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Katharina Wrohlich

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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 microsimulation 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.

JEL Classification: J13, J22

Keywords: Child care costs, labor supply estimation

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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.

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 Germany¹. 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.

The policy debate in Germany is mostly about increasing the amount of child care facilities and to extend opening hours of existing institutions, not about reducing private costs. Although free preschool child care is still a political goal of the federal government, in these times of tight fiscal policies subsidies to child care facilities are currently reduced in many cities, which increases parents' fees considerably.

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 mothers² 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

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.

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 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.

Labor supply effects of child care costs are usually measured by price of child care costs elasticities. I calculate these elasticities by simulating a one percent increase of the private child care costs. Further, I simulate two policy reforms, (i) a 25 percent increase in child private care costs and (ii) a 100 percent subsidy, which means setting all private costs at zero.

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 percent increase in the hourly price of child care are small (participation declines by 0.01 - 0.03 percentage points and hours decline by 0.03 - 0.09 percent, varying by region) though significant. Increasing private child care costs by 25 percent would result in a decline of the labor force participation of mothers of 1 percentage point in west and 0.5 percentage points in east Germany. Finally, if child care were free for all households, mothers' labor force participation would rise by 3 percentage points in west and 1.5 percentage points in east 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 facilities 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, 111.8³ 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).

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 Familie) 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

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).

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 and 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 and 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 limited availability of child care facilities and the low 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'

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

employment behavior (e.g. Kreyenfeld and Hank 1999, Spieß and Büchel 2003). German studies on the impact of availability of child care facilities on maternal employment report differing 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.

Child care has many dimensions, such as quality, availability and costs. On top of the political agenda in Germany is an increase in availability of child care places. Also quality issues have been discussed recently, especially in the context of the poor performance of German pupils in the PISA study⁵. Reducing the private costs of child care is not a primary political goal at the moment. Although the Federal Ministry of Families, Seniors, Women and Youth states that “free preschool child care must not be a distant prospect” (BMBFSFJ 2003, p.18), the prevailing tendency is to increase parents’ fees to child care facilities. For example, the municipality of Berlin increased parents’ fees considerably in January 2004. Also in other cities, private child care costs have been rising⁶.

⁵ The PISA (Programme for International Student Assessment) study is a survey of the knowledge and skills of 15-year-olds in the principal industrialised countries undertaken by the OECD.

⁶ For example, in the city of Marburg, parent’s fees have been increased by 25 percent in January 2004. In April 2004, parent’s fees will be increased by about 10 percent in the city of Wiesbaden. Also in Saxony an increase of parent’s fees is discussed.

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

	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 Blau and Robins 1988, 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.⁷

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 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 eight⁸. 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.

⁷ 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.

⁸ 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.

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 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:

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

where $x = (y, l_m, l_f)'$. 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.:

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

Assuming that ε_k is distributed identically across all hours categories according to an extreme-value distribution⁹, 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):

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

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 behavior¹⁰.

⁹ 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 (2004), 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.

¹⁰ Civil servants represent about 4 percent and self employed about 8 percent of the working population (GSOEP, wave 2002).

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 overtime¹¹. 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 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

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

* 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

¹¹ 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.

system¹². 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 correction¹³. 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 / child allowances, child-rearing 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. The measure of child care costs that are deducted from the simulated household income is described in the following section.

At this stage, several assumptions that result from my approach of implementing child care costs in the labor supply model should be mentioned explicitly. First, it is assumed that all households purchase formal child care according to the mothers' working hours, even if the father is not working. If the mother is not working, child care costs are set at zero, which is in line with an interpretation of child care costs as costs of employment; if a mother is not working, child care costs can be interpreted as consumption and should not be subtracted from the net household income. Another implication is that possibilities of free informal child care (e.g. by other relatives such as grandparents etc.) are not taken into

¹² The same microsimulation model has already been used in, among others, Steiner 2000, Steiner and Wrohlich 2003 and 2004. A detailed description of the model can be obtained from the author upon request.

¹³ 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.

account. These assumptions imply that an extension of the mother's working hours always lead to an increase in total child care costs. Finally, it is also assumed that every family can purchase desired hours of child care at the estimated price, implying that at the given price, there is no rationing in child care places. All these assumptions lead to an overestimation of the effects presented in section 5.2.

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 years¹⁴. 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:

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

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

¹⁴ 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.

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):

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

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

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

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

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

$\phi(\cdot)$ being the normal probability density function and $\Phi(\cdot)$ 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:

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

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

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

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 two policy simulations.

5.1 Results of the Child Care Cost Estimation

Descriptive statistics of variables used for estimation can be found in table A1 in the appendix. 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.

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' income¹⁵. 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 (λ) is not significant.

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.

Table 7: Results of the selection equation

<i>Variables</i>	Probability (Utilization=1)	
	<i>Coefficient</i>	<i>Standard Error</i>
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 categorical 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.

¹⁵ 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)

Dependent variable: hourly expenditure on child care (per child)		
<i>Variables</i>	<i>Coefficient</i>	<i>Standard Error</i>
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 uncensored		
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)

Hours category	East		West	
	Actual	Predicted	Actual	Predicted
<i>Couple Households</i>				
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.

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 table A2 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 percent change in the gross wage lie in the range between 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.¹⁶

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

	Women in Couple Households	
	East	West
	<i>Participation Elasticities (in percentage points)</i>	
All women	0.09 (0.06 – 0.11)	0.13 (0.11 – 0.16)
Women with children up to 6	0.12 (0.08 – 0.16)	0.13 (0.10 – 0.15)
	<i>Hours Elasticities (in percent)</i>	
All women	0.21 (0.14 – 0.27)	0.38 (0.31 – 0.44)
Women with children up to 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 is usually captured in terms of price elasticities, i.e. the labor supply changes resulting from a one percent increase in the child care costs. Additionally, I also simulate a 25 percent increase in the private costs of child care and a hundred percent subsidy of child care costs. The results of these simulations are reported in table 11.

The effects of a one percent increase 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 - 0.03 percentage points. Total working hours would decrease by 0.04 - 0.09 percent. Compared to results from studies on US,

¹⁶ 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).

Canadian or UK data, which report participation elasticities in the range between -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. This is not surprising, since child care facilities are already highly subsidized in Germany and therefore the share of the costs that is borne privately is rather low (see section 2; Table A3 in the appendix shows the percent changes in income resulting from the different simulations). The reason why the labor supply effects in east Germany are lower than in the west is due to the fact that both, labor supply elasticities (i.e. the reactions to any kind of income change) and the percent income change due to a rise in child care costs are lower in the east.

Table 11: Labor supply elasticities with respect to changes in the hourly price of child care (women with children up to 6 only)

1 % increase in child care costs		25 % increase in child care costs		100% subsidy to child care costs	
East	West	East	West	East	West
<i>Participation Elasticities (in percentage points)*</i>					
-0.02 (-0.02 - -0.01)	-0.03 (-0.03 - -0.02)	-0.41 (-0.55 - -0.27)	-0.73 (-0.86 - -0.61)	1.51 (0.98 – 2.04)	2.80 (2.31 – 3.28)
<i>Hours Elasticities (in percent)*</i>					
-0.04 (-0.05 - -0.02)	-0.09 (-0.10 - -0.07)	-0.97 (-1.32 - -0.63)	-2.21 (-2.59 - -1.83)	3.64 (2.33 – 4.94)	8.64 (7.05 – 10.23)

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

* Baselines:

Labor force participation of mothers with preschool children is 63% in east and 43% in west Germany.
Average weekly working hours of this group are 16.6 hours in east and 8.6 hours in west Germany.

An increase in parents' fees of 25 percent would lead to a decline in the participation rate of mothers by about 0.5 percentage points in east and about 1 percentage points in west Germany. Mothers' working hours would be reduced by about 1 percent in east and by about 2 percent in west Germany. If one takes into account that some households might have the possibility to draw on free, informal child care arrangements, these effects might be overestimated. Still, when considering policies that increase parents' fees to child care facilities, it is important to note that these policies significantly affect mothers' employment decisions.

In most of the international studies, reductions in child care costs rather than increases are simulated. 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. Running a policy simulation of a hundred percent subsidy to child care costs for Germany, I find an increase in the participation rate of mothers with

preschool children of about 3 percentage points in the west and about 1.5 percentage points in the east. Average weekly working hours would rise by about 4 percent in east and by about 9 percent in west Germany. These results show that the above cited political goal of providing free preschool child care would lead to a considerably higher labor force participation and longer working hours of mothers.

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 relatively small, though significant effect of child care costs on mothers' labor supply behavior. Participation elasticities with respect to a one percent increase in child care costs range between -0.02 (east) and -0.03 (west) percentage points, while hours elasticities amount to between -0.04 (east) and -0.09 (west) percent. 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 percent of net household income) are higher in west Germany. In case that subsidies to child care facilities are cut and private child care costs increase by 25 percent, the participation rate of mothers would decrease by 1 percentage point (0.5 in the east) and working hours would decrease by 2 percent (1 percent in the east). A simulation of a policy reform of the opposite direction, namely providing a hundred percent subsidy of child care costs, shows that in this case, labor force participation of mothers would rise by about 3 percentage points (1.5 in the east) and average working hours would increase by 9 percent (4 percent in the east).

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 price of child care elasticities 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. However, the effects are significant, and policies that lead to an increase in the private costs of child care do result in a lower labor force participation of mothers.

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Appendix:

**Table A1: Descriptive Statistics of Variables
Used in the Estimation of Child Care Costs**

	<i>Variable</i>	<i>Sample Mean</i>
Dependent variable in selection equation	in child care facility yes/no	0.59
Exogenous variables in the selection equation Sample: all children up to the age of six years (sample size 1345)	age of child (in years)	3.87
	# of children < 3	0.67
	# of children 3-6	0.83
	# of children 6-10	0.34
	# of children 10-14	0.18
	# of children > 14	2.11
	other income (in Euro per month)	2461
	other female adult in hh	0.02
	other unemployed adult in hh	0.06
	age of mother (in years)	33.78
	mother's years of schooling	12.30
	mother not German	0.15
	mother's health status***	0.77
	region 1*	0.17
	region 2*	0.39
	region 3*	0.31
	size of city**	3.91
Dependent variable in Tobit model	hourly child care costs (in Euro)	0.76
Exogenous variables in the Tobit model Sample: all children up to the age of six years attending child care facilities (sample size 771)	age of child (in years)	4.7
	# of children < 3	0.4
	# of children 3-6	1.1
	mother's years of schooling	12.5
	net household income (in Euro per month)	3420
	region1*	0.15
	region2*	0.37
	region3*	0.30
	size of city**	3.91

* 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.

** The variable size of city is a categorial variable that takes on values 1 to 7.

*** Mother's health status is defined as grade of disablement. 98% of all children's mothers are not disabled, therefore for them the value of this variable is zero. 1 percent of all children have a value between 5 and 50, another 1 percent between 50 and 100.

Table A2: Results of Conditional Logit Labor Supply Estimation, Couples

<i>Variable</i>	<i>Coefficient</i>	<i>Standard Error</i>
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

Table A3: Percent change in simulated net household income

Hours category	Percent change in net household income due to...							
	... 1% increase in the mother's wage		...1% increase in the hourly price of child care		... 25% increase in the hourly price of child care		... 100% subsidy of child care costs	
	East	West	East	West	East	West	East	West
0/0*	0	0	0	0	0	0	0	0
0/19	0.23	0.25	-0.03	-0.05	-0.89	-1.31	3.37	5.10
0/40	0.33	0.39	-0.06	-0.09	-1.48	-2.18	5.63	8.48
37/0	0	0	0	0	0	0	0	0
37/8.5	0.07	0.05	-0.02	-0.03	-0.52	-0.69	1.99	2.66
37/18	0.15	0.15	-0.02	-0.03	-0.56	-0.73	2.15	2.83
37/27	0.26	0.22	-0.03	-0.04	-0.80	-1.05	3.03	4.04
37/38.5	0.32	0.28	-0.04	-0.05	-1.00	-1.29	3.67	4.99
37/45	0.36	0.32	-0.04	-0.05	-1.04	-1.40	3.94	5.40
47/0	0	0	0	0	0	0	0	0
47/8.5	0.06	0.04	-0.02	-0.02	-0.46	-0.59	1.76	2.27
47/18	0.17	0.13	-0.02	-0.02	-0.50	-0.63	1.90	2.44
47/27	0.23	0.18	-0.03	-0.04	-0.70	-0.91	2.67	3.50
47/38.5	0.28	0.24	-0.03	-0.04	-0.86	-1.14	3.29	4.38
47/45	0.32	0.27	-0.04	-0.05	-0.93	-1.23	3.54	4.76

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