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THE FACTORS AFFECTING THE USE OF ELDERLY CARE AND THE NEED FOR RESOURCES BY 2030 IN FINLAND

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Abstract: A nation-wide interview survey data is used to analyse by means of ordered logit models the impacts of age, dependency and other factors on probabilities to use home and community care for the elderly. With these models and the age profile of the institutional care, we have made projections of service specific dependency, age and gender distributions by 2030. In our scenarios we assume that improvements in functional ability of the elderly will by 2030 increase the average starting-age for using home and community care by three or five years and delay the admission into institutional care by three years. We also make an assumption that quality of care is raised by increasing staffing levels in the care of elderly to the level which was considered sufficient for good quality care according to recommendations made by a recent expert working group. To meet the resource needs caused by the rise in the projected number of elderly population would require 1.9 % annual increase in operating costs. Increasing staffing levels to correspond good quality care would increase costs by 2.6 % annually. However, postponing the average starting-age by three years would leave the annual increase to 1.2 %, even with better care quality. In case good quality of care is desired already by 2010 operating costs would need to be increased by 3.6 % annually.

Key words: Elderly care, dependency, quality of care, macrosimulation.

Tiivistelmä: Vanhuksille kotiin annettavien palvelujen käytön todennäköisyyksiin vaikuttavia tekijöitä tutkittiin vuoden 1998 vanhusbarometriaineistolla. Näiden mallien ja laitospalvelujen ikäjakauman perusteella laadittiin palvelukohtaiset arviot vanhusten vuoden 2030 toimintakyky-, sukupuoli- ja ikäjakaumasta. Tutkimuksen skenaarioissa oletettiin, SOMERA -toimikunnan mukaisesti, että avopalvelujen käytön aloitusikä siirtyy vuoteen 2030 mennessä kolme tai viisi vuotta ja laitospalvelujen kolme vuotta myöhemmäksi. Resurssiskenaarioissa asetettiin tavoitteeksi nostaa sekä laitos-, että kotipalvelujen laatu tasolle "hyvä", joka vastaa laitoshoidon osalta karkeasti muiden Pohjoismaiden tasoa. Pelkkä väestönkehitys merkitsisi aikajaksolla 1,9 prosentin vuosikasvua vanhustenhoidon kustannuksiin. Hyvä hoidon taso nostaisi vuosikasvun 2,6 prosenttiin. Toimintakyvyn paraneminen niin, että palvelujen käyttö myöhentyisi kolmella vuodella kuitenkin leikkaisi kustannusten kasvuvauhdin hyvälläkin hoidolla 1,2 prosenttiin. Jos hoidon hyvä laatutaso halutaan saavuttaa jo vuoteen 2010 mennessä, kasvaisivat vanhustenhuollon käyttökustannukset 3,6 prosenttia vuosittain.

Asiasanat: Vanhustenhuolto, toimintakyky, hoidon laatu, stimulointimallit

Foreword

The ageing of the population is a major challenge for Finland, where the population is ageing faster than in the other EU countries. This means that the need for institutional care, pension costs and the expenses of the social and health services are increasing.

The report analyses the factors influencing the use of social and health services by the elderly. On the basis of the analysis, scenarios for the growth in expenditure by the services are presented until the year 2030. The report is a scientific background report to the publication "Seniori-Suomi - ikääntyvän väestön taloudelliset vaikutukset" (Sitra's reports 30, written in Finnish), which was published in February 2003.

This new report is published in the series of the Government Institute for Economic Research and the research work has been done with the support of Sitra. The advisory group for the project included Kalevi Luoma, Research Manager, Reino Hjerppe, Director-General, and Aki Kangasharju, Research Director, from the Government Institute for Economic Research (VATT), Unto Häkkinen, Research Professor from the National Research and Development Centre for Welfare and Health (Stakes), Carita Putkonen, Fiscal Counsellor from the Finnish Ministry of Finance, Antti Hautamäki, Research Director from Sitra, and the undersigned. All of them to be complimented.

Helsinki, April 10, 2003

Vesa-Matti Lahti

Research Manager

Finnish National Fund for Research and Development Sitra

Esipuhe

Väestön ikääntyminen on suuri haaste Suomelle, jonka väestö ikääntyy muita EU-maita nopeammin. Tämä merkitsee sitä, että hoitotarve, eläkemenot sekä sosiaali- ja terveyspalveluiden kustannukset kasvavat.

Tässä raportissa analysoidaan vanhusten sosiaali- ja terveyspalvelujen käyttöön vaikuttavia tekijöitä ja esitetään niiden pohjalta skenaariot palvelujen kustannuskehityksestä vuoteen 2030 saakka. Raportti on helmikuussa 2003 julkistetun "Seniori-Suomi - ikääntyvän väestön taloudelliset vaikutukset" -julkaisun (Sitran raportteja 30) tieteellinen taustaraportti.

Raportti julkaistaan Valtion taloudellisen tutkimuskeskuksen sarjassa ja sen tutkimustyö on tehty Sitran tuella. Hankkeen johtoryhmään kuuluivat allekirjoittaneen lisäksi tutkimuspäällikkö Kalevi Luoma, ylijohtaja Reino Hjerppe ja tutkimusjohtaja Aki Kangasharju Valtion taloudellisesta tutkimuskeskuksesta, tutkimusprofessori Unto Häkkinen Stakesista, finanssineuvos Carita Putkonen valtiovarainministeriöstä ja tutkimusjohtaja Antti Hautamäki Sitrasta. He kaikki ansaitsevat suuren kiitoksen.

Helsingissä 10.4.2003

Vesa-Matti Lahti

Tutkimuspäällikkö

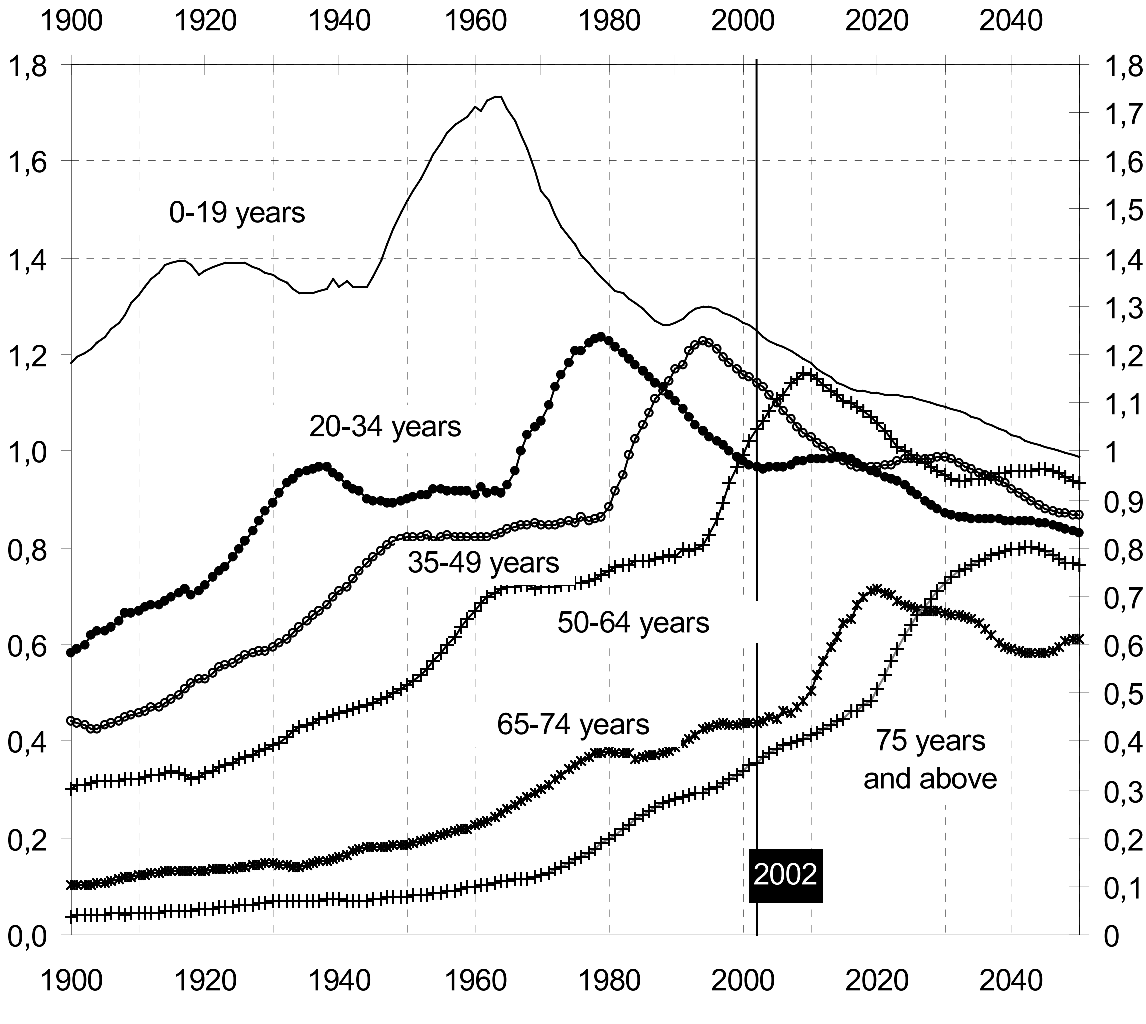
Suomen itsenäisyyden juhlarahasto Sitra

Contents

1. Introduction

During the next decades the demographic composition of the Finnish population will change dramatically. Due to the combined effects of increased longevity and ageing of the large post-war baby boom cohorts the share of elderly population will rise considerably. The share of those aged 75 years or more will rise from the current 7 percent to approximately 14 percent in 2030, also their absolute number will double (Figure 1). Thereafter the population structure is expected to be relatively stable.

Figure 1. *Finnish population by age groups between 1900-2050. Population forecast based on population 2001, millions*



The baby-boom cohorts lived their economically most productive years from the 1960s to the early 2000s. During that period Finland's per capita GDP grew on average by three percent a year (OECD 2002). Thus, the expectations of the increasing elderly population about future pension benefits level and available elderly care may well be higher than the ones of the current elderly. A number of studies on economic consequences of ageing have already taken place. This paper deals only with elderly care. The pension benefits are extensively discussed in Sosiaali ja Terveysministeriö (2002) and Parkkinen (2002) and Lassila and Valkonen (2002). These studies analyse also the impact of ageing on social and health care expenditure, based on population forecasts, expected economic growth and the age profiles of the social and health services. The results show that with reasonable assumptions on future productivity growth, the GDP share public expenditure on social and health care will grow about 2 percentage units, from the current 7.5 percent by 2030. In this paper we take into account a wider spectrum of factors connected to the use of these services. We concentrate solely on the social and health services provided to the elderly making use of detailed data on these services and their recipients.

The current service profile, the way in which services are distributed among the elderly, is multidimensional. In addition to demographic factors like age and gender the demand for health and elderly care is affected by dependency, social and housing conditions of the elderly. Fiscal and resource constraints in the supply of elderly care also have an effect on the quantity of care that is actually provided. These factors are linked to each other, so that it is almost impossible to figure out exactly what are the driving forces behind the need and receipt of care. In this paper, we examine the role of all the above-mentioned factors with two independent data sets. The role on fiscal factors is studied in institutional care, where municipal level panel data is used to find out how demography and the availability of different funding sources contribute to the quantity and distribution of service home, homes for the elderly, and long term inpatient care. A nation-wide interview study data of non-institutionalised elderly population is used to examine the role of age, gender, dependency and social environment.

Using the elderly population survey, we estimate the probabilities of receiving a certain type of care for 24 population cells, each describing a particular combination of age, gender, and dependency group. These cell probabilities are used in conjunction with the national population forecasts to yield an estimate on the future service usage. The main reference for this type of macrosimulation study is Wittenberg et. al. (1998), where the emphasis is on the links between the circumstances of individuals and the receipt of services.

Given the results of the models we formulate predicted changes in the coverage of in-home domicile services and institutional care for elderly population. To give an idea of what could be done to ease the adjustment of the elderly care sector we study consequences of a hypothetical improvement in the ability of the elderly to run their daily tasks independently. A comparable shift in entering the domicile and institutional care is mirrored in the number of users within publicly provided care. EVERGREEN 2000 model (Vaarama et. al. 1998) is then used to calculate resources needed by 2030. The model uses detailed service specific information on the resources needed and unit costs. Assuming that more workforce per institutionalised client and more time used with an elderly living home means better care quality, we have used the figures from the national proposal for better elderly care quality (STM ja Kuntaliitto 2002) in the EVERGREEN 2000 model to see how much resources would be needed if the recommendations of the proposal were to be followed.

Our primary goal in this paper is to study what kind of changes in use of services and resources could be expected under two assumptions. First, the dependency of the elderly population is expected to diminish, pushing the starting-age of domicile and institutional service use upwards. Second, increasing the quality of care increases resources needed. The two assumptions induce opposite shifts in resource needs. From policy target setting point of view, we try to find an answer to the question how much dependency should be improved in order to make enough resources available to increase the quality of care. These targets are not independent of each other, but good quality of care will also contribute to the reduced dependency.

This report is not only a detailed version of the results reported in Luoma et. al. (2003) chapters 3.4 and 4, but includes some further analysis of the results.

2. The models for care utilisation

2.1 Data

The Ministry of Social Affairs and Health executed the national elderly barometer survey in 1993 and 1998[1]. In this study we exploit only the 1998 survey. The gross sample of 1450 above 60 years old not receiving institutional care was drawn from the 1997 population. The Statistics Finland interviewed personally altogether 1036 respondents successfully. Weights for each gender and age groups were calculated to fix sample loss and make the obtained sample representative for the non-institutionalised elderly population above 60 years in 1997 in Finland. In service use model estimations we have limited the analysis to the elderly above 65 years old. This sub-sample contains 895 respondents corresponding to the population of 574500 elderly.

The survey data enables us to model the intensity of service use. It is measured on ordinal scale [0,4] as no use, less than once a month, once or twice a month, once or twice a week and daily or almost daily respectively. We use ordered logistic-model for home help services, support services, home nursing and cleaning; thus receipt and intensity of care is considered as a joint process dependent on the same set of variables. For the rest of the services binomial logistic model is used to model whether the individual is a service recipients or not. For the mathematical and stochastic specification of the models, see Appendix I.

2.1.1 Dependency measure

Problems in activities in daily living (ADL) are classified into four ordinal categories: no problems at all, minor problems, severe problems and insurmountable problems. Originally the survey included 13 different ADLs, but only ten of those were taken into the study. Of those cooking, laundry, cleaning and transactions outside home are classified as instrumental ADLs (IADL) and eating, washing, dressing and undressing, getting in and out of the bed, use of bathroom and problems in urine continence are considered as personal ADLs (PADL).

The dichotomous variable `DEPENDENCY` summarises problems in activities of daily living. The variable got integer values [0,3] with no disabilities, only IADL disabilities, minor problem in PADLs and severe or insurmountable disabilities respectively. Increased dependency is considered as an immediate reason for the

[1] See Vaarama, et. al. (1999) Vanhusbarometri 1998 for the detailed history of the survey. The data set is also extensively analysed in Vaarama and Kaitsaari (2002).

service use. Naturally, causes for altered dependency can be numerous. In the independent ordered logistic regression of the DEPENDENCY on reported sickness and injuries of the respondents in the Table 1, the role of mental and physical factors is evident. The figures are average probabilities over the subset of data covering the respondents with reported sickness or injury. Therefore the co-existence of the multiple physical or mental problems are taken into account in proportion of their existence.

Table 1. *Probabilities in having problems in activities of daily living for interviewees with a certain sickness or injury. The average predictions of the probability model*

	No disabilities	IADL	PADL1	PADL2
Injured after an accident*	36.2	31	24.2	8.6
Musculoskeletal diseases	28.8	31.8	28.6	10.8
Cardiovascular diseases	34.6	31	25.2	9.1
Respiratory organs	28.6	30.3	29.4	12.1
Mental disorders*	24.1	30.2	32	13.7
Skin diseases	26.6	30.1	30.4	12.9
Metabolic disorders	28.8	30.4	29	11.8
Digestive diseases*	27.5	30.2	29.8	12.4
Impaired eyesight or audition	32.2	31.6	26.5	9.7
Others	30.6	30.6	27.8	11.02

IADL= Problems in instrumental activities of daily living.
PADL1= Problems in two personal activities of daily living, at the most.
PADL2= Problems in more than two activities of daily living.
*Parameter not statistically significant at 10 % confidence level.

Respondents with cardiovascular diseases seem to have less PADL related problems, on average, whereas skin problems seems to be connected to increased dependency status. A noteworthy point is, that musculoskeletal diseases do not appear to raise dependency risk above other diseases and injuries.

In the rest of the study dependency is used as an explanatory variable for the service usage. In those models partition of having minor or insurmountable problems in personal ADL appeared to work poorly. Therefore we ended up using two separate dummy variables to describe the presence of dependency. In the rest of the text, unit values of variables ADL1 and ADL2 denotes the presence of instrumental ADL problems or presence of personal ADL problems respectively. The estimated parameters of these variables indicate response to the ADL0 i.e. no disabilities.

2.1.2 Age measure

In the models of different service utilisation, in addition to dependency, the client's age is supposed to have a central role. However, it is not always clear how age should enter into the models. A simple approach is to use age or a monotone transformation of it, but this was considered too restrictive, as changes in clients' need may appear too abrupt for any sensible transformation. Instead, we let the impact of the age change according to the preselected age groups and if necessary also allow other variables to have a joint impact with age on service use. The age related variables are denoted as AGE for the linear age, DAGEXX for the age group dummy XX indicating the lower limit of the 5-age range (e.g. DAGE75 equal to 1 for the respondents between 75 and 79).

The simple dummy grouping of age does not usually work satisfactorily. The way the client's age enters in to the model is likely non-linear, however non-linearity may enter in the model in several ways. A parametric transformation, e.g. squaring, may work well, but implies a rather strong maintained hypothesis. An alternative is to use a discrete function, allowing the slope change at given age nodes. Altering the set of nodes this gives an approximation to arbitrary non-linear function. However, our problem is that variation in service usage is dependent on also other factors related to age. To save degrees of freedom and to keep model as simple as possible we have imposed non-linearity in age using cross terms with other variables. The strongest emphasis in the model is on the impact of gender (GENDER), age (AGE) and dependency (ADL1 and ADL2) structure of the population. Therefore age and dependency enter in the model both as independent variables and semi-continuous or dummy cross terms with gender. These variables are labelled as MADL1, MADL2 and FADL1AGE, FADL2AGE and MADL1AGE, MADL2AGE, where F and M are shortcuts for female and male respectively, ADL1 and ADL2 shortcuts for instrumental and personal disabilities in daily living respectively and AGE for the age of the respondent. MADL1 and MADL2 are dummies, FADL1AGE and other semi-continuos variables have value of AGE for the respondents in the reference group, otherwise zero.

2.1.3 Other variables

The other determinants of the service utilisation considered necessary are the client's gender (dummy variable GENDER, value 1 indicating a male respondent), living alone indicator (dummy variable ALONE, value 1 if living alone). Most of the services are arranged and/or subsidised by the municipalities. To indicate this supply effect we have used several variables like government subsidies to municipalities (variable GOVGRANT) and municipal tax rate (variable TAXRATE). Government grants are somewhat problematic, as their amount is dependent on both demographic factors of the municipality and its financial situation. A high tax rate usually indicates weak tax base of the municipality, perhaps due to unfavourable demographics structure or structural problems in local economy.

In the survey also availability of informal care was asked. Respondents were first asked if they received any help in their daily activities, no matter what kind of help. For those receiving some help, the sources of the help was asked. The list covered both informal and formal care-givers and respondents were asked to list all of them and name one who helps the most. The structure allows a detailed modelling of the informal care giving. However, to keep scenarios as simple as possible we have used a dummy variable `INFHELP`, to describe, if the respondent considered having received any help in daily activities from relatives, friends and neighbourhood.

Finally, the economic position of the elderly is usually considered to have an impact on demand and use of services. However, the production costs of intensive domicile care and all forms of institutional care usually exceed the capacity of the elderly to pay for these services. For example operating costs per day range from 30 euros in regular service housing (not including accommodation) to 104 euros in health centre inpatient care (Rajala et. al. 2001). Domicile services are not necessary much cheaper, as home help services with 10-29 visits a month costs about 17 euros a day, but with 30-79 visits already 52 euros. The higher intensities of home help services are as expensive as inpatient care (*ibid.*). The average amount of pensions in 2001 was 999 euros (Social Insurance Institution (Kela, 2002, Table 11). If recipients of domicile services were required to pay full price for services they consume, daily use of these services would be beyond the means of an average pensioner. However, these services are mainly financed by taxes. User charges cover only a fraction of their production, or purchasing costs. In institutional care, the maximum service fee can not exceed 80 percent of the resident's disposable income. Therefore, disposable income is not usually a constraining factor in service usage. Our data set included an interviewee declared estimate on monthly disposable income. This had no explanatory power in any of the service usage models estimated.

2.2 Home help services

The survey covered questions about use, intensity and satisfaction of 19 different services that support respondents ability to live in their own home. The simulation program used in the next stage counts the number of users, intensity of use and costs of 11 domicile[2] services. We can satisfactorily match only three of the care options between survey and the model. However these services, namely home help services, support services and home nursing are considered as

[2] By domicile or non-institutional services we mean the care given in the client's own residence.

the most important ones. Home help services cover all the services and help given at clients home (e.g. support in personal tasks, necessary daily housekeeping), whereas support services are typically either delivered to the home (e.g. meals on wheels, grocery shopping, cleaning) or offered outside the residence (day centre services, escorting, short-term institutional care). We model home help services and home nursing as independent tasks. Support services are subdivided into cleaning help, meals on wheels, day centre services and bathing and later aggregated for the simulations.

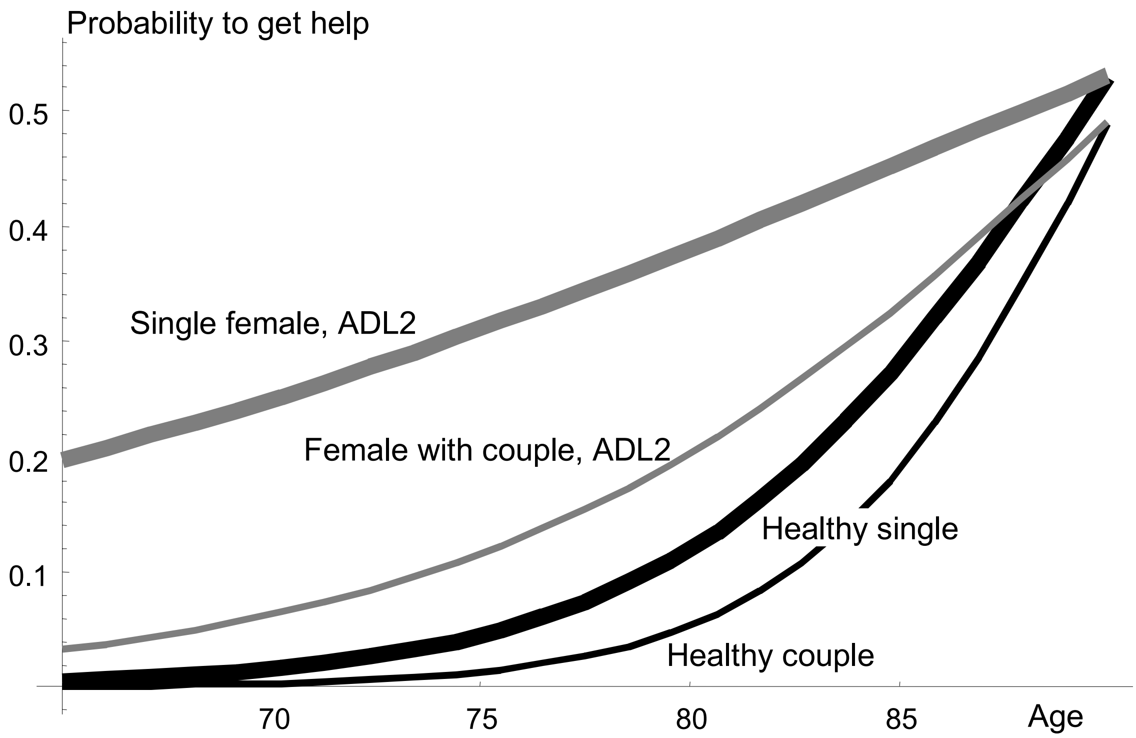
The model estimates for the home help services are reported in Table 2. Age and dependency categories were statistically significant predictors for the receipt of home help service, whereas gender as independent variable failed the test. Therefore, gender appears in the model only in conjunction with disabilities and age. Except for informal help (`INFHELP`) and tax rate (`TAXRATE`), single parameter gives only a partial impact of the variable considered.

Table 2. Ordered logit estimates for home help services

Survey ordered logistic regression									
Number of obs		1031	Population size		752236				
Sub-population no. of obs		895	Sub-population size		574901				
F(13,1018)		10.51	Prob > F		0				
Home help services	Coef.	Std. Err.	T	P>t	Marginal effects by intensities				
					0	1	2	3	4
AGE	0.283	0.044	6.45	0	-	+	+	+	+
ALONE	6.639	3.521	1.89	0.06	-	+	+	+	+
ALONEAGE	-0.072	0.045	-1.61	0.108	+	-	-	-	-
ADL1	15.685	5.778	2.71	0.007	-	+	+	+	+
ADL2	13.507	4.084	3.31	0.001	-	+	+	+	+
MADL1	-15.273	5.805	-2.63	0.009	+	-	-	-	-
MADL2	-11.277	3.984	-2.83	0.005	+	-	-	-	-
FADL1AGE	-0.189	0.074	-2.57	0.01	+	-	-	-	-
FADL2AGE	-0.150	0.051	-2.91	0.004	+	-	-	-	-
MADL1AGE	-0.021	0.012	-1.72	0.086	+	-	-	-	-
MADL2AGE	-0.027	0.009	-3.21	0.001	+	-	-	-	-
INFHELP	1.165	0.297	3.92	0	-	+	+	+	+
TAXRATE	-0.035	0.012	-2.85	0.004	+	-	-	-	-
κ_1	23.715	3.585	6.62	0					
κ_2	24.014	3.579	6.71	0					
κ_3	24.471	3.575	6.84	0					
κ_4	25.651	3.594	7.14	0					

As noted in Appendix I the parameter values should be interpreted with care. The probability generated by an observation is dependent on the value of explanatory variables and the intensity of the care considered. As indicated in the five last columns in the Table 2, the signs of the marginal values are choice specific. The full set of marginal values is reported in Appendix III.

Figure 2. Contribution of age to the probability to use home help services. Model predictions for a selected sets of elderly[3]



`AGE` has a positive independent marginal effect on home help services. All the other age related cross terms, `ALONEAGE`, `FADL1` and `FADL2`, `MADL1` and `MADL2` are negative, indicating the lower effect on probabilities to get help than independent variables suggest. As the value of these variables is always equal to `AGE` or zero, none of the cases has negative net marginal effect on service use. The highest marginal effect (but not the probability) is given to the healthy female or male elderly. The variable `ALONEAGE` is equal to `AGE` if respondent lived alone, otherwise zero. Thus the cross effect of living alone and age is somewhat lower than the independent parameter estimates suggests. Figure 2 presents predicted contribution of age to probability levels to use help for four different cases, namely: 1) healthy females and males couples, 2) healthy females

[3] Note that probabilities in the figure are not "complete". Availability of informal help and supply factors will shift the drawn lines.

and males living alone, 3) female couples having problems in personal activities of daily living (ADL2) and 4) female singles with ADL2 type problems.

As expected the healthy elderly living with a mate are the most likely to live without home help services. However, for them the probability of receiving help increases most rapidly with age. Females with a mate having problems in personal activities of daily living are more likely to report usage of home help services than their healthy peers. However the difference is rather small, at highest a little over 10 percent for elderly aged 80. Being single does not have a great impact for healthy elderly, but really matters for singles with ADL2 type problems. Within age range 75 to 80, their probability to use (public) services is more than 20 percent higher. The role of living alone decreases as people get older and turns negative with the oldest elderly. However, the impact of ADL problems and gender seems to disappear as people get older.

Independent dependency parameters `ADL1` and `ADL2` reflect the probabilities relative to healthy population. Variables `MADL1` and `MADL2` indicate generally lower probabilities to use home help services for the male. As well as with variable `AGE`, `FADL1AGE` and related variables strengthen the dependency effect.

Informal help has a positive effect on service use. This is a kind of complementary relationship; a positive amount of informal help is expected with publicly provided care.

The supply effect of service use is measured by the municipal tax rate. A higher tax rate is connected to smaller probability to use home help services. There is a negative correlation between tax rate and population of the municipality (-0.22 year 2000). Thus, it looks like small (and rural) communities are less likely to offer services to homes.

It is already evident from the analysis of the Figure 2, that a lot of interesting features are hidden in probability structures of the estimated models. However, the main goal of the models presented here is in their use for simulation purposes. For that purpose, the analysis of the home help services, as well as the other service usage models, will be completed in the next section. We leave the detailed study of the probability changes to the future studies, but present here only the estimated models and the basic statistical inference around the models for other domicile services.

2.3 Home nursing

Having personal disabilities appeared as the only significant dependency measure for the use of home nursing. The role of age is taken into account for clients above 80 years as a dummy and a semi-continuous variable DAGE80 being equal to AGE if respondent was above 80 years old and 0 otherwise. No supply factors appeared significant. The parameter estimates of ordered logit-model are reported in table 3.

The dummy parameter of AGE is negative, but DAGE80 never gets value 1 without variable AGE80 having a value above 80. Age does not have statistically significant impact to the use of home nursing for the elderly younger than 80 years. To the elderly that older, the net impact of the age variables is always positive. Thus ageing as well as dependency increases the need for home nursing. From the appendix III, we can conclude, that personal disability has 15-20 times higher marginal effect than an additional year in life.

Table 3. Parameter estimates of home nursing

<table>
<tr><td colspan="10">Survey ordered logistic regression</td></tr>
<tr><td colspan="2">Number of obs</td><td>1029</td><td colspan="2">Population size</td><td colspan="5">751781</td></tr>
<tr><td colspan="2">Sub-population no. of obs</td><td>893</td><td colspan="2">Sub-population size</td><td colspan="5">574446</td></tr>
<tr><td colspan="2">F(3,1026)</td><td>24.48</td><td colspan="2">Prob > F</td><td colspan="5">0</td></tr>
<tr><td>Home nursing</td><td>Coef.</td><td>Std. Err.</td><td>T</td><td>P>|t|</td><td colspan="5">Marginal effects by intensities</td></tr>
<tr><td>Intensity</td><td></td><td></td><td></td><td></td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>DAGE80</td><td>-10.436</td><td>4.903</td><td>-2.13</td><td>0.034</td><td>+</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>AGE80</td><td>0.135</td><td>0.058</td><td>2.31</td><td>0.021</td><td>-</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>ADL2</td><td>1.800</td><td>0.278</td><td>6.48</td><td>0</td><td>-</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td>κ_1</td><td>3.278</td><td>0.235</td><td>13.98</td><td>0</td><td colspan="5"></td></tr>
<tr><td>κ_2</td><td>3.887</td><td>0.234</td><td>16.6</td><td>0</td><td colspan="5"></td></tr>
<tr><td>κ_3</td><td>4.712</td><td>0.300</td><td>15.72</td><td>0</td><td colspan="5"></td></tr>
<tr><td>κ_4</td><td>6.414</td><td>0.554</td><td>11.59</td><td>0</td><td colspan="5"></td></tr>
</table>

2.4 Support services

Support services consist of several different home and community care services. We have used the four main support services available from the survey, namely help with cleaning, meals on wheels, help with bathing and services provided at day centres. This set of services is relatively heterogeneous, thus we have constructed for each service a model of its own, and the model predictions are later added up for the simulations.

2.4.1 Help with cleaning

The intensity of cleaning services varies most among the support services and we are able to use the same ordered logit model as for the home help services and home nursing. Even if the role of gender appears important, it has no independent explanatory power. The greatest differences between genders appeared among younger elderly, where females were more likely to get help and among the oldest old where the converse holds. Table 4 reports the parameter estimates.

Table 4. Parameter estimates for the receipt of help with cleaning services

Survey ordered logistic regression									
Number of obs		1030	Population size		751929				
Sub-population no. Of obs		894	Sub-population size		574594				
F(5, 1025)		29.69	Prob > F		0				
Cleaning services	Coef.	Std. Err.	T	P>|t|	Marginal effects by intensities				
Intensity					0	1	2	3	4
`FAGE`	0.095	0.021	4.420	0.000	-	+	+	+	+
`MAGE`	0.099	0.021	4.630	0.000	-	+	+	+	+
`Alone`	1.305	0.292	4.480	0.000	-	+	+	+	+
`ADL2`	1.351	0.252	5.350	0.000	-	+	+	+	+
`INFHELP`	1.393	0.297	4.690	0.000	-	+	+	+	+
κ_1	10.727	1.574	6.810	0.000					
κ_2	11.248	1.563	7.200	0.000					
κ_3	12.533	1.587	7.900	0.000					
κ_4	14.794	1.546	9.570	0.000					

The male and female age patterns are, on average, very close to each other. Living alone, problems in personal activities and available informal help increases the need for cleaning help, the size of each effect being approximately the same. As well as in home help services, the availability of informal help seems to be connected with increased need of support.

2.4.2 Meals on wheels

The same set of variables as for the cleaning services was found significant for the meals on wheels, but the model is simplified to binomial logit. Again differences between genders are small, but both parameters are statistically significant.

Table 5. Parameter estimates for the meals on wheels model

Survey logistics regression					
Number of obs		1031	Population size	752236	
Sub-population no. Of obs		894	Sub-population size	574901	
F(5,1026)		23.36	Prob > F	0	
Meals on wheels	Coef.	Std. Err.	T	P>|t|	Marginal effects
FAGE	0.115	0.027	4.210	0.000	0.002
MAGE	0.123	0.027	4.500	0.000	0.002
Alone	1.407	0.334	4.220	0.000	0.032
ADL2	1.065	0.310	3.430	0.001	0.024
INFHELP	1.194	0.342	3.490	0.000	0.033
CONSTANT	-13.153	1.992	-6.600	0.000	

According to the Appendix I, the marginal effects should be proportional to parameters. However, the parameter value of ALONE is higher than INFHELP, but the marginal value of INFHELP is slightly higher. This is because both of the marginal values are calculated independently using the means of other explanatory variables and change of dummy from 0 to 1. Thus the mean (or frequency) of ALONE and INFHELP shift the range where each other's marginal effects are calculated.

2.4.3 Help with bathing

About 78% of those, who received help in daily hygiene received it once or twice a week. Just gender specific age, living alone and informal help appeared significant factors. The insignificance of dependency variables may also reflect the social dimension of sauna-services. They are usually offered outside the residence and are served also for recreational purposes.

Table 6. Parameter estimates for the bathing model

Survey logistics regression					
Number of obs		1031	Population size	752236	
Sub-population no. Of obs		895	Sub-population size	574901	
F(4,1027)		20.93	Prob > F	0	
Bathing	Coef.	Std. Err.	T	P>|t|	Marginal effects
FAGE	0.135	0.036	3.720	0	0.001
MAGE	0.122	0.037	3.250	0.001	0.001
ALONE	0.810	0.464	1.750	0.081	0.009
INFHELP	1.596	0.442	3.610	0	0.031
CONSTANT	-14.070	2.629	-5.350	0	

2.4.4 Services provided at service centres

This group of services covers all the support given in day centres. They are not all recreational, but also physical rehabilitation and meals may be included in daily program. The intensity of support is distributed between seldom and weekly, but the total number of respondents using day centre services is only 43, giving rather small service intensity specific frequencies. Therefore day centre services are modelled as binomial logit.

Table 7. Parameter estimates for the day centres' model

Survey logistics regression					
Number of obs		1029	Population size		751781
Sub-population no. of obs		893	Sub-population size		574446
F(5,1024)		6.6	Prob > F		0
Day centres	Coef.	Std. Err.	T	P>|t|	Marginal effects
AGE	0.119	0.055	2.150	0.032	0.003
DAGE80	-1.429	0.625	-2.280	0.023	-0.019
DAGE85	-0.293	0.722	-0.410	0.685	-0.006
ALONE	0.794	0.424	1.870	0.061	0.02
INFHELP	1.234	0.448	2.750	0.006	0.045
CONSTANT	-12.325	3.961	-3.110	0.002	

The two age dummies are overlapping. Thus age effect on service use for elderly above 85 years is a combination of all the three age variables. The use of services provided in day centres increases with age but the for the elderly over 80 years of age the effect decreases. Living alone and informal help increases the use of day centre services.

Given models and estimated parameters it is easy to calculate any probability conditional on the values of explanatory variables. However, the strategies how to select values of explanatory variables differ. As noted in appendix I, in the discussion of the statistical model, instead of using means or equivalent measures of explanatory variables we will use sub-sample means of predictions.

2.5 Institutional care

Service homes, homes for the elderly and health centre hospitals constitute the main alternatives for providing institutional care for the elderly. They differ not only in care intensity but also in the division of financial responsibility between clients, municipality and Social Insurance Institution (SII). Service homes do not necessarily have a nurse available 24 hours a day and clients are living in their own (or rented) flats and purchase the services they need either from the keeper or the third party supplier. Clients are eligible for housing allowances and are entitled to reimbursements from SII for costs of prescribed medicines. In case a client can not afford the entire care needed, municipal agency subsidises the patient. In several cases the service housing is directly or indirectly under municipal control, and prices are bilaterally contracted. Homes for the elderly have nurses available 24 hours a day and clients are formally considered to be in need of institutional care. Thus clients are “hospitalised” and they pay a mean-tested rate on all the care and pharmaceuticals they need. Elderly with severe disabilities and in need of constant long term care are taken care in municipal health centre hospitals for a mean-tested fixed rate. If only the health and dependency status of the elderly allows it, municipalities have great fiscal incentives to keep elderly in service homes.

These three institutional care alternatives are simultaneously related to each other. Especially a client may be assigned to service home or a home for the elderly according to the places available. These relationships would be most appropriately modelled as simultaneous equations, but we did not get enough statistical support for simultaneous relationships. Therefore, we use the seemingly unrelated (SUR) estimator to take account of the joint variation of the error terms.

In all three estimated equations the dependent variable was expressed as a share of the total elderly population aged 75 years. The data facilitated also the levels of service use between 1994 – 1996, but using annual panel appeared problematic, as the number of beds and places is not immediately affected by annual changes of demographic parameters and available finance. The data from 1994 and 1995 was considered less reliable than data from 1996 onwards[4]. Therefore the dependent variables are expressed as differences from 1996 to 2000. Also the explanatory variables are expressed in a comparable form. The demographic variables `DiffAGE65-85` and `DiffAGE85+` are percentage differences of the share of the age group. `DiffTAXBASE` is the change of (municipal) taxable income per capita (1000 FIM). As the Finnish Slot Machine Association grants are distributed annually for the next operation year, the variable `FSMAGRANT` is the amount of grants per capita above 75 years old from 1995-1999. Variable `POORHOUSING` is the share of elderly (75+ years old) households who reported having poor or very poor housing conditions in 1996. When all these variable get zero value, we do not expect to see any changes in the share of elderly receiving the particular type of care, thus models are estimated without intercepts.

[4] Most of the SOTKA database variables were first collected 1994. The municipals obviously have had problems in producing comparable data over the first years.

Table 8. Parameter estimates of the institutional care equations

Seemingly unrelated regressions				
Equation (diff. of)	Obs	Parms	χ^2	Prob(>χ^2)
Service housing	436	5	181.2235	0
Homes for the elderly	436	4	115.001	0
Inpatient	436	2	42.83485	0
Parameter estimates by equation				
	Coef.	Std. Err.	P>|t|	Mean
Diff service housing				0,017
FSMAGRANT	0.0010	0.0004	2.8	2.5 (4.4)
DiffTAXBASE	0.0009	0.0003	3.19	-1,78
POORHOUSING	0.1019	0.0467	2.18	0.048
DiffAGE65-84	0.4729	0.1893	2.5	0.0072
DiffAGE85+	2.9790	0.5932	5.02	0.0022
Diff homes for the elderly				-0,011
FSMAGRANT	-0.0012	0.0003	-4.63	2.5 (4.4)
POORHOUSING	-0.1317	0.0323	-4.08	0.048
DiffAGE65-84	-0.2654	0.1275	-2.08	0.0072
DiffAGE85+	0.4752	0.4175	1.14	0.0022
Diff Inpatient				0.006
GOVSUB	-0.0006	0.0003	-1.98	
DiffAGE65-84	-0.3512	0.0960	-3.66	-1,78
DiffAGE85+	-0.7672	0.2992	-2.56	0.0022

A degree of symmetry in the SUR estimates is present, even if the parameters are unrestricted. The estimates of parameters `FSMAGRANT`, `POORHOUSING` and `DiffAGE65-84` are approximately equal but have opposite signs to the service housing and homes for the elderly equations. This suggests that FMSA grants have encouraged the replacement of care in homes for the elderly by service housing especially among younger elderly. From the oldest group, elderly above 85 year old, both service housing and municipal hospitals take clients. The signs of the parameters confirm that the role of homes for the elderly in general have been declining in the late 90's. As the `DiffAGE85+` parameter is indefinite in sign results do not indicate a pressure to increase the supply of care in homes for the elderly.

The contribution of each independent variable to the form of care is easiest seen by comparing their contributions at the sample means (the last column of the parameter table). The size of `FSMAGRANT` tells that the average grants from the period of 1995-1999, about € 740 (4400 FIM) per elderly above 75 years old, increased the share of service housing residents of the total number of elderly

75+ by 0,5 percent. The initial level being 5,5 percent and average increase in share being 1,7 percent. Thus the role of FSMA grants has not been particularly strong, accounting less than 1/3 of the service housing share increase. The share of oldest (`DiffAGE85+`) and poor housing conditions seem to explain slightly more (0,6 percentage units) each in favour for the service housing.

The contribution of these variables for the homes for the elderly are reversed, with the difference that the oldest group does not have a significant impact. Therefore the FSMA grants have had relatively greater role in vacating homes for the elderly than creating service housing.

For the health centre hospitals the share of the both age groups has had a negative effect on the share of hospitalised elderly. Obviously this is due to the chosen policy to favour service housing and health centres in short term care. The government subsidies on investments include also subsidies to day centres combined with health centres, helping the elderly to postpone hospitalisation.

Even if the models of institutional care seem to explain reasonably well the changes that took place in the late 1990's, they are not that useful for predicting future use of care. The size of the elderly cohorts have changed only moderately over the estimation period compared to projected change by 2030. Also, promoting the supply of service homes has been a result of intentional nation-wide policy. Substituting the population forecasts over next 30 years to the models easily yield perverse results. Thus, unlike the models for domicile service, these models for institutional care will not be used for the simulation. However we should bear in mind from these models, that the role of fiscal incentives (government subsidies, FSMA grants and cost shifting) seem to have less impact on final outcome than generally expected.

3. Simulations

3.1 Predictions of the service use

All the predictions of the service usage are conditional on the population forecast of Statistics Finland 2001 (see Figure 1). It is a demographic trend model based on observed trends in birth rate, mortality and migration.

The basic tool used in simulations is EVERGREEN 2000 program (Vaarama et. al. 1998). It is a spreadsheet based program designed originally for a municipal level follow up, assessment, planning and reporting of the elderly care, but it can be used equally well in national level planning. In the target-setting section of the model, user can feed in the desired, or expected, target levels of the service users and intensity of service. It will use the current (or desired) labour and capital productivity as well as current investment and unit costs to calculate the operating costs of each service.

3.2 Service profiles at 2030

EVERGREEN 2000 is a planning model, where the number of elderly using services, expressed as a share of population aged 65 years or more, is an exogenous variable. Also the intensity of service use is exogenous. To yield the service profiles, the share of each cohort using services, we need to produce predictions of likely number of service users at target year 2030. The probability models estimated above are the natural starting points, but at least two alternative strategies could be used to calculate the predictions for the service use.

The most straightforward way would be to substitute age in the models and use appropriate values, usually survey means, instead of other exogenous values. This is, however, somewhat problematic, as the probability model predictions are non-linear, thus linear mean-estimator of the explanatory variable (or any other estimate of expected value) does not yield average probability. This is a problem especially for the dummy variables.

Alternatively, we could use the averages of fitted values or more precisely, average probabilities over the of appropriately selected sub-samples or cells. Our main interests are in the impact of age, dependency and gender distribution on future patterns of service use. We will let each cell express probability to use particular service for a person with specified gender and dependency classification within certain range of age. As we need to count average probability of the cell, enough observations should be left in each cell after disaggregation of the data set. The respondents were of age 60-90. As the legal retirement age in Finland is 65 we will use range 65-90. As the level of service need is in general low and stable for those below 75 years, we divide the respondents into the following age categories: 65-74, 75-79, 80-84 and 85+. The dependency variable consists of three ordered groups: non-ADL, only instrumental ADL and personal ADL-disabilities. For some services the number of personal ADL-disabilities and the type of disability appeared significant, but for the simulation purposes the number of observations in each cell gets too low.

With two gender groups, three ADL groups and four age groups we can divide observations in 24 cells. Even with that rough grouping the frequencies for the oldest age group are problematically low. The cell frequencies are reported in Table 9.

Table 9. Grouping of the probabilities and the cell frequencies from the survey

Survey cell frequencies				
	Age 65-74	Age 75-79	Age 80-84	Age 85+
Female non ADL	118	46	17	5
Female IADL	52	31	28	7
Female PADL	62	52	61	18
Male non ADL	91	25	19	4
Male IADL	74	35	26	11
Male PADL	49	31	22	14

Cell grouping for the simulations				
	Age 65-74	Age 75-79	Age 80-84	Age 85+
Female non ADL	118	46	22	
Female IADL	52	31	35	
Female PADL	62	52	61	18
Male non ADL	91	25	23	
Male IADL	74	35	37	
Male PADL	49	31	36	

From the left hand side panel in Table 9 it is clear that non ADL and IADL cells for both genders above 85 years old are too small for reliable estimates of the mean. For the PADL cells the number of males above 85 years is also considered too low. For the PADL disabled females above 85 years four more observations and low variation in means of predictions suggest keeping the cell separate from age 80-84.

The Statistics Finland population forecasts cover the whole population up to 100 years in one year age groups and 100+. The survey was limited to the non-institutionalised elderly less than 91 years old. We will not try to expand model predictions beyond the sample range. Instead we give the same predicted probability for elderly above 90 years, than those in the oldest ADL disability cell of the gender. This is a conservative guess having little effect on predictions, since the share of elderly above 90 years old living home is relatively small. We have no information concerning future shares of non-institutionalised elderly. All the scenarios will be based on current shares (see Appendix IV).

The service patterns from the survey are reported in the Appendix II. For the ordered logistic models each of the five service intensities have they own probability distribution. For each service, probabilities are organised in five tables. The first table reports the probabilities for not using the service and the rest of the tables give the probabilities for using the services with certain intensity. The EVERGREEN 2000 program does not use intensity groups, but uses aggregates, number of visits per week and the number of clients. Thus, instead of aggregating the intensity tables with exogenous weights[5] we have ended up using the "residual" probability 1- (not receiving help) to calculate the number of clients receiving help or support in domestic daily life. Also for the binomial logit models (i.e. bathing and day centres) the share of elderly population projections are based on single table giving probability to get service in hand.

3.3 Scenarios

In addition to the expected increase in the elderly population, the need for care, personnel and the cost of services in the future depends crucially on changes in dependency and service usage patterns, or to whom services are allocated. The number of personnel needed depends not only on the number of service recipients, but also on the desired quality of care.

Expected dependency changes

The dependency rate of the future elderly cohorts depends on current health status of the working age cohorts, and the future development of their health. Table 1 reported the predicted probabilities for dependency classifications conditional on the different sicknesses and injuries. A remarkable point is that variation in the probabilities between them is low. This is probably due to simultaneous occurrence of multiple illnesses.

According to the Terveys 2000 (Health 2000) study, the prevalence of health problems and functional limitations of adult Finns have decreased considerably during the last 20 years (Klaukka 2002, Aromaa and Koskinen 2002). Health of elderly Finnish population has also significantly got better and their ability to carry out activities of daily living improved. Development has been especially

[5] The intensity tables could be aggregated to the weekly level using exogenous weights, e.g. Weekly users = 4 (daily) + 1 (weekly) + ½ (monthly) + ¼ (seldom), number of clients in intensity group in parenthesis.
.

positive with regard to musculoskeletal and cardiovascular diseases. These changes should show up in reduced levels of dependency.

Overall it seems that health and functional status of the elderly has improved significantly over the last 20 years. Thus it seem reasonable to predict that also the physical dependency among the future elderly will be less common than it is today. The expected longer life span will evidently increase the number of articular diseases, but this will have impact on the oldest old cohorts already likely to be in need of more intensive care. The changes in mental dependency is mostly conditional on the occurrence of Altzheimer and related dementing diseases. They seem to be strongly linked to the ageing process, without any clear environmental or patients' life cycle related reasons. Without significant advances in the treatment of dementia, increased incidence of mental disability caused by it endangers the total positive trend towards reduced dependency[6]. Anyway, advances in Altzheimer care have already taken place and are expected in the future.

Also the SOMERA-commission[7] has in its calculations assumed that improved health and functional capacity of the elderly leads to the postponement in the use of care services on average by 3 – 5 years within next 30 years. The view is rather optimistic, and especially in institutional care, it has little support from the past trends. However, we will consider resource impacts of three and five years average shifts in age profile of service use. This would mean that by 2030 the elderly would have the same service patterns in domicile care as three or five years younger elderly have today. Even if the entry into the institutional care over the last 10 years has been postponed only by 0,3 years, we consider resource consequences that an increase by three years in the average age of entering inpatient care would entail.

For the domicile care we used the elderly barometer data and the estimated service patterns to approximate the impact of reduced dependency of the elderly. First, a simple ordered logistic model for each gender, where the disability status of the interviewee was explained by her age, was estimated. Second, the marginal values of the age at the group means (i.e. 69.5, 77, 82 and 87) were calculated (Table 10). Finally, the change in probability to have a certain dependency status at a certain age group was calculated linearly by multiplying the marginal value by the assumed number of years, the age profile of disability was supposed to shift.

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[6] See also Vaarama et. al. (2002) and references herein for the more detailed discussion on expected dementia figures.

[7] In April 2000 the Ministry of Social Affairs and Health in Finland established the commission for the evaluation of development of social expenditure SOMERA to define the long-term development of social expenditure and financing.

Table 10. The marginal impact of age on probabilities of disability status by gender

	Age65-74	Age75-79	Age80-84	Age85+
FADL0	-2.10 %	-1.91 %	-1.62 %	-1.29 %
FADL1	0.45 %	-0.12 %	-0.48 %	-0.70 %
FADL2	1.66 %	2.03 %	2.10 %	1.99 %
Sum, Females	0%	0%	0%	0%
MADL0	-1.88 %	-1.59 %	-1.31 %	-1.03 %
MADL1	0.63 %	-0.07 %	-0.54 %	-0.90 %
MADL2	1.25 %	1.66 %	1.85 %	1.93 %
Sum, Males	0%	0%	0%	0%

According to Table 10 females have a slightly higher marginal probability to get highest dependency classification than males. This is especially the case for the elderly less than 80 years old. Also the probability of having no disabilities decreases more rapidly with age for females than for males. For both genders, the probability of instrumental disabilities (ADL1) increases only for the youngest age group, whereas for the elderly above 75 years old all the ADL1 marginal probabilities are negative and all the personal disability (ADL2) marginal probabilities are clearly positive. This is to say that, for the older people emergence of personal disabilities (ADL2) dominate and if instrumental disabilities appear, they coexist with the personal ones.

The survey based dependency distributions and assumed changes in tables are reported in Appendix IV.

Service usage patterns, prioritisation

For municipally provided services the receipt of services is needs-tested and the final number of clients and intensity of care provided depends on prioritisation and targeting decisions made by professionals who are responsible for care management. Thus, the current patterns of home and community care services estimated from barometer data are already filtered by decisions made in care management process. We have no reason to believe that domicile services are currently given out too easily, but in the future increased wealth of the elderly may well make possible to let the clients with no or just minor disabilities take care of the services by their own. As we have no definite rule on who should not receive or should receive less care, we will not impose any prioritisation rules in scenarios.

Elderly care resources

Ministry of Social Affairs and the Association of Finnish Local and Regional Authorities have recently published a guide to better quality in elderly care (Sosiaali- ja terveysministeriö ja Kuntaliitto 2001). The starting point for the discussion is the Nordic comparison is the number of elderly above 65 years old for one worker in elderly care, Table 11.

Table 11. Comparison of resources and coverage of elderly care in Nordic countries

	Number of 65+ years olds for one worker*	Home help service clients, % of the 65+ years olds	Institutional care clients** % of the 65/67+ years olds
Finland	17.0	5	6.5
Sweden	7.8	8	7.7
Norway	9.8	16	11.1
Denmark	7.9	24	9.0

*All the personnel within elderly care
** Including also service housing
Source: Vaarama et. al. (2001) Tables 3,4 and 5.

The relative number of care personnel in Finland is about the half of the other Nordic countries, which is only partly reflected in the coverage of care. Especially compared to Sweden, Finnish elderly care resources look undersized. Denmark and Norway appear to distribute services to a wider range of population with relatively less personnel. However, at least in Denmark the intensity of home help services is lower than in Finland (see e.g. appendix in Vaarama et. al. 2001), where home help services are to a great extend targeted to the oldest and frailest elderly. Comparable intensity data from Norway is not available.

In institutional care 1999 the amount of care personnel per client was on average 0.42 in homes for the elderly and 0.66 in health centre inpatient care. For the service housing figures are not available (Vaarama, 2001). In the guide for better quality of care, the working group regarded that the good quality of care required at least 0.8 care-givers per resident in a 25 bed ward. Institutions with the number of nursing personnel per resident between 0.5 and 0.6 are considered to have fair staffing levels and those where the number exceeds 1.2 are regarded excellent. Staffing levels regarded as good are just enough to make it possible to have two nurses during night shifts and six during other shifts.

Given these suggestions for better quality of care, staffing levels in Finnish homes for the elderly are currently left below “fair” grade and health centre inpatient care performs somewhere between “fair” and “good” grade. In our scenarios we increase the number of personnel so that the staffing levels reach the working group recommendation for the "good" quality of institutional care by year 2030.

Depending on the reference, an average either two hours a week[8] or 2.8 visits a week[9] per client of home help services are currently given. As the average time of a visit is something less than an hour[10], the statistics give approximately an equal figure of care intensity. The workgroup suggestion is that intensity of home help services should be doubled, i.e. to 4 hours a week on average. In our scenarios we have ended up to raise intensity from 2.8 visits to 4 visits a week. Given that we keep the number of visits per home help employee constant, this is not as such enough to double the home help service resources. Therefore we also alter the intensity of the home nursing by increasing the time a nurse will spend with each client roughly by 20%, letting the number of weekly visits decrease from 43.1 to 35[11].

Table 12. The scenarios with respect to changes in dependency of the elderly and resources allocated to elderly care

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="3">Changes in dependency</td></tr>
<tr><td>Current</td><td>3 years shift onwards both in domicile and institutional care</td><td>5 years shift in domicile and 3 years shift in institutional care</td></tr>
<tr><td rowspan="2">Resources allocated to elderly care</td><td>Current</td><td>I Trend</td><td>II (Current3+3) Current resources and 3 years shift in care needed by 2030</td><td>III (Current3+5) Current resources and 3 or 5 years shift in institutional and domicile care needed respectively by 2030</td></tr>
<tr><td>Resources allocated to reach care quality level "good" by 2030. Intensity of domicile services doubled.</td><td>IV Good care</td><td>V (Good3+3) Good care and 3 years shift in care needed by 2030.</td><td>VI (Good3+5) Good care and 3 or 5 years shift in institutional and domicile care needed respectively by 2030</td></tr>
</table>

8 Workgroup for guides to improve quality of elderly care, Vaarama et. al. (2001).

9 SOTKA database.

10 No reliable statistics are available.

11 The estimate of 20% increased time per client is based on approximately 50% share of a nurses time budget used to actual care, the rest of the time used to travelling and administrative tasks.

Table 12 summarises the scenario framework used in the study. Keeping the interpretation simple, scenarios differ from each other only in two dimensions, with respect to changes in dependency and resources allocated.

The trend scenario (I) is a straightforward projection using current service patterns and population forecasts. The scenario also fails accounting the impact of altering gender structure on service usage or resources needed.

The good care scenario (IV) imposes more resources to intensified service homes, homes for the elderly and inpatient care as well as to domicile care. The expected changes are summarised in Table 13. The care personnel in inpatient care and homes for the elderly is sized according the quality criteria “good” to 0.8 employees per patient. For the intensified service housing slightly less personnel is suggested, 0.7 employees per resident. These changes also reflect the increased dependency of the clients in service homes and homes for the elderly. We keep the staffing of the regular service houses at their current level, 0.32 employees per resident, as their clients will partly rely on publicly or privately supplied domicile care. We have also increased the resources of long term somatic and psychiatric care to the “good” level, although their role for elderly care resource usage is currently low.

Table 13. Resources allocated to institutional care and domicile services in scenarios Good care, Good(3+3) and Good(3+5)

	Current level	Level by target year		
Institutional care	1999	2010	2020	2030
Service housing care personnel per bed	0.3	0.3	0.3	0.3
Intensified service housing care personnel per bed	0.5	0.57	0.63	0.7
Homes for elderly care personnel per bed	0.5	0.6	0.7	0.8
Inpatient at health centres, inpatient ward employees per bed	0.6	0.67	0.73	0.8
Somatic special care, inpatient ward employees per long term care bed	0.4	0.53	0.67	0.8
Psychiatric care, inpatient ward employees per long term care bed	0.7	0.73	0.78	0.8
Home help services and home nursing				
Home help service productivity: visits/employee /week	22	22	22	22
Home help service: visits/client/week	2.8	3.2	3.6	4
Home nursing productivity: visits/nurse/week	43.1	40.4	37.7	35

The actual coverage of the domicile services at target year depends on the number of elderly living home, their dependency and the expected usage of the care. The numbers of users are calculated for each gender with their own coefficients. Although, for the simplicity, the formula here for the number of elderly receiving particular care is written without a subscript indicating the gender.

$$USERS_t = \sum_{j\in Age}\sum_{i\in ADL}\left(p_t^j \times d_i^j \times c_i^j \times NI^j\right).$$

Where

$p_t^j =$ Population in age group j, at target year t.

$d_i^j =$ Share of population with disability classigfication i in age group j.

$c_i^j =$ Share (probability) in age group j with disability classification i to use particular service.

$NI^j =$ Share of non institutionalised elderly in age group j.

$Age = \{$65-74 years, 75-79 years, 80-84 years,85+ years$\}$

$ADL = \{$Non ADL, Instrumental ADL, Personal ADL$\}$

The coefficients used in the formula are listed in Appendix II. In the scenarios dependency pattern is shifted 3 or 5 years onwards, altering the coefficients d_i^j in a way explained in Appendix IV. In the EVERGREEN 2000 model the coverage of a service is expressed as a share of the population above 65 years old. As the EVERGREEN and elderly barometer data bases are not exactly equal, we have used EVERGREEN database as a starting value, but estimated the shifts in service coverage according the models estimated from the barometer data.

To estimate the coverage of the institutional care, we have used SOTKA statistics on male and female residents and patients in care-giving institutions. The statistics seem to include measurement (or bookkeeping) errors and the age distribution of patients naturally includes some stochastic variation. This type of irregular variation of cohorts is troublesome, when age distributions are used to predict future service usage and shifts in it. In most of the cases the distribution is not monotone, therefore we have smoothened the distributions by linear discrete models. An example of smoothing the distribution of the short term homes for the elderly is given in Appendix V. The smoothened age distributions and population forecasts are used to calculate the expected numbers of patients in each form of institutional care. For the scenarios, where shifts in dependency were assumed, each cohort has a probability for care of 3 years younger cohort.

Table 14 reports the resulting coverage of institutional and non-institutional care under alternative assumptions.

Altogether the coverage of the institutional care, including service housing will drop from 7.3 percent to 5.7 percent of the population aged 65 years. The main changes will take place in homes for the elderly and health centre's inpatient care coverage, which will drop by 50 – 60 percent. As the service housing coverage will be kept constant their share of the institutional care will grow from 25 percent to 36 percent. No changes are assumed between regular and intensified service housing. In domicile care, 5 years shift in care by 2030 is needed to decrease the total coverage of help and support of the elderly population. However it seems evident, that gender/age/dependency structure of the ageing population will decrease the relative number of domicile service users around year 2020.

Table 14. Shifts in care coverage after given changes in dependency, scenarios: Current3+3, Current3+5, Good3+3 and Good3+5

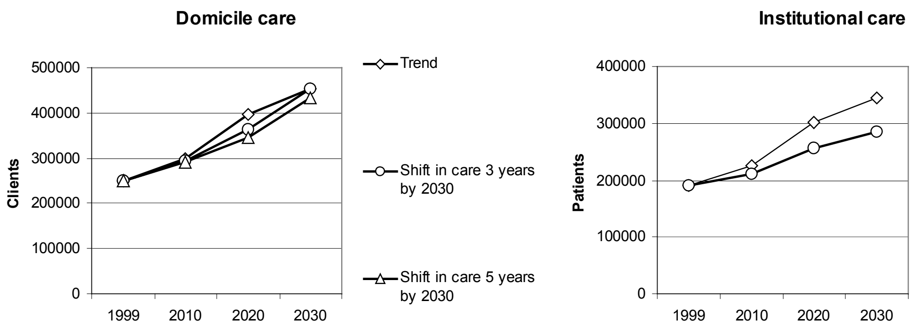
	Current level	Target year		
	1999	2010	2020	2030
3 years shift in care needed by 2030				
Domicile care	Percent, relative to population aged 65 years			
Home help service clients	11	10.8	10.1	11.1
Home nursing clients	8.2	8.1	7.5	7.8
Support service clients	13.5	13.3	12.2	14.0
Institutional care				
Beds in regular service housing	1.4	1.4	1.4	1.4
Beds in intensified service housing	0.7	0.7	0.7	0.7
Long term beds in homes for the elderly	2.6	2.0	1.5	1.0
Short term beds in homes for the elderly	0.2	0.2	0.2	0.2
Long term inpatient beds in health centres	2.2	1.6	1.3	1.0
Short term inpatient beds in health centres	0.5	0.5	0.5	0.5
Long term psychiatric care beds	0.1	0.1	0.1	0.1
Long term somatic care beds	0.2	0.1	0.1	0.1
Long term inpatient care altogether	5.6	4.5	3.7	2.9
Inpatient and service housing altogether	8.4	7.3	6.5	5.7
5 years shift in care needed by 2030				
Domicile care	Percent, relative to population aged 65 years			
Home help service clients	11	10.7	9.5	10.5
Home nursing clients	8.2	7.9	7.1	7.3
Support service clients	13.5	13.1	11.7	13.4

3.4 Expected changes in resource usage

The elderly population above 65 years old is expected to increase by 81% by 2030. This is to say from 770 000 to 1 390 000 people. The time perspective is long, and the economy should be able to adjust to the corresponding proportional rise in social and health related expenses, taken that economy-wide productivity growth will follow the historical trends (see e.g. Luoma et. al. 2003). Therefore, we will use the population forecast as a benchmark for the other scenarios. Improved functional ability of the ageing population will in part ease the adjustment to the population pressure, giving also room to improve the quality of care.

All the results are based on observed service usage at the end of the millennium. As the future cohorts are more wealthy and accustomed to a higher standard of living, the actual changes in services to be used are likely be higher than presented here. If we consider current supply with given quality improvements as a sufficient standard also for the future, these figures give estimate on care and resources needed for publicly provided elderly care services.

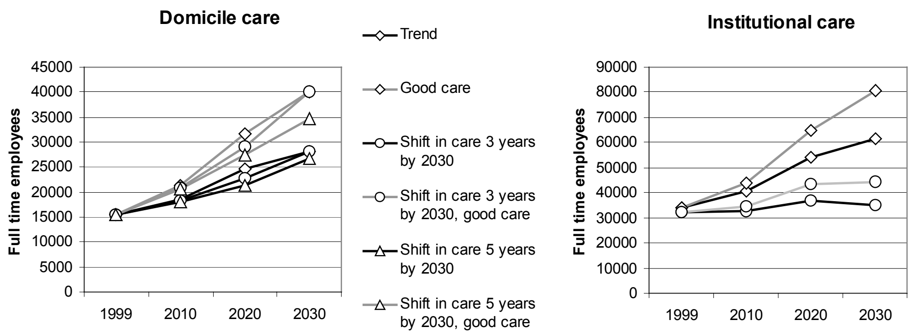
Figure 3. Number of elderly using care



According to our models, shifts in probability to use domicile services have only a moderate impact on the number of clients (Figure 3, left panel). The only remarkable difference from the trend is expected around year 2020, when the baby boomers (about 75 years olds) already belong to the elderly, but still have relatively low probability to use care. The assumed shifts in disability strengthen this effect but the trend level will be reached again by 2030 or immediately after that.

In institutional care (Figure 3, right panel) reduced dependency will have a more substantial effect. By 2010 the population trend induces about 19 percent increase in the number of patients, but the assumed shift in dependency would reduce the growth to 11 percent. Over the whole period, the postponement of dependency by 3 years would keep the rise in the total number of patients in 50 percent.

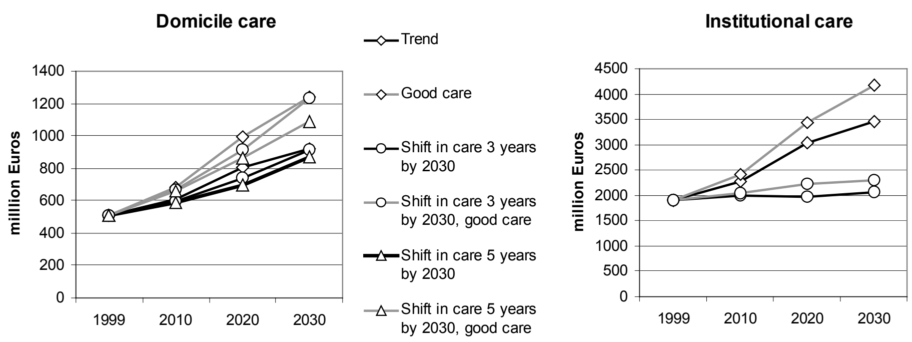
Figure 4. Number of employees needed



The resources needed in social services, especially in services given at home, go hand in hand with the number of clients. Thus in domicile care with current service quality, number of care personnel needed will grow steadily with the elderly population (Figure 4, left panel). Increasing the number of visits per client in home help services and extending the visits of home nursing will increase the number of employees from 15500 to 40000 instead of 28000 employees needed according to the current trend. Again at least 5 years shift in care probabilities is needed to give a noteworthy decrease in workforce under good care scenario.

In institutional care the scenarios differ from each other more radically. Currently 34000 employees take care of 190000 patients (Figure 4, right panel). According to the trend almost 62000 employees will be needed to take care of 344 000 patients. Three years postponement in the use of care would keep the required number of employees approximately at current level, leaving room to improve the quality of care. Even with good care and less dependent elderly population; just 44000 employees would be needed to run the required number of somatic and psychiatric inpatient care, as well as service housing and houses for the elderly.

Figure 5. Operating costs



The growth in operating costs is of the same order of magnitude as the rise in the number of care personnel. The € 508 million operating cost of the domicile elderly care in the year 1999 is expected to increase to € 920 millions (Figure 5, left panel). The good care option is about 35 percent more expensive without any change in dependency, but only 18 percent more expensive if the target postponement of 5 years will be reached.

Reaching good quality of care within 30 years is rather unambitious target. For example safety reasons[12] suggest accelerated schedule, e.g. 10 years, for quality improvements. Even if we had not directly simulated resources needed for this scenario, we can use the linearity of the EVERGREEN 2000 model to derive expected need of resources. In the model the good would cost proportionally about the same in 10 years as in 30 years. This is to say that good care is about 35 % more expensive also in 2010. Thus, taking into account the population pressure, good domicile care at 2010 would cost about € 818 million, about 60 percent more than today.

Institutional care operating costs are currently € 1910 millions and they are expected to increase to € 3460 millions by 2030 (Figure 5, right panel). The good care quality would cost about € 4160 millions, only 20 percent more than the population trend estimate gives. Counting the assumed shift in the care needed, operating costs will increase only moderately to € 2060 or € 2300 million without or with good care option respectively. Getting good care quality in accelerated schedule by 2010 would mean institutional care operating costs of €2730 millions instead of the population trend implied € 2280 millions.

The simulation results are summarised in Table 15, where both domicile and institutional care are summed up and the expected operating costs in alternative cases are expressed in annual growth percent required to match the population induced needs and/or targets set for the quality of care.

The operating cost growth estimates in Table 15 are based on the year 1999. Thus four budget years are already fixed and their contribution to the 2010 target achievement is crucial. Unfortunately, no comparable nation-wide data is available after 1999. Also the figures do not assume any operating cost increases due to labour market pressure.

[12] The current personnel in institutional care is not always enough to keep two persons a ward in night shift. Service housing units usually do not have personnel available 24 hours a day.

Table 15. The required annual growth in operating costs needed to match elderly population growth and targets set for the good care

	Target year					
	2010			2030		
	Domicile	Institu-tional	Total	Domicile	Institu-tional	Total
Population trend	1.6	1.6	1.6	1.9	1.9	1.9
Good care	4,4[1]	3.3[1]	3.6[1]	2.9	2.5	2.6
Good care with 3 years improved ability				2.9	0.5	1.2
Good care with 5 years improved ability				2.5		1.1[2]

[1]Assuming trend growth and an additional 35 % increase by 2010 in domicile care and 20% in institutional care to reach quality level "good care".
[2] Scenario Good3+5, i.e. 3 years improvement in institutional care by 2030.

If elderly population growth were the only factor affecting operating costs, they would grow an average at annual speed of 1.6 percent by year 2010 and 1.9 percent by 2030. Thus the population induced cost pressure will accelerate after year 2010 and will be on average 2.1 percent between 2010 - 2030. Targeting to the year 2030 good quality of the care requires about 1 percent additional increase in annual growth in domicile care and 0.6 percent in institutional care. Improving the functional ability of the elderly so that dependency would be postponed by three years does not seem to have any impact on domicile care, but it clearly affects the operating costs of institutional care. The required annual growth would be about 0.5 in real terms, far less than the population trend suggests.

A far more attractive scenario from the welfare point of view is to accelerate the change toward good care quality so that it would be reached already by 2010. Given that good care by 2010 is proportionally as expensive as it is by 2030, in domicile care the operating cost should be increased annually on average by 4.4 percent and in institutional care by 3.3 percent. Total expenditures should increase annually 3.6 percent from 1999 to 2010. In these figures both population trend and increased staffing levels required by good quality care are taken into account. We can not read directly from the simulation results, how much reduced dependency of the elderly dependency would ease cost pressures, but the time period is obviously relatively short for it to have a visible impact. This is also reflected in operating costs in Figure 5, where improvements in functional ability of the elderly do not make a difference within first 11 years.

The expected growth of the operating costs due to the growth of elderly population will be higher after 2020 than before. Therefore in order to reach both targets simulated in this paper, it looks like a good idea to invest to the improving quality of the care now, when population pressure is weaker. Especially the investment in domicile care would be a good starting point to improve independent ability in elderly daily living. In the long run it could help reaching economically a more affordable service mix by decreasing the need of institutional care.

4. Discussion

In this study we have projected assumptions on dependency of the elderly and the desired improvements in the contents of elderly care to the expected number of elderly within publicly provided care and the resources needed to produce them. Unlike in any previous studies using Finnish data, we have been able to model the impact of physical and social factors on the use of domicile care. Using the elderly barometer interview survey data, home help services, home nursing and the set of four support services: cleaning, meals on wheels, bathing and services provided at day centres all got their own models with service specific set of explanatory variables. The models and the data provide a detailed picture on how age, dependency, social environment and service supply related factors contribute to the probabilities of for the elderly to use services. Together with population forecasts these results were used to calculate expected number of service users at 2030.

According to the models estimated in this study dependency measured by problems in personal activities of daily living and living alone are important determinants for the use of domicile services. Their impact, however, varies with age of the elderly. For younger elderly the impact of dependency is clear, but for the oldest group the impact of increased dependency cannot be separated from the impact of age. Even if analysis of the same data (Vaarama and Kaitsaari 2002) show, that in some special groups informal help has substituted home help services, our analysis based on the whole data show, that informal help complements publicly provided domicile services. They go hand in hand, but unfortunately analysis here is not enough to quantify this effect.

Regrettably, comparable data on institutional care was not available. We had to be content with register data. However, we were able to compile institutional care data (as well as domicile service data) into the form, where resource needed of each service and care form were computable in EVERGREEN 2000 -model. The model calculates for each service the number of users conditional on the size of elderly population, resources needed with desired intensity of care and operating costs of the services. As usually in simulation models, the actual service and resource levels calculated are not that interesting, but scenarios should be compared to each other. Our key findings are, that good care scenario is likely to increase required personnel, as well as operating cost, by 29 percent to the trend level and that reduced dependency decreases cost by 32 percent as such and even with more intensive good care by 19 percent. The compounded effect of good care and dependency shift is clearly cost saving. These results, expressed in the form of annual operation cost growth needed to match the target, are also reported in Table 15 (page 31).

According to our projections the increase in the number of care personnel should be higher than what SOMERA commission presents in its report. Assumptions about dependency are the same as the commission's, but our specification of good care quality increases considerably the need for care personnel. It is hard to figure out from public sources the detailed (and comparable) figures of the commission, but at least in home help services and home nursing the commission assumes that 7500 more (not including replacements) workers are needed, whereas our specification suggests that about 12 000 more carers and nurses should be hired. Although this means a substantial increase in the number of workers employed in elderly care, it should be economically possible given enough time for the economy to adjust. However, increasing the number of social and health sector employees at the time when labour supply is falling without rising their relative wages and salaries, is a difficult task. Therefore operating costs in elderly care will probably rise more rapidly than fixed price calculations made in our study suggest.

Policies how to decrease dependency are not discussed in detail here, but the obvious direction is a comprehensive view of the elderly care. According to this view people are not just taken care of but the care plan takes into account the whole social and physical environment an elderly belongs to and is also willing to invest in pre-emptive actions. The good quality of care is an essential part of comprehensive care, as it decreases dependency and makes it easier for the elderly to live in their familiar environments. The solution presented here is only a partial one, but the message is clear; policies decreasing the dependency are an effective tool to ease adjustment processes.

The approach here has been based on so called macrosimulation models. The estimated probabilities of the population groups to use services are used together with population forecasts to predict future demands. An alternative would be to use a microsimulation model, where behaviour of a representative sample is studied over time. In addition to the sample, the main problem in the microsimulation approach is the need of transfer probabilities e.g. from health status to another or from domicile to institutional care. This type of research would aid especially in forecasting pre-mortal cost pressure, which is supposed to be one of the key elements of the future cost of care (for discussion see Zweifel et. al. 1999). Actually all the data needed to estimate transfer probabilities is already available. The elderly barometer studies from 1993 and 1998 (Vaarama et. al. 1999) cover all the background and interview time health and service use status information needed. Combining this information with national HILMO-registers would give transfer probabilities to the institutional care. Also a local, but with larger population coverage executed TamELSA study (Jylhä et. al. 1992) could be used for these purposes.

Appendix

APPENDIX I: Predictions from ordered logistic model

The survey data available allows a detailed probability modelling of the service use. We have data available not only on selection, whether a respondent received a care, but also on the intensity of the care. In services like home help and cleaning the intensity varies enough to make sense for the ordered probabilistic model, whereas for example meals on wheels are usually received daily or not at all, a simple binomial probabilistic model suffices. In this chapter we discuss the ordered probabilistic model, with a short review on the basic statistic model and give the most emphasis on the interpretation of the results and the way model prediction should be calculated.

The ordered probability models are developed to explain variation in ordered discrete choices, like choices of the care intensity. The measured probability is not only conditional on the selection of explanatory variables but also on the choice of probability function. The most usual choices are the logistic and normal distribution with unit variance. Let $F(\cdot)$ denote the cumulative distribution of either logistic or normal distribution and $f(\cdot)$ its density function. The expected value of the distribution is set as a function of explanatory variables ($k\times 1$ vector $\boldsymbol{x}$ for each observation) and parameters ($k\times 1$ vector $\boldsymbol{\beta}$) to be estimated and the cutting points $\kappa_j, j\in[0,J]$ where J is equal to number of discrete choices in endogenous variable *y*. The probability of a choice is set so that

$$\begin{aligned}&\Pr(y=j-1)=F\left(\kappa_j-\boldsymbol{\beta}'\boldsymbol{x}\right)-F\left(\kappa_{j-1}-\boldsymbol{\beta}'\boldsymbol{x}\right)\forall j\in[1,J]\\&\text{where } \kappa_0=-\infty \text{ and } \kappa_J=\infty\end{aligned}\qquad(1)$$

The problem is to estimate k unknown parameters $\boldsymbol{\beta}$ and $J-1$ cutting points $\kappa_1,\ldots,\kappa_{J-1}$. To keep probabilities always positive, it is supposed that $0<\kappa_1<\ldots<\kappa_{J-1}$.

The “slope” parameters $\boldsymbol{\beta}$ are somewhat tricky to explain. They do not get the traditional marginal value interpretation. The derivatives (marginal values) w.r.t. $\boldsymbol{x}$ of the probability to choose $y=j$ are

$$\frac{\partial\Pr(y=j)}{\partial\boldsymbol{x}}=\left[f\left(\kappa_j-\boldsymbol{\beta}'\boldsymbol{x}\right)-f\left(\kappa_{j-1}-\boldsymbol{\beta}'\boldsymbol{x}\right)\right]\boldsymbol{\beta}\qquad(2)$$

For the given vector $\boldsymbol{x}$, the marginal values of variables are proportional to parameter values $\boldsymbol{\beta}$. However condition $\kappa_j > \kappa_{j-1}$ does not guarantee any sign condition for the bracketed expression. Instead, the marginal impact is likely to change sign if the density function is quasi-concave (e.g. bell shaped). This is not a completely harmless condition. Consider for example a case, where most of the density is concentrated on the first choice in symmetric density function. Thus $\kappa_1 - \boldsymbol{\beta}'\boldsymbol{x}$ may be located right of the mean, so does all the densities for higher choices of *y*. From (2) it follows, that all the marginal probabilities thereafter have equal signs. This is a strong maintained hypothesis of the ordered probability model that a modeller has to consider in advance. One way to take control over the speed densities are accumulated is using non-linear (in variables) functions or discrete parameterisations of the explanatory variables.

The predicted probabilities and marginal values are conditional on the selected values of independent variables. A common way is to report them in data means. This is a rough measure, giving an idea on the magnitudes, and will be used in this study to report marginal values from the estimated models. However, our primary goal is to predict the probabilities of care in the population. Therefore, we use all the population to calculate probability predictions, and report population weighted means. The strategy selected makes also easy to calculate predictions for the sub-samples selected according the subset of explanatory variables. The variation in the predicted probabilities is then conditional on the non-controlled set of explanatory variables.

Using normal or logistic densities make only sense if all the choices may be considered emerging from the same distribution. For example the selection processes whether to use services or not may be different from intensity of service use. To model this we should be able to identify factors independently contributing to the client's enter to use facilities of the formal service sector. Unfortunately we have no data available on selection specific variables like accessibility of the certain service or service providers.

The choice of distribution is generally a matter of convenience as far as error term is plausibly modelled either as the logistic or normal distribution. The models give approximately equal results, even if logistic distribution gives greater probability for small $\boldsymbol{\beta}'\boldsymbol{x}$.

APPENDIX II: **Patterns of service use**

The following tables refer to the coefficients in formula page 26.

Share of non-institutionalised elderly (NI^j)

	Male	Female
Age 65-74	95%	97%
Age 75-79	90%	92%
Age 80-84	74%	74%
Age 85+	74%	74%

Disability distribution of the elderly (d_i^j)

The rows are

FADL0, Female with no reported disabilities

FADL1, Female with at least one reported instrumental disability, but no reported personal disabilities.

FADL2, Female with at least one reported personal disability

MADL0, MADL1 and MADL2 as above but for male elderly.

	age65-74	age75-79	Age80-84	age85+
FADL0	50.862 %	35.659 %	16.038 %	16.667 %
FADL1	22.414 %	24.031 %	26.415 %	23.333 %
FADL2	26.724 %	40.310 %	57.547 %	60.000 %
MADL0	42.523 %	27.473 %	28.358 %	13.793 %
MADL1	34.579 %	38.462 %	38.806 %	37.931 %
MADL2	22.897 %	34.066 %	32.836 %	48.276 %

Source: observed distribution from elderly barometer interview study.

Share (Probability) to use a particular service (c_i^j)

In each service, the first table (needs no help) reports coefficient $1-c_i^j$. Home help service and home nursing coefficient are used as reported. Support services is an adjusted sum of users of cleaning service, bathing, recreation centres and meals on wheels, taking account that a female user uses on average 1.5 services and a male user uses 1.4 services.

Home help services

Needs no help, $1-c_i^j$

	Age 65-74	Age 75-79	Age 80-84	Age 85+
FADL0	0.992	0.962	0.822	0.822
FADL1	0.932	0.882	0.774	0.774
FADL2	0.815	0.667	0.588	0.547
MADL0	0.994	0.969	0.840	0.840
MADL1	0.989	0.966	0.823	0.823
MADL2	0.929	0.715	0.749	0.749

Needs help seldom

	Age 65-74	Age 5-79	Age 80-84	Age 85+
FADL0	0.002	0.009	0.036	0.036
FADL1	0.016	0.027	0.045	0.045
FADL2	0.036	0.056	0.063	0.066
MADL0	0.001	0.008	0.034	0.034
MADL1	0.003	0.008	0.035	0.035
MADL2	0.016	0.048	0.042	0.042

Needs help monthly

	Age 65-74	Age 75-79	Age 80-84	Age 85+
FADL0	0.002	0.010	0.044	0.044
FADL1	0.018	0.031	0.055	0.055
FADL2	0.044	0.075	0.087	0.093
MADL0	0.002	0.008	0.041	0.041
MADL1	0.003	0.009	0.043	0.043
MADL2	0.018	0.063	0.055	0.055

Needs help weekly

	Age 65-74	Age 5-79	Age 80-84	Age 85+
FADL0	0.003	0.013	0.064	0.064
FADL1	0.023	0.041	0.082	0.082
FADL2	0.067	0.125	0.156	0.172
MADL0	0.002	0.010	0.057	0.057
MADL1	0.004	0.011	0.064	0.064
MADL2	0.024	0.106	0.093	0.093

Needs help daily

	Age 65-74	Age 75-79	Age 80-84	Age 85+
FADL0	0.001	0.006	0.034	0.034
FADL1	0.011	0.020	0.044	0.044
FADL2	0.037	0.077	0.107	0.123
MADL0	0.001	0.005	0.029	0.029
MADL1	0.002	0.005	0.035	0.035
MADL2	0.012	0.068	0.061	0.061

Cleaning services

Needs no help, $1-c_j^i$

	Age 65-74	Age 75-79	Age 80-84	Age 85+
FADL0	0.965	0.927	0.827	0.827
FADL1	0.966	0.917	0.783	0.783
FADL2	0.817	0.656	0.583	0.532
MADL0	0.964	0.925	0.829	0.829
MADL1	0.963	0.940	0.786	0.786
MADL2	0.855	0.726	0.528	0.528

Needs help seldom

	Age 65-74	Age 5-79	Age 80-84	Age 85+
FADL0	0.014	0.028	0.058	0.058
FADL1	0.013	0.031	0.069	0.069
FADL2	0.060	0.092	0.100	0.104
MADL0	0.014	0.028	0.058	0.058
MADL1	0.014	0.023	0.066	0.066
MADL2	0.049	0.079	0.087	0.087

Needs help monthly

	Age 65-74	Age 75-79	Age 80-84	Age 85+
FADL0	0.015	0.032	0.078	0.078
FADL1	0.015	0.037	0.098	0.098
FADL2	0.083	0.155	0.185	0.204
MADL0	0.015	0.033	0.077	0.077
MADL1	0.016	0.026	0.097	0.097
MADL2	0.065	0.123	0.183	0.183

Needs help weekly

	Age 65-74	Age 5-79	Age 80-84	Age 85+
FADL0	0.006	0.012	0.033	0.033
FADL1	0.005	0.014	0.044	0.044
FADL2	0.036	0.085	0.114	0.138
MADL0	0.006	0.012	0.032	0.032
MADL1	0.006	0.009	0.045	0.045
MADL2	0.027	0.063	0.167	0.167

Needs help daily

	Age 65-74	Age 75-79	Age 80-84	Age 85+
FADL0	0.001	0.001	0.004	0.004
FADL1	0.001	0.002	0.006	0.006
FADL2	0.005	0.012	0.017	0.022
MADL0	0.001	0.001	0.004	0.004
MADL1	0.001	0.001	0.006	0.006
MADL2	0.003	0.009	0.035	0.035

Home nursing

Needs no help, $1-c_j^i$

	Age 65-74	Age 75-79	Age 80-84	Age 85+
FADL0	0.964	0.964	0.921	0.921
FADL1	0.964	0.964	0.925	0.925
FADL2	0.814	0.814	0.706	0.555
MADL0	0.964	0.964	0.924	0.924
MADL1	0.964	0.964	0.923	0.923
MADL2	0.814	0.814	0.642	0.642

Needs help seldom

	Age 65-74	Age 5-79	Age 80-84	Age 85+
FADL0	0.016	0.016	0.034	0.034
FADL1	0.016	0.016	0.033	0.033
FADL2	0.075	0.075	0.109	0.140
MADL0	0.016	0.016	0.033	0.033
MADL1	0.016	0.016	0.034	0.034
MADL2	0.075	0.075	0.122	0.122

Needs help monthly

	Age 65-74	Age 75-79	Age 80-84	Age 85+
FADL0	0.011	0.011	0.025	0.025
FADL1	0.011	0.011	0.023	0.023
FADL2	0.059	0.059	0.094	0.143
MADL0	0.011	0.011	0.024	0.024
MADL1	0.011	0.011	0.024	0.024
MADL2	0.059	0.059	0.115	0.115

Needs help weekly

	Age 65-74	Age 5-79	Age 80-84	Age 85+
FADL0	0.007	0.007	0.016	0.016
FADL1	0.007	0.007	0.016	0.016
FADL2	0.042	0.042	0.073	0.128
MADL0	0.007	0.007	0.016	0.016
MADL1	0.007	0.007	0.016	0.016
MADL2	0.042	0.042	0.096	0.096

Needs help daily

	Age 65-74	Age 75-79	Age 80-84	Age 85+
FADL0	0.002	0.002	0.004	0.004
FADL1	0.002	0.002	0.004	0.004
FADL2	0.010	0.010	0.018	0.034
MADL0	0.002	0.002	0.004	0.004
MADL1	0.002	0.002	0.004	0.004
MADL2	0.010	0.010	0.025	0.025

Bathing

Probability to get service, c_j^i

	Age 65-74	Age 75-79	Age 80-84	Age 85+
FADL0	0.017	0.041	0.130	0.130
FADL1	0.018	0.048	0.175	0.175
FADL2	0.030	0.086	0.145	0.196
MADL0	0.005	0.012	0.039	0.039
MADL1	0.006	0.011	0.054	0.054
MADL2	0.008	0.020	0.084	0.084

Meals on wheels

Probability to get service, c_j^i

	Age 65-74	Age 75-79	Age 80-84	Age 85+
FADL0	0.014	0.035	0.102	0.102
FADL1	0.013	0.041	0.125	0.125
FADL2	0.067	0.163	0.230	0.295
MADL0	0.018	0.045	0.119	0.119
MADL1	0.018	0.035	0.155	0.155
MADL2	0.061	0.151	0.352	0.352

Recreation centres

Probability to get service, c_j^i

	Age 65-74	Age 75-79	Age 80-84	Age 85+
FADL0	0.028	0.064	0.044	0.044
FADL1	0.029	0.073	0.059	0.059
FADL2	0.045	0.112	0.052	0.057
MADL0	0.023	0.053	0.036	0.036
MADL1	0.025	0.047	0.045	0.045
MADL2	0.030	0.073	0.062	0.062

Appendix III: **Marginal values of domicile service models**

Marginal values are evaluated at sample means. For the dummy variables as shift from 0 to 1, for all the other variables as point derivatives.

Ordered logistic models

Home help services

	No help	Seldom	Mothly	Weekly	Daily
Age	-0.0033	0.0008	0.0009	0.0011	0.0005
Alone	-0.4991	0.0739	0.1059	0.1932	0.1261
Aloneage	0.0008	-0.0002	-0.0002	-0.0003	-0.0001
ADL1	-0.9988	0.0003	0.0007	0.0047	0.9931
ADL2	-0.9961	0.0011	0.0026	0.0162	0.9762
MADL1	0.0022	-0.0006	-0.0006	-0.0007	-0.0003
MADL2	0.0017	-0.0004	-0.0005	-0.0006	-0.0003
FADL1age	0.0002	-0.0001	-0.0001	-0.0001	0.0000
FADL2age	0.0003	-0.0001	-0.0001	-0.0001	0.0000
MADL1age	0.1060	-0.0252	-0.0281	-0.0359	-0.0168
MADL2age	0.0303	-0.0077	-0.0082	-0.0100	-0.0045
INFHELP	-0.0224	0.0056	0.0060	0.0074	0.0034
TAXRATE	0.0004	-0.0001	-0.0001	-0.0001	-0.0001

Cleaning services

FAGE	-0.0039	0.0015	0.0017	0.0006	0.0001
MAGE	-0.0041	0.0016	0.0018	0.0006	0.0001
Alone	-0.0690	0.0258	0.0305	0.0113	0.0013
ADL2	-0.0791	0.0293	0.0351	0.0131	0.0016
INFHELP	-0.0995	0.0359	0.0445	0.0170	0.0020

Home nursing

DAGE80	0.1324	-0.0557	-0.0416	-0.0285	-0.0066
AGE80	-0.0076	0.0032	0.0024	0.0016	0.0004
ADL2	-0.1570	0.0615	0.0501	0.0366	0.0087

Binomial logit models

	Bathing	Meals on wheels	Recreation centres
FAGE	0.001	0.002	
MAGE	0.001	0.002	
AGE			0.0026
DAGE80			-0.0188
DAGE85			-0.0056
Alone	0.009	0.032	0.0199
INFHELP	0.031	0.033	0.0450
ADL2		0.024	

APPENDIX IV: **Disability changes**

The original distribution is estimated from the elderly barometer-data. The improvement of disability is calculated using marginal values from the ordered logistic model for each sex, where disability classification was explained by age. The two last tables report percentage changes relative to cells in the first table.

Survey distribution for the disability

	age65-74	age75-79	Age80-84	Age85+
FADL0	50.862 %	35.659 %	16.038 %	16.667 %
FADL1	22.414 %	24.031 %	26.415 %	23.333 %
FADL2	26.724 %	40.310 %	57.547 %	60.000 %
Female	100 %	100 %	100 %	100 %
MADL0	42.523 %	27.473 %	28.358 %	13.793 %
MADL1	34.579 %	38.462 %	38.806 %	37.931 %
MADL2	22.897 %	34.066 %	32.836 %	48.276 %
Male	100 %	100 %	100 %	100 %

Disability improvement due to 3 years average shift in getting disabled , difference (%) to cells in the first table

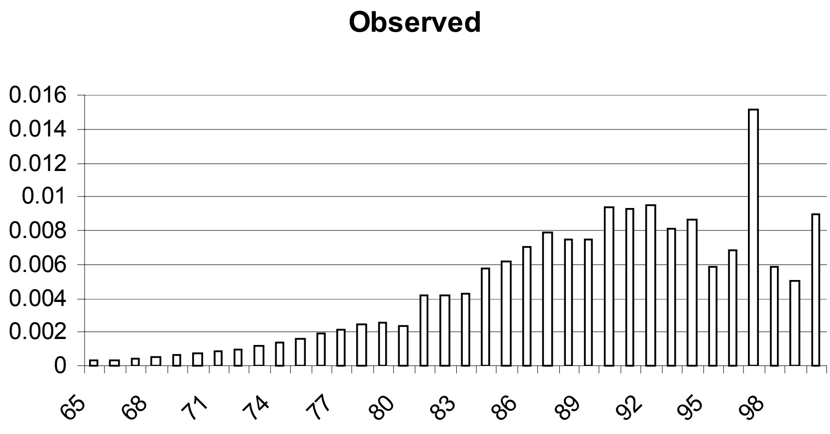
	age65-74	age75-79	Age80-84	Age85+
FADL0	6	6	5	4
FADL1	-1	0	1	2
FADL2	-5	-6	-6	-6
Female	0	0	0	0
MADL0	6	5	4	3
MADL1	-2	0	2	3
MADL2	-4	-5	-6	-6
Male	0	0	0	0

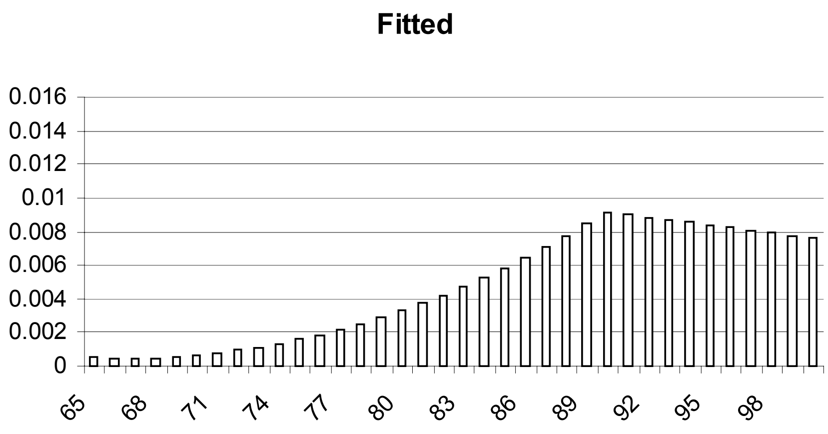
Disability improvement due to 5 years average shift in getting disabled , difference (%) to cells in the first table

	age65-74	age75-79	Age80-84	Age85+
FADL0	11	10	8	6
FADL1	-2	1	2	4
FADL2	-8	-10	-11	-10
Female	0	0	0	0
MADL0	9	8	7	5
MADL1	-3	0	3	5
MADL2	-6	-8	-9	-10
Male	0	0	0	0

APPENDIX V: **Age Distribution of Institutional Care**

The first figure presents the number of beds per males between 65 - 100 years old in the short-term homes for the eldelry. The second figure is the fit (or smooth) of the model.





$$y_t = \alpha + \beta x_t^1 + \beta x_t^2 + \varepsilon_t, \quad \varepsilon_t \sim N(0,\sigma), \quad t = \{65,\ldots,100\},$$

where

y_t = beds per male aged t years,

x_t^1 = age if $t \leq 90$, otherwise 0,

x_t^2 = age if $t > 90$, otherwise 0.

The dependency shift is calculated by assigning to each cohort the bed frequency of 3 years younger cohort.

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