Does the Father Matter for the Time Children Spend in Child Care?*

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Abstract

This paper analyses whether the fathers matter for the number of hours that their children spend in subsidized child care. More explicitly, we estimate two non-nested models of child care demand in Sweden. The dual care taker model allows both parents' labour supplies to vary and includes several personal characteristics of the father as well as for the mother. The single care taker model follows earlier research and assumes that the father's labour supply is fixed and exogenous to the family's child care demand. The parameter estimates indicate that several of the father's characteristics are associated with the time his child spends in child care. J-tests and bootstrap J-tests are performed to compare the models. The tests show that the single care taker model can be rejected in favour of the dual care taker model while the dual care taker model cannot be rejected in favour of the single care taker model.

Keywords: Child care demand; Subsidized child care; Dual care taker model
JEL Classification: J13

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1 Introduction

This paper concerns the demand for child care by Swedish parents and analyses whether the fathers' preferences and labour supply choices influence the number of hours that children spend in subsidized child care. To focus on the father is an approach that differs from the traditional literature where child care demand often has been related to the mother's labour supply, see e.g., Blau and Robins (1988) and Michalopoulus et al. (1992). In this literature, the father's labour force participation is assumed to be predetermined and he is often assumed to not spend any time caring for his child. Consequently, the mother is the only potential child care giver in the family. The father's role is simply to provide income to support his family. A few papers, for example Joesch and Hiedemann (2002), include the father's preferences and labour supply choices in the theoretical model, but his characteristics are still excluded in the empirical model. Since the focus has been on the mother and her labour supply, the determinants of hours of care have received little attention.[1] Instead, most papers study the mother's labour supply and how it is affected by child care price and quality.[2]

To assume that only the mother determines child care demand may not be appropriate when considering families of today in the OECD countries. During the second half of the 20th century, women have entered the labour market and many mothers continue to work after a child is born. Statistics from OECD (2001) show that employment rates of mothers with young children have risen rapidly in almost all countries during the 1990s. There are also indications of increasing involvement of fathers in child care and other household tasks. One obvious example of this

[1]Exceptions include e.g., Hotz and Kilburn (1992), Blau and Hagy (1998), Joesch (1998), and Joesch and Hiedemann (2002). However, empirically, these studies draw on the traditional model and exclude the father from the model of child care demand. There is one empirical study of child care demand in Sweden by Wikström (2007) that includes both the father and the mother. Nevertheless, since this study does not include any variables related to income, it is difficult to compare the results to other studies.

[2]See e.g., Connelly (1992), Ribar (1995), Averett et al. (1997) and Kimmel (1998) for the U.S., Lokshin (2004) for Russia, and Kornstad and Thoresen (2007) for Norway. There is also an emerging literature that incorporates the effect of rationing, see e.g., Gustafsson and Stafford (1992) for Sweden, Wrohlich (2006) for Germany, and Del Boca and Vuri (2007) for Italy.

development is Sweden. Swedish men contribute the most (together with Canadian men) to unpaid household work and Swedish mothers have among the highest labour market participation rates in the world.[3] The Swedish government has launched a number of family reforms that facilitate mothers' participation in the labour market and encourage fathers to take care of their children. For example, both fathers and mothers have legal rights to parental leave and part time work after childbirth, with the possibility of regaining full time work later. Subsidized child care of high quality and high availability is publicly provided and heavily utilized by Swedish parents. Previous studies show that specialization within the Swedish households has decreased as women's share of market work has increased.[4] In addition, the proportion of parental leave days that the Swedish fathers utilize has increased from 8.8 percent in 1990 to 17.2 in 2003.[5]

If both parents are involved in their child's care, one could assume that both parents' preferences and labour supply choices influence the time their child spends in child care as well. If that is true, we cannot base a study of child care demand on a model where the mother is the only decision maker. Therefore, in this paper, we derive a different model, which treats both parents in the same way. In this family model, both parents are potential child care givers and both parents' labour supplies are allowed to vary. Consequently, the corresponding empirical model includes both the father's and the mother's wage rates and other characteristics of both parents.

A model where both parents are equally included seems to be the first choice for a study of child care demand in Sweden. However, since it has not yet been empirically tested which model that best fits the Swedish data, and as a comparison with earlier studies, we also estimate a model that follows earlier research. In this model, the mother is assumed to be the only child care giver and the father's preferences does not affect child care demand. To compare the empirical models, J-tests and bootstrap J-tests are performed. As far as we know, no previous study

[3]See OECD (2001) for more information about work and family life in the OECD countries. See also Table 4 in Appendix for a comparison of mothers' employment rates and fertility rates in different countries.

[4]See, e.g., Anxo (2002).

[5]Socialdepartementet (2004).

has empirically studied whether the father's characteristics are associated with the number of hours that his child spends in child care or whether a single care taker or a dual care taker model is to prefer. In addition, studies that focus on hours of care are rare and this paper adds to that literature.

The paper is organized as follows: Section 2 presents a theoretical framework, which motivates the variables that are included in the empirical models. The next section describes the data and the including variables. Section 4 introduces the empirical models and describes the specification tests. Section 5 presents the empirical results and section 6 concludes.

2 Theoretical framework

In this section, two theoretical models of family child care demand are presented. The models aim at determining what factors influence the parents' choice of hours of subsidized care and are used to motivate the variables in the empirical models. The first model is a dual care taker model that includes both parents as potential care givers. The second model is a single care taker model where the mother is the only potential care giver.

2.1 Dual care taker model

Let us start with a model where both the father and the mother are potential child care givers. Both parents' labour supplies are allowed to vary. All families are considered to be potential users of subsidized child care and to simplify the model, each family is assumed to have only one child. Utility is assumed to be a function of child care quality (Q), consumption (C), the mother's and father's leisure time (L_M, L_F), mother's and father's time spent with child (t_M, t_F) and exogenous characteristics related to the mother, the father, and other exogenous characteristics (Z_M, Z_F, Z_O). The family utility function can be expressed as

$$U = U\left\{Q, C, L_M, L_F, t_M, t_F, Z_{M,} Z_{F,} Z_O\right\}$$

The family faces time and budget constraints. If we normalize the total amount of time available to each parent to one, the time constraints can be written

$$1 = l_i + t_i + L_i \quad , \quad i = m, f$$

$$\tilde{t} = t_M + t_F + x$$

where l_M is the mother's hours of market work, l_F is the father's hours of market work, t_M is the mother's time spent caring for child, t_F is the father's time spent caring for child, x is hours of subsidized child care, and $\tilde{t}$ is the total number of hours that the child needs care.

In Sweden, child care fees are proportional to family labour income up to a limit.[6] Let $A = (a_y, a)$ be the parameters of the fee system, where a_y is a fee proportional to income and a is a fixed fee corresponding to the maximum fee. The fee system is such that $A = (a_y, 0)$ for families whose family labour income is below the limit and $A = (0, a)$ for families whose family labour income is above the limit.

A family budget constraint that takes into consideration the child care fees to be paid by parents can be written

$$C = \tilde{w}_M * l_M + \tilde{w}_F * l_F + \tilde{y}$$

where $\tilde{w}_M$ is the mother's hourly marginal wage rate calculated as $w_M(1 - \tau - a_y)$ where τ is the marginal income tax and $\tilde{w}_F$ is the father's hourly marginal wage rate calculated as $w_F(1 - \tau - a_y)$. The term $\tilde{y}$ is other income reduced by a potential fixed fee, $(y - a)$.

Optimal hours of child care are obtained by maximizing the utility function subject to the constraints and solving the first order conditions simultaneously. The demand for child care can be described by the following reduced form

$$x = x(\tilde{w}_M, \tilde{w}_F, \tilde{y}, Z_M, Z_F, Z_O, Q, \tilde{t})$$

[6] In 2002 this limit was 38000 SEK per month. For preschool care, the fee was three per cent for the first child, two per cent for the second child and one per cent for the third child. No fee was paid for the forth child. This implies that the maximum fee for the first child was 1140 SEK per month. See Holmlund and Wikström (2005) for a more detailed description of the fee system.

Child care demand is a function of the father's and the mother's marginal wage rates, other income reduced by the maximum fee for parents who have a total income above the maximum fee limit, other paternal and maternal characteristics, other characteristics, child care quality, and the total time that the child needs care.

2.2 Single care taker model

For comparison, we derive a single care taker model, based on earlier research by e.g., Ribar (1992) and Hotz and Kilburn (1992). In this model, the father is assumed to work a fixed number of hours and he is not a potential child care giver. The mother is assumed to make decisions about her labour supply and about child care hours. Utility is assumed to be a function of child care quality (Q), consumption (C), mother's leisure time (L_M), father's leisure time ($\bar{L}_F$), mothers time spent with the child (t_M), exogenous characteristics related to the mother (Z_M) and other exogenous characteristics (Z_O). The time constraint for the mother is similar to the dual care taker model, while the child's time constraint is different since the father no longer is a care taker. The budget constraint is also slightly different. In the single care taker model, the father's wage rate does not directly affect child care demand since his labour supply is assumed to be fixed and exogenous. His wage rate is excluded from the model, while his annual income from labour is included in other income. The reduced form is obtained in analogy to the dual care taker model and can be written

$$x = x(\tilde{w}_M, \tilde{y}, Z_M, Z_O, Q, \tilde{t})$$

where $\tilde{y} = y - a + \bar{l}_F \tilde{w}_F$.

When only the mother is a potential care taker, the child care hours are determined by the mother's marginal wage rate, other income, the mother's characteristics, other characteristics that affect the parents' preferences, child care quality and the total time that the child needs care. The only variable that is directly related to the father is other income, where his annual income from labour is included.

3 Data

The study is based on the dataset "Tid och Pengar" (Time and Money) which was put together by the Swedish Social Insurance Agency. The data was collected through telephone interviews in January 2003. One of the parents of 1578 children born in 1999 was interviewed about the family's child care choices and labour supplies as well as socioeconomic and demographic factors. In addition, register data containing income related variables was added for both parents covering the years 1993 to 2002. In this study, we use the variables from 2002. "Tid och Pengar" is combined with information about the different municipalities' child care fee systems and variables related to child care quality. Different structural variables are also added. This data is provided by the Swedish National Agency for Education and refers to the year 2003. Since the observed child is born in 1999, child care demand is measured for children who were four years old in 2003.

The sample used in this study consists of two parent households where both parents are reported as working full time or part time.[7] Parents with extremely low or high (less than 50 SEK or more than 500 SEK) gross hourly wages are excluded as well as parents who reported a large number of working hours (more than 50 hours per week). Lastly, some households are excluded due to missing values. The final sample consists of 683 households.[8] Descriptive statistics for the sample are presented in Table 1.

3.1 Variable description

3.1.1 Dependent variable

The dependent variable is the number of hours per week that the child spends in subsidized care. Hours in subsidized care is constructed from the inquiry questions

[7]Parents who are unemployed or on parental leave are rationed in Sweden. They cannot freely choose number of hours of public child care, but they are guaranteed 15 hours per week by law. We will not discuss rationing in this paper and these families are therefore excluded. Students are excluded due to measurement errors produced by missing values in annual incomes from labour and working hours.

[8]Table 5 in Appendix gives the details on how the sample is obtained.

Table 1: Descriptive statistics

	Mean	SD	Min	Max
Hours in subsidized child care	29.5	10.4	0	55
Mother's gross wage rate	118	47.5	51.2	500
Mother's marginal wage rate	76.2	25.6	33.1	340
Father's gross wage rate	147	57.3	51.0	468
Father's marginal wage rate	81.3	21.8	33.7	222
Other income, dual care taker model	56.4	37.2	4.0	182
Other income, single care taker model	223	69.0	79.0	617
Siblings 0-6 years	0.45	0.55	0	2
Siblings 7-12 years	0.56	0.70	0	3
Mother's age	33.9	4.4	21	49
Father's age	36.2	5.3	24	55
Dummy variable mother born abroad	0.03		0	1
Dummy variable father born abroad	0.02		0	1
Inhabitants in centre	83.5	12.9	31	100
Tax base per capita	132	20.8	101	251
Municipality's cost for child care	82.8	8.2	58.0	125
Children/staff ratio	5.4	0.45	3.7	6.7
Children per preschool group	17.2	1.5	13.5	22.7

Note: other income, tax base and cost for child care are expressed in thousands of SEK.

"How is your child care arranged today?" and "How many hours per week does your child spend in child care?" and corresponds to hours in preschool or family day care. Children who have another care than preschool and family day care are assigned zero hours of subsidized care.[9]

Unfortunately, the inquiry does not indicate whether the preschools and family day care were subsidized or not. Preschool and family day care could include both public and private facilities. However, we treat all children who attended a preschool or family day care as users of subsidized care. This is motivated by two reasons. First, a vast majority of the children in preschool or family day care attend public facilities. Statistics show that 82 per cent of all 1-5 year olds were enrolled in some preschool activity, i.e., public or private preschool or family day care, in 2002. 79.9 per cent of those children attended public preschools that were run by the municipalities, while 10.4 per cent attended a facility (preschool or family day care) that operated under non-municipal auspices.[10] Second, if a family chooses a non-municipal preschool or family day care that is approved by the municipality, they usually pay the same fee as they would have done if they had chosen a public preschool in the same municipality. Most private preschools are included in the publicly subsidized system. Therefore, we believe that it is reasonable to treat all children who attend preschool or family day care as users of subsidized child care.

3.1.2 Independent variables

The independent variables include characteristics of the parents and the family as well as variables related to the municipality. Some of these variables are explained in more detail below.

The family characteristics include parents' ages, parents' origin, number of siblings in two different age categories and different income measures. Two dummy variables that indicate whether the mother or the father was born in Sweden have

[9] Proportions of children in different child care modes in the data "Tid och Pengar" are presented in Table 6 in Appendix.

[10] These statistics are partly own calculations based on Skolverket (2004) and the Parental Inquiry 2002 (conducted by the National Agency for Education). See Skolverket (2004) for more information about the child care system in Sweden.

been constructed to control for parents origin. The siblings variables refer to number of siblings in two different age categories: 0-6 and 7-12. Three different income measures are utilized; mother's marginal wage rate, father's marginal wage rate and other income.

Gross wage per hour (w) is derived by dividing annual income from labour by annual working hours.[11] Marginal wage rates are then calculated as $w_i(1-\tau-a_y)$ for $i = mother, father$, where τ is marginal tax rate and a_y is the sum of the proportional child care fees for all children in the household that are between 0 and 6 years old.[12] For mothers and fathers in households who face the maximum fee, $a_y = 0$.[13]

Other income consists of the parents' virtual income components and actual non labour income, which in our case consists of child allowance, housing allowance and social assistance. The virtual income components correspond to the intercept incomes that are obtained when linearizing each parent's budget constraint around the tax segment where the observed hours of work are located, i.e., the intercept obtained when the individual's budget segment is extended to zero hours of work. If the parents face the maximum fee, the total fee for all children in the household is deducted from other income. In the single care taker model, where the father's labour supply is assumed to be exogenous, the father's annual net income from

[11]Working hours correspond to the inquiry questions "how many hours do you/your partner work an ordinary week, including overtime?". To obtain annual working hours the weekly measure has been multiplied by 52. We have also tried an approach with 47 weeks per year, but that did not affect the results.

[12]We do not have information about child care hours for siblings. However, it is reasonable to believe that siblings spend the same number of hours in preschool. The fees for siblings that are older than 6 years, i.e., siblings that possibly attend after school care, are not considered.

[13]In 2002, Sweden had an individually based piecewise linear income tax system with two thresholds. For taxable incomes below the first threshold, only a municipal tax had to be paid. The municipal tax varied between 27.5 per cent and 33.4 per cent, depending on which municipality they lived in. For incomes between the first and second thresholds, an additional state tax of 20 per cent had to be paid. For incomes above the second threshold, the state tax was 25 per cent. Since we have information about the parents' annual incomes from labour, where they lived and municipal tax rates, we can account for this non-linearity when calculating our marginal wage rates.

labour is included in other income while his virtual income component is excluded.

Since the municipalities are responsible for child care provision and there may be differences in quality and availability between municipalities, some variables that are measured on a municipality level are included. Urbanization measures how large part of the municipalities inhabitants that is living in a so-called population centre.[14] A highly populated city usually has a large part of the inhabitants living in a population centre. For example, several municipalities in the Stockholm area have the value 100, which is the highest possible value. A large tax base indicates that the municipality gets a high income from the inhabitants' income taxes, i.e., tax base per capita is included to control for the municipality's resources. To control for the effect of child care quality, we include some variables that are considered to be related to the quality of child care: the municipality's cost per child for child care, number of children per preschool employee and number of children in each preschool group. These variables correspond to the average values per municipality.

4 Empirical model

To determine whether the father's characteristics influence child care demand, we estimate two reduced form models based on our theoretical framework. The dual care taker model is estimated by the following reduced form

$$x_j = \alpha^D + \beta^D \tilde{w}_{Mj} + \gamma^D \tilde{w}_{Fj} + \rho^D \tilde{y}_j^D + \theta^D Z_{Mj} + \phi^D Z_{Fj} + \psi^D Z_{Oj} + \vartheta^D Q_j + \varepsilon_j^D \quad (1)$$

where sub index j refers to household; $\tilde{w}_M$ and $\tilde{w}_F$ are the mother's and the father's hourly net wage rates respectively; $\tilde{y}^D$ is other income, including mother's and father's virtual income components and actual other incomes; Z_M is a vector of the mother's characteristics, Z_F is a vector of the father's characteristics, and Z_O is a vector of other explanatory variables that are common for both parents, e.g., other family characteristics and variables related to the municipality; Q includes variables

[14] A population centre is defined as a settlement with at least 200 inhabitants and at most 200 metres between the houses.

related to child care quality; ε^D is an error term and β^D, γ^D, ρ^D, θ^D, ϕ^D, ψ^D, and ϑ^D are coefficients.

The single care taker model is specified in a similar way

$$x_j = \alpha^S + \beta^S \tilde{w}_{Mj} + \rho^S \tilde{y}_j^S + \theta^S Z_{Mj} + \psi^S Z_{Oj} + \vartheta^S Q_j + \varepsilon_j^S \tag{2}$$

This specification excludes the father's characteristics from equation 1 and includes a definition of other income where the father's annual income is included while his virtual income component ($\tilde{y}^S$) is excluded. In this model, the father's alternative cost for leisure is irrelevant since his labour supply is fixed. However, his annual income may affect the mother's labour supply and should therefore be included as an other income.

The inclusion of income variables in the two models poses a potential endogeneity problem. Mother's marginal wage rate, father's marginal wage rate and other income may be endogenous to family child care demand and an ordinary least squares estimation may result in biased estimates.[15] To correct for endogeneity, the models are estimated using two stage least squares. In the first step, mother's marginal wage rate, father's marginal wage rate and the two different variables for other income are estimated with OLS. For identification we use dummy variables related to different education levels, which are assumed to be correlated with the income measures but uncorrelated with child care hours.[16] In addition, control variables corresponding to equations (1) and (2) are included for the two models. The coefficients obtained in these estimations are utilized to calculate predicted values. In the second step, the predicted values from the first step are included and the models from equations (1) and (2) are estimated by OLS.[17]

[15] Hausman tests have been performed to check whether the income variables are endogenous. The tests indicate that the income variables are endogenous in both models.

[16] F-tests and t-tests have been performed to assess the relevance of the instruments. The tests indicate that the instruments significantly affect the income variables, both individually and jointly.

[17] The results from the instrumental variables regressions are available from the author on request.

4.1 Specification tests

Since other income is defined differently in the two models, the models are non-nested. This means that the models are separate and that one model cannot be written as special case of the other. This imposes a problem when deciding which model specification that best fits the data. We cannot simply impose restrictions on one model to obtain the other model and examine the significance of the loss of fit that arises. Instead, we have to turn to procedures for testing non-nested regression models. Almost all literature on non-nested hypothesis testing in the context of regression models relies on the work of Cox (1961; 1962). However, even though the Cox test is very general, it is not always easy to implement. One alternative test is the J-test, which will be used in this paper.

4.1.1 The J-test

The J-test was proposed by Davidson and Mackinnon (1981) and has several appealing features. The J-test is intuitive, convenient to implement and easily generalized to allow for several non-nested alternative regression models. In addition, the test may be more powerful than comparable tests.[18] When conducting a J-test, a maintained hypothesis (model 1) is defined which then is confronted by a competing hypothesis (model 2). The success of the competing hypothesis is determined by whether or not it has any explanatory power, given the explanation provided by the maintained hypothesis. If so, the maintained hypothesis is rejected. Practically, this is done by adding a supplementary variable, comprising the fitted values from the competing model fitted to the same data, to the maintained model and evaluating its significance. Then the hypotheses are reversed, i.e., the competing hypothesis becomes the maintained, and the procedure is repeated to test the other model.

In our setting, the J statistics are the t statistics for $\lambda = 0$ in the regressions

$$x_j = S_j\eta + \lambda_2(D_j\hat{\zeta}) + \varepsilon_j \tag{3}$$

$$x_j = D_j\zeta + \lambda_1(S_j\hat{\eta}) + \varepsilon_j \tag{4}$$

[18] See, e.g., Fan and Li (1995) and Godfrey (1998).

where S includes all vectors of variables included in the single care taker model, D contains all vectors of variables included in the dual care taker model and η and ζ are coefficients.

4.1.2 The Bootstrap J-test

Fan and Lee (1995) and Davidson and Mackinnon (2002) draw attention to some drawbacks of the proposed J-test. One difficulty is that the J-test suffers from a size distortion when the regressors in the null model are near orthogonal to those in the alternative model. In addition, the test is not exact in finite samples and its finite-sample distribution can be very far from the normal distribution that it follows asymptotically. It is also well known that the J-test tends to over reject the null. This implies that we need better approximations of the finite sample distribution of the J-test statistic. One way to obtain that is to perform bootstrapped J-tests, where a bootstrap sample is used to compute a J-test statistic, J^*, in exactly the same way as the ordinary J-test statistic ($\hat{J}$).[19] The procedure is repeated B number of times and the empirical reference distribution for the J-test statistic under the maintained hypothesis is thus obtained. The bootstrap test is done by calculating a bootstrap P value and rejecting the null hypothesis whenever this P value is less than the level of the test.

The bootstrap P value can be computed by the formula

$$\hat{p}^*(\hat{J}) = \frac{1}{B}\sum_{j=1}^{B} I(J_j^* \geq \hat{J})$$

where I is an indicator function that equals 1 if its argument is true and 0 otherwise. This assumes that the test is a one-sided test.[20]

[19] $\hat{J}$ corresponds to the t statistic of λ in the section above where the ordinary J-test is described.

[20] The bootstrap procedure is described more in detail in Davidson and Mackinnon (2002) and Fan and Li (1995).

5 Empirical findings

Table 2 presents the results for the two models, estimated by 2SLS.[21] We start with a comment on the parameter estimates of the two models, which is followed by different J-tests that aim at determining which model that performs best.

5.1 Parameter estimates

Let us start with the parameter estimates for the dual care taker model. In this model, the characteristics of both parents are included, as well as other control variables. The parents' marginal wage rates both have negative signs. This implies that the higher a parent's wage rate is, the fewer hours her/his child spends in child care. However, none of the parents' wage parameters are significantly determined which indicates that wages are not important when explaining child care demand for our sample. This is not surprising, since the sample consists of families where both parents are working. Since informal care is rare in Sweden, almost all families with two working parents have a need of subsidized child care during parental working hours and this need is not determined by the level of the wages. Swedish child care fees are also very low and affordable for most families. In addition, when both parents are involved in their child's care, the child care hours are determined by both parents' working hours and there is no simple correlation between one parent's working hours and the time the child spends in child care. Other income is positively associated with child care hours and statistically significant. This is somewhat surprising since we expect leisure and time spent with children to be normal goods.

The effect of siblings is significant and similar to what has been found by others, e.g., Joesch and Hiedemann (2002). More siblings result in fewer hours of child care and younger siblings have a larger effect than older siblings. For every sibling under the age of six, the child spends approximately 3.5 hours less in child care, while having a sibling age 7-12 decreases the time spent in child care with approximately one hour. One possible explanation to this is that one of the parents may be more

[21] The models have also been estimated by OLS as a comparison. The results from the OLS estimations are reported in Table 7 in Appendix.

Table 2: Estimation results

	Dual care taker model		Single care taker model	
	2SLS		2SLS	
Covariate	Estimate	S.E	Estimate	S.E
Family level				
Mother's marginal wage rate	-0.02	0.09	0.17**	0.07
Father's marginal wage rate	-0.23	0.28		
Other income	0.22*	0.12	-0.009	0.009
Siblings 0-6 years	-3.48***	0.81	-3.50***	0.82
Siblings 7-12 years	-1.10*	0.58	-1.22**	0.62
Mother's age	0.23	0.15	0.07	0.10
Father's age	-0.38*	0.21		
Mother born abroad	4.44*	2.51	0.75	2.64
Father born abroad	-11.15***	3.80		
Municipal level				
Urbanization	0.10**	0.05	0.08**	0.04
Tax base	0.06	0.05	0.03	0.03
Cost for child care	-0.02	0.07	-0.05	0.06
Children/staff	1.56	1.33	-0.30	1.03
Children/group	-0.11	0.26	-0.16	0.25
Intercept	24.30*	14.18	16.38	10.40
Sample size	683		683	
Adj R-squared	0.11		0.08	

Note: other income, tax base and cost for child care are expressed in thousands of SEK.

Standard errors are heteroscedastic consistent.

*** $p \leq 0.01$, ** $p \leq 0.05$,* $p \leq 0.1$

likely to work part time if there are younger children in the family. If the parent is at home with one child, he or she may as well look after more children without putting in that much more time. This implies that there may be increasing returns to scale in family child care.

Continuing with the variables that are related to the parents, we find a negative correlation between the father's age and child care hours. The mother's age is not significantly determined. Since previous studies by, e.g., Brayfield and Hoffert (1995), Johanesen et al. (1996), and Joesch (1998), provide evidence of the importance of race and ethnicity for child care decisions, two dummy variables that indicate whether the mother and the father are born outside of Sweden were included. The results imply that if the father is born outside of Sweden, the number of hours spent in subsidized child care decreases with approximately 11 hours. Having a mother born outside of Sweden increases the time in child care by approximately 4.5 hours. The importance of origin may depend on values and beliefs about appropriate ways to care for children and effects of maternal employment on children. However, since only a limited number of parents in our sample are born outside of Sweden and the standard errors are high, these results should be interpreted with caution.

Several variables that are measured on a municipally level were included to control for supply side effects and quality of care. Among those variables, only urbanization seems to be associated with child care demand. If the family lives in a municipality where many of the inhabitants are living in a population centre, the time spent in child care increases. This effect is probably due to availability of child care. If you live in a highly populated area, it is more likely that you have a preschool nearby and this may affect the demand as well. The tax base has no effect on child care hours. Lastly, none of the quality related variables seems to affect child care demand. One reason for this could be that, due to Swedish national standards for quality in child care, the variation in the quality measures between municipalities is small. The lack of variation could make it difficult to capture any effects. Another possible explanation is that the variables are measured on a municipality level and that all within-municipality variation is ignored. The lack of significance could also indicate that parents actually do not care about quality, or that the variables are not relevant proxies for quality.

Now, let us briefly comment on the results for the single care taker model. In this model, only the mother is a potential care giver. In contrary to the dual care taker model, the mother's marginal wage rate has a positive and significant effect on child care hours. The father's wage rate is not included. Instead, his annual income from labour is assumed to have a similar effect as other non-labour incomes and is added to other income. The effect of other income is negative in this model, while it was positive in the dual care taker model. However, other income is not significantly determined in the single care taker model. The effect of siblings follows the dual care taker model, both in significance and magnitude. Mother's age is still insignificant while the dummy variable that indicates whether the mother is born abroad loses its significance. The variables that are measured on a municipal level all yield similar results as in the dual care taker model. The only variable that is associated with child care demand is urbanization. Tax base and the quality related variables parameter estimates are not significantly determined.

These estimation results provide some evidence for an inclusion of the father in the model of child care demand. When considering the point estimates of the dual care take model both the father's age and whether he is born abroad affect child care hours. His wage rate is not significantly determined but neither is the mother's. In addition, the adjusted R-square value is higher for the model where both parents are equally included. However, to compare the models more formally, we must use a test that accounts for the fact that the models are non-nested.

5.2 Results from the J-tests

The parameter estimates of the dual care taker model indicate that the father matters for child care demand. To formally test which model specification that is to prefer, J-tests are performed (as described in section 4.1). The results from the J-tests are presented in Table 3.

Let us start with the J-test of the single care taker model. The null hypothesis is that the fitted values from the dual care taker model do not significantly contribute to the single care taker model. The test returns a t statistic for the fitted values that equals 4.46, which enables us to reject the null at a five per cent significance

Table 3: Results from the J-tests and Bootstrap J-tests

		Maintained hypothesis			
		Single care taker model		Dual care taker model	
Test	Covariate	t ratio	P value	t ratio	P value
J-test	Fitted values from competing hypothesis	4.46	0.00	-0.81	0.42
Bootstrap J-test	Fitted values from competing hypothesis	-0.02[1]	0.00	0.34[1]	0.88

Note: The models correspond to the 2SLS in section 5.1. [1]The t ratios for the bootstrap J-tests correspond to the mean t ratio.

level. Thus, we can reject the single care taker model in favour of the dual care taker model. In order to test the dual care taker model, the null hypothesis is reversed. The dual care taker model is now defined as the maintained model and the null hypothesis is that the fitted values from the single care taker model do not significantly contribute to the dual care taker model. The t statistic for the fitted values equals -0.81. This implies that we cannot reject the null hypothesis on a five per cent significance level. The single care taker model does not contribute significantly to the dual care taker model.

However, since the J-test is not exact in finite samples, the results from the tests must be interpreted with some caution. In order to obtain more conclusive results, we follow Davidson and Mackinnon (2002) and bootstrap the J-tests. The bootstrap produces an empirical reference distribution for the J-statistic under the maintained hypothesis. The bootstrap J-tests are conducted as described in section 4. 49 999 bootstrap samples have been created for each model and corresponding J-statistics and P values are calculated. The results are presented in Table 3.

First, the single care taker model is defined as the maintained hypothesis. The bootstrap P value equals 0.00, i.e., there are no bootstrap t ratios that exceed the observed value of 4.46 from the ordinary J-test. This implies that we can still reject the single care taker model in favour of the dual care taker model.

Second, we let the dual care taker model be the maintained hypothesis and repeat the procedure. We obtain a bootstrap P value equal to 0.88. This means that 88 per cent of the bootstrap t ratios exceed the observed value of -0.81 from the ordinary J-test. This implies that a rejection on a five per cent level is not possible and that the dual care taker model cannot be rejected in favour of the single care taker model.

The results from the bootstrap J-tests follow the results from the ordinary J-tests. The single care taker model is still rejected in favour of the dual care taker model while the dual care taker model cannot be rejected in favour of the single care taker model. The dual care taker model appears to be a more correct specification of child care demand in Sweden. Together with the results from the 2SLS, we conclude that the father's characteristics are important for child care demand in Sweden and that both parents' characteristics should be included in the estimations.

6 Conclusions

This paper provided empirical evidence of whether the father's characteristics should be included in the estimations of child care demand. We estimated two models of child care demand, one that includes both parents equally much and one that follows earlier research and where the only trace of the father is his annual income that is included as an other income. The parameter estimates indicated that the fathers' characteristics influence the number of hours that their children spend in subsidized child care. In addition, the J-tests and the bootstrap J-tests provided similar results; i.e., that a model specification that includes the father's characteristics in the same way as the mother's is to prefer. The results support the hypothesis that both parents' characteristics are important for the child care demand of Swedish families.

Nearly all previous studies about child care demand ignore the fact that the father's characteristics could be associated with child care demand. Most studies assume that since the father is more likely to work full time, the child care hours are determined by the mother and her characteristics and preferences. However, our results show that even though the Swedish fathers often work more hours than the mothers do, they still influence family child care demand. One possible explanation

to this is that fathers that are involved and interested in their child's care and well-being affect child care demand through their preferences, even though they have long working hours. Another explanation is that many parents divide the responsibility for leaving and picking up at preschool and some utilize flexible working hours to decrease the time that the child spends in subsidized care. The parents' wages did not affect child care demand, while their ages and origin did. This result indicates that preferences are more important than economic incentives. Since child care costs are relatively low in Sweden, and we only study families with working parents, this result is not surprising.

This study is based on Swedish data and we cannot say anything about whether the dual care taker model is appropriate for other OECD countries. However, since the employment rates of women have been increasing in almost all OECD countries, one may suspect that the dual care taker model could be appropriate for other countries as well. Estimating a single care taker model, without taking the father's preferences and leisure/labour choice into account could lead to omitted variable problems and bias. Therefore, more research in this area is needed. For example, it would be interesting to see if the fathers matter for child care demand in other Nordic countries, which have similar governmental family policies and social security system. For Sweden, now when we have determined that the dual care taker model best fits the data, a natural next step is to develop a richer model for child care demand that allows for interaction effects, and estimate the parents' labour supplies and child care demand simultaneously.

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Appendix

Table 4: Employment rates and fertility rates

	Employment rates of mothers with child under 6[1]	Total fertility rate[2]
Belgium	69.5	1.61
Finland	58.8	1.76
France	56.2	1.89
Germany	51.1	1.34
Greece	48.6	1.27
Italy	45.7	1.29
Netherlands	60.7	1.75
Norway	72.8	1.80
Spain	41.8	1.29
Sweden	77.8	1.71
U.K	55.8	1.71
USA	61.5	2.07

[1]Data refers to 1999, except for Sweden and Finland where data refers to 2000 and 1998 respectively. Source: OECD Employment Outlook 2001

[2]Data refers to the period 2000-2005. Source: Eurostat

Table 5: Estimation sample

Interviewed families	1578
Exclusions:	
Parents not living together	166
Missing family status	1
Mother does not work	540
Missing mother's employment	19
Father does not work	139
Missing father's employment	149
Remaining families	867
Mother wage missing or < 50 SEK	63
Father wage missing or < 50 SEK	79
Mother working hours > 51	5
Father working hours > 51	57
Remaining families	697
Missing on other variables	14
Remaining sample for estimations	683

Table 6: Mode of care

	Share of families in each mode	
Mode of care	Sample 1	Sample 2
Preschool or family day care	89.9	95.1
Private care taker in own home	0.4	0.4
Relative	0.8	1.0
Parents work and take care of child	0.5	0.6
One parent is on parental leave	5.0	0.9
One parent works from home	1.5	0.3
One parent is unemployed or on sick leave	0.9	0.1
Other	0.8	0.9
Don´t know/won´t answer	0.2	0.7
Total	100	100
N	1567	683

Data refers to the dataset "Tid och Pengar". Sample 1 consists of all families where the selected child was born in 1999, both working and not working, single and cohabiting. Sample 2 corresponds to the sample used in the analysis, see section 3.

Table 7: OLS estimation results for hours in subsidized child care

	Dual care taker model		Single care taker model	
	OLS		OLS	
Covariate	Estimate	S.E	Estimate	S.E
Family level				
Mother's marginal wage rate	-0.03*	0.02	-0.03*	0.02
Father's marginal wage rate	-0.03	0.02		
Other income	0.03***	0.01	0.01**	0.006
Siblings 0-6 years	-3.45***	0.80	-3.30***	0.82
Siblings 7-12 years	-1.35**	0.61	-1.31**	0.63
Mother's age	0.33***	0.12	0.23***	0.09
Father's age	-0.16	0.11		
Mother born abroad	3.07	2.20	0.27	2.69
Father born abroad	-11.07***	3.20		
Municipal level				
Urbanization	0.08**	0.04	0.08**	0.04
Tax base	0.06**	0.02	0.05**	0.02
Cost for child care	-0.04	0.06	-0.04	0.06
Children/staff	0.46	0.99	0.35	0.99
Children/group	-0.10	0.26	-0.14	0.25
Intercept	16.52	10.48	13.79	10.27
Sample size	683		683	
Adj R-squared	0.11		0.09	

Note: other income, tax base and cost for child care are expressed in thousands of SEK.

Standard errors are heteroscedastic consistent

*** p≤0.01, ** p≤0.05,* p≤0.1