

Aging Parents, Health Care, and the Family; Estimating a Structural Model

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May 2008

Preliminary

Abstract

We develop a structural model of inter-sibling decision making to analyze the process of informal care provision by adult children to their parents. Each child chooses the number of visits paid to parents and the amount of time actually spent on providing care, taking into account opportunity costs in terms of time and money, and the behavior of siblings. A key element in the analysis is the distinction between cooperative and non-cooperative equilibria.

A tentative data exploration using SHARE reveals that the stylized empirical facts are consistent with qualitative predictions from the model: children provide more care the larger the difficulties their parents experience in daily life; children provide less care when they live farther away and when they are more involved in paid work; and the occurrence of conflicts in families is associated with less care provided.

To estimate the parameters of the structural model we formulate the model as a discrete choice problem. Maximum simulated likelihood will be used to obtain estimates of the parameter values.

We indicate how the model can be used to assess the effects of a variety of policy measures aimed at encouraging the provision of low-cost informal care, such as compensating travel expenses, compensating informal care, changing the price of formal care, and promoting cooperative sibling behavior. One important issue is the possibility of unintended side effects, such as discouraging labor force participation.

1 Introduction

When parents age, their adult children usually face deteriorating parental health and their increased need for care. For the children, the question arises how to balance the goal of appropriately caring for parents with other goals in life, such as work and own family. Governments also face the challenge how to reconcile the conflicting goals of encouraging the provision of care for the elderly by families, and encouraging (female) participation in the labor market.

A prerequisite for designing effective policies in this area is to understand the complex decision making process at the level of individual families. Key issues in this decision process is how much non-family care to purchase in the market, possibly from a nursing home, and how much each child contributes to caring. The outcome of the decision making process depends on a large number of factors, including the labor market potential and the own family situation of each child, the costs and quality of market alternatives, the distances between the parental home and each child's home, the health status of the parents, and the nature of interactions between siblings (cooperative versus non-cooperative).

The purpose of this paper is to analyze this complex process by developing a structural model of sibling decision making. In the model, each sibling's preferences are characterized by a utility function defined over own consumption, own leisure, the number of visits paid to the parents, and the total amount of care the parents receive. Each sibling faces a time constraint and a budget constraint, which depend on the sibling's (potential) wage in the labor market, the price and quality of market alternatives for care, and the time and monetary costs of traveling to the parental home. Our model builds on Hiedemann and Stern (1999), but is fully structural, with an explicit focus on the role of (and potential welfare gains from) coordination and cooperation between siblings (Hiedemann and Stern only

consider non-cooperative equilibria).

We bring the model to the data using the SHARE survey (Survey of Health, Ageing and Retirement in Europe). In the empirical part of the current, preliminary version of the paper we verify whether the stylized empirical facts in the SHARE data are consistent with a number of qualitative predictions from the model. In the next version of the paper, we will use SHARE to estimate the structural parameters of the model. SHARE includes information on the distances between the parental and children's homes, labor market participation, number of visits to parents, amount of time spent on caring for parents, and on the nature of the relationships between parents and siblings, like the occurrence of conflicts. Sources of identification of the econometric model will include shocks in the health condition of parents between the two SHARE waves, and variation in co-payment rates for government subsidized care across and within countries and between waves. Unlike earlier literature on intrahousehold decision making, we will be able to exploit the availability of survey information on family conflicts to help distinguishing between cooperative and non-cooperative equilibria. SHARE does not contain wage and income data of the children. Therefore we use EU-SILC (European Union Statistics on Income and Living Conditions) as additional data to make wage rate predictions.

The model allows to assess the effects of various policies, such as changes in co-payment rates for formal care, and various types of subsidies to support child provided care to parents (like reimbursement of travel costs).

The paper proceeds as follows. First, section 2 discusses relevant literature on informal care giving. Then, in section 3 we specify the structural model. Section 4 discusses the strategy to estimate the parameters of the structural model. Section 5 discusses the data that are used in this study, and informally tests some of the predictions of the model. Section 6 presents the estimation results. Section 7 considers the social planner's problem. Fi-

nally, section 8 presents preliminary conclusions.

2 Literature Review

In the economic, demographic, sociological, and psychological literature on the elderly, considerable attention has been paid to the degree to which children support their (elderly) parents. Support itself is usually distinguished into instrumental support on the one hand, and social and emotional support on the other hand (Hogan and Eggebeen 1995; Silverstein and Bengtson 1997).

With instrumental support, authors refer to practical help to parents (e.g., running errands, doing household work), help with personal care (e.g., washing, bathing, caring for when sick), and financial support to parents. Research shows that children often provide practical help to their parents. Even at later ages, however, parents more often help children than children help parents (Kohli 1999). Hence, there hardly is a reversal of the flow of practical support exchange as parents age. Help with personal care is more rare, in part because the demand for such support is lower and in part because parents often seek formal channels for these types of support. Financial support to parents is rarely given by children in western societies, except among immigrants. In non-western societies, it is more common and often more obligatory that adult children financially support their parents (Frankenberg, Lillard, and Willis 2002; Lee, Parish, and Willis 1994).

With social and emotional support, authors refer to a range of things, including visiting one's parents, keeping them company, giving advice, providing comfort, and so forth. Intergenerational contact is most frequently studied (Lye 1996). Contact can be regarded as support but it is different in that contact may also yield benefits to the (adult) child. Hence, contact can be beneficial to both members of the dyad. There may be asymmetry, however, for example, when parents want more contact than the child.

Research shows that parents more often take initiative for contact than children. Moreover, one can also argue that giving of instrumental support yields benefits to the child, just like paying a visit to one's parents. Research has shown that people who give support have increased levels of well-being (Umberson 1992). More generally, contact and support probably have both costs and benefits to the child, and the balance between costs and benefits can only be answered in empirical research.

The empirical literature on support of children to (elderly) parents has focused on a large number of potential determinants. Theoretically, these determinants can be distinguished into demand and supply variables. Demand variables are characteristics of parents which indicate the degree to which parents need support of a particular child. Supply variables have to do with how much support giving costs to the child. In the sociological and psychological literature, demand variables are often called 'need' indicators and supply variables are often called 'structural' variables. Sociologists and psychologists also consider the influence of kinship norms on support, but this is less relevant in the present context (Lee, Netzer, and Coward 1994).

Demand variables probably have the largest and most consistent effects on support. For example, parents receive more support when they have health problems, when they have limited capacities for daily functioning (poor ADL scores), when they are older, and when they are no longer living with a partner (Grundy 2005; Klein Ikkink, Van Tilburg, and Knipscheer 1999; Silverstein, Parrott, and Bengtson 1995; Spitze and Logan 1989). Living with a partner is related to need for support because the partner is the prime source of giving support to an elderly person (Dykstra 1993). Further research shows that there is variation among societies in the degree to which children respond to the need of their parents, with children in individualistic countries like Sweden and the Netherlands being less responsive (Kalmijn and Saraceno 2008). Note that support increases with parental age, but

contact does not, this declines with age (Kalmijn 2007). Hence, with old age, the nature of the contact becomes more oriented toward instrumental support.

Supply variables are variables that have to do with the costs of giving support to an elderly parent. Giving support and paying a visit are time intensive. The time costs increase if support also requires traveling, which usually is the case. There are also financial costs involved, but there is little evidence that the child's income situation affects contact or support (Klein Ikkink, Van Tilburg, and Knipscheer 1999; Waite and Harrison 1992). There are social status gradients in contact and support, but these have more to do with education and less with financial aspects of status (Kalmijn and Dykstra 2006). For the giving of financial support to parents, income is obviously of central importance, but this is primarily relevant in non-western societies (Frankenberg, Lillard, and Willis 2002). In western societies, the time costs seem of much greater importance.

The clearest evidence for this comes from studies focusing on direct variation in the time costs, using distance or travel time as an indicator. Research shows a strong and consistent negative effect geographic distance on support and contact (Eggebeen 1992; Greenwell and Bengtson 1997; Grundy and Shelton 2001; Kalmijn 2006; Klein Ikkink, Van Tilburg, and Knipscheer 1999; Lawton, Silverstein, and Bengtson 1994; Spitze and Logan 1990). The effects are obviously strongest for face-to-face contact and weaker if telephone contact is also included. Nonetheless, even telephone contact is negatively affected by distance, perhaps because of the greater financial costs of calling over greater distances. The effect of distance is usually specified with a logarithmic function because a given difference in distance matters more at shorter distance than at longer distances. One of the problems with prevailing studies on the effect of distance has been that distance is endogenous. For example, longitudinal research has shown that declining parental

health increases the chances that the child moves closer to the parents (Silverstein 1995). Hence, the association between distance and support in a cross-sectional study may be the product of effects in two directions.

Weaker evidence for time costs comes from studies focusing on variation in the time budget of children. The most frequently studied variable here is women's employment. Surprisingly, most studies show no negative effect of women's employment on contact or support (Kalmijn and Saraceno 2008; Klein Ikkink, Van Tilburg, and Knipscheer 1999; Spitze and Logan 1991; Waite and Harrison 1992). Why this result does not appear as expected is unclear. It is nevertheless an important result in light of the larger debates about ageing. Several authors have pointed to the conflict there is between women's increasing economic role in society on the one hand, and the increasing need for informal support to the elderly on the other hand (Kohli 1999). At the individual level, there appears to be no such conflict-many employed women are also caregivers to their parents. How this double task affects their well-being is another matter.

Another source of variation in the children's time budget lies in the question of whether the child has own children living in the home. Several authors have hypothesized that caring for one's own children competes with the support children give to their elderly parents. This phenomenon has been referred to as the 'sandwich generation'. There is indeed some evidence that the support daughters give to parents is negatively affected by having children (Klein Ikkink, Van Tilburg, and Knipscheer 1999), but there is also evidence for a null effect (Eggebeen and Hogan 1990). A complication is that having own children in fact increases contact levels with the parent due to the grandparenting role (Kalmijn and Dykstra 2006). The strengthened tie with a parent can give occasion to an increase in support to parents, possibly in return for the grandparenting role that parents play. This may be a reason why there are no consistent effects of having children on support.

A final determinant has to do with the interaction between demand and supply, and that is the size and structure of the family. Sibsize (defined as the number of siblings of the child) can be important in two ways, depending on whether one takes the perspective of children or parents (Spitze and Logan 1991). First, parents will need less help of each individual child when they have more children. In other words, at the dyad level, support and contact may decline with family size. This result has been found in all studies that use dyads in the analyses or that analyze data from the perspective of children. The more siblings a child has, the less often the child visits the parent and the less often he or she gives support to the parent (Kalmijn 2007; Kalmijn and Saraceno 2008; Spitze and Logan 1991). The effects are even stronger for the number of adult children living at home, which is especially common in southern European countries. The more (adult) children there are in the household, the less help there is from, and the less frequent contact there is with children outside the household (Kalmijn and Saraceno 2008; Waite and Harrison 1992). Hence, children are each other substitutes for support, but resident children are the first ones parents rely on.

At the level of the family (which is important from the perspective of the parent), sibsize may have a different effect. Sibsize (or family size, when we talk about parents) may increase the chances that the parent will receive any support. After all, the more candidates there are, the more likely it is that at least someone will give support. This effect has been examined in studies which focus on support receiving, i.e., these analyze data from the perspective of parents. A positive effect on contact was found for contact (Kalmijn and Dykstra 2006) and for receiving informal help among unmarried parents (Spitze and Logan 1989). Given that the effect of family size is driven by the logic of probability, Kalmijn and Dykstra have compared the effect of family size to what one would expect. Given that

at the dyad level, the chance of weekly contact is about 50 percent, they calculate that probabilities for having weekly contact with at least one child are 75 in two-child families, 88 percent in three-child families, 94 in four-child families, and 97 in five-child families. When they compare these to the actual percentages of parents having weekly contact, they observe two deviations. First, the observed level of contact in families with one child is higher than estimated. Apparently, ties to a single child are quite strong, either because of larger investments in such a child or because the single child feels a greater responsibility toward his or her parents. Second, the observed level of contact in families of size two and above are lower than estimated. If one regards help to parents as a collective good, this lower than expected level for larger families may point to the fact that collective goods are more difficult to produce when group size increases (Hardin 1982). In other words, there can be a tendency of children to shirk their responsibilities if there are many siblings who can do the work.

3 A Structural Model

We specify a structural model to predict the number of visits an adult child pays his/her parent, and the amounts of time he or she spends on caring and on paid work. The child derives utility from leisure, consumption, the number of contacts his parents receive, and the amount of care his parents receive. The utility function is maximized subject to a time and budget constraint. In subsection 3.1 we consider the model with one adult child. In subsection 3.2 we extend the model such that two (adult) siblings are involved.

3.1 One (adult) child

Consider an adult child without siblings. The utility function and the time and budget constraints are specified as:

$$U^k = \alpha_l \log(t_l - \gamma_l) + \alpha_y \log(c - \gamma_c) + \alpha_{sf} \log(t_s + t_f - \gamma_{sf}^*) + \alpha_k \log(k - \gamma_k) \quad (1)$$

subject to

$$t_l + t_h + t_s + (\tau d + v)k = T \quad (2)$$

$$c + kp_d d = wt_h + \mu \quad (3)$$

where

t_l = leisure (hours)

c = consumption

t_s = informal care, social support (hours)

t_f = formal care (hours)

k = number of visits (per week)

t_h = labour time (hours)

d = distance to parent (return trip, km)

τ = travel time per kilometer (hours)

v = time per visit (not spend on informal care, hours)

T = total time (# hours in one week)

p_d = travel costs (per kilometer)

w = wage (per hour)

μ = nonlabor income

The Stone-Geary functional form is restrictive, but allows (with some exceptions) for explicit solutions of the behavioral equations and captures the key issues of the analysis. In a future version of the paper we will also consider more flexible functional forms.

While the amount of formal care is beyond direct control of the adult child, it depends on the amount of time he/she spends on informal care. Assume that if the child does not provide any care the parent purchases or receives F hours of formal care. If the child provides t_s hours of informal care, formal care is reduced by δt_s . So

$$t_f = F - \delta \cdot t_s, \quad 0 \leq \delta < 1 \quad (4)$$

(Note that if $\delta \geq 1$ the child would not have an incentive to provide any care.) Substitution of (4) into (1) and rewriting shows that maximizing (1) is equivalent to maximizing

$$U^k = \alpha_l \log(t_l - \gamma_l) + \alpha_y \log(c - \gamma_c) + \alpha_{sf} \log(t_s - \gamma_{sf}) + \alpha_k \log(k - \gamma_k) \quad (5)$$

with $\gamma_{sf} = (\gamma_{sf}^* - F)/(1 - \delta)$.¹ Utility is maximized subject to the time and budget constraints, and the non-negativity constraints on t_l , t_s , t_h , c , and k . We solve the maximization problem by first determining the maximum utility for each k (as k is discrete). Herewith, we distinguish between $k = 0$ and $k > 0$. If $k = 0$, it has to hold that $t_s = 0$ (one cannot give informal care without any visit). On the other hand, if $k > 0$, the hours of informal care (t_s) has to be greater than zero (if a child visits the parent with the reason to give social support, he gives at least some social support).

In case of the corner solution ($k = 0$ and $t_s = 0$), optimal time use and consumption is given by

$$\begin{cases} t_l &= \gamma_l + \frac{\alpha_l}{\alpha_l + \alpha_y} \left(T + \frac{\mu}{w} - \gamma_l - \frac{\gamma_c}{w} \right) \\ c &= \gamma_c + w \frac{\alpha_y}{\alpha_l + \alpha_y} \left(T + \frac{\mu}{w} - \gamma_l - \frac{\gamma_c}{w} \right) \\ t_s &= 0 \\ t_h &= \frac{\gamma_c + k p_d d - \mu}{w} + \frac{\alpha_y}{\alpha_l + \alpha_y} \left(T + \frac{\mu}{w} - \gamma_l - \frac{\gamma_c}{w} \right) \end{cases} \quad (6)$$

¹We assume that the wage rate is not affected by the provision of informal care. In an empirical reduced form study, Bolin *et al.* do not find any statistically significant wage effects of informal care provision.

with utility

$$\begin{aligned}\Psi^0 &= \alpha_l \log(\alpha_l) + \alpha_y \log(w\alpha_y) \\ &+ (\alpha_l + \alpha_y) \log\left(\frac{1}{\alpha_l + \alpha_y} \left(T + \frac{\mu}{w} - \gamma_l - \frac{\gamma_c}{w}\right)\right) \\ &+ \alpha_{sf} \log(-\gamma_{sf}) + \alpha_k \log(-\gamma_k)\end{aligned}\quad (7)$$

To obtain that $t_h \geq 0$, in case

$$\mu > \gamma_c + w \frac{\alpha_y}{\alpha_l} (T - \gamma_l)$$

(6) has to be replaced by

$$\begin{cases} t_l &= T \\ c &= \mu \\ t_s &= 0 \\ t_h &= 0 \end{cases}\quad (8)$$

and (7) has to be replaced by

$$\begin{aligned}\Psi^0 &= \alpha_l \log(T - \gamma_l) + \alpha_y \log(\mu - \gamma_c) \\ &+ \alpha_{sf} \log(-\gamma_{sf}) + \alpha_k \log(-\gamma_k)\end{aligned}\quad (9)$$

For the interior solution ($k > 0$ and $t_s > 0$) optimal time use and consumption is given by

$$\begin{cases} t_l = \gamma_l + \frac{\alpha_l}{1 - \alpha_k} \left(T + \frac{\mu}{w} - \gamma_l - \frac{\gamma_c}{w} - \gamma_{sf} - k\left(\frac{p_{dd}}{w} + \tau d + v\right)\right) \\ c = \gamma_c + w \frac{\alpha_y}{1 - \alpha_k} \left(T + \frac{\mu}{w} - \gamma_l - \frac{\gamma_c}{w} - \gamma_{sf} - k\left(\frac{p_{dd}}{w} + \tau d + v\right)\right) \\ t_s = \gamma_{sf} + \frac{\alpha_{sf}}{1 - \alpha_k} \left(T + \frac{\mu}{w} - \gamma_l - \frac{\gamma_c}{w} - \gamma_{sf} - k\left(\frac{p_{dd}}{w} + \tau d + v\right)\right) \\ t_h = \frac{\gamma_c + k p_{dd} - \mu}{w} + \frac{\alpha_y}{\alpha_l + \alpha_y + \alpha_{sf}} \left(T + \frac{\mu}{w} - \gamma_l - \frac{\gamma_c}{w} - \gamma_{sf} - k\left(\frac{p_{dd}}{w} + \tau d + v\right)\right) \end{cases}\quad (10)$$

The corresponding utility is

$$\begin{aligned}\Psi^k &= \alpha_l \log(\alpha_l) + \alpha_y \log(w\alpha_y) + \alpha_{sf} \log(\alpha_{sf}) + \alpha_k \log(k - \gamma_k) \\ &+ (1 - \alpha_k) \log\left(\frac{1}{1 - \alpha_k} \left(T + \frac{\mu}{w} - \gamma_l - \frac{\gamma_c}{w} - \gamma_{sf} - k\left(\frac{p_{dd}}{w} + \tau d + v\right)\right)\right)\end{aligned}\quad (11)$$

To obtain that $t_h \geq 0$, in case

$$\mu > \gamma_c + kp_d d + w \frac{\alpha_y}{\alpha_l + \alpha_{sf}} (T - \gamma_l - \gamma_{sf} - k(\tau d + v))$$

(10) has to be replaced by

$$\begin{cases} t_l = \gamma_l + \frac{\alpha_l}{\alpha_l + \alpha_{sf}} (T - \gamma_l - \gamma_{sf} - k(\tau d + v)) \\ c = \gamma_c + w \frac{\alpha_y}{\alpha_l + \alpha_{sf}} (T - \gamma_l - \gamma_{sf} - k(\tau d + v)) \\ t_s = \gamma_{sf} + \frac{\alpha_{sf}}{\alpha_l + \alpha_{sf}} (T - \gamma_l - \gamma_{sf} - k(\tau d + v)) \\ t_h = 0 \end{cases} \quad (12)$$

and (11) has to be replaced by

$$\begin{aligned} \Psi^k = & \alpha_l \log(\alpha_l) + \alpha_y \log(w\alpha_y) + \alpha_{sf} \log(\alpha_{sf}) + \alpha_k \log(k - \gamma_k) \\ & + (1 - \alpha_k) \log\left(\frac{1}{\alpha_l + \alpha_{sf}} (T - \gamma_l - \gamma_{sf} - k(\tau d + v))\right) \end{aligned} \quad (13)$$

Next, k can be chosen such that utility is maximized. The optimal k is:

$$k = \underset{k \in \{0,1,2,\dots\}}{\operatorname{argmax}} \{\Psi^k\}$$

As we now know the optimal k , we also know the optimal values of the endogenous variables t_l , c , t_s and t_h .

We end this section with an example. In this example the parameter values are: $p_d = 0.4$, $\tau = 0.025$, $v = 1$, $\alpha_l = 0.25$, $\alpha_y = 0.30$, $\alpha_{sf} = 0.15$, $\alpha_k = 0.30$, $\gamma_l = 110$, $\gamma_c = 400$, $\gamma_k = -1$, $\gamma_{sf}^* = 10$, $\delta = 0$, $F = 11$, $T = 168$, $\mu = 0$. In Figure 1 we let the distance between the child and the parents vary between 5 and 200 kilometers. As can be seen, the number of contacts decrease from 9 to 1. Further, when the distance increases, the hours of social support decrease. The jumps can be explained by the number of contacts. At the distances where the number of contacts decrease, the spared travel time is (partly) invested in more social support. In this figure wage is assumed to be equal to 15 euros per hour

In Figure 2 we let the wage of the (adult) child vary and investigate the number of contacts and the hours of social support the child gives to his

parents. As can be seen, an increasing wage results in more contacts and more social support. The drops in social support at the wage of 11, 21, and 38 euro per hour can be explained by the increase in the number of contacts at these wage rates. Extra contacts demand extra resources, such that the hours of social support drop. The distance between the parents and the child in this figure is assumed to be 100 kilometers.

Figure 1: One adult child

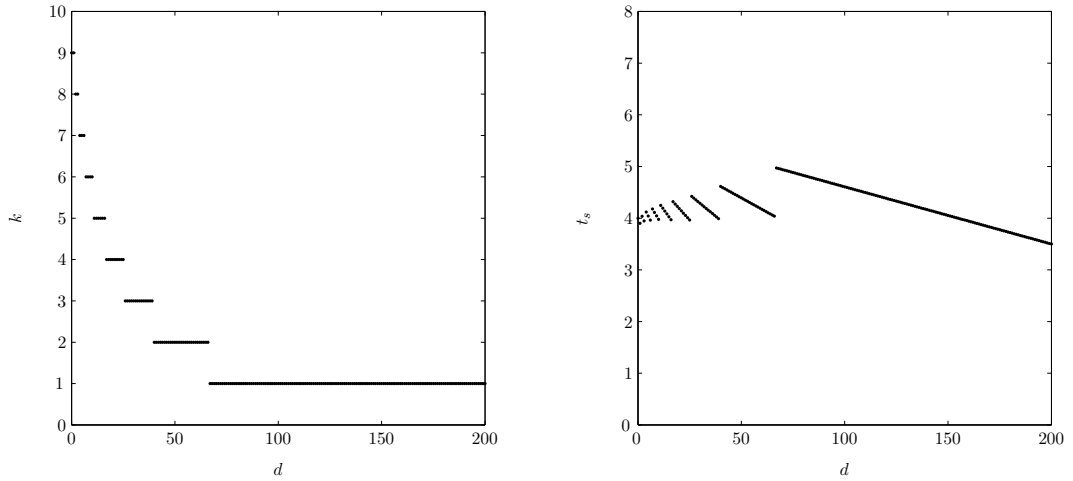
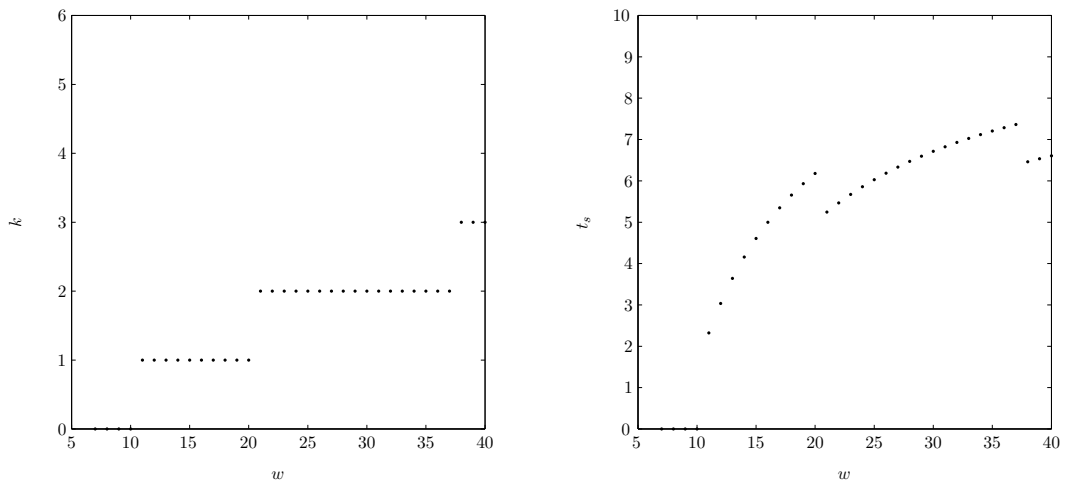


Figure 2: One adult child



3.2 Two (adult) children

In this section we extend the model in section 3.1, such that two adult children are involved. As in section 3.1, the child derives utility from leisure, consumption, the number of contacts and the amount of care his parents receive. The main difference with section 3.1 is that now also the sibling can provide social support, which generates utility but does not affect the child's own time and budget constraint. The utility sibling 1 derives from his own actions and his siblings actions is denoted by $U_1(k_1, t_{s1}, k_2, t_{s2})$. The maximization problem of child 1 becomes:

$$\begin{aligned} \max U_1(k_1, t_{s1}, k_2, t_{s2}) = & \alpha_{l1} \log(t_{l1} - \gamma_{l1}) + \alpha_{y1} \log(c_1 - \gamma_{c1}) \\ & + \alpha_{sf1} \log(t_{s1} + t_{s2} + t_f - \gamma_{sf}^*) + \alpha_{k1} \log(k_1 + k_2 - \gamma_k) \end{aligned} \quad (14)$$

subject to

$$t_{l1} + t_{h1} + t_{s1} + (\tau d_1 + v)k_1 = T \quad (15)$$

$$c_1 + k_1 p_d d_1 = w_1 t_{h1} + \mu_1 \quad (16)$$

As in the previous section, the amount of formal care is given by

$$t_f = F - \delta \cdot (t_{s1} + t_{s2}), \quad 0 \leq \delta < 1 \quad (17)$$

$$(18)$$

Substitution of (17) into (14) and rewriting shows that maximizing (14) is equivalent to maximizing

$$\begin{aligned} \max U_1(k_1, t_{s1}, k_2, t_{s2}) = & \alpha_{l1} \log(t_{l1} - \gamma_{l1}) + \alpha_{y1} \log(c_1 - \gamma_{c1}) \\ & + \alpha_{sf1} \log(t_{s1} + t_{s2} - \gamma_{sf}) + \alpha_{k1} \log(k_1 + k_2 - \gamma_k) \end{aligned} \quad (19)$$

with $\gamma_{sf} = (\gamma_{sf}^* - F)/(1 - \delta)$.

For child 2 the same holds, with the subscripts 1 and 2 interchanged. We focus on the maximization problem for sibling 1 . Solving the maximization

problem we get that, given k_1 , k_2 , t_{s1} and t_{s2} , it is optimal for sibling 1 to choose

$$\begin{cases} t_{l1} = \gamma_{l1} + \frac{\alpha_{l1}}{\alpha_{l1} + \alpha_{y1}} \left(T + \frac{\mu_1}{w_1} - \gamma_{l1} - \frac{\gamma_{c1}}{w_1} - k_1 \left(\frac{p_d d_1}{w_1} + \tau d_1 + v \right) - t_{s1} \right) \\ c_1 = \gamma_{c1} + w_1 \frac{\alpha_{y1}}{\alpha_{l1} + \alpha_{y1}} \left(T + \frac{\mu_1}{w_1} - \gamma_{l1} - \frac{\gamma_{c1}}{w_1} - k_1 \left(\frac{p_d d_1}{w_1} + \tau d_1 + v \right) - t_{s1} \right) \\ t_{h1} = \frac{\gamma_{c1} + k_1 p_d d_1 - \mu_1}{w_1} + \frac{\alpha_{y1}}{\alpha_{l1} + \alpha_{y1}} \left(T + \frac{\mu_1}{w_1} - \gamma_{l1} - \frac{\gamma_{c1}}{w_1} - k_1 \left(\frac{p_d d_1}{w_1} + \tau d_1 + v \right) - t_{s1} \right) \end{cases} \quad (20)$$

The utility for sibling 1 is then equal to

$$\begin{aligned} \Psi_1(k_1, t_{s1}, k_2, t_{s2}) = & \alpha_{l1} \log(\alpha_{l1}) + \alpha_{y1} \log(w_1 \alpha_{y1}) \\ & + \alpha_{sf1} \log(t_{s1} + t_{s2} - \gamma_{sf}) + \alpha_{k1} \log(k_1 + k_2 - \gamma_k) \\ & + (\alpha_{l1} + \alpha_{y1}) \log\left(\frac{1}{\alpha_{l1} + \alpha_{y1}} \left(T + \frac{\mu_1}{w_1} - \gamma_{l1} - \frac{\gamma_{c1}}{w_1} \right. \right. \\ & \left. \left. - k_1 \left(\frac{p_d d_1}{w_1} + \tau d_1 + v \right) - t_{s1} \right)\right) \end{aligned} \quad (21)$$

Note that in case $k_1 = 0$ and/or $k_2 = 0$, t_{s1} and/or t_{s2} have to be zero. Furthermore, when $k_1 > 0$ and/or $k_2 > 0$, t_{s1} and/or t_{s2} have to be greater than zero.

To obtain that $t_{h1} \geq 0$, in case

$$\mu_1 > \gamma_{c1} + k_1 p_d d_1 + w_1 \frac{\alpha_{y1}}{\alpha_{l1} + \alpha_{y1}} \left(T + \frac{\mu_1}{w_1} - \gamma_{l1} - \frac{\gamma_{c1}}{w_1} - k_1 \left(\frac{p_d d_1}{w_1} + \tau d_1 + v \right) - t_{s1} \right)$$

(20) has to be replaced by

$$\begin{cases} t_{l1} = T - t_{s1} - k_1(\tau d_1 + v) \\ c_1 = \mu_1 - k_1 p_d d_1 \\ t_{h1} = 0 \end{cases} \quad (22)$$

and (21) has to be replaced by

$$\begin{aligned} \Psi_1(k_1, t_{s1}, k_2, t_{s2}) = & \alpha_{l1} \log(T - t_{s1} - k_1(\tau d_1 + v) - \gamma_{l1}) + \alpha_{y1} \log(\mu - k_1 p_d d_1 - \gamma_{c1}) \\ & + \alpha_{sf1} \log(t_{s1} + t_{s2} - \gamma_{sf}) + \alpha_{k1} \log(k_1 + k_2 - \gamma_k) \end{aligned} \quad (23)$$

The maximization problem of sibling 2 is solved analogously.

In the Nash equilibrium, both siblings maximize their utility given the action of the other player. The number of contacts (k_1 and k_2) are discrete. The number of hours of social support (t_{s1} and t_{s2}) are not, however, to find the overall Nash equilibrium we consider t_{s1} and t_{s2} to be discrete. We can narrow the steps as small as we want.

With the purpose to clarify the model, we continue this section with some examples.

Table 1 gives an example of a game between two siblings. In this game the Nash equilibrium is $k_1 = 0$, $t_{s1} = 0$, $k_2 = 0$ and $t_{s2} = 0$, hereby denoted with $(0, 0, 0, 0)$.

Sometimes the prisoner's dilemma is present. In the game proposed in Table 1 this is the case. Here, the Nash equilibrium is $(0,0,0,0)$ with utility 2.015 for each sibling. However, both siblings should be better off when they both provide one visit with two hours of informal care to the parent $(1,2,1,2)$. The utility for both siblings is then 2.047.

To see what happens to the Nash equilibria when the distance or the wage of one of the siblings change, we have made figures where we let the distance and the wage of sibling 1 vary. In the figures it is assumed that $p_d = 0.4$, $\tau = 0.025$, $v = 1$, $d_2 = 100$, $w_2 = 15$, $\alpha_{li} = 0.25$, $\alpha_{yi} = 0.3$, $\alpha_{sfi} = 0.15$, $\alpha_{ki} = 0.3$, $\gamma_{li} = 110$, $\gamma_{ci} = 400$, $\gamma_k = -1$, $\gamma_{sf}^* = 10$, $\delta = 0$, $T = 168$, $\mu_i = 0$, $F = 11$ for $i = 1, 2$. Further, in Figure 3 to 5 it is assumed that the wage of sibling 1 is 15 euro per hour (the same as w_2), and in Figure 6 to 8 it is assumed that the distance of sibling 1 to his parents is 100 kilometer (the same as d_2).

In case the distance of sibling 1 increases, the number of contacts of this sibling with his parent decreases (Figure 3). Sometimes, there is more than one Nash equilibrium. In the figure we then show the average of these equilibria. In Figure 3 it can also be seen how the number of contacts of sibling 2 with his parent are influenced by the distance of sibling 1.

Figure 4 shows how the hours of social support changes with d_1 . In general it can be concluded that the hours of social support of sibling 1 decreases when the distance to his parents increases. On the other hand, sibling 2, then, increases the hours of social support. Upward jumps in the hours of social support for sibling 1 (such as at a distance of 26 and 40 kilometers) can be explained by the drop in the number of contacts which takes place at the same moment. The resources spared by the reduction of the number of contacts are (partly) spend to more social support. Figure 5 gives the total number of contacts and total hours of social support the parents receive. Surprisingly, the total hours of social support is higher at a distance of 80 then at the distance of for example 20 kilometers. Herewith, one has to take into account that the distance of sibling 2 is assumed to be 100 kilometer. At $d_1 = 20$ sibling 1 is the only child who provides social care. At the distance of 80 (where the difference between d_1 and d_2 is less), both children provide social support, and totally this results in more hours.

Figure 6 shows how the number of contacts of sibling 1 and 2 evolve when the wage of sibling 1 increases. Also here, at some wages there is more than one Nash equilibrium. Under the specified parameter values, the number of contacts of sibling 1 increases from zero to three when his wage rate increases from 5 to 40 euros per hour. The number of contacts of sibling 2 with his parents decrease from one to zero. Figure 7 shows that as long $w_1 < w_2$, sibling 2 provides all social support. When $w_1 > w_2$ the opposite occurs. The total number of contacts and hours of social care are presented in Figure 8.

Figure 3: Nash equilibria, number of contacts

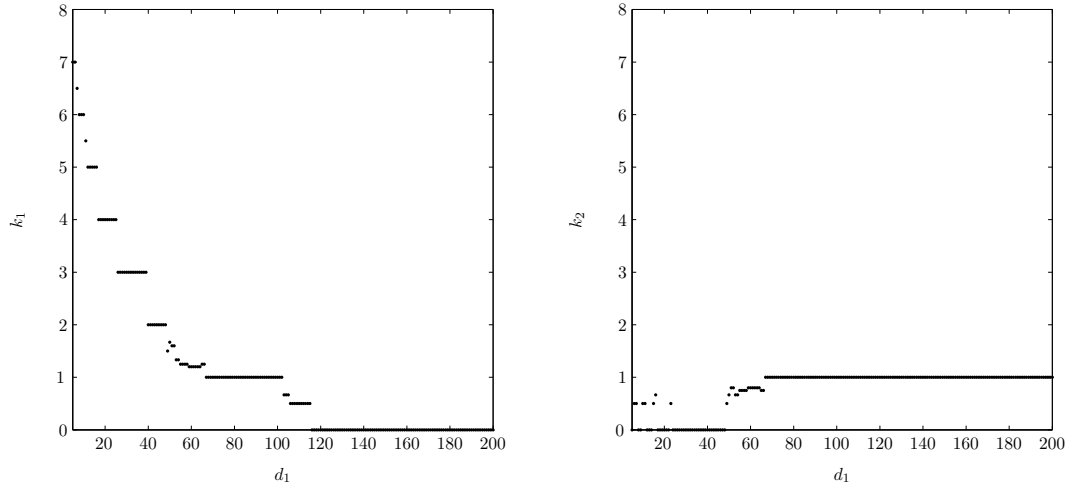


Figure 4: Nash equilibria, hours of social support

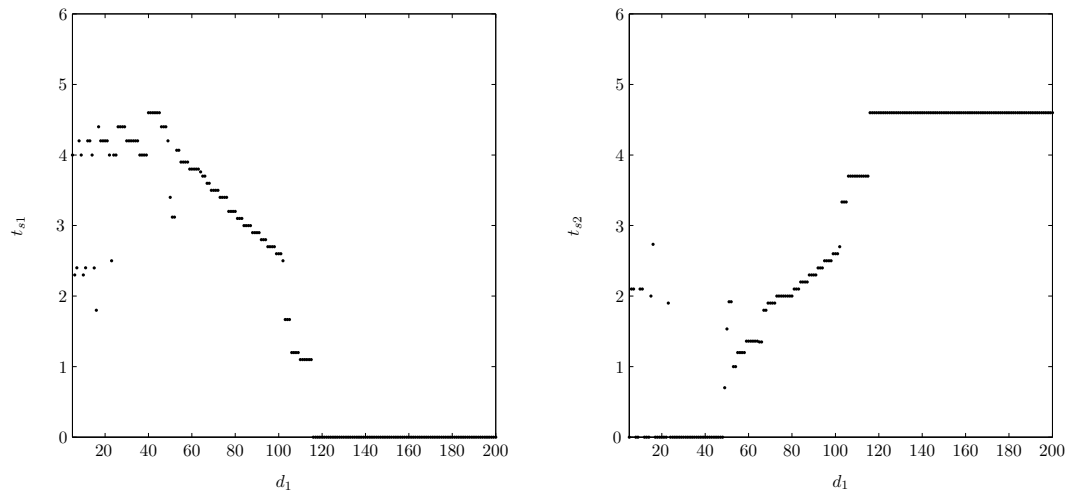


Figure 5: Nash equilibria, total number of contacts and hours of social support

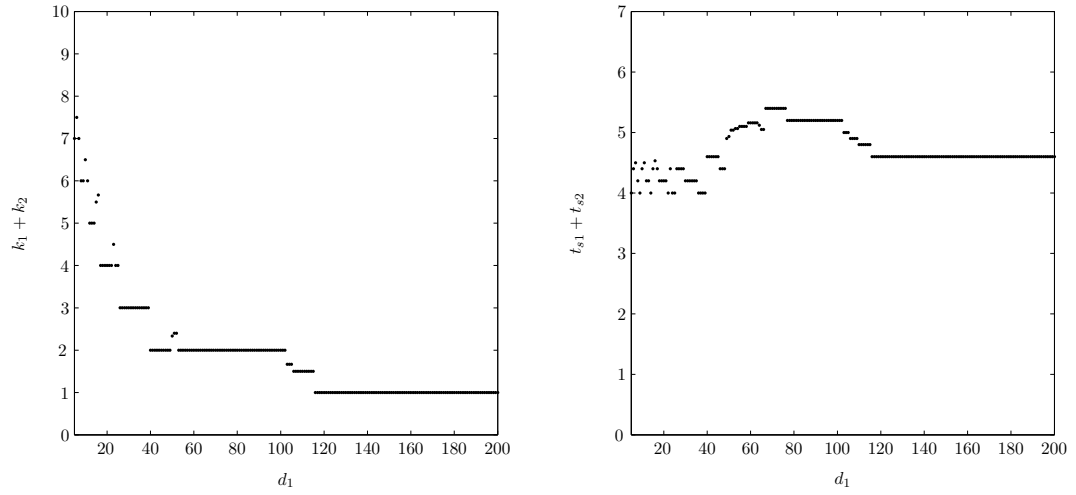


Figure 6: Nash equilibria, number of contacts

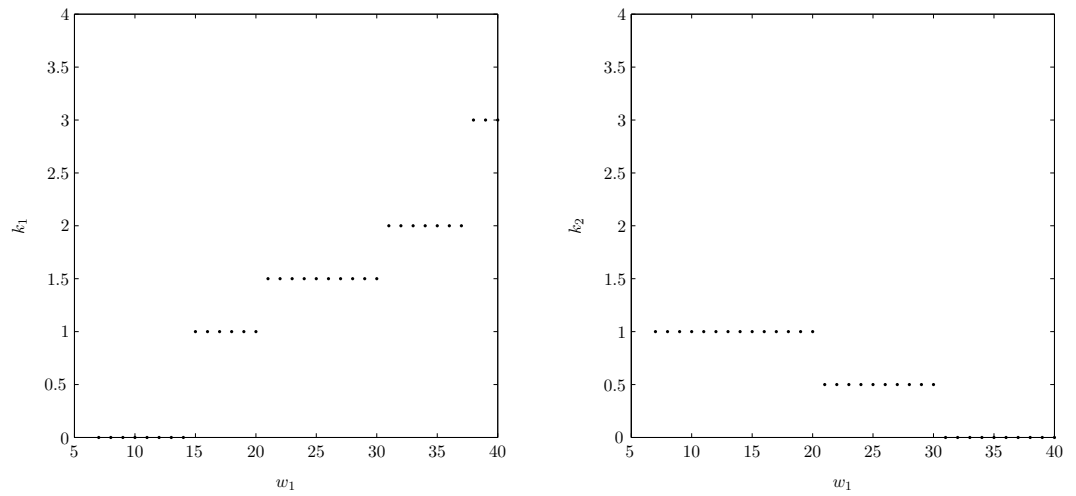


Figure 7: Nash equilibria, hours of social support

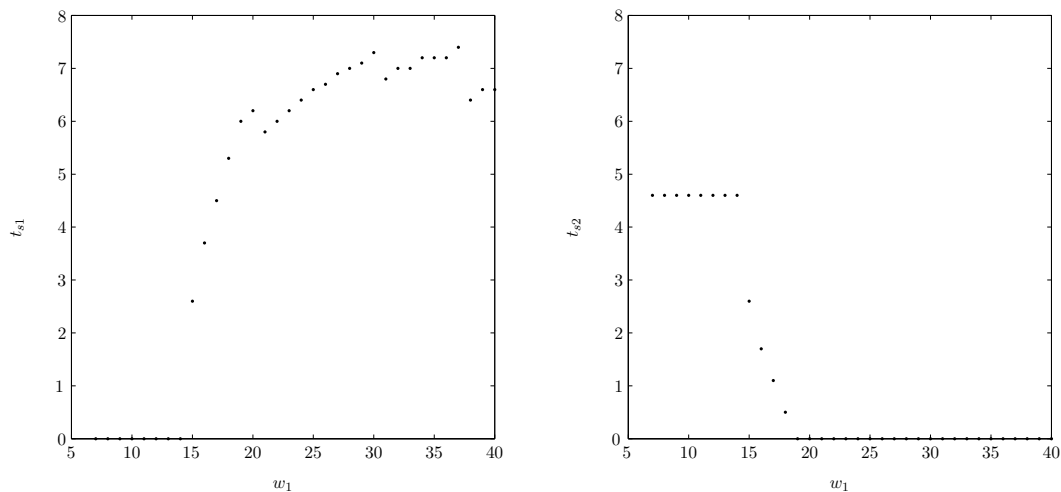
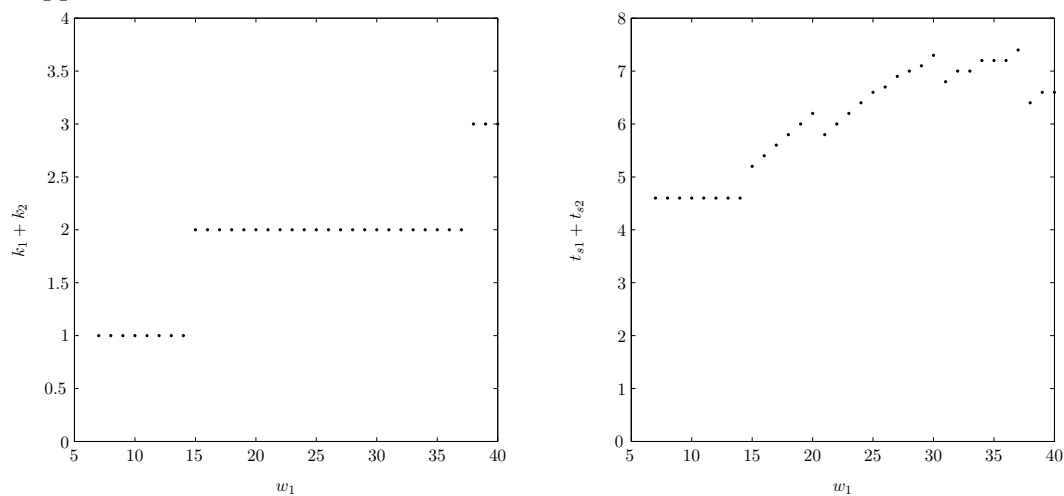


Figure 8: Nash equilibria, total number of contacts and hours of social support



Instead of the noncooperative Nash equilibrium, siblings may behave cooperatively. We are interested in the comparison of the noncooperative and cooperative results. In order to visualize the difference we make figures 3 to 8 again, with the same parameter values, but now with a cooperative equilibrium.

Let's assume that the siblings maximize the sum of their utilities

$$U_1(k_1, t_{s1}, k_2, t_{s2}) + U_2(k_1, t_{s1}, k_2, t_{s2})$$

subject to

$$t_i + t_{hi} + t_{si} + (\tau d_i + v)k_i = T \quad (24)$$

$$c_i + k_i p_d d_i = w_i t_{hi} + \mu_i \quad (25)$$

for $i = 1, 2$.

Figures 9 to 11 show the results.

From comparing figures 9 to 14 with figures 3 to 8, we can conclude that (as expected) the number of contacts and the hours of social support are higher when siblings behave cooperatively. Furthermore, when we compare the figures for one child with the Nash equilibria for two siblings, parents do not receive much more care with two siblings (this is due to the fact that for both siblings the care given by the sibling is a perfect substitute for their own care).

Figure 9: Cooperative equilibrium, number of contacts

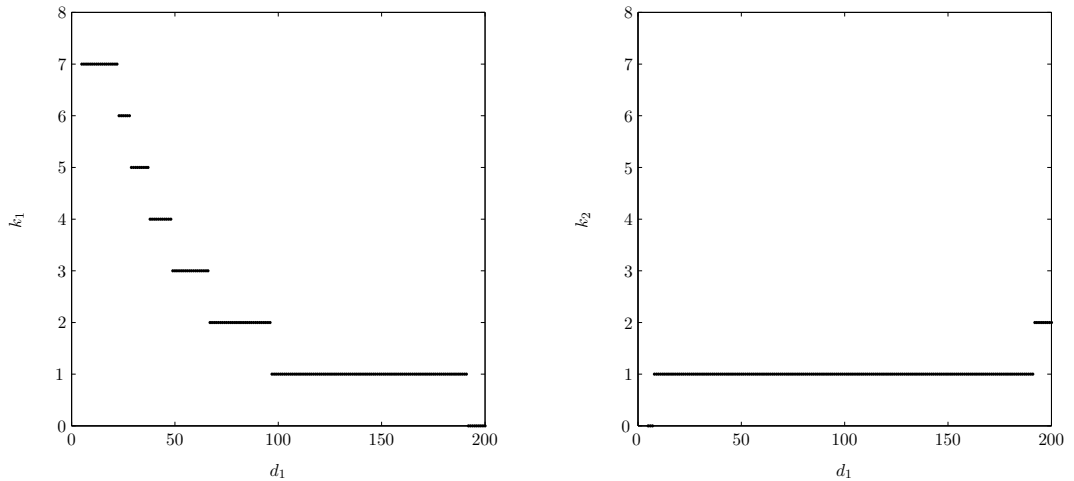


Figure 10: Cooperative equilibrium, hours of social support

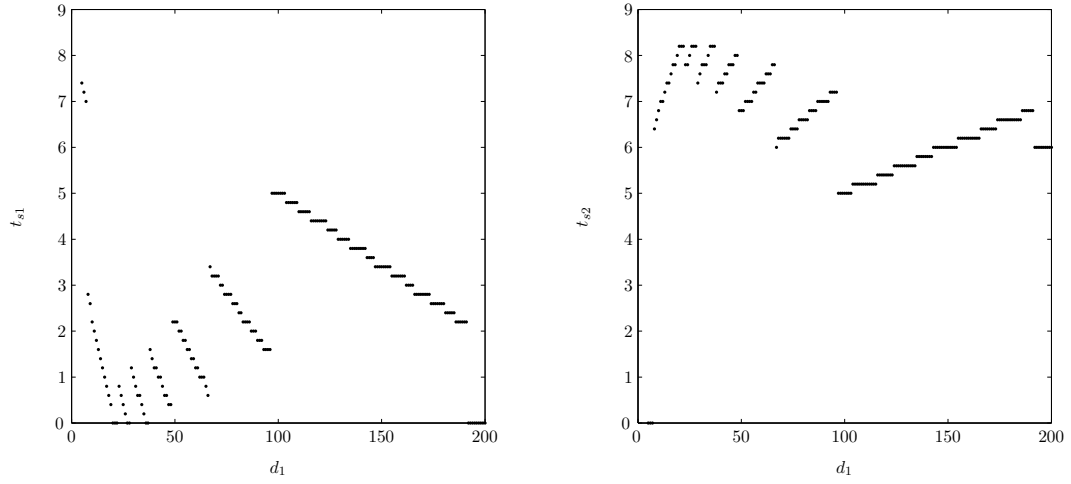


Figure 11: Cooperative equilibrium, total number of contacts and hours of social support

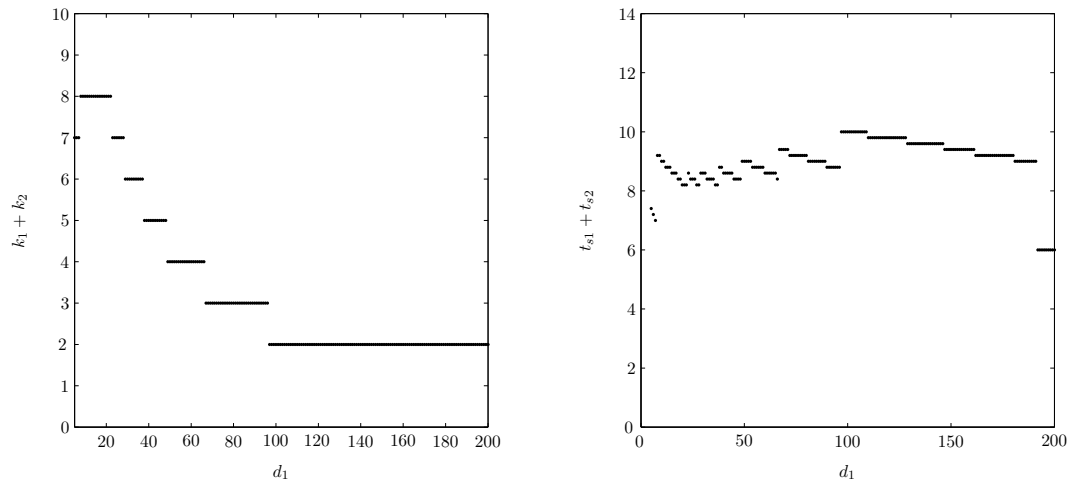


Figure 12: Cooperative equilibrium, number of contacts

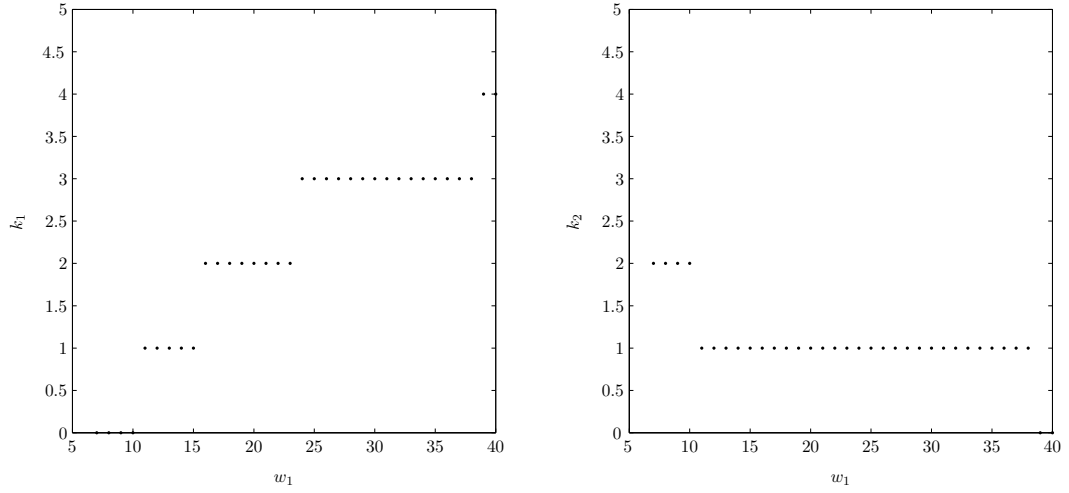


Figure 13: Cooperative equilibrium, hours of social support

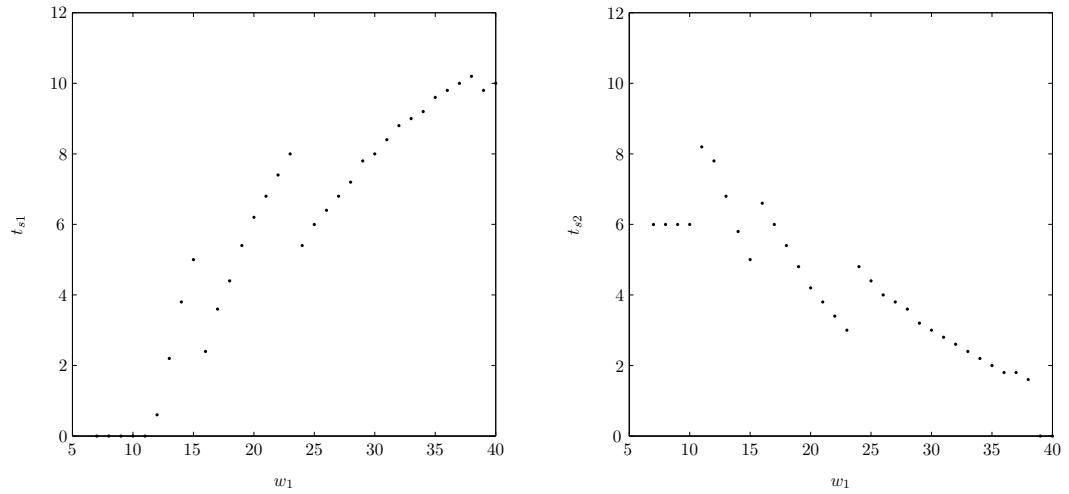
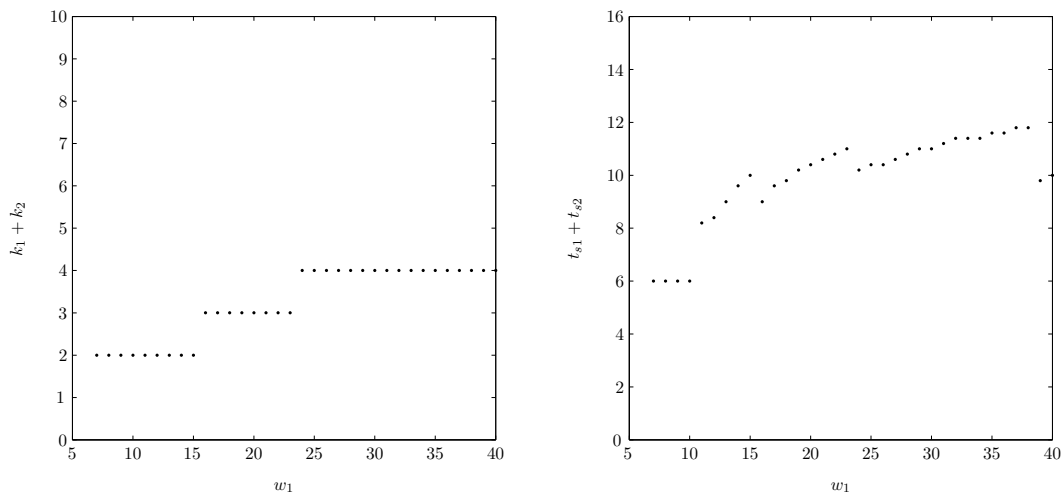


Figure 14: Cooperative equilibrium, total number of contacts and hours of social support



4 Estimation strategy

This section describes the estimation strategy. At first we specify the way we estimate the parameters of the model. Secondly we describe how we impute wage rates in the model (as they are not present in the SHARE data).

4.1 Estimation of the parameters

To estimate the parameters of the structural model we formulate the model as a discrete choice problem. In this discrete choice problem individuals can choose between different combinations of labor (t_h) and informal care (k and t_s). With regard to labor we distinguish between full-time employed, part-time employed, and not employed. Concerning informal care we consider the choice to give no informal care, giving informal care between 0 and 2 hours a week, between 2 and 8 hours a week and giving more than 8 hours informal care a week. In total we thus have a choice set of 12 alternatives (3x4).

Heterogeneity between adult children is introduced by distance, wage,

and the several γ 's, where

$$\gamma_l = X_l\beta_l + \epsilon_l \quad (26)$$

$$\gamma_{sf} = X_{sf}\beta_{sf} + \epsilon_{sf} \quad (27)$$

$$\gamma_c = X_c\beta_c + \epsilon_c \quad (28)$$

$$\gamma_k = -1 \quad (29)$$

X_l contains characteristics which are likely to influence the amount of leisure time the adult child needs (for example the presence of children in the household). X_{sf} , which is used to determine the minimum amount of care the parents need, includes for example the health of the parents. X_c contains characteristics which influence the minimum amount of consumption needed. Unobserved heterogeneity is captured through $\epsilon = (\epsilon_l, \epsilon_c, \epsilon_{sf})$ (individuals with the same characteristics may choose different alternatives). ϵ is distributed jointly normal with mean zero and covariance Σ_ϵ .

In estimating the model we maximize the likelihood function, where the likelihood contribution of an individual who chooses alternative j out of the 12 alternatives is

$$L(\beta, \Sigma_\epsilon | X, d, w, \mu) = \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} I_{[U_j \geq U_k \forall k \neq j]} p(\epsilon_l, \epsilon_{sf}, \epsilon_c) d\epsilon_l d\epsilon_{sf} d\epsilon_c, \quad (30)$$

where $p(\epsilon_l, \epsilon_{sf}, \epsilon_c)$ is the joint probability density function for ϵ (a trivariate normal probability density function).

Lerman and Manski (1981) have introduced the idea to approximate this three-dimensional integral with a frequency simulator, equation (30) then is approximated by

$$L_R(\beta, \Sigma_\epsilon | X, d, w, \mu) = \frac{1}{R} \sum_{r=1}^R I_{[U_j \geq U_k \forall k \neq j]}^r, \quad (31)$$

where R is the number of draws per observation, used to approximate the integral. The estimator obtained by maximizing the sum of (31) over all

individuals is known as the maximum simulated likelihood estimator (MSL).

The draws $r = 1 \dots R$ are from a trivariate normal distribution with mean zero and variance Σ_ϵ . A draw can be obtained by taking 3 (pseudo-random) draws from a standard normal distribution (let's call them $\theta = (\theta_1, \theta_2, \theta_3)'$) and then calculate $\epsilon = L\theta$. Here, L is the Choleski factor of Σ_ϵ (the unique lower triangular matrix such that $LL' = \Sigma_\epsilon$).²

Integrals can be approximated with fewer draws (R) when using Halton draws instead of pseudo-random draws. This is because Halton sequences provide more coverage of the density which has to be integrated. For more information about the derivation of Halton sequences see for example Train (2003), or Drukker and Gates (2006), who discuss the advantages of Halton sequences when using simulation to approximate integrals numerically. We need three Halton sequences. According to Train (2003), initial terms of Hamilton sequences can be highly correlated, therefore we drop the first 10 elements for every sequence. (The minimum number of elements one should drop equals the largest prime that is used in creating the Halton sequences).

The frequency simulator has two drawbacks. First, L_R is a step function in the parameters. A small change in one of the parameters will often not lead to an increase or decrease of L_R . L_R only increases when the parameters change such that for more draws alternative j is chosen. Because of this step function, gradient based optimization is not possible. Second, the frequency simulator requires a very large number of draws to estimate small probabilities accurately. To overcome these problems McFadden (1989) proposed a smoothed simulator, the 'kernel smoothed frequency simulator'. Instead of

² ϵ is normally distributed because the sum of normals is normal. Furthermore, the covariance of ϵ is Σ_ϵ because $\text{Var}(\epsilon) = E(\epsilon\epsilon') = E(L\theta(\theta L)') = LE(\theta\theta')L' = L\text{Var}(\theta)L' = LIL' = LL' = \Sigma_\epsilon$ (Train, 2003).

(31) we get for each individual

$$L_R^s(\beta, \Sigma_\epsilon | X, d, w, \mu) = \frac{1}{R} \sum_{r=1}^R \frac{e^{U_j^r/\lambda}}{\sum_{k=1}^K e^{U_k^r/\lambda}}, \quad (32)$$

where $\lambda > 0$ is a scale factor which determines the degree of smoothing. When we choose λ closer to zero, the scale of the utilities is higher and the absolute differences between the utilities of the different alternatives become larger. This results in probabilities which are closer to zero and one, so that L_R^s (32) approximates L_R (31) when we set λ close to zero.

The MSL and ML estimator are asymptotically equivalent when R tends to infinity at a sufficiently large rate (when R rises faster than \sqrt{N}). Then the estimates are consistent, asymptotically normal and efficient (see Gourieroux and Monfort 1996, Train 2003).

4.2 Estimation of wage rates

In SHARE the wage rates of the adult children are unknown, therefore we use wage rate predictions. We construct a wage equation and estimate this equation using the ‘European Union Statistics on Income and Living Conditions’ (EU-SILC).

In EU-SILC we can only observe wages for workers. However, the working population is no randomly chosen subsample from the population. The people with comparatively high wages (given, for example, their education level) decide to work. There may be sample selection bias, which means that there are unobservables which influence the decision to participate as well as the wage rate.

A commonly used method to deal with this sample selection is the method by Heckman (1979). Heckman takes selection bias into account by adding an equation which models the participation decision, and allowing

for nonzero correlation between the wage and the participation equation.

Arellano and Meghir (1992) have also combined two datasets and have used the Heckman correction to take selection bias into account. They estimate labour supply using the U.K. Labour Force Survey (LFS) and use the U.K. Family Expenditure Survey (FES) to impute wages and other income. In Cameron and Trivedi (2005) sample selection models are described very well.

With EU-SILC we estimate the following model:

$$w_i^* = X'_{wi}\beta_w + \epsilon_{wi} \quad (33a)$$

$$p_i^* = X'_{pi}\beta_p + \epsilon_{pi} \quad (33b)$$

$$w_i = w_i^* \quad \text{if } p_i^* > 0 \quad (33c)$$

$$w_i = 0 \quad \text{if } p_i^* \leq 0 \quad (33d)$$

where (33a) is the wage equation and (33b) is the (probit type) participation equation. We assume that ϵ_{wi} and ϵ_{pi} have a bivariate normal distribution

$$\begin{bmatrix} \epsilon_w \\ \epsilon_p \end{bmatrix} \sim N \left[\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_w^2 & \sigma_{wp} \\ \sigma_{wp} & \sigma_p^2 \end{bmatrix} \right] \quad (34)$$

The parameters $\beta_w, \beta_p, \sigma_w^2, \sigma_p^2$ and σ_{wp} can be estimated using Heckman's two step estimator but also using FIML, which is more efficient.

In our structural model we fill in the estimated wage equation. Furthermore, we take into account that the predicted wage rate has an error (ϵ_w). We use the estimated covariance (σ_w^2) to simulate the prediction errors and integrate the predication errors out. Soest (1995) also uses estimated standard deviations of the errors in the wage equation to account for predication errors.

Instead of (30), the likelihood contribution of an individual choosing alternative j becomes

$$L(\beta, \Sigma_\epsilon | X, d, \beta_w, \mu) = \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} I_{[U_j \geq U_k \forall k \neq j]} p(\epsilon_l, \epsilon_{sf}, \epsilon_c, \epsilon_w) d\epsilon_l d\epsilon_{sf} d\epsilon_c d\epsilon_w, \quad (35)$$

where $p(\epsilon_l, \epsilon_{sf}, \epsilon_c, \epsilon_w)$ is the joint probability density function for ϵ .

$$\begin{bmatrix} \epsilon_l \\ \epsilon_c \\ \epsilon_{sf} \\ \epsilon_w \end{bmatrix} \sim N \left[\begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_l^2 & \sigma_{l,c} & \sigma_{l,sf} & \sigma_{l,w} \\ & \sigma_c^2 & \sigma_{c,sf} & \sigma_{c,w} \\ & & \sigma_{sf}^2 & \sigma_{sf,w} \\ & & & \sigma_w^2 \end{bmatrix} \right] \quad (36)$$

We estimate (35) using the kernel smoothed frequency simulator (explained in section 4.1). Equation (32) becomes

$$L_R^s(\beta, \Sigma_\epsilon | X, d, \beta_w, \sigma_w^2, \mu) = \frac{1}{R} \sum_{r=1}^R \frac{e^{U_j^r/\lambda}}{\sum_{k=1}^K e^{U_k^r/\lambda}}, \quad (37)$$

where the draws $r = 1 \dots R$ are now from a multivariate (4-dimensional) normal distribution with mean zero and variance Σ_ϵ .

5 Data

This section describes the data. We use SHARE to estimate the structural parameters of the model (5.1). EU-SILC is used to estimate wage rates (5.2).

5.1 SHARE

The Survey of Health, Ageing and Retirement in Europe (SHARE) is a multidisciplinary database of micro data on health, socio-economic status and social and family networks of individuals. In the current version of the paper we use the 2004 wave; the next version will also use the second wave of SHARE (which is expected to become available in 2008). Eleven countries have contributed data to the 2004 SHARE dataset. Three regions can be distinguished: Scandinavia (Denmark and Sweden), Central Europe (Austria, France, Germany, Switzerland, Belgium, the Netherlands) and the Mediterranean (Spain, Italy and Greece). Eligible respondents are all household members aged 50 and over, plus their spouses, independent of age. The questionnaire is composed by face-to-face computer-aided personal

interviews (CAPI), plus a self-completion drop-off part with questions that command more privacy.

In contrast with papers such as Bonsang (2006) and Bolin, Lindgren, Lundborg (2007), where informal care given by the respondents is studied, in this paper we consider the respondents in their role of receiver of informal care. The reason is that we want to have information for all siblings within a family. The respondents (in our case ‘the parents’) give information about all their children. If we would consider the respondents as the providers of informal care, there would be no information on the amount of care the siblings of the respondents give to their parents. Further, by considering the respondents as the receivers of informal care, we also have information on the receivers’ health condition, for instance, self-reported health, physical functioning and the utilization of health-care facilities. The respondents provide basic information on all their children that are still alive (sex, year of birth and distance to the parents). Due to the length of the interview, further information (such as education, household situation and employment of the child) is gathered for at most four children.

From the SHARE data we remove households where children, grandchildren, siblings and other non-relatives are living in the same household as the (interviewed) parents. This is because informal care giving within the household is not detailed enough in the data. We concentrate on parents who only receive support from outside the household. Households with missings for relevant variables are removed. Here, Greece and Switzerland fall out because of missings for home care. Finally we remove the interviewed households who have no (adult) children. 9,769 households are left, with 23,215 (adult) children involved.

Table 2 presents descriptives on the number of households and accompanying (adult) children by country. Note that the percentage of households

from Italy and Spain is relatively low. In these countries a lot of parents are living in the same household as their (adult) children. As explained above, we have excluded these households.

In the examples of section 3 we saw that in general a higher distance between children and their parents causes a lower level of social support. For children living independently from their parents Table 3 shows a strong negative relationship between distance and social support provided (except for more than 500 kilometers, but here are very few observations). Furthermore, the table shows that when parents are in bad health, social support increases.

Table 4 presents the relation between informal care and daily activity. The difference in giving social support by people who are full time employed and part-time employed has the expected sign but is small. Adult children who are retired are very often involved in social support. Note that retired persons have relatively older parents.

In section 3 we saw that in the Nash equilibrium two children give in total almost the same amount of care as one child (with the same preferences and characteristics). In case two siblings behave cooperatively, two siblings together give more care than one child. Table 5 shows the relationship between the number of siblings and informal care. Further, a distinction is made between families with conflicts and families without conflicts (as conflicts may influence the provision of social support). In families with more children, relatively less children are involved in informal care. Further, up to 5 children, involvement in informal care is lower in families with conflicts. The conflict question in SHARE refers to conflicts in general, not specifically related to providing informal care.

5.2 EU-SILC

As explained in section 4.2, we estimate a wage equation using the ‘European Union Statistics on Income and Living Conditions’ (EU-SILC). EU-SILC contains microdata on income, poverty, social exclusion and living conditions in Europe. Almost all countries in SHARE are available in EU-SILC. Israel is the only country which is available in SHARE but not in EU-SILC.

In the data we select people younger than 70, and remove household who receive income out of self-employment. Furthermore, we remove people who are permanently sick or disabled and observations which have missings for one or more of the relevant variables (the variables we use in the model).

Net wage rates are computed by

$$\frac{\text{total disposable household income}}{\text{total household gross income}} * \frac{\text{employee income}}{\# \text{ months work} * \# \text{ hours per week} * 52/12}, \quad (38)$$

where

$$\begin{aligned} \text{employee income} &= \text{employee cash or near cash income} \\ &\quad + \text{non-cash employee income} \\ \# \text{ months work} &= \# \text{ months on full-time work in income} \\ &\quad + \# \text{ months on part time work in income} \\ \# \text{ hours per week} &= \# \text{ hours usually worked per week in main job} \\ &\quad + \# \text{ hours usually worked in second, third, ... jobs} \end{aligned}$$

In (38) after tax wage rates are computed by multiplying the gross wage rate with the ratio of total disposable household income and total household gross income. This is not completely correct. To do it correctly one should include the tax system in the model. At least for this moment we use this simplification. Table 6 shows some descriptives of the data. At this moment we only have the data of The Netherlands available. Later on we will show summary statistics of all countries.

6 Estimation results

This section presents the estimation results of the wage equation and the parameters of the structural model. We start with the estimation results of the wage equation, as these are needed to estimate the parameters of the structural model.

6.1 Estimation of the wage equation

Table 7 and 8 show the estimation results when 1) we do not take into account sample selection 2) we use Heckman's two step estimator 3) we use FIML.

At this moment we only have the data of the Netherlands available. Later on, we will also estimate these equations for other countries.

Table 7 presents the results of the two-part model using

- (a) probit for participation
- (b) linear regression with $\ln(\text{wage rate})$ as dependent variable.

In this model sample selection is not taken into account. The signs of the coefficients are plausible. The results show that males have a higher probability of participation than females, participation decreases as from about the age of 50, a higher education level results in a higher probability of participation, a partner has a positive effect on the participation of men and children have a positive effect on the participation of men, but a negative effect on the participation of women. With regard to the wage rate we see that males have, *ceteris paribus*, higher wage rates than females. Furthermore, wage rates increase approximately until the age of 48 (also cohort effects will play a role here). As expected, a higher education level results in a higher wage rate.

Secondly, Table 8 presents the results of the sample selection model, estimated by maximum likelihood (FIML) and estimated with Heckman's

two-step estimator. The coefficients are quite similar and are also comparable to the coefficients in Table 7. σ_{wp} is not significantly different from zero, indicating that sample selection is no significant issue. We will use the FIML estimates from EU-SILC for the estimation of the parameters of the structural model with SHARE.

6.2 Estimation of the parameters in the structural model

In the next version of this paper this section will present the estimates of parameters in the structural model, based on the data described in section 5 and using the strategy described in section 4.

7 Policy Evaluation

Several countries represented in SHARE have implemented policies aimed at encouraging low-cost provision of long-term care. For example, in the Netherlands, individuals who care for someone with a chronic illness who would otherwise be institutionalized can receive an amount of 250 euros, as a “financial appreciation of caring”. Little is known about the effectiveness and efficiency of these policies. One important issue is the possibility of unintended side effects, such as discouraging labor force participation.

This section describes a framework that can be used to assess various policies. Possible policy instruments are: 1) a financial compensation for the hours of social support; 2) a financial compensation for traveling expenses; 3) help such that siblings behave more cooperatively; 4) policies that change the distance between parents and their children (for example, the social rent sector could weigh informal care by their assignment of houses, or senior houses could be built in residential areas).

While the model presented above applies to a single family, the empirical version to be estimated will allow for heterogeneity across families and coun-

tries. Preference parameters will depend on observed characteristics, such as gender, education, health status, and family status, of the adult children and the parents. In addition, adult children face different budget and time constraints, due to variation in wages and in distances to the parental home.

To analyze the effects of policies consider the adjusted budget constraint for a single adult child:

$$c + kp_d d = t_h w(1 - \tau_h) + \tau_d d + \tau_s t_s,$$

where τ_h tax on income, τ_d compensation for travel expenses, τ_s compensation for social support. The net government revenue from this household is given by:

$$R = t_h w \tau_h - \tau_d d - \tau_s t_s - p_f (F - \delta t_s), \quad (39)$$

with p_f denoting the price of formal care. The first term in the righthand side of (39) is the labor income tax received. The second and third terms are the compensations for travel expenses and for providing informal care, respectively. The fourth term is the amount the government spends on formal care.

A simple example of a social planning problem is to maximize R subject to a given level of care provided. Thus the government's problem is to choose τ_h , τ_d , τ_s , and δ such that R is maximized subject to $t_s + t_f = \bar{F}$, taking into account the family's response to these financial incentives.

A similar (though slightly more complicated) approach can be developed for the case of two adult children.

8 Conclusions

We have presented a structural model to analyze families' complex decisions regarding care provision for aging parents. The model focuses on the strategic interactions between siblings, and can be used to assess the effects of a variety of policy measures.

A tentative exploration of the data reveals that the stylized empirical facts in the SHARE data are consistent with a number of qualitative predictions from the model: children provide more care the larger the difficulties their parents experience in daily life; children provide less care when they live farther away and when they are more involved in paid work; and the occurrence of conflicts in families is associated with less care provided. With the structural model we can clarify and understand the nature of these correlations.

In the next version of the paper we will present the estimation results of parameters of the structural model, obtained by maximum simulated likelihood. We will use the first two SHARE waves, allowing for heterogeneity in preferences, constraints, and institutions within countries represented.

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Table 1: Pay off matrix

	$k_2 = 0, t_{s2} = 0$	$k_2 = 1, t_{s2} = 1$	$k_2 = 1, t_{s2} = 2$
$k_1 = 0, t_{s1} = 0$	(2.015, 2.015)	(2.361, 1.774)	(2.463, 1.818)
$k_1 = 1, t_{s1} = 1$	(1.774, 2.361)	(1.977, 1.977)	(2.049, 1.991)
$k_1 = 1, t_{s1} = 2$	(1.818, 2.463)	(1.991, 2.049)	(2.047, 2.047)

In this example it is assumed that $p_d = 0.4, \tau = 0.025, v = 1, d_i = 350, \alpha_{li} = 0.25, \alpha_{yi} = 0.25, \alpha_{sfi} = 0.25, \alpha_{ki} = 0.25, \gamma_{li} = 110, \gamma_{ci} = 400, \gamma_k = -1, \gamma_{sf}^* = 10, \delta = 0, T = 168, \mu_i = 0, wage = 14.2$ and $F = 11$ for $i = 1, 2$.

Table 2: Descriptive statistics

Country	# households	%	# (adult) children	%
Austria	716	7	1,500	6
Germany	1,039	11	2,127	9
Sweden	1,550	16	3,786	16
Netherlands	1,245	13	3,203	14
Spain	566	6	1,414	6
Italy	549	6	1,227	5
France	1,137	12	2,639	11
Denmark	796	8	1,887	8
Belgium	1,426	15	3,286	14
Israel	745	8	2,146	9
Total	9,769		23,215	

This table presents the number of households per country. Further, the number of adult children involved are given.

Table 3: Distance and social support

Distance	% social support	% social support, bad health	# hours	# hours conditional on giving support
less than 1 km away	13.2	19.0	1.1	8.4
between 1 and 5 km	10.4	17.4	0.6	5.3
between 5 and 25 km	8.6	15.5	0.4	5.0
between 25 and 100 km	6.5	12.0	0.3	4.2
between 100 and 500 km	3.9	7.7	0.1	3.5
more than 500 km	1.6	3.0	0.2	9.6
more than 500 km another country	1.2	0.8	0.1	11.2
Total	8.0	13.7	0.5	5.7

For each distance category the columns present: the percentage of children involved in social support, the percentage of children involved in social support when at least one of the parents has bad health conditions, the average hours of social support per week and the average hours of social support per week conditional on giving any social support.

Table 4: Employment and social support

Daily activity	% social support	% social support, bad health	# hours	# hours conditional on giving support
full-time	7.4	12.2	0.3	4.3
part-time	9.8	17.3	0.6	5.6
self-employed	7.7	14.8	0.4	5.4
unemployed	11.9	22.4	0.7	6.2
in education	5.7	18.2	0.3	5.0
parental leave	4.5	8.7	0.4	9.9
(early) retirement	21.6	21.1	1.8	8.2
sick	10.2	15.7	0.6	6.4
looking after home	10.7	20.3	1.5	13.9

For each daily activity the columns present: the percentage of children involved in social support, the percentage of children involved in social support when at least one of the parents has bad health conditions, the average hours of social support per week and the average hours of social support per week conditional on giving any social support.

Table 5: Number of siblings, conflicts, and social support

# siblings	% social support, no conflicts	% social support, conflicts
1	13.4	8.6
2	8.5	7.1
3	6.9	4.6
4	6.9	6.7
5	5.1	6.7
6 or more	5.1	6.5

This table presents the percentage of adult children involved in social support by sibsize and the presence of conflicts in the family.

Table 6: Descriptives EU-SILC

Variable	Mean	Std. Dev.	N
male	0.51	0.5	10801
age	42.83	14.21	10801
net wage rate	12.19	5.83	6483
primary education	0.07	0.26	10801
secondary education	0.64	0.48	10801
tertiary education	0.29	0.45	10801
man with partner	0.45	0.50	10801
woman with partner	0.39	0.49	10801
man with child	0.24	0.43	10801
woman with child	0.21	0.41	10801

Some descriptives of the EU-SILC data, which we use to estimate the wage equation.

Table 7: Estimation results wage equation, two-part model

Variable	participation		ln (wage rate)	
	Coeff (a)	Std. Err.	Coeff (b)	Std. Err.
male	0.176	(0.075)	0.160	(0.009)
age			0.080	(0.003)
age ²			-0.001	(0.000)
age 30 - age 39	0.896	(0.053)		
age 40 - age 49	0.840	(0.052)		
age 50 - age 59	0.244	(0.043)		
age \geq 60	-1.962	(0.062)		
secondary education	0.401	(0.064)	0.135	(0.023)
tertiary education	0.994	(0.070)	0.410	(0.024)
man with partner	0.203	(0.065)		
woman with partner	-0.089	(0.052)		
man with child	0.756	(0.064)		
woman with child	-0.255	(0.047)		
Intercept	-0.339	(0.081)	0.324	(0.060)

Estimation results of the two-part model (separate participation and wage equation). In this model sample selection is not taken into account.

Table 8: Estimation results sample selection model

Variable	Coefficient	Std. Err.	Coefficient	Std. Err.
Equation 1 : ln(wage rate)	FIML		two-step	
male	0.163	(0.010)	0.166	(0.012)
age	0.081	(0.004)	0.082	(0.004)
age ²	-0.001	(0.000)	-0.001	(0.000)
secondary education	0.137	(0.023)	0.138	(0.023)
tertiary education	0.412	(0.024)	0.416	(0.025)
Intercept	0.299	(0.077)		
Equation 2 : participation	FIML		two-step	
male	0.137	(0.080)	0.127	(0.078)
age 30 - age 39	0.882	(0.054)	0.881	(0.054)
age 40 - age 49	0.797	(0.055)	0.790	(0.054)
age 50 - age 59	0.167	(0.045)	0.166	(0.045)
age \geq 60	-1.990	(0.065)	-1.989	(0.065)
secondary education	0.409	(0.067)	0.409	(0.067)
tertiary education	0.988	(0.073)	0.987	(0.073)
man with partner	0.244	(0.069)	0.248	(0.069)
woman with partner	-0.097	(0.054)	-0.101	(0.053)
man with child	0.784	(0.067)	0.790	(0.066)
woman with child	-0.235	(0.049)	-0.233	(0.049)
Intercept	-0.390	(0.085)	-0.385	(0.084)
ρ	0.024		0.053	
σ_w^2	0.342		0.342	
$\sigma_{wp} = \rho\sigma_w^2$	0.008	(0.016)	0.018	(0.024)

Estimation results of the sample selection model, estimated by MLE and Heckman's two-step estimator.