Does informal care from children to their elderly parents substitute for formal care in Europe? [1]

Eric Bonsang[2, 3]

22/01/2008

CREPP
Working Papers 2008/01

CREPP
HEC-Management School
University of Liège

Abstract

This paper analyzes the impact of informal care by adult children on the use of long-term care among the elderly in Europe and the effect of the level of the parent's disability on this relationship. We focus on two types of formal home care that are the most likely to interact with informal care: paid domestic help and nursing care. Using the most recent European data emerging from the Survey on Health, Ageing and Retirement in Europe (SHARE), we build a two-part utilization model analyzing both the decision to use each type of formal care or not and the amount of formal care received by the elderly. Instrumental variables estimations are used to control for the potential endogeneity existing between formal and informal care. We find endogeneity of informal care in the decision to receive paid domestic help. Estimation results indicate that informal care substitutes for this type of formal home care. However, we find that this substitution effect tends to disappear as the level of disability of the elderly person increases. Finally, informal care is a weak complement to nursing care, independently of the level of disability. These results highlight the heterogeneous effects of informal care on formal care use and suggest that informal care is an effective substitute for long-term care as long as the needs of the elderly are low and require unskilled type of care. Any policy encouraging informal care to decrease long-term care expenditures should take it into account to assess its effectiveness.

Keywords: Long-term care; Informal care; Elderly; SHARE
JEL Classification: I11; I12; J14

---

[1] This paper uses data from release 2 of SHARE 2004. The SHARE data collection has been primarily funded by the European Commission through the 5th framework programme (project QLK6-CT-2001-00360 in the thematic programme Quality of Life). Additional funding came from the US National Institute on Ageing (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, Y1-AG-4553-01 and OGHA 04-064). Data collection in Austria (through the Austrian Science Foundation, FWF), Belgium (through the Belgian Science Policy Office) and Switzerland (through BBW/OFES/UFES) was nationally funded. The SHARE data collection in Israel was funded by the US National Institute on Aging (R21 AG025169), by the German-Israeli Foundation for Scientific Research and Development (G.I.F.), and by the National Insurance Institute of Israel. Further support by the European Commission through the 6th framework program (projects SHARE-I3, RII-CT-2006-062193, and COMPARE, CIT5-CT-2005-028857) is gratefully acknowledged. For methodological details see Boersch-Supan and Juerges (2005).

[2] CREPP, HEC-ULg, Boulevard du rectorat, 7, B4000 Liège, Belgium, Email: Eric.Bonsang@ulg.ac.be

[3] The author is especially grateful to Izabela Jelovac and Claire Maréchal for helpful discussions. Moreover, the author wishes to thank Sergio Perelman, Pierre Pestieau, Courtney Van Houtven, Arthur Van Soest and Jérôme Wittwer for their precious comments and suggestions. The author is also grateful to the participants of the SHARE–I3 and COMPARE Midterm Meeting (Chania, Greece), the Netspar seminar (Tilburg University, the Netherlands), the ARC Meeting (University of Liège, Belgium), and "la Journée d'Etude Marché du Travail et Prise en Charge de la Dépendance" (Paris-Dauphine University, France). This paper enters in the frame of ARC (Actions de Recherches Concertées) between the CREPP (Centre de Recherche en Economie Publique et de la Population) and the Faculty of Psychology of the University of Liège.

1. Introduction

Population ageing in most developed countries will undoubtedly have important effects on the demand for long-term care.[4] The growing proportion of elderly is likely to increase substantially long-term care demand (Yang et al., 2003; Pezzin et al., 1996). As a percentage of GDP, projected long-term care expenditure would increase by 168% in Germany, 149% in Spain, 138% in Italy between 2000 and 2050 (Comas-Herrera et al., 2003). To cope with this issue, it is necessary to find a way to limit the burden imposed by this process. Historically, family has always been the major source of care for dependent individuals. One suggested solution to slow down the expected increase in long-term care expenditure is to encourage the development of informal care provided by the family to their frail elderly. Briefly, informal care means unpaid, non-organised assistance given to an ill or disabled person offered within the social network while formal care is professionally organised paid help (Portrait and al., 2000). Indeed, it is thought that informal care is less costly than formal care arrangements. Moreover, the elderly sometimes prefers this alternative. However, this solution is likely to lessen long-term care expenditure only if informal care is an effective substitute for formal care.

The aim of this paper is to assess the effects of informal care provided by the adult children to their elderly parents on the demand for formal home care in Europe. For this purpose, we use data from the Survey of Health, Ageing and Retirement in Europe (SHARE) to estimate a model of formal care demand for the elderly. We focus on two types of formal home care that are the most likely to interact with informal care: paid domestic help and nursing care. Paid domestic help consists in professional help in doing tasks such as doing work around the house or the garden or shopping for groceries. Nursing care mainly consists in personal care provided by professionals in order to help the dependent individual to perform basic tasks such as dressing, bathing or using the toilet. Moreover, we analyse whether the relationship between formal and informal care differs according to the disability level of the elderly. To our knowledge, this particular issue has not yet been analysed in the literature. If the effect of informal care is heterogeneous according to the disability level, this may have important implications regarding the effectiveness of policies encouraging informal care in order to decrease the long-term care expenditures. More particularly, if informal care only substitutes for formal care use among individuals with low disability, any policy encouraging informal care is likely to have limited effects on long term care expenditures.

Several studies have analysed the relationship between formal and informal care but no clear results emerge regarding the substitutability of these two types of help. Ettner (1994) shows that Medicaid home care subsidies have increased the use of formal care and reduced informal care among the no institutionalised persons regarding no medical care. Pezzin and Schone (1999) find a substitution relationship between paid home care when analysing the informal care given by adult daughters to their elderly parents. On the contrary, Langa and al. (2001) find a rather complementary relationship: the increase in home health care that took place during the 1990s in the United States has mostly benefited individuals with a relatively high social support. Moreover, Christianson (1988) shows that the increase in formal care due to the Channeling, which consists in a National Long Term Care Demonstration that took place during the 1980's in US, has virtually no effect on the supply of informal care. Pezzin and al. (1996) also find a limited substitution between publicly provided home care and informal care. Instead of relieving informal caregivers, they can result in more help given to elderly. Van Houtven and Norton (2004) obtain different results depending on the type of care granted. They find a net substitution for all types of care except for outpatient surgery. This

[4] Long-term care is defined as a range of services for persons who are dependent on help with basic activities of daily living.

high variability in the results is partly due to the endogeneity existing between formal and informal care. The most recent studies (Van Houtven and Norton, 2004, 2007; Pezzin and Schone, 1999; Charles and Sevak, 2005; Bolin et al, 2007) take into account this endogeneity bias. It is worth noting that these studies usually find that the two types of help are substitute. Bolin et al (2007) have also analysed the effect of informal care on the use of different types of formal and medical care in Europe using SHARE data. They find that informal care substitutes for formal home care while it is a complement to doctor and hospital visit. In the present study, we focus on the use formal home care and analyses separately nursing care and paid domestic help while Bolin et al (2007) consider home care as a whole without distinguishing the two types of care. We show that it is important to distinguish the type of home care as informal care has different effect with respect to the home care considered. Moreover, we highlight the heterogeneity in the effect of informal care on formal care use with respect to the level of disability of the elderly.

Before going further into the analysis, it is first interesting to roughly compare the use of formal and informal care among the elderly across European countries. Northern European countries mainly rely on the State in the provision of care to the elderly while family is the main source of care for the elderly in Southern Europe. Figure 1 sketches a preliminary result from the SHARE-data by analysing the relationship between the provision of informal care by the adult children on the demand for paid domestic help and nursing care by the elderly (65 year-old or over) across nine European countries.

Figure 1 about here

Paid domestic help to the elderly appears less used in countries where informal care from the adult children is more intensively provided. However, no clear relationship between nursing care and informal care emerges from this cross-country comparison. These preliminary results suggest that informal care is an effective substitute for paid domestic help while it is not related to the use of nursing care. However, a more detailed analysis at the micro-level is required in order to assess the robustness of these preliminary results.

The empirical analysis of the effect informal care on formal care use by older individuals raises several issues. First, the decision to provide informal care to parents and the decision to use formal care are simultaneously determined. Moreover, spurious positive correlation may exist between formal and informal care because unobserved negative health characteristics (Charles and Sevak, 2005), or unobserved preferences for care are likely to increase the demand for both formal and informal care. As a result, the model will use instrumental variables for informal care that are related to the provision of informal care and can plausibly be assumed not to be correlated to the error term of the formal care use equation. We argue that the geographical distance of the nearest child and the number of sons and daughters fulfil the conditions for being valid instruments for informal care.

The remainder of this paper is organised as follows. The next section briefly discusses the conceptual framework and highlights the main issues raised in analysing relationship between the demand for formal and informal care. Section 3 explains the empirical model and discusses the econometric issues. Section 4 provides a description of the SHARE data and the variables used in the empirical model. Section 5 presents the estimation results and Section 6 checks those results by performing some sensitivity analysis. Finally, Section 7 concludes.

2. Formal versus informal care

Theoretical models related to the utilisation of formal and informal care among the elderly are mainly based on the family-decision making process and a health production function

(Grossman, 1972; Van Houtven and Norton, 2004) or an ability for the elderly to perform activities of daily living function (Stabile et al, 2006) using as inputs formal and informal care. According to those models, the relationship between informal and formal care depends then on the sign of the derivative of the marginal product of formal care (in the production of health) with respect to informal care, which means that complementarity or substitution between formal and informal care is essentially an empirical issue (Bolin et al., 2007). In this paper, we test whether the relationship between formal and informal care differs according to the disability level of the elderly. Conceptually, it consists in analysing whether disability level has an effect on the derivative of the marginal product of formal care with respect to informal care in the production of health or the ability to perform activities of daily living.

The empirical relationship between formal and informal care is not straightforward. As mentioned previously, prior studies on this topic provide mitigated results regarding the nature and the sign of the link between these two types of care. This inconsistency highlights the complexity of the mechanisms lying behind the relationship between formal and informal care. Several aspects are important to take into account in order to analyse the provision of formal and informal care.

First, endogeneity of informal care in a model explaining formal care use is likely to be present for at least two reasons: the decision to provide informal care to parents and the decision to use formal care are simultaneously determined (Van Houtven and Norton, 2004). Moreover, spurious positive correlation may exist between formal and informal care. It may be due to unobserved negative health characteristics that are likely to increase the demand for both formal and informal care (Charles and Sevak, 2005) or to unobserved preferences for care affecting both formal and informal care use.

Second, the relationship between formal and informal care is likely to differ according to the type of formal care used (Van Houtven and Norton, 2004; Bolin et al, 2007). In practice, care encompasses a great number of services ranging from personal care to gardening or shopping. While it is difficult to distinguish the type of informal care due to its multidimensional nature, formal care providers can specialise in certain aspects of care and the type of care provided can be better identified. Informal care is likely to be substitute for formal care that requires low skills such as shopping for grocery or cleaning the house. However, this substitution effect may not apply to formal care demanding higher skills such as personal care: children are less likely to be able to perform such tasks or the parent may be reluctant that their children help them for dressing, bathing or going to the toilet. As a result, we expect that the substitution effect between informal care and formal care is larger for paid domestic help (a low skilled care) than for nursing care.

Finally, the disability level of the elderly may change the link between these two types of care: informal care is likely to be a substitute for elderly with low disability while it may become complementary for the highly handicapped individuals. When the dependency is low, informal care is likely to substitute for formal care as the type of help required demands low skills and few commitments. However, as the disability level increases, the burden imposed by care becomes so heavy that it requires both formal and informal care. At this stage, the relationship between formal and informal care is likely to become complementary, the informal carer acting as the agent of the dependent elderly to improve the formal care services. The informal carer is likely to be better informed about the needs of the dependent and the formal care services than the dependent herself, especially in case of mental health disease.

3. Empirical model

The empirical model consists in analysing the causal effect of informal care from the children to their elderly parents on the demand for formal care. The analysis addresses the following issues: endogeneity, differential effects by types of formal care and by disability level. While the first two issues have been analysed in the literature (Van Houtven and Norton, 2004; Bolin et al., 2007), this paper is the first to analyse the relationship between formal and informal care according to the disability level of the elderly.

Our model focuses on two types of formal home care: nursing care and paid domestic help. The distributions of these two variables are characterised by high proportions of zeros. In principle, a tobit model can be used to take this particularity into account. However, the tobit model assumes that the effects of the explanatory variables on the probability to receive the « treatment » and the quantity used once the « treatment » is received have the same direction. This may not be the case. In order to check for this possibility, we use a two-part model introduced by Duan et al. (1983) that allows to separate behaviour into two stages, first a decision about receiving the treatment and then, a decision about the level of this treatment conditional on receiving any. The parent's utilisation of formal care (g_{ij}) is a function of informal care (h_i), the disability level (D_i) and a vector of socio-demographic characteristics (X_i). The subscript i represents the individual and the j =1, 2 the two types of formal care analysed in this paper. The two-part model assumes that part one, $P(g_{ij} > 0)$, is described by a binary probit model such that:

$$P(g_{ij} > 0 \mid X_i, h_i, D_i) = \Phi(\gamma_{1j} + X_i\gamma_{Xj} + \gamma_{hj}\ln(1+h_i) + f(D_i, \gamma_{Dj})), \quad (1)$$

where $\Phi(.)$ represents the cumulative density function of the standard normal, *f(.)* is a polynomial in disability (D_i) allowing non-linear disability effect on the demand for formal care (our model uses the quadratic function) and $\gamma_{1j}, \gamma_{Xj}, \gamma_{hj}$, and γ_{Dj} are parameters to be estimated. Part two corresponds to the following equation assuming that the logarithm of the positive values of g_{ij} is linear in X_i, $\ln(1+h_i)$, and *f(*D_i*, .)*:

$$E[\ln(g_{ij}) \mid g_{ij} > 0, X_i, h_i, D_i] = \beta_{1j} + X_i\beta_{Xj} + \beta_{hj}\ln(1+h_i) + f(D_i, \beta_{Dj}), \quad (2)$$

where $\beta_{1j}, \beta_{Xj}, \beta_{hj}$, and β_{Dj} are parameters to be estimated by OLS.

As mentioned before, we suspect that the main variable of interest, informal care (h_i), is endogenous because of the possible simultaneity between formal and informal care and unobserved characteristics that lead to spurious correlation between the two variables of interest. As a result, we have to control for the endogeneity in the model in order to get unbiased estimates of the effect of informal care on the demand for formal care. Regarding the part one of the two-part model, the standard approach of instrumental variables estimation used in linear model provides inconsistent estimates when applied to nonlinear model. Instead, Rivers and Vuong (1988) propose a two-step approach to get consistent estimates for the probit model in presence of endogeneity. This method consists in including the residuals of the first stage equation in the second stage equation. It is worth noting that the resulting coefficients are estimated only up to scale. However, their sign and significance are of interest. Furthermore, we can consistently estimate the average partial effect and thus the elasticity of formal care with respect to informal care by adjusting the scaled coefficients appropriately (Wooldridge, 2002, p.474). [5] Part one of the two-part model is estimated by

[5] See Appendix 1 for the calculation of the elasticity.

using Amemiya's Generalized Least Squares (Newey, 1987).[6] Part two uses the standard two-stage least squares estimation.

The instrumental variables have to be correlated with the provision of informal care but not with the error terms of the formal care utilisation equation. The choice of such variables is driven by the potential effect that they can have on the supply of informal care by the children. Geographical distance from children is a possible candidate as it might represent a substantial cost of caring for the informal caregiver. Several studies have shown the importance of this variable for the provision of informal care (Charles and Sevak, 2005; Stern, 1995). Children living further away from their parents are less likely to provide informal care than closer children. This variable thus fulfils the first condition to be a valid instrument for informal care. However, the second condition, requiring no correlation between the error terms of the formal care equation and the instrumental variable, is not necessarily satisfied. Parents may choose to move nearer to their children when their health deteriorates, or children may choose to live near their disabled parents. If the model does not fully take into account the effects of health on the use of formal care, the error terms are likely to be negatively correlated to the distance to the nearest child. However, Charles and Sevak (2005) find no evidence that children are more likely to live close by when their parent is in bad health. Bolin et al (2007) use a dummy indicating whether the elderly has children living less than 100 kilometers away as an instrument using SHARE data and their instruments passes the overidentification restriction test. Moreover, Stern (1995) shows that, although it is endogenous to the supply of informal care from the children, distance is a strong predictor of informal care supply and the related endogeneity bias is very limited. A sensitivity analysis in Section 6.1 will test the effect of excluding distance from the set of instruments. Other components having potential impacts on the supply of informal care are the number of children and their gender. Numerous studies show that daughters provide more care to their parents than sons (see, for example, Horowitz, 1985). A test of overidentifying restriction will assess the validity of our set of instruments for each of the model considered in this paper. It is worth noting that we tried other instruments for informal care: the number of grandchildren, the age of the children, and their education level. All these instruments have only a poor predictive power regarding the supply of informal care and are not used in our analysis.

The dependent variable of the informal care equation is the logarithm of the average number of hours of informal care received per month by the children. A unit was added to the natural hours of care before the log transformation to avoid the problem of zero hours (Pezzin et al., 1996). This gives:

$$E[\ln(1+h_i) \mid X_i, D_i, C_i] = \delta_1 + X_i\delta_X + f(D_i, \delta_D) + C_i\delta_C, \quad (3)$$

where C_i is a vector of the children characteristics mentioned above and $\delta_1, \delta_X, \delta_h$ and δ_D are parameters to be estimated by OLS.

The model is first estimated ignoring the possibility that the coefficient on informal care may differ according to the disability degree of the elderly. In a second step, this assumption is relaxed allowing informal care to have different effects on formal care according to the disability degree of the dependent individual. The two-part model can now be described by the following equations:

$$P(g_{ij} > 0 \mid X_i, h_i, D_i) = \Phi(\gamma'_{1j} + X_i\gamma'_{Xj} + \gamma'_{hj}\ln(1+h_i) + f(D_i, \gamma'_{Dj}) + \gamma'_{Dhj} D_i \ln(1+h_i)), \quad (4)$$

$$E[\ln(g_{ij}) \mid g_{ij} > 0, X_i, h_i, D_i] = \beta'_{1j} + X_i\beta'_{Xj} + \beta'_{hj}\ln(1+h_i) + f(D_i, \beta'_{Dj}) + \beta'_{Dhj} D_i \ln(1+h_i). \quad (5)$$

[6] The statistical package used is Stata 9 and the estimation command is "ivprobit".

This implies that the model to be estimated has now one more endogenous variable. This new feature requires new instruments in order to identify the effect of the interaction term on the demand for formal care. The candidate for such an instrument is the product of the disability degree and the distance from the nearest child. The first-stage equations of the IV model are described as follows:

$$E[\ln(1+h_i) \mid X_i, D_i, C_i] = \delta'_1 + X_i\delta'_X + f(D_i, \delta'_D) + C_i\delta'_C + D_iC_i\delta'_{DC}, \quad (6)$$

$$E[D_i \ln(1+h_i) \mid X_i, D_i, C_i] = \delta''_1 + X_i\delta''_X + f(D_i, \delta''_D) + C_i\delta''_C + D_iC_i\delta''_{DC}. \quad (7)$$

4. Data

SHARE is a European multi-disciplinary survey including more than 30,000 persons aged 50 and over, and coming from 11 European countries ranging from Scandinavia to the Mediterranean, and Israel.[7] We use in this paper the release 2 of the first wave of the survey, which was conducted in 2004. The survey brings together many disciplines, including demography, economics, epidemiology, psychology and sociology. The data were collected using a computer assisted personal interviewing (CAPI) program, supplemented by a self-completion paper and pencil questionnaire. For more details on the sampling procedure, questionnaire contents and fieldwork methodology, readers must refer to Börsch-Supan et al. (2005).

4.1. Sample selection criteria

To be selected in our analysis, respondents have to be at least 65 year-old, to have between one and four children[8] and not to live with one of their children or in institution. We exclude individuals living with their children because it is difficult to distinguish the way, the type and the importance of the transfers that take place within a household. Moreover, the analysis focuses on the formal care in the community because the sampling design of the first wave of SHARE does not include institutionalised individuals. This may potentially affect our results if the decision to institutionalise an older individual represents a substantial substitution of formal care for informal care (Pezzin et al., 1996). Moreover, we discard observations with missing or unreliable values for the variables of interest and the other explanatory variables. Finally, we do not use data from Greece, Israel and Switzerland because we do not have the information about formal care use in these countries. Our final sample includes 7,329 observations for nine European countries. Table 1 presents the summary statistics of the main variables used in the model.

Table 1 about here

4.2. Dependent variables: the use of formal care

This paper analyses the demand for two types of formal care: paid domestic help and nursing care. As a high number of respondents do not use these types of formal care at all, we create two dummies equal to one when the corresponding formal care has been used during the twelve months preceding the survey and zero otherwise. Regarding the quantity, the respondents are asked to report the number of weeks and the average number of hours per

[7] The first wave of SHARE data includes twelve countries: Austria (AU), Belgium (BE), Germany (DE), Denmark (DK), France (FR), Greece (GR), Italy (IT), Netherlands (NL), Spain (ES), Sweden (SE), Switzerland (CH) and Israel (IL).

[8] Parents with more than four children account only for a small fraction of the population.

week they received the corresponding formal care (paid domestic help or nursing care) during the twelve months preceding the survey. Our dependent variables are the product of these two measures divided by 12 to get the average number of hours per month.

4.3. Informal care and the instrumental variables

The informal care measure used in this paper is the average total number of hours of informal care received from the children of the respondent per month.[9] This variable is based on three questions that ask the respondent to give the relationship with the caregiver (if any), the frequency (daily, weekly, monthly or less often) of informal care received and the average number of hours per day/week/month/year respectively. We transform these variables into a measure of the average total number of hours of informal care received from the children per month.

Informal care given by the children is assumed to depend on several children characteristics that are independent of the demand for formal care. As discussed in the previous section we assume that geographical proximity and the gender of the children mainly explain the supply of informal care to the parents. The gender composition of the children is represented by the number of sons and daughters of the respondent. Geographical proximity corresponds to the distance of the nearest child from the elderly parent. In SHARE, this variable is allowed to take the following categories: the children can live either in the same building (but not the same household), less than 1 kilometre away, between 1 and 5 kilometres away, between 5 and 25 kilometres away, between 25 and 100 kilometres away, between 100 and 500 kilometres away or more than 500 kilometres away. From this variable, we compute a new variable, the distance from the nearest child, by assigning the number of kilometres corresponding to the middle of the bandwidth of each possible categorical answer.

4.4. Parent's explanatory variables

The demand for formal care is assumed to depend on various parent's characteristics. First, our empirical model includes several socio-demographic variables: gender, age, years of education, household composition (whether the parent lives alone or not) and home ownership. Moreover, the model also includes dummies related to the country-specific net-worth quartile (including housing wealth) and gross household income quartile of the respondent to take into account the ability to pay of the elderly.[10] Finally, we construct a health-related index representing the disability level of the elderly in order to have only one variable related to health in the model. This allows us to analyse more easily the interaction of informal care and the disability level on the demand for formal care[11]. This index is constructed on the basis of a categorical variable from the SHARE questionnaire that asks to which extent, if any, the respondent is limited in his daily activities because of health-related problem, and numerous objective variables on the health status of the individual that are available in SHARE. These variables include a set of dummies related to the chronic diseases, the symptoms, the limitations with the Activities of Daily Living (ADL) and the Instrumental Activities of Daily Living (IADL), and the mobility limitations of the respondent.[12] In order

[9] In SHARE, the information about the amount of informal care received is collected for only up to three potential informal caregivers. So, if the respondent has more than three caregivers, it is possible that our variable of informal care underestimates the amount of informal care provided by all the children.
[10] Household income is only available in gross amount in the wave 1 of SHARE.
[11] The model has also been estimated using all the health-related variables separately in the model that does not take into account the cross effects of informal care and the disability level on the demand for formal care but the results are not significantly affected by this modification.
[12] See the Appendix 2 for more details about the variables used.

to get a synthetic index of the disability level of the respondent, we perform an ordered probit model with the limitation question as dependent variable and the set of dummies as explanatory variables. [13] Most of the variables have expected sign and are significantly different from zero. From these results, we compute the latent index and define it as the disability level of the respondent. This variable has the advantage to take into account many aspects of the health of the respondent. Section 6 also estimates the model using alternative specifications of the disability level of the elderly.

5. Estimation results

In this section, we present the estimation results for our model. We show both the estimation of the two-part model considering the provision of informal care as exogenous and the same model taking into account the possible endogeneity of this variable on the demand for formal care. Moreover, we distinguish two types of formal home care: nursing care and paid domestic help. All equations include country-dummies to take into account the cross-country heterogeneity regarding the provision of formal and informal care.[14]

5.1. Informal care supply equation

Table 2 presents the estimation results for the informal care equation. The model has an adjusted-R^2 of 15.7%. The variable corresponding to the number of daughters has a significant positive impact on the provision of informal care to older parents. The distance to the nearest child and its square are highly significant regarding the hours of informal care received. The further the children are, the lower the provision of informal care. The F-test of the excluded instruments suggested by Bound et al. (1995) confirms that they are significant predictors of informal care supply (F (4, 7303) = 28.18).

It is worth noting that informal care depends on several other variables included in the model. First, informal care provision is higher among older individuals and those with low education level. Moreover, individuals living alone are more likely to receive informal care. Wealthier parents receive less informal care while homeowners receive more. Finally, results indicate that the disability level of the elderly significantly increases the supply of informal care.

Table 2 about here

5.2. Paid domestic help demand equation

Table 3 presents the estimation results of the two-part model for the use of paid domestic help. Looking at the model assuming exogeneity of children's informal care, the estimated coefficients on the logarithm of total hours of informal care are positive and significant for both the choice and the intensity equation. However, the null hypothesis of the Wald test of exogeneity of informal care is significantly rejected in the instrumental variable (IV) probit equation ($\chi_1^2 = 12.16$) indicating that informal care is endogenous to the decision to use paid domestic help. As a result, the coefficient estimates from the simple probit equation are inconsistent. The model passes the overidentification restriction test ($\chi_3^2 = 3.25$) indicating that the selected instruments are independent from the error terms of the structural equation. The IV probit equation reveals a negative and highly significant relationship between the decision

[13] The results from the ordered probit model are available in Appendix 2.
[14] Results for these country-dummies are not presented in the Tables but are available in Appendix 3.

to get paid domestic help and informal care. This confirms our expectations that informal care is a substitute for paid domestic help. Regarding the intensity equation of paid domestic help, the null hypothesis of the Wu-Hausman test is not rejected (F(1, 611) = 0.31) indicating that the exogeneity of informal care on the intensity of paid domestic help cannot be rejected. However, as endogeneity as been detected in part one of the demand for paid domestic help model, we focus on the results assuming endogeneity even if the data failed to reject the hypothesis of exogenity for the intensity equation. The effect of informal care on the number of hours of paid domestic help is positive and significant at the 10-percent level. Informal care is a substitute in the choice of the use of paid domestic help but is a complement in the intensity of it. From these results, we compute the elasticity of paid domestic use with respect to informal care for the average individual taking into account that the parameters of the IV probit are only estimated up to scale[15]. A 10-percent increase of informal care leads to a decrease by 7-percent of the use of paid domestic help (See Table 6).

Table 3 about here

It is worth noting several other results obtained from this analysis. Regarding the individual characteristics, elderly women are more likely to use paid domestic help than men. Age is also a factor that increases the need for more paid domestic help. Education plays no role in the decision to pay for such care but has a significant positive impact regarding the quantity of domestic help conditional on having any. The coefficients on income quartiles indicate a positive and significant relationship between income and paid domestic help. The disability level is as expected an important factor of formal domestic help decision among elderly in Europe. Moreover, elderly parents living alone are much more likely to use this kind of formal care. This could come from a potential substitution effect of informal care from other individuals (mainly the spouse) living in the same household.

5.3. Nursing care demand equation

Table 4 presents the results from the two-part model of nursing care use. Regarding the decision to receive such care, the Wald test does not reject the exogeneity of informal care on the dependent variable ($\chi_1^2 = 0.20$). Moreover, the null hypothesis of the Wu-Hausman test of exogeneity of informal care on the intensity of nursing care is not rejected (F(1,424) = 0.35). As a result, the simple two-part model is preferred to the model assuming endogeneity of informal care on nursing care. The simple two-part model exhibits a positive and significant relationship between informal care and the decision to receive nursing care but it is not significant regarding the quantity of nursing care received conditional on receiving any. This means that informal care from the children is complementary to the demand of nursing care in the decision to resort to such care. However, the computed elasticity of the average individual is low: a 10-percent increase of informal care leads to an increase by 2-percent of nursing care use (See Table 6).

Table 4 about here

Age and living alone have a positive effect on the probability to receive nursing care. Moreover, the disability level appears as having a significant positive effect on both the decision and the quantity of nursing care.

[15] See Appendix 1 for more details about the computation of the elasticities.

5.4. The relationship between informal care and formal care demand according to the disability level

This section analyses in deeper details the interaction between formal and informal care regarding the disability level of the elderly. In order to do so, we introduce in the empirical model the product of informal care and the disability level of the elderly. The model now has one additional endogenous variable and thus requires additional instruments: these are naturally the product of the distance from the nearest child and the disability level of the elderly and the product of the number of sons and daughters, and the disability level.

Table 5 about here

Table 5 presents the results of the paid domestic use model including the interaction term between informal care and the disability level of the elderly. The exogeneity hypothesis of the Wald test is significantly rejected regarding the decision to use paid domestic help ($\chi^2_2 = 11.29$) and the instruments pass the over-identification tests ($\chi^2_5 = 4.31$). Moreover, the hypothesis of exogeneity of informal care is also rejected for the intensity of paid domestic help (F(2, 609) = 3.09). As expected, the interaction term between informal care and the disability level is positive and significant suggesting that the substitution effect is lower for elderly suffering from high disability level. Regarding the intensity of paid domestic help, the coefficient on informal care is negative but not significant and the coefficient on the interaction term is negative and significant, confirming our results. The elasticity of paid domestic help with respect to informal care for the average individual is computed at three different values of the disability level index corresponding to individuals suffering from no limitation (disability level = 0.47), those being limited but not severely (disability level = 1.19) and those being severely limited (disability level = 2.15). The elasticity estimates are – 1.77, - 1.04 and - 0.27 respectively, the latter being not significant at the five-percent level (See Table 6).

The results from the nursing care equation are not presented because the inclusion of the interaction term between informal care and the disability level has no significant effect and does not change the results from the previous section.

Table 6 about here

6. Sensitivity analysis

6.1. The instruments

Using geographical distance as an instrument for informal care might be criticised because this variable is likely not to be exogenous to the use of formal care. As discussed earlier, children may live closer to their parents when the latter are in worse health, moreover, children may choose to live nearer to their parents if the availability of formal care is scarce in the region where the parents live. As a check, we estimate the model after having dropped geographical distance from the model. Moreover, we add to our sample all individuals being 65 year-old or over and having no children (1,291 individuals). The instruments for informal care are now the number of sons and the number of daughters of the respondents. Table 7 presents the results of the extended two-part model of paid domestic help.[16] Results are

[16] The results from the nursing care equation are not shown as the hypothesis of exogeneity of informal care is not rejected. The results from the simple two-part model from Table 4 still hold.

consistent with those obtained from the model using geographical distance as additional instrument. The coefficient on informal care is still negative and significant at the 10-percent level and the coefficient on the interaction term between informal care and the disability level is still positive but no more significant for the decision equation. Regarding the intensity of the use of paid domestic help, the coefficient on informal care is also negative and significant while the coefficient on the interaction term is positive and significant. The estimated elasticity of paid domestic help use with respect to informal care is -1.37 for individuals with no limitations, -0.80 for respondents limited, but not severely, and -0.19 for those severely limited with their daily activities (See Table 8). As a result, this estimation shows that the use of geographical distance from the nearest children as an instrument for informal care does not affect the main results of this analysis.

Table 7 about here

6.2. The disability level

We now test some alternatives regarding the measurement of the disability level. We estimate the model using different variables related to the disability level of the elderly to analyse the effect of disability on the relationship between formal and informal care. This sensitivity analysis is only conducted for the use of paid domestic help as the effect of disability level is unimportant in the relationship between informal and nursing care.

The first sensitivity analysis consists in estimating the model with no interaction term between informal care and the disability level on three types of individuals separately: individuals suffering from severe limitations in their daily activities, those being limited to some extend and those having no limitations.[17] These groups are computed from the categorical variable that asks to which extent, if any, the respondent is limited in his daily activities because of health-related problem. Results from this analysis are consistent with those obtained in the previous section.[18] The computed elasticity of paid domestic help with respect to informal care for the average individual of each category is equal to - 1.48 for individuals not limited in their daily activities, - 0.89 for those limited, but not severely, and - 0.003 for those severely limited.[19]

6.3. The sample definition

The sample selection of our main results is all individuals being at least 65 year-old and having between one and four children. It is worth noting that our results are robust to changes in the sample definition. Several sample selection have been tested. All single individuals being 65 year-old or more, all individuals being 70 year-old or over, and all individuals being at least 65 year-old and being limited in their daily activities (those limited, but not severely, and those severely limited). In all case, the signs of the coefficients remain the same as in our preferred model. However, these results fail to be significant for some of the selected sample.

[17] Note that our constructed variable for the disability level is still included in this model to take into account the heterogeneity of the disability level within each category.
[18] Results are available upon request.
[19] The bootstrapped elasticities for individuals with no limitation or being limited, but not severely are significantly different from zero at the 5-percent level.

7. Conclusion

This paper analyses the use of formal home care and informal care of the elderly in Europe. Using the most recent European data coming from the first wave of SHARE, we construct a two-part utilisation model estimating the effects of informal care supply from the children on the demand for paid domestic help and nursing care among their elderly parents in nine European countries. The model takes into account the potential endogenous relationship between formal and informal care by using children characteristics as instruments. Results indicate that informal care is endogenous to the decision to use domestic paid help while no endogeneity is detected regarding the nursing care equation. Moreover, we find that informal care is a substitute for paid domestic help. However, the substitution effect tends to disappear for elderly suffering from heavy disability. Finally, nursing care appears as being a weak complement to informal care whatever the disability level.

These findings have a cost implication: based on our results, encouraging informal care will have only significant effects among elderly with low disability and for unskilled care. As a result, such policies are likely to have limited effect on the long-term care expenditures in Europe.

References

Bolin, K.; Lindgren, B.; Lundborg, P. (2007): Informal and Formal Care Among Single-Living Elderly in Europe, Health Economics (Published Online) DOI: 10.1002/hec.1275.

Börsch-Supan A., Jürges, H. (eds), 2005, The Survey of Health, Ageing and Retirement in Europe - Methodology, Mannheim: MEA.

Bound, J., Jaeger, D. A., Baker, R. M., 1995. Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak. Journal of the American Statistical Association, 90, 443–450.

Charles, K.K., Sevak, P., 2005. Can family caregiving substitute for nursing home care? Journal of Health Economics 24, 1174-1190.

Comas-Herrera, A., Costa-Font, J., Gori, C., di Maio, A., Patxot, C., Pickard, L., Pozzi, A., Rothgang, H., Wittenberg, R., 2003. European study of long-term care expenditure: Investigating the sensitivity of projections of future long-term care expenditure in Germany, Spain, Italy and the United Kingdom to changes in assumptions about demography, dependency, informal care, formal care and unit costs. Report to the European Commission, Employment and Social Affairs DG.Grant Number VS/2001/0272.PSSRU Discussion Paper 1840.

Christianson, J.B., 1988. The evaluation of the national long-term care demonstration: the effect of channelling on informal caregiving. Health Services Research 23 (1), 99-117.

Duan, N., Manning, W.G. Jr., Morris, C.N., Newhouse, J.P., 1983. A comparison of alternative models for the demand for medical care. Journal of Business and Economic Statistics, 1, 2, 115-126.

Ettner, S.L., 1994. The effect of the medicaid home care benefit on long-term care choices of the elderly. Economic Inquiry, 32, 103-127.

Grossman, M., 1972. On the concept of health capital and the demand for health, Journal of Political Economy, 80, 223-255.

Horowitz, A., 1985, Family caregiving to the frail elderly. Annual Review of Gerontology and Geriatrics 6, 194-246.

Langa, K.M., Chernew, M.E., Kabeto, M.U., Katz, S.J., 2001, The explosion in paid home care in the 1990s: who received the additional services?, Medical Care, Vol. 39, No. 2, 147-157.

Newey, W. K., 1987. Efficient estimation of limited dependent variable models with endogenous explanatory variables, Journal of Econometrics 36, 231-250.

Pezzin L.E., Schone B., 1999. Intergenerational household formation, female labour supply, and informal caregiving : a bargaining approach. Journal of Human Resources, vol. 34, 475-503.

Pezzin, L.E., Schone, B.S., 1997. The allocation of resources in intergenerational households: adult children and their elderly parents. American Economic Review, Vol. 87, No. 2, Papers and Proceedings of the Hundred and Fourth Annual Meeting of the American Economic Association, 460-464.

Pezzin, L.E., Kemper, P. and Reschovsky, J., 1996. Does publicly provided home care substitute for family care? Experimental evidence with endogenous living arrangements. The Journal of Human Resources 31, 3, 650-676.

Portrait, F., Lindeboom, M., Deeg, D., 2000. The use of long-term care services by the Dutch elderly. Health Economics 9, 513-531.

Rivers, D., Vuong, Q.H., 1988. Limited information estimators and exogeneity tests for simultaneous probit models. Journal of Econometrics 39 (3), 347-366.

Stabile, M., Laporte, A., Coyte P.C., 2006. Household responses to public home care programs, Journal of Health Economics, 25, 674-701.

Stern, S., 1995. Estimating family long-term care decisions in the presence of endogenous child characteristics. The Journal of Human Resources 30, 3, 551-580.

Van Houtven, C.H., Norton, E.C., 2004. Informal care and health care use of older adults. Journal of Health Economics 23, 1159-1180.

Van Houtven, C.H., Norton, E.C., 2007. Informal care and Medicare expenditures: testing for heterogeneous treatment effects, Journal of Health Economics, doi:10.1016/j.jhealeco.2007.03.002.

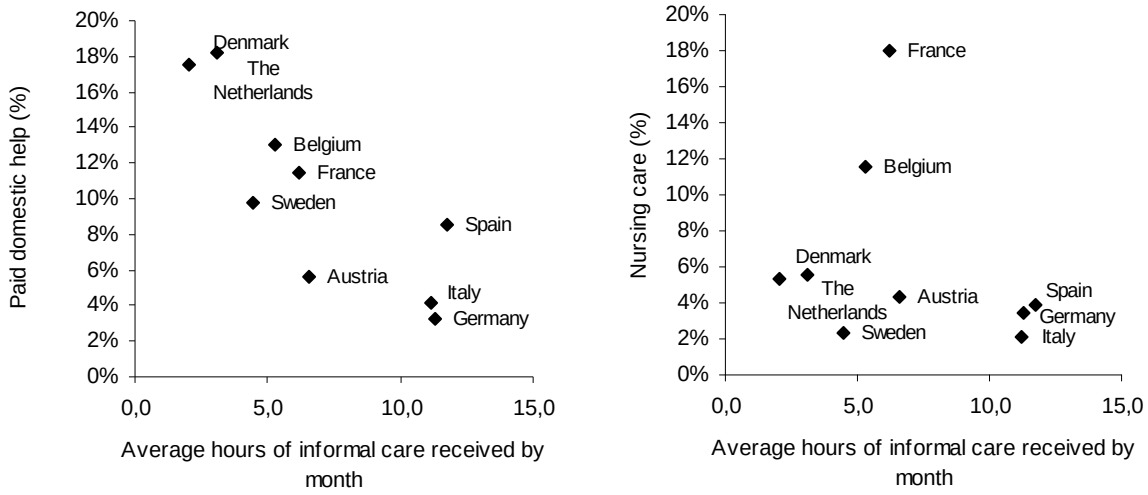
Viitanen, T. K., 2007. Informal and formal care in Europe. IZA Discussion Paper, No. 2648.

Wooldridge, J. M., 2002. Econometric Analysis of Cross Section and Panel Data, MIT press.

Yang, Z., Norton, E. C., Stearns, S. C., 2003. Longevity and health care expenditures: the real reasons older people spend more. The Journals of gerontology. Series B, Psychological sciences and social sciences, 58(1), 2–10.

Tables and Figures

Figure 1. The relationship between paid domestic help and nursing care use, and the informal care provided by adult children among the 65 year-old or over



Note: These figures show the relationship between paid domestic help and nursing care use, and the informal care received by the adult children. The results is based on individuals being 65 year-old or over having at least one child and not living with any of their children. Informal care corresponds to the sum of the average number of hours of care given by each child per month. Data are weighted.

Table 1. Summary statistics

	All countries	Austria	Belgium	Denmark	France	Germany	Italy	The Netherlands	Spain	Sweden
N	7,329	605	1,166	521	921	1,004	618	802	578	1,114
Receive paid domestic help	8.7%	5.0%	14.7%	17.5%	10.3%	2.2%	2.6%	12.7%	6.2%	6.5%
Receive nursing care	6.1%	4.0%	11.7%	5.6%	16.7%	1.9%	1.9%	3.7%	4.2%	1.7%
Hours of informal care from the children per month	5.6	6.0	5.7	3.3	5.8	8.6	7.7	1.4	10.1	3.0
Woman	53.5%	58.8%	54.2%	55.7%	58.1%	51.6%	53.1%	48.5%	54.8%	50.2%
Age	73.3	73.1	73.3	74.3	74.0	72.3	72.7	73.1	73.8	73.7
Single household	27.7%	42.5%	29.2%	39.7%	34.1%	21.6%	20.9%	21.8%	18.0%	25.9%
Years of education	9.4	10.9	9.4	11.7	7.5	13.2	5.8	10.5	4.2	9.5
Home-owner	69.4%	54.2%	78.6%	69.1%	76.1%	55.6%	80.3%	45.4%	92.4%	74.1%
Limited in activities because of a health problem:										
Severely limited	17.2%	15.9%	18.2%	15.2%	20.4%	21.6%	16.0%	19.6%	6.4%	15.4%
Limited, but not severely	33.9%	40.3%	28.9%	37.6%	27.8%	41.0%	35.0%	26.3%	42.6%	32.6%
Not limited	49.0%	43.8%	52.9%	47.2%	51.8%	37.4%	49.0%	54.1%	51.0%	52.0%
Yearly household gross income (median)	40,816	36,612	41,715	40,614	47,429	40,157	27,332	52,937	18,231	47,855
Net worth (median)	342,175	176,239	412,665	399,135	447,532	351,774	336,401	348,514	288,654	262,531
Number of sons	1.1	1.0	1.1	1.2	1.1	1.0	1.1	1.2	1.1	1.2
Number of daughters	1.1	1.1	1.1	1.2	1.1	1.1	1.1	1.2	1.1	1.1
Total number of children	2.2	2.1	2.3	2.4	2.2	2.1	2.2	2.4	2.3	2.3
Distance from the nearest child (in kilometres)	42.9	39.9	21.7	48.1	71.3	51.0	27.9	25.8	32.4	59.7

Table 2. Determinants of informal care provided by the children in Europe.

Dependent variable: log $(1+h_i)$	
Intercept	-1.929***
	(0.167)
Woman	0.064**
	(0.026)
Age	0.028***
	(0.002)
Years of education	-0.015***
	(0.004)
Single household	0.325***
	(0.033)
Home-owner	0.106***
	(0.036)
Net worth quartile:	
1st	-
2nd	-0.052
	(0.038)
3rd	-0.099**
	(0.044)
4th	-0.079*
	(0.046)
Income quartile:	
1st	-
2nd	0.039
	(0.033)
3rd	0.034
	(0.038)
4th	0.090**
	(0.040)
Disability level	0.126***
	(0.035)
(Disability level) ^{2}	0.034***
	(0.010)
Country dummies	yes
Instrumental variables	
Number of sons	0.011
	(0.015)
Number of daughters	0.050***
	(0.016)
Distance to the nearest child (in kilometres)	-0.002***
	(0.000)
(Distance to the nearest child) ^{2}	0.000***
	(0.000)
R^2	0.157
N	7,329

Note: *, **, *** means that the coefficient estimate is significantly different from zero at the 10%, 5%, 1 %-level respectively. Standard errors are in parentheses.

Table 3. Two-part model of paid domestic help use.

Dependent variable: g_1	Probit model	IV Probit model	OLS	IV OLS
Intercept	-7.227***	-8.510***	0.563	0.708
	(0.355)	(0.540)	(0.582)	(0.630)
Log (h+1)	0.059***	-0.621***	0.122***	0.181*
	(0.019)	(0.205)	(0.027)	(0.109)
Woman	0.258***	0.298***	-0.099	-0.104
	(0.058)	(0.062)	(0.094)	(0.093)
Age	0.058***	0.077***	0.011*	0.009
	(0.004)	(0.007)	(0.006)	(0.007)
Years of education	0.008	-0.004	0.026**	0.027**
	(0.008)	(0.009)	(0.013)	(0.013)
Single household	0.502***	0.717***	0.059	0.055
	(0.065)	(0.095)	(0.101)	(0.100)
Home-owner	-0.046	0.021	0.047	0.021
	(0.076)	(0.083)	(0.118)	(0.125)
Wealth quartile:				
1st	-	-	-	-
2nd	0.000	-0.035	-0.015	0.005
	(0.080)	(0.085)	(0.125)	(0.128)
3rd	-0.075	-0.152	-0.126	-0.119
	(0.094)	(0.102)	(0.150)	(0.149)
4th	0.010	-0.049	-0.289*	-0.282*
	(0.102)	(0.108)	(0.170)	(0.168)
Income quartile:				
1st	-	-	-	-
2nd	0.110	0.132*	0.069	0.079
	(0.070)	(0.074)	(0.107)	(0.107)
3rd	0.018	0.034	0.378**	0.382***
	(0.088)	(0.092)	(0.145)	(0.143)
4th	0.182**	0.230**	0.299**	0.323**
	(0.087)	(0.093)	(0.139)	(0.144)
Disability level	0.635***	0.729***	-0.031	-0.058
	(0.074)	(0.083)	(0.119)	(0.127)
(Disability level) ²	-0.048***	-0.026	0.056**	0.059**
	(0.018)	(0.020)	(0.026)	(0.026)
Country dummies	yes	yes	yes	yes
(pseudo-) R^2	0.337		0.207	0.229
N	7,329	7,329	635	635

Note: *, **, *** means that the coefficient estimate is significantly different from zero at the 10%, 5%, 1 %-level respectively. Standard errors are in parentheses.

Table 4. Two-part model of nursing care use.

Dependent variable: g_2	Probit model	IV Probit model	OLS	IV OLS
Intercept	-4.245***	-4.058***	0.001	-0.226
	(0.380)	(0.556)	(0.696)	(0.782)
Log (h+1)	0.078***	0.175	0.051	-0.044
	(0.021)	(0.220)	(0.035)	(0.161)
Woman	0.034	0.027	-0.025	-0.020
	(0.062)	(0.063)	(0.117)	(0.115)
Age	0.017***	0.015*	0.005	0.008
	(0.005)	(0.008)	(0.008)	(0.010)
Years of education	0.002	0.003	0.008	0.007
	(0.008)	(0.009)	(0.013)	(0.013)
Single household	0.122*	0.091	0.158	0.236
	(0.073)	(0.101)	(0.141)	(0.189)
Home-owner	-0.032	-0.040	-0.094	-0.066
	(0.084)	(0.086)	(0.154)	(0.158)
Wealth quartile:				
1st	-	-	-	-
2nd	-0.075	-0.071	-0.098	-0.079
	(0.088)	(0.089)	(0.158)	(0.159)
3rd	-0.054	-0.045	0.250	0.290
	(0.100)	(0.102)	(0.177)	(0.187)
4th	0.000	0.006	0.055	0.065
	(0.106)	(0.107)	(0.194)	(0.192)
Income quartile:				
1st	-	-	-	-
2nd	-0.042	-0.045	-0.016	-0.025
	(0.075)	(0.076)	(0.140)	(0.138)
3rd	-0.033	-0.034	0.026	0.016
	(0.089)	(0.090)	(0.163)	(0.161)
4th	-0.003	-0.009	0.095	0.067
	(0.091)	(0.092)	(0.168)	(0.171)
Disability level	0.426***	0.413***	0.425***	0.483***
	(0.078)	(0.083)	(0.148)	(0.174)
(Disability level) ²	0.012	0.008	-0.026	-0.034
	(0.018)	(0.020)	(0.032)	(0.034)
Country dummies	yes	yes	yes	yes
(pseudo-) R^2	0.273		0.318	0.341
N	7,329	7,329	448	448

Note: *, **, *** means that the coefficient estimate is significantly different from zero at the 10%, 5%, 1 %-level respectively. Standard errors are in parentheses.

Table 5. Two-part model of paid domestic help use (extended).

Dependent variable: g_1	Probit model	IV Probit model	OLS	IV OLS
Intercept	-7.278***	-8.390***	0.641	1.424**
	(0.356)	(0.526)	(0.586)	(0.704)
Log (h+1)	0.134***	-1.323**	0.062	-0.401
	(0.037)	(0.519)	(0.060)	(0.337)
(Disability level)*Log (h+1)	-0.038**	0.413**	0.026	0.252**
	(0.016)	(0.196)	(0.024)	(0.121)
Woman	0.263***	0.286***	-0.104	-0.149
	(0.059)	(0.064)	(0.094)	(0.101)
Age	0.058***	0.077***	0.011*	0.003
	(0.004)	(0.007)	(0.006)	(0.008)
Years of education	0.009	-0.009	0.026**	0.027**
	(0.008)	(0.010)	(0.013)	(0.014)
Single household	0.497***	0.748***	0.064	0.104
	(0.066)	(0.108)	(0.101)	(0.110)
Home-owner	-0.044	0.016	0.056	0.112
	(0.076)	(0.085)	(0.118)	(0.145)
Wealth quartile:				
1st	-	-	-	-
2nd	-0.002	-0.033	-0.022	-0.066
	(0.080)	(0.088)	(0.125)	(0.144)
3rd	-0.076	-0.154	-0.132	-0.171
	(0.094)	(0.105)	(0.150)	(0.162)
4th	0.004	-0.044	-0.287*	-0.269
	(0.102)	(0.111)	(0.170)	(0.180)
Income quartile:				
1st	-	-	-	-
2nd	0.110	0.140*	0.073	0.114
	(0.070)	(0.077)	(0.107)	(0.114)
3rd	0.019	0.042	0.370**	0.312**
	(0.088)	(0.095)	(0.145)	(0.157)
4th	0.178**	0.261***	0.300**	0.332**
	(0.087)	(0.099)	(0.139)	(0.153)
Disability level	0.630***	0.855***	-0.039	-0.128
	(0.074)	(0.117)	(0.119)	(0.135)
(Disability level) ²	-0.038**	-0.149***	0.052**	0.018
	(0.018)	(0.057)	(0.026)	(0.035)
Country dummies	yes	yes	yes	yes
(pseudo-) R^2	0338		0.207	0.121
N	7,329	7,329	635	635

Note: *, **, *** means that the coefficient estimate is significantly different from zero at the 10%, 5%, 1 %-level respectively. Standard errors are in parentheses.

Table 6. Elasticity of formal care with respect to informal care

			Elasticities	[Bootstrapped confidence interval]
Paid domestic help	Benchmark model		-0.70*	[-1.08;-0.32]
	Extended model	Average	-1.22*	[-1.83;-0.62]
		No limitation	-1.77*	[-2.65;-0.89]
		Not severely limited	-1.04*	[-1.55;-0.54]
		Severely limited	-0.27	[-0.56; 0.02]
Nursing care	Benchmark model		0.2	[0.09; 0.30]

Note: The 95% confidence intervals are bootstrapped.
* means that the coefficient is significant at the 5%-level.

Table 7. Two-part model of paid domestic help use (extended).

Dependent variable: g_1	Probit model	IV Probit model	OLS	IV OLS
Intercept	-6.835***	-7.318***	0.667	0.986*
	(0.307)	(0.377)	(0.499)	(0.541)
Log (h+1)	0.118***	-0.748*	0.035	-0.438*
	(0.036)	(0.429)	(0.058)	(0.230)
(Disability level)*Log (h+1)	-0.035**	0.247	0.035	0.234***
	(0.016)	(0.169)	(0.023)	(0.084)
Woman	0.241***	0.259***	-0.111	-0.135
	(0.052)	(0.053)	(0.084)	(0.087)
Age	0.053***	0.062***	0.009*	0.007
	(0.004)	(0.005)	(0.006)	(0.006)
Years of education	0.010	0.000	0.020*	0.022*
	(0.007)	(0.008)	(0.011)	(0.012)
Single household	0.548***	0.642***	0.159*	0.190**
	(0.058)	(0.073)	(0.091)	(0.095)
Home-owner	-0.016	0.007	0.089	0.154
	(0.068)	(0.071)	(0.105)	(0.115)
Wealth quartile:				
1st	-	-	-	-
2nd	-0.037	-0.046	-0.004	-0.053
	(0.070)	(0.073)	(0.111)	(0.118)
3rd	-0.097	-0.127	-0.142	-0.170
	(0.083)	(0.086)	(0.132)	(0.137)
4th	-0.075	-0.084	-0.102	-0.061
	(0.091)	(0.094)	(0.152)	(0.158)
Income quartile:				
1st	-	-	-	-
2nd	0.090	0.110*	0.126	0.148
	(0.062)	(0.065)	(0.097)	(0.101)
3rd	0.085	0.095	0.424***	0.385***
	(0.077)	(0.079)	(0.127)	(0.132)
4th	0.203**	0.245***	0.206	0.196
	(0.078)	(0.083)	(0.128)	(0.134)
Disability level	0.655***	0.771***	0.010	-0.039
	(0.067)	(0.091)	(0.106)	(0.115)
(Disability level) ²	-0.046***	-0.105**	0.037	0.015
	(0.017)	(0.042)	(0.023)	(0.026)
Country dummies	yes	yes	yes	yes
(pseudo-) R^2	0.326		0.189	0.134
N	8,620	8,620	804	804

Note: *, **, *** means that the coefficient estimate is significantly different from zero at the 10%, 5%, 1 %-level respectively. Standard errors are in parentheses.

Table 8. Elasticity of formal care with respect to informal care. Instruments: number of sons and daughters.

			Elasticities	[Bootstrapped confidence interval]
Paid domestic help	Extended model	Average	-0.94*	[-1.58;-0.30]
		No limitation	-1.37*	[-2.38;-0.36]
		Not severely limited	-0.80*	[-1.32;-0.28]
		Severely limited	-0.19	[-0.47; 0.08]

Note: The 95% confidence intervals are bootstrapped.
* means that the coefficient is significant at the 5%-level.

Appendix 1: The computation of the elasticity of formal care with respect to informal care.

The elasticity of formal care with respect to informal care from the two-part model can be computed as follows:

$$\varepsilon_{jh} = \frac{\partial E(g_j \mid \overline{X})}{\partial h} \frac{\overline{h}}{E(g_j \mid \overline{X})} = \frac{\overline{h}}{\overline{h}+1}\left(\frac{\phi(\overline{X}\hat{\gamma}_j)}{\Phi(\overline{X}\hat{\gamma}_j)} \hat{\gamma}_{hj} + \hat{\beta}_{hj} \right)$$

Where ε_{jh} is the elasticity of formal care *j* with respect to informal care (*h*), $\overline{h}$ is the sample average of the number of hours of informal care received by month, $\overline{X}$ is the vector of the sample average of all explanatory variables, $\hat{\gamma}_j$ is the vector of the coefficients estimates and $\hat{\gamma}_{hj}$ is the coefficient related to $\ln(1+h_i)$ in the part one equation. The instrumental variable probit model used in the part one of the two-part model only estimates the coefficients up to scale. As a result, we have to adjust these scaled coefficients to get the parameters of interest of the part one equation, $\hat{\gamma}_j$. When we have one endogenous variable in the structural model, Wooldridge (2002, p.474) shows that the scaled parameters have to be divided by the factor $(\hat{\theta}_j^2 \hat{\tau}^2 + 1)^{1/2}$, where $\hat{\theta}_j$ is the scaled coefficient related to the first stage equation residuals in the second stage equation of the IV probit model, and $\hat{\tau}^2$ is the estimated variance of these residuals.

The elasticity of formal care *j* with respect to informal care from the extended two-part model allowing for heterogeneous effect of informal care with respect to the disability level is computed as follows:

$$\varepsilon_{jh} = \frac{\partial E(g_j \mid \overline{X})}{\partial h} \frac{\overline{h}}{E(g_j \mid \overline{X})} = \frac{\overline{h}}{\overline{h}+1}\left(\frac{\phi(\overline{X}\hat{\gamma}'_j)}{\Phi(\overline{X}\hat{\gamma}'_j)} (\hat{\gamma}'_{hj} + D\hat{\gamma}'_{Dhj}) + (\hat{\beta}'_{hj} + D\hat{\beta}'_{Dhj}) \right)$$

Once again, the instrumental variable probit model gives the coefficients of the part one equation up to scale and have to be adjusted in order to compute the elasticities. In this case, the model has now two endogenous variables and the second stage equation includes the residuals of the two first stage equations (one for each endogenous variable). The adjustment factor by which the scaled coefficients have to be corrected is now $(\hat{\theta}_{1j}^2 \hat{\tau}_1^2 + \hat{\theta}_{2j}^2 \hat{\tau}_2^2 + 2\hat{\theta}_{1j}\hat{\theta}_{2j}\hat{\sigma}_{12} + 1)^{1/2}$ where $\hat{\theta}_{kj}^2$ corresponds to the estimated coefficient of the residuals from the first stage equation of the endogenous variable *k* in the second stage equation, $\hat{\tau}_k^2$ is the estimated variance of the residuals form the first stage equation of the endogenous variable *k* and $\hat{\sigma}_{12}$ is the estimated covariance of the two residuals. For each elasticity estimates, we bootstrap confidence intervals.

Appendix 2: The construction of the disability level

Activities of Daily Living (ADL):

These variables are related to basic tasks of everyday life. The respondent is asked about his ability to perform the following ADL:

- Dressing, including putting on shoes and socks
- Walking across a room
- Bathing or showering
- Eating, such as cutting up your food
- Getting in or out of bed
- Using the toilet, including getting up or down

Instrumental Activities of Daily Living scale (IADL):

These variables are activities of daily living that are related to the ability of the individual to live independently. The respondent is asked about his ability to perform the following IADL:

- Using a map to figure out how to get around in a strange place
- Preparing a hot meal
- Shopping for groceries
- Making telephone calls
- Taking medications
- Doing work around the house or garden
- Managing money, such as paying bills and keeping track of expenses

Mobility limitations:

It corresponds to the number of limitations with mobility, arm function and fine motor function reported by each individual. These are:

- Walking 100 metres
- Sitting for about two hours
- Getting up from a chair after sitting for long periods
- Climbing several flights of stairs without resting
- Climbing one flight of stairs without resting
- Stooping, kneeling, or crouching
- Reaching or extending your arms above shoulder level
- Pulling or pushing large objects like a living room chair
- Lifting or carrying weights over 10 pounds/5 kilos, like a heavy bag of groceries
- Picking up a small coin from a table

Chronic diseases:

It refers to a list of conditions of the respondent diagnosed by a doctor:

- A heart attack including myocardial infarction or coronary thrombosis or any other heart
  problem including congestive heart failure
- High blood pressure or hypertension
- High blood cholesterol
- A stroke or cerebral vascular disease
- Diabetes or high blood sugar
- Chronic lung disease such as chronic bronchitis or emphysema
- Asthma
- Arthritis, including osteoarthritis, or rheumatism
- Osteoporosis
- Cancer or malignant tumour, including leukaemia or lympho ma, but excluding minor skin
  cancers
- Stomach or duodenal ulcer, peptic ulcer
- Parkinson disease
- Cataracts
- Hip fracture or femoral fracture
- Other conditions, not yet mentioned

Symptoms:

It corresponds to the following symptoms reported by the respondent:

- Pain in your back, knees, hips or any other joint
- Heart trouble or angina, chest pain during exercise
- Breathlessness, difficulty breathing
- Persistent cough
- Swollen legs
- Sleeping problems
- Falling down
- Fear of falling down
- Dizziness, faints or blackouts
- Stomach or intestine problems, including constipation, air, diarrhoea
- Incontinence or involuntary loss of urine
- Other symptoms, not yet mentioned

Table A1. Ordered probit model of limitation with daily activities

	Coefficient	(Std error)
Chronic diseases:		
Heart attack	0.301***	(0.041)
High blood pressure	0.029	(0.031)
High blood cholesterol	-0.085**	(0.036)
Stroke or cerebral vascular disease	0.430***	(0.067)
Diabetes	0.164***	(0.045)
Chronic lung disease	0.214***	(0.061)
Asthma	0.204***	(0.066)
Arthritis	0.159***	(0.036)
Osteoporosis	0.069	(0.050)
Cancer	0.342***	(0.052)
Stomach or duodenal ulcer	0.226***	(0.059)
Parkinson disease	0.688***	(0.158)
Cataracts	-0.073*	(0.043)
Hip fracture	0.271***	(0.086)
Other conditions	0.429***	(0.038)
Symptoms:		
Pain in the back. knees. hips or any other joint	0.249***	(0.033)
Heart trouble or angina	0.312***	(0.053)
Breathlessness	0.172***	(0.046)
Persistent cough	0.071	(0.064)
Swollen legs	0.057	(0.043)
Sleeping problems	0.029	(0.038)
Falling down	0.091	(0.067)
Fear of falling down	0.099**	(0.048)
Dizziness. faints or blackouts	0.150***	(0.047)
Stomach or intestine problems	0.053	(0.043)
Incontinence	-0.051	(0.054)
Other symptoms	0.295***	(0.070)
Mobility limitations:		
Walking 100 meters	0.434***	(0.051)
Sitting for about two hours	0.097**	(0.049)
Getting up from a chair after sitting for long periods	0.112***	(0.040)
Climbing several flights of stairs without resting	0.309***	(0.037)
Climbing one flight of stair without resting	0.074	(0.050)
Stooping. kneeling. or crouching	0.192***	(0.036)
Reaching or extending your arms above shoulder level	0.162***	(0.054)
Pulling or pushing large objects like a living room chair	0.143***	(0.047)
Lifting or carrying weights over 10 pounds/5 kilos. like a heavy bag of groceries	0.161***	(0.041)
Picking up a small coin from a table	0.013	(0.076)
ADL:		
Dressing. including putting on shoes and socks	0.150**	(0.064)
Walking across a room	0.256*	(0.133)
Bathing or showering	0.143*	(0.075)
Eating. such as cutting up your food	-0.120	(0.130)
Getting in or out of bed	-0.041	(0.107)
Using the toilet. including up or down	-0.261*	(0.134)
IADL:		

Using a map to figure out how to get around in a strange place	-0.206***	(0.054)
Preparing a hot meal	0.065	(0.096)
Shopping for groceries	0.202***	(0.076)
Making telephone calls	0.214*	(0.120)
Taking medications	0.170	(0.136)
Doing work around the house or garden	0.533***	(0.054)
Managing money. such as paying bills and keeping track of expenses	0.122	(0.086)
Pseudo-R^2	0.240	

Appendix 3: Coefficient estimates of the country dummies

Table 2 (continued): Determinants of informal care received by the parents in Europe.
Country dummies

Dependent variable: ln (h_i + 1)	
Sweden	-
Denmark	0.083
	(0.055)
The Netherlands	-0.066
	(0.049)
Germany	0.443***
	(0.047)
Belgium	0.027
	(0.043)
France	0.023
	(0.046)
Austria	0.212***
	(0.053)
Italy	-0.019
	(0.053)
Spain	-0.026
	(0.056)

Table 3 (continued): Two-part model of paid domestic help use.
Country dummies

Dependent variable: g_i	Probit model	IV Probit model	OLS	IV OLS
Sweden	-	-	-	-
Denmark	0.720***	0.804***	-0.607***	-0.603***
	(0.108)	(0.118)	(0.163)	(0.161)
The Netherlands	0.724***	0.723***	0.206	0.222
	(0.103)	(0.109)	(0.164)	(0.164)
Germany	-0.664***	-0.340**	-0.060	-0.126
	(0.140)	(0.174)	(0.257)	(0.279)
Belgium	0.632***	0.697***	0.428***	0.424***
	(0.093)	(0.100)	(0.149)	(0.147)
France	0.236**	0.254**	0.486***	0.477***
	(0.103)	(0.109)	(0.164)	(0.162)
Austria	-0.225*	-0.050	0.036	0.021
	(0.131)	(0.146)	(0.229)	(0.227)
Italy	-0.415***	-0.386**	0.854***	0.905***
	(0.154)	(0.158)	(0.298)	(0.307)
Spain	0.054	0.050	0.418*	0.421*
	(0.131)	(0.138)	(0.225)	(0.222)

Table 4 (continued): Two-part model of nursing care use.
Country dummies

Dependent variable: g_2	Probit model	IV Probit model	OLS	IV OLS
Sweden	-	-	-	-
Denmark	0.611***	0.599***	-0.077	-0.083
	(0.153)	(0.155)	(0.313)	(0.307)
The Netherlands	0.573***	0.573***	0.672**	0.576
	(0.147)	(0.148)	(0.317)	(0.351)
Germany	-0.045	-0.090	0.565	0.627*
	(0.165)	(0.194)	(0.358)	(0.367)
Belgium	1.100***	1.090***	0.052	-0.007
	(0.125)	(0.127)	(0.267)	(0.280)
France	1.367***	1.363***	-0.401	-0.481
	(0.126)	(0.127)	(0.266)	(0.293)
Austria	0.433***	0.410**	1.453***	1.434***
	(0.157)	(0.165)	(0.328)	(0.323)
Italy	-0.003	-0.006	-0.236	-0.276
	(0.183)	(0.184)	(0.396)	(0.395)
Spain	0.426***	0.425***	-0.643*	-0.648*
	(0.162)	(0.162)	(0.342)	(0.337)

Table 5 (continued): Two-part model of paid domestic help use (extended).
Country dummies

Dependent variable: g_1	Probit model	IV Probit model	OLS	IV OLS
Sweden	-	-	-	-
Denmark	0.717***	0.849***	-0.599***	-0.525***
	(0.108)	(0.127)	(0.163)	(0.175)
The Netherlands	0.725***	0.733***	0.213	0.280
	(0.103)	(0.113)	(0.164)	(0.176)
Germany	-0.668***	-0.233	-0.059	-0.095
	(0.140)	(0.203)	(0.257)	(0.300)
Belgium	0.628***	0.714***	0.437***	0.506***
	(0.093)	(0.105)	(0.149)	(0.162)
France	0.235**	0.251**	0.489***	0.511***
	(0.103)	(0.112)	(0.164)	(0.175)
Austria	-0.233*	-0.015	0.040	0.071
	(0.131)	(0.156)	(0.229)	(0.245)
Italy	-0.423***	-0.384**	0.879***	1.132***
	(0.154)	(0.162)	(0.298)	(0.333)
Spain	0.058	0.041	0.415*	0.391
	(0.131)	(0.142)	(0.225)	(0.238)