the hourly cost of child care. Finally, I will also report the labor supply effects of a policy simulation that would set all private child care costs at zero.

5.1 Results of the Child Care Cost Estimation

Table 7 shows the results from the probit estimation of the selection model. Significant predictors of mother's labor force participation are the age of the child, the number of children according to different age groups, presence of an unemployed adult (other than the mother) in the household, the mother's years of schooling and the regional dummy variables. Since the Laender of east Germany (including Berlin) are the base category, the negative coefficients of the regional dummy variables indicate that in most Laender of the west, utilization of formal child care is lower than in the east.

Table 7: Results of the selection equation

	Probability (Utilization=1)	
Variables	*Coefficient*	*Standard Error*
age of child	0.7552**	0.04925
# children <3	-0.2975**	0.1272
# children 3-6	0.1538	0.1282
# children 6-10	-0.3146**	0.1239
# children 10-14	-0.3116*	0.1696
# children > 14	-0.0133	0.0910
other income[†]	-0.0294*	0.0162
other female adult in hh	-0.3514	0.4496
other unemployed adult in hh	-0.4013*	0.2346
age of mother	0.0206*	0.0114
mother's years of schooling	0.0618**	0.0205
mother not German	-0.0878	0.1286
mother's health status	-0.0046	0.0051
size of city[+]	0.1090	0.0740
region1 ("north-west") [++]	-1.3386**	0.4202
region2 ("middle-west") [++]	-0.8058**	0.3858
region3 ("south-west") [++]	-0.5043	0.3558
region1*size [+, ++]	-0.0114	0.0959
region2*size[+, ++]	-0.8650	0.0916
region3*size[+, ++]	-0.1561*	0.0890
constant	-3.0376**	0.4884
Number of observations: 1345		
Pseudo $R^2 = 0.47$		

* indicates significance at 10% significance level
** indicates significance at 5% significance level
[†] Other income was divided by thousand.
[+] The variable size of city is a categorial variable that takes on values 1 to 7.
[++] The regional dummy variables are defined as follows:
Region1: Schleswig-Holstein, Hamburg, Niedersachsen and Bremen
Region2: Nordrhein-Westfalen, Hessen and Rheinland-Pfalz
Region4: Bayern and Baden-Württemberg,
leaving all Laender of the former GDR and Berlin as base category.

In the Tobit estimation of hourly child care costs, the number of children between 3 and 6, net household income, the size of the city and some of the regional variables are significant predictors. The negative coefficient of the number of children between 3 and 6 reflects the fact that most facilities give a discount when more than one child from the same household are in one facility. The positive sign of the coefficient of net household income indicates that the facilities charge fees depending on parents' income[13]. Also mother's years of schooling have a positive significant effect of hourly child care expenses. This effect can be explained by the fact that better educated women tend to demand child care of higher quality. The selection correction term (lambda) is not significant.

[13] I employed a Durbin-Hausman-Wu Test on endogeneity of the income variable. A simulated hypothetical income variable, where working hours are held constant over all households, was used as instrument. On the basis of this test, I could not find evidence for endogeneity of the income variable.

Table 8: Results of the child care cost estimation (Tobit)

Dependend variable: hourly expenditure on child care (per child)		
Variables	*Coefficient*	*Standard Error*
age of child	-0.0468	0.0351
# children under 3	-0.0656*	0.0378
# children 3-6	-0.2402**	0.0426
mother's years of schooling	0.0350**	0.0081
net household income†	0.0803**	0.0126
size of city	-0.0419*	0.0231
region1	-0.5862**	0.1446
region2	-0.0032	0.1208
region3	-0.0041	0.1149
region1*size	-0.0129	0.0320
region2*size	0.0731**	0.0299
region3*size	0.0572*	0.0316
lambda	-0.1235	0.1110
constant	0.4815*	0.2591
sigma	0.5058	
Number of observations: 771 64 left-censored at child care costs = 0 707 unscensored		
Pseudo $R^2 = 0.13$		

* indicates significance at 10% significance level
** indicates significance at 5% significance level
† Net household income was divided by thousand.

Table 9: Average actual and predicted values of child care costs* by hours categories and region (in € per month)

	East		West	
Hours category	**Actual**	**Predicted**	**Actual**	**Predicted**
Couple Households				
0/0**	0	0	17	0
0/19	38	55	29	83
0/40	104	109	33	165
37/0	0	0	36	0
37/8.5	46	48	50	72
37/18	47	55	76	83
37/27	91	82	123	124
37/38.5	106	109	107	166
37/45	209	123	137	186
47/0	0	0	40	0
47/8.5	43	48	72	72
47/18	72	55	71	83
47/27	67	82	107	124
47/38.5	125	109	194	166
47/45	146	123	110	186

* Sum of all (monthly) child care costs for children under the age of six per household
** First number refers to working hours of the father, second number to hours of the mother.

As outlined in section 4.2, the predicted values of hourly child care costs are multiplied by 21.5 (average workdays per month) and by daily working hours of the mother to get predicted monthly child care costs, which are then subtracted from net household income. Table 9 shows the average predicted and actual values of monthly child care costs over all households with children under 6, by hours category.

5.2 Results from the Structural Labor Supply Model

The conditional logit labor supply estimation is based on the whole sample of couple households described in section 4.2. Estimation results in terms of coefficients of the household utility function are reported in the appendix. The labor supply elasticities with respect to a one percent wage increase are within the range that is also reported by other studies (see Steiner 2000). According to my estimation, the participation rate of women in couple households would rise by 0.13 percentage points in the west and by 0.09 percentage points in the east. The hours elasticities with respect to a one percentage change in the gross wage lie in the range 0.21 and 0.38, depending on region. Looking at the group of women with preschool children, the labor supply elasticities lie above the average of all women, however, these differences are not statistically significant. It might be interesting to note that the labor supply elasticities obtained from the above-described household utility model do not differ significantly from the elasticities obtained by an estimation of the same model without taking into account child care costs (see Steiner and Wrohlich 2004).

Table 10: Labor supply elasticities with respect to a one percentage increase in the wage rate

	Women in Couple Households	
	East	West
	Participation Elasticities (in percentage points)	
All women	0.09 (0.06 – 0.11)	0.13 (0.11 – 0.16)
Women with children under 6	0.12 (0.08 – 0.16)	0.13 (0.10 – 0.15)
	Hours Elasticities (in percent)	
All women	0.21 (0.14 – 0.27)	0.38 (0.31 – 0.44)
Women with children under 6	0.32 (0.21 – 0.42)	0.45 (0.37 – 0.53)

Numbers in parentheses refer to bootstrap confidence intervals (100 repetitions).

The impact of child care costs on mothers labor supply can be captured by the labor supply elasticities with respect to a one percentage change in the hourly price of child care. The results of this simulation are reported in table 11. The effects are rather small, though significant: In case of a one percent increase in the hourly cost of child care, labor force participation of mothers with preschool children would decrease by 0.02 to 0.03 percentage points. Total working hours would decrease by 0.04 to 0.09 percent. Compared to the labor supply effects that result from a change in the gross wage rate, the effects resulting from an increase in child care costs are rather small. This is due to the fact that the percentage change in net household income for households with children under the age of six are considerably larger in the case of a one percentage change of the mother's wage than in the case of a one percentage change in child care costs, as can be seen in table 13.

Table 11: Labor supply elasticities with respect to a one percentage increase in the hourly price of child care

	Women in Couple Households	
	East	West
	Participation Elasticities (in percentage points)	
Women with children under 6	-0.02 (-0.02 – -0.01)	-0.03 (-0.03 – -0.02)
	Hours Elasticities (in percent)	
Women with children under 6	-0.04 (-0.05 – -0.02)	-0.09 (-0.10 – -0.07)

Numbers in parentheses refer to bootstrap confidence intervals (100 repetitions).

Finally, table 12 reports the labor supply effects resulting from a policy simulation, in which all households receive a 100 percent subsidy of child care expenditures (without taking into account the financing side of such a policy measure). In this case, the labor supply effects are considerable: The labor force participation rate of women with preschool children in west Germany would rise by about 3 percentage points in the west (from 51 to 54 percent) and by 1.5 percentage points in the east (from 68 to 69.5 percent). Total working hours of mothers with children under the age of six would rise by about 9 percent in west and by about 4 percent in east Germany. The reason why the labor supply effects resulting from this policy simulation are much lower in east Germany is due to the fact that child care costs are much lower in the east. Therefore, the policy simulation leads to a lower percentage change in net household income for households in east Germany (see table 13).

Table 12: Labor supply effects of a policy simulation of a hundred percent subsidy on child care expenditures

	Women in couple households	
	East	West
	Participation Elasticities (in percentage points)	
Women with children under 6	1.51 (0.98 – 2.04)	2.80 (2.31 – 3.28)
	Hours Elasticities (in percent)	
Women with children under 6	3.64 (2.33 – 4.94)	8.64 (7.05 – 10.23)

Numbers in parentheses refer to bootstrap confidence intervals (100 repetitions).

Table 13: Percentage change in simulated net household income

	Percentage change in net household income due to…					
Hours category	… 1% increase in the mother's wage		…1% increase in hourly price of child care		… policy simulation that gives a 100% subsidy on child care expenses	
	East	West	East	West	East	West
0/0*	0	0	0	0	0	0
0/19	0.23	0.25	-0.03	-0.05	3.37	5.10
0/40	0.33	0.39	-0.06	-0.09	5.63	8.48
37/0	0	0	0	0	0	0
37/8.5	0.07	0.05	-0.02	-0.03	1.99	2.66
37/18	0.15	0.15	-0.02	-0.03	2.15	2.83
37/27	0.26	0.22	-0.03	-0.04	3.03	4.04
37/38.5	0.32	0.28	-0.04	-0.05	3.67	4.99
37/45	0.36	0.32	-0.04	-0.05	3.94	5.40
47/0	0	0	0	0	0	0
47/8.5	0.06	0.04	-0.02	-0.02	1.76	2.27
47/18	0.17	0.13	-0.02	-0.02	1.90	2.44
47/27	0.23	0.18	-0.03	-0.04	2.67	3.50
47/38.5	0.28	0.24	-0.03	-0.04	3.29	4.38
47/45	0.32	0.27	-0.04	-0.05	3.54	4.76

* First number refers to working hours of the father, second number to working hours of the mother.

The results show that, although child care is already highly subsidized in Germany, a hundred percent subsidy of child care expenditures would increase the labor force participation by a few percentage points. However, compared to results reported from North-American or UK studies, these labor supply effects are rather small. Viitanen (2004a) reports an increase in the labor force participation by 25.4 percentage points in case of a 100 percent subsidy of private child care costs. In a study using data for the US, Han and Waldfogel (2001) simulate a subsidy of 25 percent and report an increase in the labor force participation rate of married mothers with preschool children of 3 percentage points. This difference in the size of the effects is not surprising, since private child care costs are much lower in Germany than they are in the US or the UK.

6 Summary and Conclusion

The aim of this study was to analyze the effect of child care costs on the labor supply of women with preschool children in Germany. Following the approach widely used in the international literature, I estimate child care costs on the basis of a selection model using data from the GSOEP, wave 2002. Labor supply is modeled on the basis of a structural household utility model. In contrast to the only previous German study on this subject (Merkle 1994), which uses data from 1987, I do find a small, though significant effect of child care costs on mothers' labor supply behavior. Participation elasticities with respect to a one percentage increase in child care costs range between -0.02 in east and -0.03 in west Germany percentage points, while hours elasticities amount to -0.04 in the east and -0.09 in the west. The labor supply effects of a policy simulation, which would set child care costs at zero, are considerable: The participation rate of women with preschool children would rise by 3 percentage points (1.5 in the east) and working hours would increase by 9 percent (3.5 percent in the east). The reason for the difference between the effects in east and west Germany is that both, labor supply elasticities of women and child care costs (also as percentage of net household income) are higher in west Germany.

Compared to results from studies from the US, Canada or the UK, which report participation elasticities from -0.02 (Ribar 1995) to -0.8 (Averett et.al. 1997), the results of my study are located at the lower end of the range. The relatively small elasticities might essentially reflect the fact that, since child care facilities are already highly subsidized in Germany, the percentage change in household income due to a simulated change in child care costs is much lower than it might be the case in other countries.

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Appendix:

Results of Conditional Logit Labor Supply Estimation, Couples

Variable	*Coefficient*	*Standard Error*
income	7.4575**	3.0379
income squared	0.4118**	0.1771
income*husband's leisure	-1.8161**	0.2589
income*wife's leisure	-1.0749**	0.2461
husband's leisure	64.3626**	4.6140
husband's leisure squared	-4.5045**	0.2880
wife's leisure	103.3008**	6.1480
wife's leisure squared	-9.6803**	0.6022
husband's leisure*wife's leisure	-2.2138**	0.3758
husband's leisure*dummy1	-0.9501**	0.3211
wife's leisure* dummy2	-0.3377	0.3235
husband's leisure*wife's leisure*dummy3	0.1219	0.1152
income*dummy3	1.0728	2.2914
income squared*dummy3	-0.0140**	0.1795
husband's leisure*dummy4	-10.2645**	2.0862
wife's leisure*dummy4	-12.1814**	1.9537
husband's leisure*wife's leisure*dummy4	2.4260**	0.5140
income*dummy4	2.0155*	1.0827
income squared*dummy4	-0.2049**	0.0905
husband's leisure*husband's age	-0.2863**	0.0592
husband's leisure squared*husband's age squared	0.3982**	0.0656
wife's leisure*wife's age	-0.5013**	0.0689
wife's leisure squared*wife's age squared	0.7317**	0.0819
husband's leisure*husband's health status	1.9939**	0.4537
wife's leisure*wife's health status	2.4169**	0.6802
wife's leisure*dummy5	4.1890**	0.2300
wife's leisure*dummy6	2.5404**	0.1719
wife's leisure*dummy7	0.6680**	0.1707
dummy8	-1.4176**	0.1402
dummy9	-1.4877**	0.0712
dummy10	-1.5780**	0.0858
dummy11	-1.2804**	0.0862
Number of observations: 52245 (3483 households, thereof 504 with children under the age of six)		
Pseudo $R^2 = 0.14$		

Dummy1: Husband is German
Dummy2: Wife is German
Dummy3: Head of household (person answering the GSOEP household questionnaire) is German
Dummy4: Household is living in east Germany
Dummy5: Children under the age of 6 in household
Dummy6: Children under the age of 16 in household
Dummy7: Children under the age of 17 in household
Dummy8: Part-time category: wife working 19 hours, husband working 0 hours
Dummy9: Part-time category: wife working 8.5 hours
Dummy10: Part-time category: wife working 18 hours
Dummy11: Part-time category: wife working 27 hours
* indicates significance at 10 % significance level
** indicates significance at 5 % significance level