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Statistics Norway  
Research Department

Thor Olav Thoresen

# Distributional and Behavioural Effects of Child Care Subsidies

# Papers

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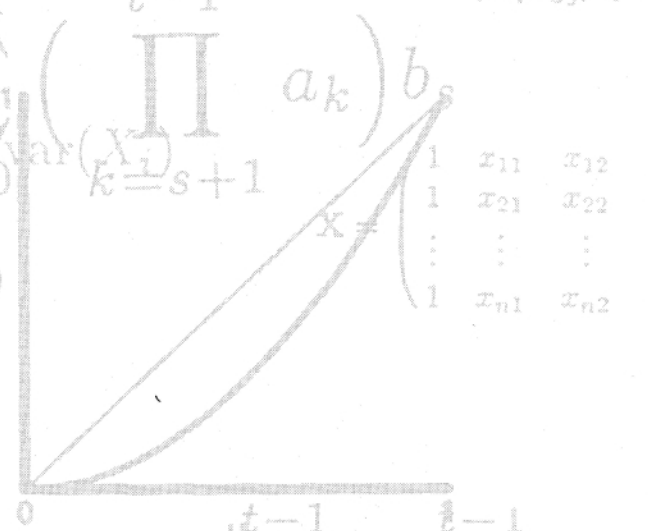
Statistisk sentralbyrå



$$+ \frac{2}{dt} \sum_{i>j} \sum_{j=1} \text{Cov}_a(X_i, X_j)$$

$$\beta = \begin{pmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_m \end{pmatrix}$$

$$\text{var}\left(\sum_{i=1}^n a_i X_i\right) = \sum_{i=1}^n a_i^2 \text{var}(X_i) + \sum_{i=1}^{t-1} \sum_{k=s+1}^{t-1} \left(\prod_{k=s+1}^{t-1} a_k\right) b_s$$



$$\text{var}\left(\sum_{i=1}^n a_i X_i\right) = \sum_{i=1}^n a_i^2 \text{var}(X_i) + \sum_{i=1}^{t-1} \sum_{k=s+1}^{t-1} \left(\prod_{k=s+1}^{t-1} a_k\right) \sum_{i=1}^n (y_i - (\hat{a}x_i + \hat{b}))^2$$

**This is corrected version of Discussion Paper no. 135. Figure 6.2 was incorrect in the previous version. Nothing but this figure has been changed.**

*Thor Olav Thoresen*

## **Distributional and Behavioural Effects of Child Care Subsidies**

**Abstract:**

A methodology to describe the distributional and behavioural effects of child care subsidies is presented within a micro simulation framework. We discuss the effects of changing the governmental policy to support families with preschool children, from today's subsidisation of spaces at child care centres to an equal cash transfer to all families with preschoolers. In the decision model applied (Michalopoulos et al. 1992) the mother chooses consumption, market time and average quality of child care. The model is adjusted to the Norwegian child care market and data for mothers who both are employed and receiving child care subsidies (1990) are used, since this group of mothers is assumed to respond most to the reform. Weaknesses in data and simplifying model assumptions imply that the results must be used with caution. Results from our simulation experiment do not indicate any large decrease in mothers labour supply, when altering the transfer system. The reform will give a substantial decrease in inequality among households with preschoolers, since the child care subsidies very much favour well-off households.

**Keywords:** Child care, distribution, household behaviour, inequality, labour supply, micro simulation, subsidies.

**JEL classification:** C81, D31, D63, H23, J13, J22.

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# 1. Introduction

Approximately 35 per cent of all Norwegian children aged 0-6 years attended child care centres by the end of 1990. In spite of governmental programs, for many years aiming at increasing the supply of child care services, there is still an excess demand for child care services. There are however large regional variations. But in most municipalities in Norway the number of slots available at child care centres is not adequate to meet the demand for nonparental care at existing subsidized rates. In 1990 the child care centres costed more than five billions Norwegian kroner (Statistics Norway 1992). We will return to a further description of the Norwegian child care market in section 2.

Governmental and municipal transfers to families with children contribute considerably to the economic welfare of households with small children. In this study we focus on the distributional impact and behavioural effects of child care subsidies. In most areas of Norway spaces at child care centres are still rationed. In Thoresen (1992) it was shown that governmental and municipal transfers to spaces at day care centres in Norway are very much in favour of the well-off households, using data from 1990. When included in the income concept, the subsidies make a substantial contribution to inequality.

This paper puts the child care subsidies into a micro simulation approach, using the same data from 1990 as Thoresen (1992). Any change in the subsidies will presumably affect the households' labour supply and, thus, the demand for child care. When discussing the indirect effect of child care subsidies, we employ a structural model (Michalopoulos et al. 1992) in which the decision to purchase market child care, the quality purchased and the decision to work is made simultaneously. Until recently, very little research by economists has provided useful guidance for policymakers (Blau 1991). In spite of substantial efforts to simulate how women will respond to various policies the last decades, very few studies have included effects from the child care market. The pioneering study in the economics of child care is Heckmann (1974), who recognized that a majority of working women with young children used informal methods of child care, like family members or other relatives. In Norway the first Act on child care institutions was passed in 1975 and in 1982 independent initiators were allowed to provide child care services (Løyland and Ringstad 1994). Thus, the issue of child care policy is a fairly new subject, which also explains the lack of analyses. Blau (1991) provides a good overview over how different policy issues can be elucidated by economic modelling.

The structural model is adapted to simulate the effect of an alternate policy towards households with preschool children - the cash alternative. The cash alternative is different from the present system in that the parents of all preschoolers are eligible to a certain cash subsidy, where as the subsidization of child care services only affect those who obtain a child care space. We focus on the government's instruments in policy making and therefore restrict the analysis to governmental subsidies. The model is in accordance with the approach used by Aasness and Li (1993). In section

3 we will present the model. The estimation of the behavioural model and the simulation experiment are described in section 4, where we also focus on data quality and the econometric approach.

Furthermore, child care subsidies are transfers in-kind. Transfers in-kind involves a valuation problem, which is discussed in further detail in Thoresen (1992). Here, we simply assume that the value of the transfer corresponds to the government's expenses on the service.

The distributional impacts of the transfers are analysed by the use of the tax-benefit model LOTTE. The database or the model population is derived from the latest yearly Income and Wealth Survey (IF). Data is collected from income tax returns, social security registers, other administrative registers and by interviews. The Income and Wealth Survey does not contain any information about the households' consumption of institutional day care. However, one subsample of IF 1990 is also contained in the Survey of Level of Living 1991, which gives information on day care, costs, etc. This subsample, which consists of about 3750 individuals supplies us with information about child care for about 700 households with preschool children. The conversion into population totals is done by employing a method for calibration of weights in sample surveys (Heldal 1992). This method takes care of the nonresponse in the Survey of Level of Living.

The main scope of LOTTE has been to give estimates of the budgetary and distributional consequences of changes in taxes. The model has recently been extended to include various social security transfers such as the old-age pensions, sickness benefits, maternity benefits, etc. In LOTTE there are no behavioural changes in response to changes in taxes and transfers. The tax-model calculates the direct effect without incorporating any influence on earned income. This might be sufficient when measuring the effect of small changes in tax rates, for instance. To evaluate the effect of child care subsidies, the possibility of substantial behavioural effects should be included in the analysis. The term micro simulation refers to the behavioural model analysis, which is added to the direct effect analysis.

We will keep the analysis of the direct effect and the indirect effect separated. Even if our analysis of the indirect effect involves the use a specified utility function we do not bring utility directly into consideration in the evaluation of the distributional effect. We do not estimate individuals' "ability to pay" but assume that individuals with the same observed characteristics, such as income, can be deemed to have the same level of welfare. Efforts to measure economic well-being require, however, some adjustment of income to take account of needs. Most studies of inequality and distributional effects use the households' total income as the point of departure, due to the interdependency among members of households. We compare the income of households by employing equivalence scales to measure the variation in income needed to bring households of different composition to the same welfare level. There is a wide spectrum of equivalence scales, based on different approaches, and the choice of scale can considerably affect the degree of inequality and the transfers' contribution to inequality. These questions and other methodological issues are discussed in further detail in section 5.

In section 6 we present the distributional effect of child care subsidies and describe how the overall inequality changes when the support system is altered to an equal cash-transfer system.

## **2. Child care services in Norway**

For a long period there has been an increase in female labour supply, especially among women with small children. When more women take paid work, the demand for proper child care increases. The market for child care is, however, rationed and only a part of the preschool children attends day care centres. Some children are cared for by their grandparents and some parents employ a childminder from the unregulated (and nonsubsidized) part of the market. Only parents of the children attending child care centres receive subsidies from the government, and this has caused a focus on the unfairness of the policy towards families with children. Child care centres are attractive because parents get access to a pedagogical, reliable service for their preschoolers while they can consume more leisure, do more hours of household work or supply more paid work.

In addition, there are large differences between municipalities in the probability of getting access to child care institutions. There are also substantial differences between municipalities in how much the payments from parents cover. On average, the child care fees cover about 35 per cent of the actual expenses connected with institutional child care (Ergoplan 1992). With only a smaller part of the households getting access to child care, the fairness of child care subsidies has been discussed. Some has argued that a more adequate way of supporting families with preschool children is to give all families an equal amount of cash, independent of their utilization of child care services. This way of support is referred to as the cash alternative in the simulation below.

The distinction between the subsidized and the unsubsidized child care market in Norway is not clear cut. Recently there have been a growing number of childminders receiving public subsidies. They take care of 3-5 children, their services are approved by the local authorities and they receive pedagogical guidance from a teacher. The term child care centre also includes subsidized services in the homes of regulated public caregivers.

Most child care centres are either owned by the municipality or by private organisations. The general principle is that expenditures are financed from three sources:

- government transfers (not included in the general transfer to municipalities)
- municipal transfers
- parental payments

In practice all child care institutions are subsidized by the government. All child care centres owned by the municipalities will receive support from local governments, and some private child care institutions are subsidized by the municipalities too. Others are financed through governmental

subsidies and the parental fee only. About half the centres owned by municipalities charge fees subject to family income. The governmental transfer is calculated per child and is dependent on the age of the child. Laws and regulations entail higher costs on smaller children and child care centres in Northern Norway get additional subsidies. The government aims to cover about 40 per cent of the operational expenditures and let parents and local authorities share the remaining 60 per cent equally (Department of Administration and Consumer Affairs 1987). Table 1.1 presents the governmental subsidies to child care for 1990.

**Table 1.1 Governmental subsidies per child to day care in 1990. NOK**

Hours in day care centres per week	Age	Subsidies per year	Subsidies per year in North-Troms and Finnmark
6-15	0-6 years	3 090	3 400
16-20	0-6 years	5 770	6 340
21-30	over 3 years	7 030	7 850
21-30	under 3 years	9 470	10 500
31-40	over 3 years	12 640	14 080
31-40	under 3 years	20 150	22 330
41 and more	over 3 years	15 700	17 400
41 and more	under 3 years	23 110	25 600

The households have to apply for access to institutional day care for their children and selection criteria vary dependent on ownership and among municipalities. Municipalities usually formulate criteria for child care services that they partially finance and will generally attach importance to social circumstances, such as low income, single parents, etc. Private centres (which are subsidized by governmental transfers) state their own rules for selection.

Thoresen (1992) estimated the total distributional effect of the public subsidies to day care, including both governmental subsidies and transfers from municipalities. As discussed above the municipal subsidies are only given to some child care centres in the community. The focus here is on governmental subsidies. From the Survey of Level of Living we get data on what type of child care the household utilizes and for how many hours per week the child attend the service. These data with information about the age of the child, enables us to simulate each child's subsidy, based on rates from table 1.1.



### **3. Modelling child care demand and labour supply<sup>1</sup>**

#### **3.1. A structural model for labour supply and child care consumption**

The main purpose of the behavioural part of the analysis is to establish a framework in order to simulate the effects of changing the present system of support for families with preschool children, i.e. to simulate the effects of the cash alternative. As will be apparent below, when replacing the present subsidies with a system of cash transfers, one might expect that some employed mothers prefer to stay at home and take care of the children themselves, due to the increase in child care expenses. Hence, we will focus only on those mothers who are working and whose children attend child care centres.

We start from a demand system in which the shares of consumer expenditure on various classes of goods and services are related to total expenditure and to relative prices. The model presented below is based on the assumption that family members make choices regarding consumption of child care quality, consumption of market goods and consumption of leisure. Choices are made to maximize family well-being. The model is solved for the optimum amounts of these variables as functions of their "exogenous" determinants, which are the parents' wage rates, family nonwage income, the price of child care, etc.

There is an extensive amount of literature on labour supply and female labour supply in particular (see e.g. Killingsworth (1983), Killingsworth and Heckman (1986), see also Dagsvik et al. (1986) for an analysis with Norwegian data ). The relation between wages and employment is not clear-cut and there are a variety of estimates of wage elasticities. Some studies have estimated the behavioural effects on various family decisions of changes in income, wage rates, and the price of child care. Blau and Robins (1988) estimate the child care price elasticities for married women with respect to labour supply and to the demand for purchased child care, based on a reduced form approach, that is, a model without imposing any structure on the distribution of preferences (functional form for utility). The results (US data) suggest that both the decision to become employed and the decision to purchase market child care are sensitive to child care costs. The estimated price elasticity with respect to employment is -0.38 while the estimated price elasticity with respect to market care is -0.34. Connelly (1992) similarly examines the effect of child care costs on the probability that married women with children will participate in the labour market. The elasticity of the probability of participation due to a change in the average cost of child care is -0.20, when evaluated at the mean values of probability and child care cost. Michalopoulos et al. (1992) found median Cournot elasticities for hours worked with respect to wage and nonlabour income at 0.0353 and -0.013, respectively.

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<sup>1</sup>The following model is based on Michalopoulos et al. (1992) and adapted to the Norwegian child care market.

If one begins from a general linear formulation of demand and imposes the theoretical restrictions of adding up, homogeneity and symmetry, the model known as the linear expenditure system emerges (Deaton and Muellbauer 1980). This functional form is widely used in studies of demand. Linearity refers to the linear relationship between the expenditure functions and prices and total expenditure, but the model is nonlinear in its parameters. The structural model to derive parameters specifies the intensity of the relationship between the exogenous variables and the endogenous choice variables. The economic model is closely linked to an underlying theoretical framework and is suitable for the simulations of changes in exogenous variables.

We assume that a mother with preschoolers will make decisions about consumption, labour supply and child care quality. The minimum quantities (subscript 0 in the model below) are bought first and the residual expenditure is allocated between goods in fixed proportions,  $\beta_i$ . The decision problem can be presented as follows (Michalopoulos et al. 1992):

$$(1) \quad \max_{f,x,h,Q} \{ \beta_1 \log(x-x_0) + \beta_2 \log(h_0-h) + \beta_3 \log(Q-Q_0) \}$$

subject to

$$(2) \quad px + (1-f)\alpha Q_c h = wh + E$$

and

$$(3) \quad TQ = h[(1-f)Q_c + fQ_f] + (T-h)Q_h$$

- x = consumption of goods other than child care;
- h = market time of the mother;
- Q = average quality of child care;
- p = unit price of the composite commodity x;
- w = net wage rate of the mother;
- E = effective nonlabour income (including earnings of others in the households);
- $Q_c$  = quality of subsidized care;
- $Q_h$  = quality of care provided by the mother;
- $Q_f$  = quality of free care available to the mother;
- f = 1 if free care is chosen and f=0 if subsidized care is utilised;
- T = total time available to the mother;
- $\alpha$  = the price of subsidized care per unit of quality;
- $\beta_1, \beta_2, \beta_3$ , are parameters such that  $\sum \beta_i = 1$ ;
- $x_0, Q_0$  and  $h_0$  are "minimum" consumption of other goods, minimum consumption of child care quality and maximum hours of working hours, respectively.

*The model is based on the following assumptions:*

- 1) It is assumed that the actions of other members of the family are exogenous to the decisions of the mother. This assumption is very common in models like this but is only valid when family labour supply decisions are made sequentially. Mroz (1987) gives some evidence that the husband's income is exogenous.
- 2) We assume that all of the mother's leisure time is spent caring for her children at home, which implies that there is no distinction between leisure and home production of child care. The model would have been far more complicated if home production was incorporated.
- 3) Free care is available to a working mother when she works. This assumption says that usually there are grandparents or older siblings to take care of the children. Even if hardly any preschoolers are left alone during the work day, this is a final option.
- 4) The quality of care is of course unobserved, but in order to identify parameters in the model we assume that the quality of paid care is independent of type of market care. It is assumed that laws and legislation ensure that numbers of staff per child, quality of staff, etc., are fairly equally distributed among the children who attend the service. Thus, quality per hour is normalized to one.

Equation (1) says that the mother will at least consume  $x_0$ , she (or the parents together) defines a minimum acceptable quality of child care ( $Q_0$ ), which varies across families and may be less than or equal to the quality of care provided by the parents and  $h_0$  is the maximum working hours. The mother derives utility from consumer goods, leisure and child care quality. It is assumed that the mother's leisure time is spent caring for her children at home and partially (not including any quality aspects) this gives her positive utility.

The first constraint (equation (2)) is the budget constraint. The second constraint (equation (3)) defines the average quality of care. Since we treat  $f$  as a continuous variable, the mothers can choose various shares of free care and subsidized care. But a mother will use the services so that marginal utility is equal to the price, which implies that she will utilise both categories of care if the price of market care also is zero, or there are substantial differences in the quality of free care and care in child care centers. Thus, we can't rule out the possibility that mothers' use both types of care. Nevertheless, in order to simplify the problem, we assume that the only type of nonmother care is market care and  $f=0$ .

We are only able to estimate the proportional relationship between the  $\beta$ s, not their levels. Hence, they are normalized to sum up to one. It can be shown (see e.g. Deaton and Muellbauer 1980) that to make the cost function concave, the  $\beta$ s have to be positive. There is, however, no requirement that  $x_0$ ,  $h_0$  and  $Q_0$  be positive.

The decision problem is solved employing the Lagrange method (appendix A gives a more detailed deduction of the first order-conditions). The first-order necessary conditions of optimality for a mother who chooses both to work and purchase child care are:

$$(4) \quad \frac{\beta_1 \alpha}{p(x-x_0)} = \frac{\beta_3}{T(Q-Q_0)}$$

$$(5) \quad \frac{\beta_1(w - \alpha Q_c)}{p(x - x_0)} = \frac{\beta_2}{h_0 - h} + \frac{\beta_3(Q_h - Q_c)}{T(Q - Q_0)}$$

$$(6) \quad px + \alpha Q_c h = wh + E$$

Condition (4) implies that money spent on consumer goods and child care equalizes the subjective evaluation of the marginal utility of the last amount of money spent on these goods. Condition (5) says that in optimum the loss in utility from an additional hour of work is exactly offset by the gain in utility from the additional consumption of market goods made possible by the additional earnings plus the loss (or gain) in utility from substituting nonparental child care for parental child care. Note that the actual wage, in this model is wage minus hourly child care expenses ( $w - \alpha Q_c$ ). Thus, in addition to the usual equivalence between marginal utility of consumption and marginal disutility of labour supply, this model includes the impact of child care arrangements. Market time is also associated with additional use of nonmother care, perhaps of an inferior quality than mother care. It is not presumed that purchased care is less than, equal to, or greater than child care provided by the mother, but mother's care must be equal or greater than minimum care. Since the model implies that average care must be equal to or above the minimum acceptable level of child care, purchased care might be of lower quality than minimum acceptable care, if mothers' care is of greater quality than the minimum acceptable level. Condition (6) is the budget constraint.

Equations (4), (5) and (6) define the optimum child care quality, consumption and labour supply for the mothers with preschool children. If we for a moment turn to a general utility maximization problem, using a Stone-Geary approach, the solution to the maximization of a Stone-Geary utility function lead to the following system of demand-functions:

$$(7) \quad x_i = \gamma_i + \frac{\beta_i}{P_i} \left( y - \sum_{k=1}^n P_k \gamma_k \right)$$

where  $\gamma_i$  is the minimum quantities.

Correspondingly, the system of demand-functions to the child care optimization problem is given by the following relations. Appendix B gives a more detailed deduction.

$$(8) \quad x = x_0 + \beta_1 \frac{I^*}{p}$$

$$(9) \quad Q = Q_0 + \beta_3 \frac{I^*}{\alpha T}$$

$$(10) \quad h = h_0 - \beta_2 \frac{I^*}{w^*}$$

where  $I^* = E + w^*h_0 - px_0 + \alpha T(Q_h - Q_0)$   
and  $w^* = w - \alpha Q_h$

$I^*$  represents the "supernumerary expenditure" (Deaton and Muellbauer 1980), the income that can be used on goods, leisure and child care when "minimum" consumptions are subtracted.  $w^*$  is the shadow wage, after deducting the implicit price of home care. The expression for the shadow wage is deducted by using the relationship between the marginal utility of income and the marginal utility of quality ( $-\lambda_1 \alpha = \lambda_2$ ).

Since we focus on employed mothers with expenditures on child care, the following equations bring expenditures on purchased care explicitly into the demand system, where equation (11) is the demand for subsidized child care.

$$(11) \quad Z_q = \alpha h Q_c = \alpha [h_0 Q_h - T(Q_h - Q_0)] + I^* \left( \beta_3 - \beta_2 \frac{\alpha Q_h}{w^*} \right)$$

$$(12) \quad Z_h = wh = wh_0 - \beta_2 I^* \frac{w}{w^*}$$

$$(13) \quad Z_x = px = px_0 + \beta_1 I^*$$

The equations above reveal that we must make assumptions about  $T$  and either  $\alpha$  or  $Q_c$  to estimate the demand system. As explained above, we will assume that the quality in child care centres is equal for every child attending the service and  $T$  is total time available to the mother, which we assume is 16 hours per day (as Michalopoulos et al. (1992) also do).

### 3.2. Some implications of the model

As explained above, the  $\beta$ s must be positive in order to get results in accordance with constrained utility maximization. Since we also assume that the mothers only observe a single quality level in the child care market, the mothers are not able to choose another market care quality when there are changes in exogenous variables. They can, however, reduce their labour supply and provide more child care at home. Our purpose is to check to what extent they will choose to decrease their labour supply when the present subsidies are replaced by an equal cash transfer.

From the equations (8), (9) and (10) we can derive the uncompensated elasticities of hours worked ( $h$ ), quality of purchased child care ( $Q_c$ ), and expenditures on child care ( $\alpha Q_c h$ ) with respect to the wage and nonlabour income. The Cournot elasticities for hours worked with respect to nonlabour income, wage and prices on child care quality are given by

$$(14) \quad El_E h = -\frac{\beta_2 E}{w^* h}$$

$$(15) \quad El_w h = \frac{\beta_2 w}{h} \left( \frac{I^*}{w^*} - \frac{h_0}{w^*} \right)$$

$$(16) \quad El_{\alpha} h = \frac{\alpha \beta_2}{h} \left[ \frac{(Q_b h_0 - T(Q_b - Q_0))}{w^*} - \frac{Q_b I^*}{(w^*)^2} \right]$$

It can be shown that the  $\beta$ s must be nonnegative in order to secure concavity of the cost function and a solution to the constrained utility maximization problem. (14) shows that as long as  $\beta_2$  is positive, leisure is a normal good and an increase in nonlabour income will give a reduction in labour supply. (15) displays the two contradictory effects of an increase in wages. The substitution effect will partially lead to an increase in labour supply, while the income effect will partially give a reduction in labour supply.

Equation (16) can be rearranged to

$$(17) \quad El_{\alpha h} = \frac{\alpha \beta_2}{h w^*} \left[ Q_h \left( \frac{p x_0}{w^*} - T - \frac{E}{w^*} - \frac{\alpha T (Q_h - Q_0)}{w^*} \right) \right]$$

One cannot a priori decide upon the sign of  $El_{\alpha h}$ . From (17) we see that large nonlabour income and large difference between quality of home care and minimum child care, will partially lead to a reduction in labour supply, while large minimum expenditures on other goods lead to an increase in labour supply. We expect (17) to be negative for most mothers.

The response to an extensive, large reform that makes market care more expensive and increases nonlabour income cannot be captured simply by analyses of marginal effects. Thus, we execute a simulation experiment to predict the responses to the comprehensive changes.

## 4. The behavioural effect of a new support system for families with preschool children

### 4.1 Calculation of child care subsidies and cash transfer

Before we present results from the estimation of the structural model, presented above, we explain how the subsidies and the cash transfer are calculated. When including child care subsidies in the income concept, we enter the valuation problem of in-kind subsidies (see e.g. Smeeding 1984). There are several methods to value in-kind subsidies. When examining the distributional effect of child care subsidies we do not focus on any production and consumption externalities. Thus, the government's outlay on child care is the point of departure. Part of this transfer is returned to the government by income taxes (levied on the staff at the centres) and various indirect taxation, which indicates a lower value of the subsidy than is actually transferred. We do not incorporate such reductions in the transfer, but assume that the subsidies are distributed according to table 1.1 above.

As reported in state documents (Department of Children and Family Affairs 1992) the expenses on child care subsidies for 1990 reached 1 920 millions NOK. When performing a calculation of national figures for child care subsidies by the tax-benefit model LOTTE, it hits below these figures and this is mainly due to two conditions:

- 1) The child care coverage in our material is 32.5 per cent, which is below national figures (35.9 per cent).
- 2) The respondents are asked how many hours per week their children attend day care centres. These estimates do not correspond to the opening hours at the centres, which the state subsidy is based on. Thus, a simulation of state subsidies founded on information from this questionnaire would undervalue the total transfer.

Using results from Gulbrandsen and Blix (1993, p. 23-24), we estimate the average difference between actual use of the service and the opening hours to 6.5 hours per week. When taking account of the weaknesses in the data, the model gives a total transfer to child care on 1 840 millions for 1990, which is about 4 per cent below the figures from the state accounts.

The average transfer received, in the data set, is about 12 754 NOK (estimated standard error is 605), which is lower than actual subsidies, due to weaknesses in the data, but is still a substantial amount of money. The average expenditure on child care at child care centres (parents' payments) is 15 094 NOK (estimated standard error is 820) in our material.

## 4.2 Estimation of the structural model

Since we only focus on the subsample of mothers whose children attend child care centres, we do not have to bring the selection problem into consideration. There are methods (see e.g. Heckman 1979, Maddala 1983) to counterbalance biases in a material caused by truncated variables. In this analysis we are only interested in how mothers who are employed and receive subsidies would react to changes in the way of supporting households with small children. Mothers, who do not work, or utilize other nonsubsidized categories of care will not observe any change in prices. They will only get a cash transfer, which might give a decrease in labour supply for those who are working (since leisure is assumed to be a normal good), but we will not bring these effects into consideration here. Mothers who use child care centres might reduce their labour supply considerably in response to another support model. The average household who used to pay 15 094 NOK for their child care are now due to pay 27 848 NOK for the same service.

As marginal tax rates are generally believed to influence behaviour, we adjust wages in order to include the tax system in the analysis. Wages are defined as wages net of marginal tax rates. Due to progressivity in the tax system, the budget constraint is not linear, at best piecewise linear. Thus, the marginal tax rate is endogeneous because of the link to hours in work. To deal with this endogeneity problem, we follow Michalopoulos et al. when they define marginal tax rates under the assumption that the mothers worked normal hours (37.5 hours a week in Norway). Future work with this model must include checking the effect of using different proxies to the endogeneity problem, as instrument variables for instance.

To make the linear budget constraint tangent to the nonlinear budget constraint, the budget constraint actually observed by the mothers, we adjust nonlabour income. Under proportional tax rates the budget constraint is

$$(18) \quad px + \alpha Q_h h = wh(1 - \tau) + \hat{E}$$

where  $\tau$  is the marginal tax rate. In reality the Norwegian tax system is progressive



$$(19) \quad px + \alpha Q_c h = (wh - IT) + E$$

where IT is total income tax. Combining the two expressions yields

$$(20) \quad \hat{E} = wh\tau - IT + E$$

Accordingly, when estimating the model, we have replaced E with  $\hat{E}$ . There is also a deduction in income for real expenses to child care. In 1990 this deduction was limited to 17 500 NOK for one child and 21 000 NOK for two or more children. We do not believe that this deduction is very influential in the decision process and the prices of child care are not corrected accordingly. Neither do we bring into consideration that some households are observing income dependent prices. The main reason for this is that the prices are dependent on income in previous years. Thus, the labour supply decision will only influence on future prices of child care and we do not bring intertemporal elements into the model.

Single mothers with preschool children observe other transfers than married and cohabiting parents. A major part of these transfers is reduced if the mother works. Thus, single mothers observe a different budget constraint. Our data set is not large enough to do separate analysis for lone mothers, but this problem is reduced when we only considering working mothers. We will expect the situation of working lone mothers to be more similar to that of working married mothers.

It can be assumed that the expenditure system has additive error terms (Biørn 1991). We then have

$$(21) \quad Z_x = px_0 + \beta_1 I^* + u_x$$

$$(22) \quad Z_h = wh_0 - \beta_2 I^* \frac{w}{w^*} + u_h$$

$$(23) \quad Z_q = \alpha [h_0 Q_h - T(Q_h - Q_0)] + I^* \left( \beta_3 - \beta_2 \frac{\alpha Q_h}{w^*} \right) + u_q$$

As discussed above, we assume that child care quality per hour is equal to one. This normalization will only influence upon the size of the quality parameters, not their mutual relationship, which is of importance to the model solution. To identify  $Q_0$  we also have to make an assumption about T, total time available to the mother. This is done, very simply, by multiplying number of days in the year by 16 (available hours per day).

We assume that the error terms have zero means, conditional on exogenous variables. The errors need not be normally distributed. The program (SAS) minimizes a sum of squares function employing the Gauss-Newton method. A covariance matrix of the errors is iteratively reestimated from the residuals produced by the current parameter estimates in order to improve estimates. There is a stop criterion for judging convergence of parameter estimates weighted by the covariance matrix.

### **4.3. Data**

As outlined above we utilize data from the Survey of Level of Living 1991 in combination with data from the Income and Wealth Survey 1990. The Survey of Level of Living provides information about hours in day care per week and expenditures for each child in the household, while the Income and Wealth Survey gives a fully detailed income tax return for each person in the sample. The Survey of Level of Living is an interview based survey, where one person in the household informs about herself/himself, the partner and the family. In the following we will discuss some weaknesses in data.

The model assumes consistency between hours of child care and working hours, since it is supposed that only one type of nonmother care is utilized. This is not necessarily true in practice and data confirm discrepancies between working hours and number of hours at day care for some mothers. We use the hours of care per week and the expenditures to assess the price of purchased care per unit of quality only and assume that the children are at child care centres as long as the mother works.

The main problem is to estimate the mothers' wage rate. As reported by Kornstad (1993) there are substantial measurement errors in this material when using the traditional method to deduce wages, which is to divide wage incomes with working hours. Hence, instead of using the traditional method, we calculate a new wage income based on their reported hourly wage rate and their working hours. Mothers' wage rates and working hours are accessible if they are the interviewed persons. If their husband is interviewed, only working hours of wives or cohabitants are reported and we have to use the traditional method for that group.

The basic idea is that the information at one point of the year represents the whole year, whether it is child care expenditures or wage income. We follow Kornstad (1993) when we exclude observations with wages below 40 or above 230 NOK per hour. In order to calculate taxes and marginal tax rates we let the new wage incomes replace the wage incomes in the tax benefit model. Our wage estimation approach and the censoring of data lead to concern about the reliability of this analysis. Further work with this model will examine how sensible the results are to the wage estimation method.

Our final data set contains of 164 mothers with preschool children, both working and receiving child care subsidies. Not all of them pay for the service. In fact a substantial part of the mothers,

more than expected, do not pay for their child care services (discussed in further detail in Thoresen 1992). There are reasons to believe that this is due to errors in the data registration procedures.

Table 4.1 presents descriptive statistics of the variables in the structural model. The observations are not weighted in this part of the analysis (the households were weighted in the distributional analysis) and therefore each observation contributes equally to the result below. It must be noted that children's allowances are defined as a negative tax. Consequently, the minimum nonlabour income is zero and the minimum total income tax is negative. This is just a matter of definition. Table 4.1 shows that there are substantial variations between observations.

**Table 4.1 Descriptive statistics for some variables in the estimation. 164 observations**

	Mean	Standard deviation	Minimum	Maximum
Gross wage (w)	92.18 NOK	30.04 NOK	42.86 NOK	217.33 NOK
Non labour income (E)	172 045 NOK	66 156 NOK	0 NOK	364 215 NOK
Total income tax (IT)	28 092 NOK	29 490 NOK	-25 204 NOK	145 519 NOK
Marginal tax rate ( $\tau$ )	0.43	0.09	0.34	0.58
Hourly price of child care ( $\alpha$ )	12.57	12.67	0	72.57
Working ours per year (h)	1 490	494	260	2600

#### 4.4. Estimation results

When estimating the model we let  $\beta_3$ ,  $Q_0$ ,  $px_0$  and  $h_0$  vary according to number of preschool children. There are indications that the objective function is quite flat around the minimum point and hence the parameter estimates vary little according to the choice of household characteristics included in the estimation of utility parameters. Table 4.2 presents the estimated parameters of the decision model for working mothers receiving child care subsidies. The taste parameters must be nonnegative and the quantities must be larger than the minimum required quantities, to derive estimates to our optimality problem (Deaton and Muellbauer 1980). From table 4.2 we see that not all parameters have significant values, but in the simulations below we will use the estimated values, not bringing the standard errors into consideration. Since  $\beta_1 = 1 - \beta_2 - \beta_3$ , we have an

average value of  $\beta_1$  on 0.969. The taste parameter values,  $\beta_1, \beta_2$  and  $\beta_3$ , are all between 0 and 1 and surprisingly close to the values estimated for married mothers by Michalopoulos et al. (1992), using US data. The interpretation of these results is that 96.9 per cent of full income (income after deducting "subsistence" levels) is used on consumption, approximately 3 per cent is used on child care and mothers will spend nothing on leisure.

Average subsistence level for consumption is negative, which is a bit surprising. A negative subsistence level does, however, not conflict with the theoretical underpinning of the model.

**Table 4.2 Estimated parameters by structural model**

	Parameter values and average parameter values	T-values and regression lines with T-values in parentheses (r=number of prechool children)
$\beta_2$	0.0002	0.22
$\beta_3$	0.0307	$\beta_3=0.011961 (1.64) + 0.01322r (2.35)$
Q0	1.012	$Q_0=0.639048 (9.02) + 0.262322r (6.06)$
px0	-116 590	$px_0= -583751(-2.08) + 328817r (2.55)$
h0	1 449	$h_0=1637.4 (16.78) - 132.527r (-2.23)$
Qh	1.159	15.12
Per cent px < px0	3.05	
Per cent h > h0	56.70	
Per cent Q < Q0	37.8	

To estimate Q0 we assume a value for T of 5 840. The difference between the hourly quality of mothers' child care at home (Qh) and the average minimum acceptable quality level (Q0) is positive, as expected. The quality of home care is 15 per cent above the average minimum acceptable level. Qc is normalized to one and the quality of home care is 16 per cent above the quality of subsidized care. The normalized value of subsidized care is just below the average value of the minimum level, but it is the average quality that must be above the minimum quality.

Average maximum hours of labour supply ( $h_0$ ) is about the same as the average value of working hours per year (the average of  $h$  is 1 490) and 57 per cent of the mothers are working longer hours than the "subsistence" level of leisure. This result is worrying, even if Michalopoulos et al. (1992) report a very similar result. One can argue that  $h_0$  must be interpreted as an estimate of the mean of maximum hours across individual utility functions (Michalopoulos et al. 1992) and that the model is correctly specified if one could estimate individual subsistence levels of leisure. From table 4.2 we also see that for 38 per cent of the observations the minimum child care quality is above the average quality of child care. This result is mainly due to the flat objective function around minimum and is not considered as any significant indication of failure in the theoretical approach. Minimum consumption is below consumption of goods other than child care for most observations.

In section 3.2 we derived the Cournot elasticities for hours worked with respect to nonlabour income, wages and prices on child care quality. In order to give estimates of elasticities the Cournot elasticities in section 3.2 must be adjusted according to the inclusion of marginal tax rates in our demand system. We will use the estimated (but insignificant) value of  $\beta_2$  to present median values of the mothers' reaction to small increases in nonlabour income, wages and prices of child care.

**Table 4.3 Median Cournot elasticities of hours worked with respect to nonlabour income, wage and price of child care**

$E_{Ih}$	-0.00035
$E_{lwh}$	0.000701
$E_{l\alpha h}$	-0.00008

Table 4.3 shows the median Cournot elasticities. The median effects are quite small but there is considerable variation within the group of working mothers. From table 4.3 we see that the effect of an increase in nonlabour income is negative. Hence, leisure (in fact child care at home) is a normal good for the median mother. The wage elasticity is positive which indicates that, for the median observation, the positive substitution effect more than outweighs the negative income effect. An small increase in prices on child care will give a reduction in labour supply, which is also reasonable. The overall pattern is that the effects are very small, which is mainly due to the small portion of the "supernumerary expenditure" spent on child care at home (mothers' leisure in the model).

In the next section we will use this model to show the behavioural effects of a withdrawal of child care subsidies and an increase in nonlabour income for working mothers. The direct distributional effect of this change will be demonstrated in section 6.

#### 4.4. The behavioural response to a conversion of the expenses on child care

Above we showed how marginal changes in nonlabour income, wages and prices of child care will influence the labour supply for working mothers. To illustrate how the model can be used to describe changes in policy, we use the parameter values to simulate the effect of changing the transfers to families with children. The governmental expenses on child care are removed and equally distributed per preschool child to households with preschool children. The households receive 4 267 NOK per child aged 0-6 years. This reform will give an increase in prices of child care equivalent to the subsidy, while the nonlabour income increases according to number of preschool children in the family.

The results from the estimation of the model provide parameter values that are close to or equal to zero. In the simulation procedures we employ the parameter values, not bringing standard errors into consideration. It must be emphasised that this simulation experiment is only meant to check the response of working mothers receiving child care subsidies. Thus, the selectivity problem is not making any influence on results. The model can be extended to simulate the responses of all mothers, as shown by Michalopoulos et al. (1992).

When employing the parameter values for simulation procedures, random shocks to the model parameters are generated. These random perturbations have a multivariate normal distribution based on the covariance matrix from the estimation.

In table 4.4 we compare the simulation results with pre-reform labour supply and expenditures on child care. We still normalize the quality of subsidized child care to one, as we did in the estimation above.

**Table 4.4. Hours worked and expenditures on child care in system with child care subsidies compared with system with equal cash transfer. 1990**

	Child care subsidies	Cash transfer	Change in per cent
Total hours worked	244 400	237 666	-2.8
Total expenditures on child care	2 782 978	4 721 514	69.7

The figures in table 4.4 can be weighted to national figures. Due to the insignificant taste parameter for leisure the simulation results must be interpreted with caution. Thus, to give figures of total labour supply response, might be to overstate the accuracy of the model. The interpretation here is that the simulation procedure gives an indication of the mother's response. Anyway, the model is a very simplified outline of a complex decision problem, so the conclusions will depend on the model assumptions.

The results suggest that the change in the support of families with preschool children will give a reduction in labour supply from working mothers of 2.8 per cent. The approach here implies that several mothers reduce their working time with about an hour per week on average. A more reasonable interpretation is that about 2.8 per cent of the mothers drop out of the labour market. The reduction in labour supply is larger for mothers with two or three preschool children, which is plausible, since these mothers will have a substantial reduction in effective net wage under the new transfer system.

The child care expenditures will rise with about 70 per cent. Behind the increase in expenditures there are two opposite effects. The reduction in labour supply will give a reduction in hours at child care centres, but the change has also given a substantial increase in prices of child care and thereby increased expenditures. The rise in expenditures on child care at child care centres is artificial, since the mothers in this simulation are assumed not to turn to others types of care with perhaps a lower quality (childminders, grandparents). It is likely that some mothers will use cheaper categories of care when the prices rise. Future work with this model will hopefully make it applicable for other types of care too and make it possible to assess the response for all types of care.

The key to the results in table 4.4 is the very low valuation of nonmarket time ( $\beta_2$  is very small) among the mothers in this sample. Thus, there might be considerable disutility connected to the provision of child care at home for these mothers. There are reasons to believe that their participation in market work also is motivated by other factors than income. Some of them will still work even if child care is very expensive.

The results from this simulation experiment is important as we turn to the direct, distributional effect of changing the support to households with preschool children. The very small simulated overall response to a new cash transfer system, makes it more legitimate to perform analyses without taking account of any changes in income. Ideally, one should bring the mothers' new incomes into the analyses, when showing the distributional impact of the new cash transfer schedule. So far, we regard the behavioural effects as representing overall effects and do not take account of individual responses. We are content to say that the behavioural simulation experiment indicates that the results will only deviate marginally when bringing behaviour into the analyses of distributional effects.

## 5. Measures of inequality and methodological issues concerning comparability of individuals

To discuss the distributional effects of child care subsidies, and hence compare personal well-being, there are different methodologies. As discussed in the introduction, we will not use our linear expenditure system to derive equivalent incomes when showing the direct effect of child care subsidies. In the following we will simply assume that persons with the same income are judged equally well-off. Due to the strong economical link between members of the same household, the household is our unit of analysis. Persons belonging to the same household are dependent on each others resources and even if our data permit studies based on individual income, the analysis is founded on the households' income. Thus, it is implicitly assumed that each member of the household is equally well-off. As the income is measured on the household level we need a common metric to compare the well-being of household members of different households with different characteristics. This is a complicated issue with no widespread consensus.

According to Buhmann et al. (1988) a simple characterisation of the equivalence scale is given by

$$(24) \quad M_s = s^\theta$$

where  $s$  refers to the household size. The equivalence scale elasticity,  $\theta$ , varies between zero and one.  $\theta=0$  implies no adjustment for needs,  $\theta=1$  implies income per person. The larger  $\theta$  is, the smaller are the economies of scale assumed by the equivalence scale. The change in inequality from a change in  $\theta$  can be decomposed into a concentration effect and a reranking effect. Unadjusted income is positively correlated with household size (this is an empirical fact for Norway), and as  $\theta$  increases, the concentration effect (the change in relative spread holding rankings fixed) has an inequality reducing effect. However, the reranking effect becomes stronger as  $\theta$  increases and income and household size are negatively correlated for large  $\theta$ 's.

When focusing on the relation between the size of the household and welfare, we highlight the size of the households' influence on welfare. In fact other characteristics, as age, location, health of members, etc., generally affect the scales (Coulter et al. 1992). But Buhmann et al. (1988) demonstrate that (24) is a good approximation to most scales currently in use. By using this approach to household comparability, we are to some extent, able to check the sensitivity of choice of equivalence scales on our results.

The calculations are made on basis of distributions with same weight on each person irrespective of the size of the family to whom they belong (Danziger and Taussig 1979, Sen 1979).

We will present estimates on inequality by the Gini coefficient. An essential characteristic of the Gini coefficient is that it is decomposable in factor components, which is very advantageous when estimating the influence from transfers. The point of departure is the Lorenz-curve



$$(25) \quad L(u) = \frac{1}{\mu_0} \int_0^u F^{-1}(t) dt, \quad 0 \leq u \leq 1$$

where  $F^{-1}$  is the left inverse of the cumulative distribution function  $F$ . The Gini coefficient summarizes the information inherent in the Lorenz curve in the following way

$$(26) \quad G = \int_0^1 [1 - 2L(u)] du.$$

As demonstrated by Rao (1969), Kakwani (1977) and Aaberge (1986) the Gini coefficient is decomposable. Assume that the main variable  $Y$ , total income, is the sum of different components,

$$(27) \quad Y = \sum_{i=1}^n Y_i$$

The relation between the Gini coefficient and the components is given by the following expression,

$$(28) \quad G = \sum_{i=1}^n \frac{\mu_i}{\mu} \gamma_i$$

where  $\mu_i/\mu$  is the ratio between the means of  $Y_i$  and  $Y$ , respectively, and  $\gamma_i$  can be interpreted as the conditional Gini-inquality of factor  $i$  given the units rank order in  $Y$ .  $\gamma_i$  is called a concentration coefficient and is a measure of correlation between factor  $i$  and total income, conditional on the income units ranked in order of total income. If  $\gamma_i$  is negative, component  $i$  is negatively correlated with total income, which implies that the poorest part of the population receives an average transfer that is larger than the average transfer to the richer part of the population. If  $\gamma_i$  is equal to zero, then every household receives an equal amount of factor  $i$  and the factor holds a neutral effect.

## 6. The direct effect of support to households with preschoolers

### 6.1 The distributional effect of child care subsidies

Before we show the distributional impact of child care subsidies we give some characteristics of the households with preschool children. In table 6.1 we compare households with preschoolers attending the service with other households with preschoolers.

The most striking feature of table 6.1 is that there is no difference in average employment between the households who receive child care subsidies and the others. An explanation for this is that some households with preschoolers use other types of care, like grandparents care, childminders, etc. and both parents attend work. This result is also due to the fact that a substantial number of mothers with children at child care centres do not work outside the home. It is also worth noting that the average age of the youngest child among families receiving child care subsidies is one year above the average among families who do not receive any subsidies, which can be explained by fewer spaces at child care centres for very young preschoolers. The average disposable income is larger for households with children attending child care centres compared to the other households.

**Table 6.1. Descriptive statistics about households/families with preschool children. 1990 (697 obs.) Standard errors in parentheses**

	Households/families with preschoolers attending child care centres	Households/families with preschoolers not attending child care centres	All households/families with preschoolers
Average number of employed persons in families	1.91(0.05)	1.92 (0.04)	1.92 (0.03)
Average age of youngest child in families	3.07 (0.12)	2.0 (0.09)	2.38 (0.03)
Average number of children aged 0-6 in families	1.46 (0.04)	1.33 (0.03)	1.37 (0.02)
Average number of children aged 0-16 in families	2.00 (0.07)	1.89 (0.06)	1.93 (0.04)
Average number of persons in households	3.91 (0.07)	3.85 (0.06)	3.87 (0.04)
Average disposable income in households (NOK)	259 415 (6 548)	237 013 (4 409)	244 814 (3 691)

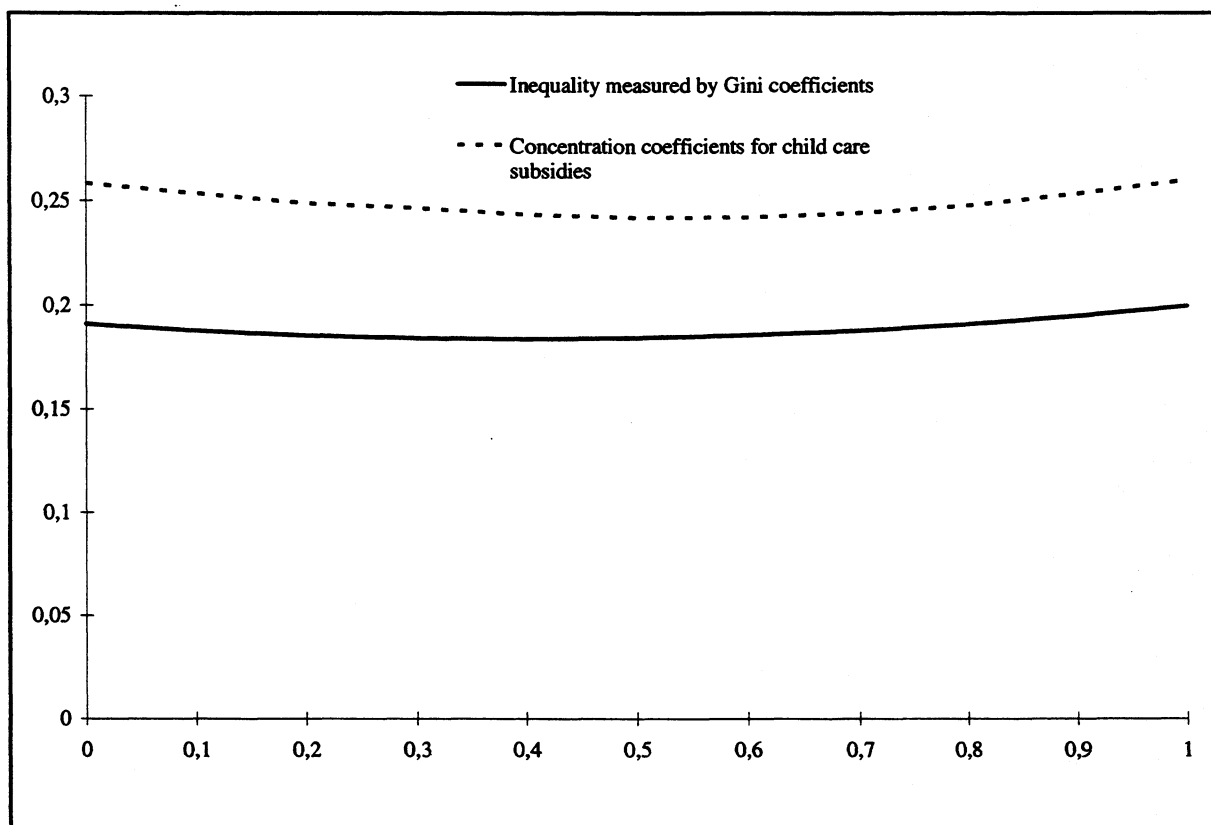
In table 6.2 we present the average level of education and the average age of mothers to preschool children. The level of education is based on a classification scheme with zero representing the lowest type of education and eight representing the highest education category. The table demonstrates that the mothers with preschoolers in child care centres are better educated than the others.

**Table 6.2 Descriptive statistics about mothers of preschool children. 1990 (697 obs.). Standard errors in parentheses**

	Mothers with preschoolers attending child care centres	Mother with preschoolers not attending child care centres	All mothers with preschoolers attending child care services
Average level of education among mothers	4.00 (0.08)	3.66 (0.06)	3.78 (0.05)
Average age of mothers	31.8 (0.3)	30.3 (0.3)	30.8 (0.2)

For the following analyses, we define extended income as disposable income plus the value of child care subsidies. Figure 6.1 shows the Gini coefficient for the extended disposable income and the concentration coefficient for child care subsidies for different values of  $\theta$  and hence different degrees of economies of scales within households. The population is households with a least one preschool child. To bring the estimated subsidies more in accordance with actual subsidies, every child's weekly attendance at child care centres is extended by 6.5 hours.

**Figure 6.1. Inequality measured by the Gini coefficient and concentration coefficient for child care subsidies with different assumptions about the degree of economies of scale. Households with preschool children. 1990**



It is questionable whether noncash income should be adjusted with the same scales as other income factors (Smeeding et al. 1993). One can argue that there are no economies of scale in in-kind subsidies. Nevertheless, the results will not be very sensitive to the value of noncash scale and thus the subsidies are divided by the same scale as cash transfers. Figure 6.1 displays how child care subsidies are unequally distributed among households with preschool children. In section 5 it was explained that a concentration coefficient equal to zero means that every household receives the same amount of subsidies. Figure 6.1 demonstrates that the concentration coefficient for day care subsidies is far above zero. In fact, the child care subsidies are more unequally distributed than total extended income. The results are only to a small degree affected by the choice of equivalence scale, which indicates that the population is very homogeneous. In order to describe how the subsidies vary according to different income levels, we bring in table 6.3 the decomposition of extended disposable income when  $M_s = \sqrt{s}$ ,  $\theta = 0.5$ . Table 6.3 shows that the well-off households receive far more subsidies than households in the lower deciles.

**Table 6.3. Mean extended disposable income (child care subsidies included) for households with preschool children decomposed with respect to disposable income and child care subsidies.**

$M_s = s^{0.5}$ .1990 (697 obs.)

Decile	Mean disposable income	Decile specific mean factor income	
		Disposable income	Child care sub-sidies
1	59727	57911	1817
2	86015	83977	2038
3	101230	99605	1625
4	111163	109347	1816
5	120866	118723	2143
6	130993	128587	2406
7	142729	139597	3132
8	155256	151386	3870
9	169221	164229	4922
10	212552	206761	5791

It must be remembered that table 6.3 only shows the distributional effect and not actual income in different income levels. Income is divided with the square root of number of household members and each observation is weighted according to the size of the household. Table 6.3 shows a strong positive correlation between extended disposable income and the subsidies. The child care subsidies in decile 9 and 10 are much higher than the subsidies received by households in deciles 1 to 5.

When total disposable income is ranked according to extended income, there is an influence from the transfer itself on the ranking of disposable income. Table 6.4 describes how average subsidies are distributed among households with preschool children ranked according to disposable income. Thus, the ranking of households in table 6.4 is based on disposable income and not extended income, as in table 6.3. In table 6.4  $\theta=0$ , which means no adjustment of income. The table demonstrates that the strong, positive link between income and subsidies is not only a result of the influence from subsidies on the ranking of incomes. Table 6.4 displays the same distributional pattern of child care subsidies as table 6.3. Disposable income (subsidies not included) is also positively correlated with child care subsidies. Table 6.4 also gives the average number of preschool children at different income levels and there are not more preschool children among the well-off households. Thus, the result is not caused by larger households at higher income levels.

**Table 6.4. The distribution of average child care subsidies among households with preschool children. 1990 (697 obs.)**

Disposable income	Child care subsidy	Average number of children aged 0-6	N
Under 100 000	5 480	1.59	20
100 000 - 200 000	4 998	1.41	100
200 000 - 250 000	3 619	1.50	131
250 000 - 300 000	5 314	1.51	191
300 000 - 350 000	7 845	1.31	131
350 000 - 450 000	8 767	1.42	97
Over 450 000	7 866	1.38	27
All	6 000	1.44	697

The positive relation between income and subsidies may be explained by the causal relation between child care and income, as described by the behavioural model above. The pedagogical, reliable service at child care centres is normally assumed to be the most appropriate type of child care for children who receive care by other adults than the parents. Hence, parents who do not get access to this service, might choose to take care of the children themselves and renounce income from working. This means that other modes of care like grandparents' care, childminders, etc., are considered to be of minor quality, are too expensive or are impossible for other reasons. Then there are parents who do not utilize organised nonparental care anyway, often arguing that preschool children get the highest quality of childhood by parents' care. The correlation between income and child care subsidies is then caused by the fact that day care lead to larger incomes, because both parents (or single-parent families) can do paid work. In table 6.1, however, we see that there are no differences between the average employment of families receiving subsidies and other families. This might indicate that there are small differences in participation between the two types of households. Nevertheless, mothers with preschool children at child care centres might work longer hours than the other group of mothers and contribute to the result that way. We cannot elucidate this question here, since we are not able to give reliable wage and working hours data for the whole group of mothers with preschoolers.

There might also be some differences in the ability to handle the bureaucratic process of applying for child care between low-income and high-income families, which may also contribute to the results in figure 6.1. About 40 per cent of the child care centres were privately owned by the end of 1990 (Statistics Norway 1991) and most of them state their own rules for selection. Hence, in the private part of the child care market there might be a larger share of well-off households. Table 6.2 shows a

substantial difference in the education level between the two groups. This indicates that there might be qualities of the selection process or/and differences in the ability to get access to spaces which leads to the observed result.

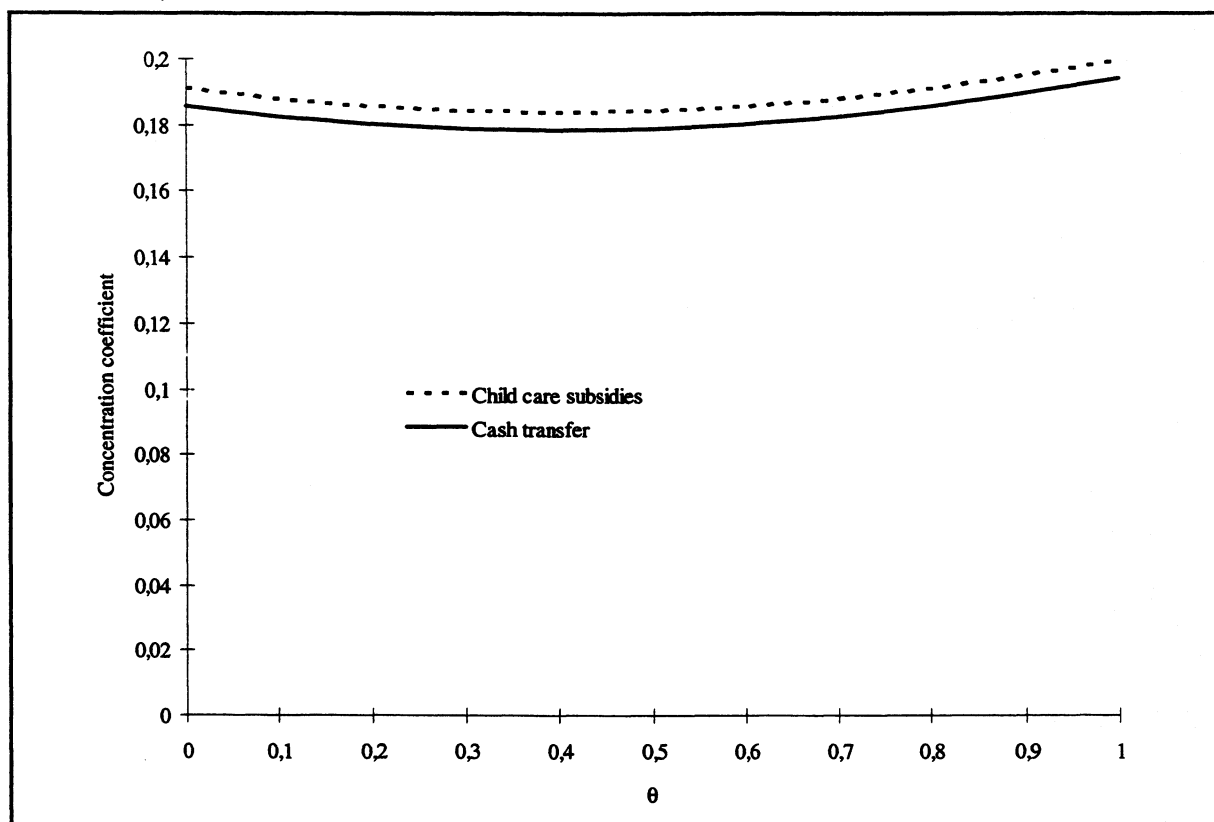
On the other hand, child care centres owned by the municipalities often give priority to children on social matters. For instance will children in single-parent families normally get access to subsidized child care. One would assume that such regulations would lead to a more evenly distributed transfer than displayed by figure 6.1, as disposable income among single-parent households is lower. In our data the coverage among single parent families is only marginally better than the coverage among other households (0.34 versus 0.29) and this group is not large enough to influence the results.

## **6.2. An alternate support system**

The distribution of child care subsidies has been and still remains a controversial political issue in Norway. There are different views on how to distribute a certain public transfer most effectively to household with small children, either through child care subsidies or through an equal cash transfer to every household. In the following we will estimate the distributional impact of changing the policy towards an equal cash transfer. We are not considering any actual proposals from political parties, but simply consider the hypothetical conversion of expenses on child care, which comprises only about 35 per cent of the households, to a transfer equally distributed per preschool child. The households receive 4 267 NOK per child aged 0-6 years.

Above it has been shown that child care subsidies are unevenly distributed. The direct effect of a change to an equal-cash transfer system will lead to less inequality, measured by a reduction in the Gini coefficient. This is documented in figure 6.2. The Gini coefficient for disposable income plus cash transfer is everywhere below the Gini coefficient for disposable income plus child care subsidies. Hence, if one changes the system of child care subsidies towards a system with equal cash transfers, this will lead to a reduction in inequality among households with preschool children, when using data for 1990. We assume that the behavioural response to the change of support system is about the same as predicted by the demand model in section 4.

**Figure 6.2. Inequality measured by the Gini coefficient when households with preschool children are supported by child care subsidies or cash transfer. Different assumptions about the degree of economies of scale. 1990**



In table 6.5 we display the incomes by deciles when  $\theta=0.5$  (see section 5 for interpretation of  $\theta$ ). The average cash transfer is larger for lower deciles, which reflect that the average number of preschool children in our material is higher in lower income levels (see table 6.4).

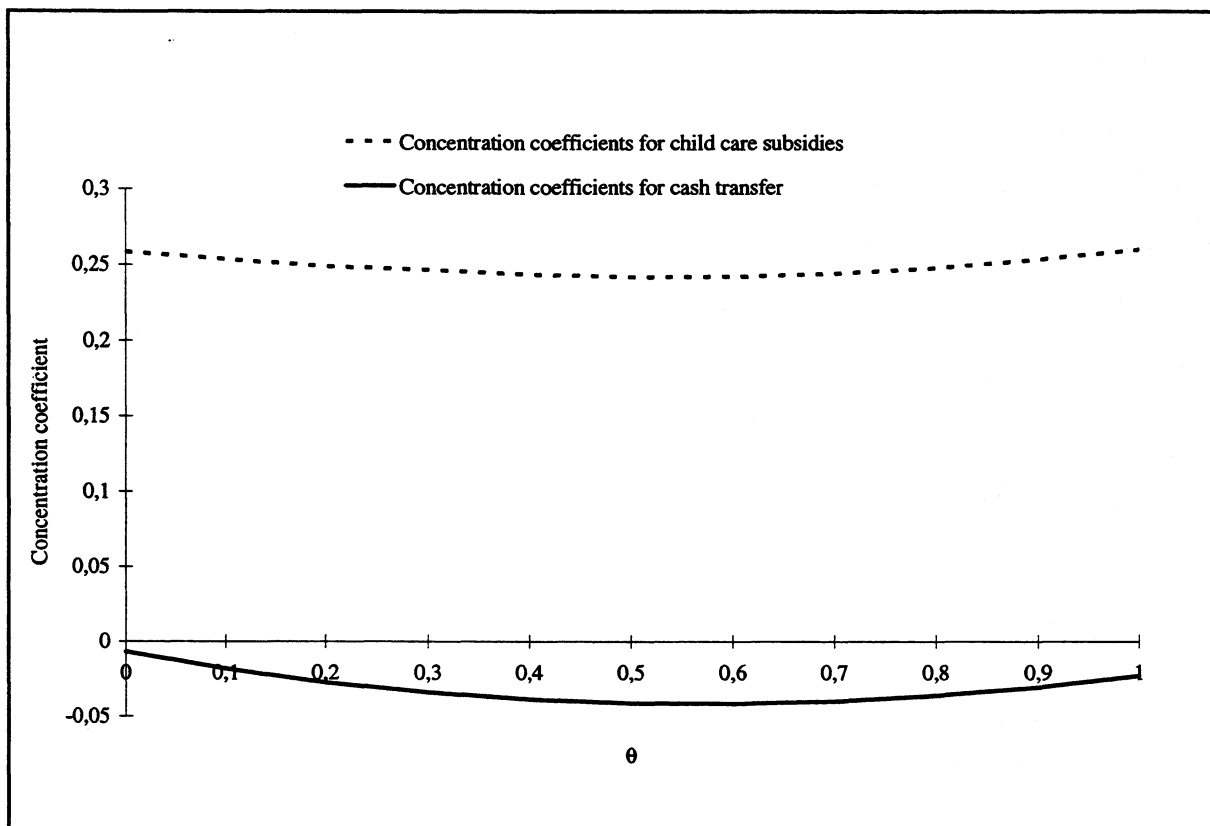


**Table 6.5 Mean extended disposable income and cash transfer when  $\theta=0,5$ . Households with preschool children. 1990 (697 obs.)**

Deciles	Extended disposable income	Cash transfer
1	60885	3426
2	87064	3236
3	102470	3096
4	112791	3258
5	121603	3143
6	131459	2887
7	142283	2974
8	153798	2671
9	167746	2791
10	210343	2770

In figure 6.3 we outline the distributive effect of the cash transfer for different values of  $\theta$  and compare it to the concentration coefficients for child care subsidies. The figure demonstrates that the results from table 6.5 are not sensitive to altering the value of  $\theta$ . The concentration coefficient is negative for all values of  $\theta$ . The results indicate that the equal cash transfer favours low-income households, which is due to more preschool children in households in lower income deciles. Thus, there is no doubt that a conversion of the in-kind subsidy into an equal cash-transfer gives a better distributional effect, which also is documented by a substantial reduction in the concentration coefficients, when comparing the two alternatives.

**Figure 6.3. Concentration coefficients for child care subsidies and cash transfer with different assumptions about the degree of economies of scale. Households with preschool children. 1990**



## 7. Conclusion

This paper has shown how a policy issue can be elucidated by a micro simulation approach. The effect of a change in the policy towards families with preschool children is brought into a decision framework of working mothers. The model is not without simplifying assumptions and deficiencies, but still gives a good theoretical introduction to the aspects of market labour, preschool children and child care.

When the policy is changed from in-kind subsidies to parts of the population to universal cash transfers to every household with preschool children, one might fear a considerable reduction in labour supply from mothers with preschool children. We assume that households receiving child care subsidies are neither rationed in the subsidized child care market nor in the labour market.

The behavioural response from the working mothers receiving subsidies is not very large. The simulation, employing a sample of mothers of preschoolers from 1990, predicts a reduction in labour supply of approximately 3 per cent. This result is mainly due to a very low valuation of child care at home for the mothers in question. However, the results of the behavioural response is based on a simplified theoretical model and there are weaknesses in data. Thus, the results from the behavioural part of the analyses must be used with caution.

We found that a universal cash transfer will give a substantial reduction in inequality, when both the in-kind subsidy and the cash transfer are included in an extended disposable income concept. The reason for this is that child care subsidies are unequally distributed and very much in favour of high income households, using data for 1990.

During the last years there has been an increase in spaces at child care centres, which gives more access to the subsidized part of the market. This will presumably reduce the very invidious distributional effect of child care subsidies. However, there are reasons to believe that many mothers will not use the service and take care of the children at home and therefore will not get the same support as other mothers. Thus, the question of distributional and behavioural effects of policies towards families with preschoolers will be important in the future. The approach presented gives a good introduction to this question and more efforts should be put in to improve the behavioural model and make the model approach more general.

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## Appendix A

We formulate the decision problem as a Lagrange problem

$$(A.1) \quad L = \beta_1 \log(x - x_0) + \beta_2 \log(h_0 - h) + \beta_3 \log(Q - Q_0) \\ - \lambda_1 [px + (1-f)\alpha Q_c h - wh - E] - \lambda_2 [h((1-f)Q_c + fQ_f) + (T-h)Q_h - TQ]$$

Maximization of utility with respect to  $x$ ,  $h$ ,  $Q_c$  and  $f$ , employing the Lagrange multiplier approach, give the following equations:

$$(A.2) \quad \frac{\partial L}{\partial x} = \frac{\beta_1}{x - x_0} - \lambda_1 p = 0$$

$$(A.3) \quad \frac{\partial L}{\partial h} = \frac{\beta_2}{h_0 - h} (-1) - \lambda_1 [(1-f)\alpha Q_c - w] - \lambda_2 [(1-f)Q_c + fQ_f - Q_h] = 0$$

$$(A.4) \quad \frac{\partial L}{\partial Q_c} = \frac{\beta_3}{Q - Q_0} \frac{\partial Q}{\partial Q_c} - \lambda_1 (1-f)\alpha h - \lambda_2 \left[ h(1-f) - \frac{\partial Q}{\partial Q_c} T \right] = 0$$

$$(A.5) \quad \frac{\partial L}{\partial f} = \lambda_1 \alpha Q_c h - \lambda_2 (Q_f h - Q_c h) = 0$$

We then get the first-order conditions for optimality for a mother who chooses both to be employed and purchase child care, that is  $f=0$ .

When  $f=0$  and  $\partial Q/\partial Q_c = h/T$ , (A.4) reduces to

$$(A.6) \quad \frac{\beta_3}{(Q - Q_0)T} - \lambda_1 \alpha = 0$$

and (A.3) reduces to

$$(A.7) \quad \frac{\beta_2}{h_0 - h}(-1) - \lambda_1(\alpha Q_c - w) - \lambda_2(Q_c - Q_h) = 0$$

$f=0$  also gives a simplified quality relation,  $TQ = hQ_c + (T-h)Q_h$ . Then (A.5) yields the following relation between  $\lambda_1$  and  $\lambda_2$

$$(A.8) \quad \lambda_1 = -\frac{\lambda_2}{\alpha}$$

(A.8) says that, in optimum for the working mother, the marginal utility of money is equal to the marginal reduction of utility caused by a small price increase on child care. Combining (A.2) and (A.6) gives

$$(A.9) \quad \frac{\beta_1 \alpha}{p(x - x_0)} = \frac{\beta_3}{T(Q - Q_0)}$$

and inserting (A.2), (A.6) and (A.8) into (A.7) gives

$$(A.10) \quad \frac{\beta_2}{h_0 - h}(-1) - \frac{\beta_1}{p(x - x_0)}[\alpha Q_c - w] + \frac{\beta_3}{T(Q - Q_0)}[Q_c - Q_h] = 0$$

Rearranging (A.10) gives (A.11)

$$(A.11) \quad \frac{\beta_1(w - \alpha Q_c)}{p(x - x_0)} = \frac{\beta_2}{h_0 - h} + \frac{\beta_3(Q_h - Q_c)}{T(Q - Q_0)}$$

(A.9) and (A.11) together with the budget constraint define the optimum child care quality, consumption and market time.

## Appendix B

From the first order conditions for maximizing of utility of income, a Stone-Geary multiplier can generally be written as

$$(B.1) \quad \lambda = \frac{\beta_i^*}{p_i(x_i - \gamma_i)}$$

where  $\gamma_i$  = is the minimum required quantities. Summing up the denominator and the numerator at the right side of (B.1) gives the following expression

$$(B.2) \quad \lambda = \frac{\sum_{i=1}^n \beta_i^*}{y - \sum_{k=1}^n p_k \gamma_k}$$

Combining (B.1) and (B.2) gives

$$(B.3) \quad \beta_i = \frac{\beta_i^*}{\sum_{k=1}^n \beta_k^*} = \frac{p_i(x_i - \gamma_i)}{y - \sum_{k=1}^n p_k \gamma_k}$$

Rearranging (B.3) leads to

$$(B.4) \quad x_i = \gamma_i + \frac{\beta_i}{p_i} (y - \sum_{k=1}^n p_k \gamma_k)$$

which is the system of (uncompensated) demand functions for a general Stone-Geary model. Applying this result on our child care decision problem we start from the first order conditions for maximum:

$$(B.5) \quad \frac{\beta_1}{x - x_0} = \lambda_1 p$$



$$(B.6) \quad \frac{\beta_2}{h_0 - h} = \lambda_1 (w - \alpha Q_h)$$

$$(B.7) \quad \frac{\beta_3}{(Q - Q_0)} = \lambda_1 \alpha T$$

(B.6) is derived by inserting A.7 into A.8 in Appendix A. In order to derive the system of demand functions (like B.4) in the case of the child care model, we must obtain an expression for the "supernumerary expenditure",  $I^* = (y - \sum p_k \gamma_k)$ .  $y$  is usually known as full income. We have  $y = \sum p_k x_k = px + (w - \alpha Q_h)(-h) + \alpha TQ$  and inserting from the quality of care constraint we get  $y = px - wh + \alpha Q_h h + \alpha Q_c h + \alpha Q_h (T - h)$ . From the budget constraint we have  $px - wh + \alpha Q_c h = E$ , which gives  $y = E + \alpha Q_h T$ . Then  $I^* = E + \alpha Q_h T + w^* h_0 - px_0 - \alpha Q_0 T$ , which after rearranging give  $I^* = E + w^* h_0 - px_0 + \alpha T(Q_h - Q_0)$ . We get the the expressions for expenditures on child care, expenditures on leisure and expenditures on all other goods, by inserting prices and "supernumerary expenditure" in the demand system associated with the Stone-Geary utility function (B.4). Remeber that  $w^* = w - \alpha Q_h$ .

$$(B.8) \quad x = x_0 + \beta_1 \frac{I^*}{p}$$

$$(B.9) \quad h = h_0 - \beta_2 \frac{I^*}{w^*}$$

$$(B.10) \quad Q = Q_0 + \beta_3 \frac{I^*}{\alpha T}$$

We get the quality of purchased care by rearranging equation (B.10) by inserting the quality constraint.

$$(B.11) \quad Q_c = Q_h - \frac{T}{h}(Q_h - Q_0) + \frac{\beta_3 I^*}{h \alpha}$$

We then get the expenditures and earned income by multiplying the demand system by prices.

$$(B.12) \quad Z_x = px = px_0 + \beta_1 I^*$$

$$(B.13) \quad Z_h = wh = wh_0 - \beta_2 I^* \frac{w}{w^*}$$

$$(B.14) \quad Z_q = \alpha h Q_c = \alpha [h_0 Q_h - T(Q_h - Q_0)] + I^* (\beta_3 - \beta_2 \frac{\alpha Q_h}{w^*})$$

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