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Tinbergen Institute Discussion Paper

Informal And Formal Care Among Single-Living Elderly In Europe

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INFORMAL AND FORMAL CARE AMONG SINGLE-LIVING ELDERLY IN EUROPE

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Abstract

The aims of this study were (1) to analyse whether informal care, provided by children or grandchildren to their elderly parents, and formal care are substitutes or complements, and (2) whether this relationship differs across Europe. The analyses were based on the newly developed SHARE (Survey of Health, Age, and Retirement in Europe) database. We found (1) that informal- and formal home care are substitutes, while informal care is a complement to doctor- and hospital visits, and (2) that these relationships in some cases differ according to a north-south gradient.

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JEL classification: I11, I12, J22

INTRODUCTION

Empirical studies have found a correlation between the amount of care and assistance supplied by close relatives or neighbours (informal care) and the amount of care supplied by the institutionalised health- and social-care systems (formal care). In two recent papers by Van Houtven & Norton [1] and Charles & Sevak [2], respectively, evidence was obtained suggesting that informal- and formal care were substitutes in the US. Previous studies have provided mixed evidence, however [3-5]. Whether informal care and formal care are substitutes or complements, naturally, depends on the exact purpose for using it. Basically, health care is utilised either in order to *restore* or to *maintain* health, whereas long-term care is provided in order to increase general welfare by facilitating the activities of daily living [6]. It seems unlikely that informal care is a substitute for formal care, when the purpose is to *restore* health in the case when highly qualified and specialised health care is demanded. On the other hand, when it comes to the day-to-day actions taken in order to assist in activities of daily living, it seems conceivable that informal- and formal care and assistance may be either substitutes or complements. For instance, informal care may make adverse future health outcomes less likely or formal care more productive, giving rise to a negative relationship between the two. A positive relationship may result, when informal care is comprised of advice and/or if the provider of informal care acts as the agent of the receiver of care [1,7,8].

The relevance of studying the relationship between informal- and formal care is highlighted by the fact that the populations in the European countries are growing older, which is brought on by the simultaneous decline in mortality- and fertility rates, and which provokes the expectation that the demand for health care and care for the elderly will rise accordingly. The proportion of individuals aged 65 and over in the 25 member countries of EU is expected to rise from about today's 16 percent to 30 percent in the year 2050 [9]. Moreover, the proportion of individuals aged 80 and more is expected to almost triple, from 4.0 percent in 2004 to 11.4 percent in 2050 [9]. The increase in the share of elderly in the population is likely to induce a positive shift in the demand for health- and social care, which may put additional pressure on the performance and finance of existing health- and elderly care systems. In the highest age groups of the population there are many individuals who have long-standing physical and/or mental disability and are dependent on assistance with basic activities of daily living through various forms of long-term

care. In addition, a number of studies have found that health-care costs rise as the proportion of elderly increases [10-12], even though the population age structure has usually been found insignificant in explaining inter-country differences in health-care expenditures [13]. There is, hence, a growing concern about increasing expenditure on long-term care services and health care over the next few decades, because of the continuing growth in the number and share of the oldest people [14].

Estimated trends on spending in long-term- and health-care for the elderly are highly sensitive, though, to trends in health status and disability of the old and very old of the population. Estimated shares of GDP on spending for the elderly are also highly sensitive to assumptions about the development of overall productivity, labour market participation, and the availability of informal care givers. For individuals with elderly parents, participation in the labour market and giving informal care and assistance are, of course, inter-related decisions [15-17]. In order to shape public-policy efforts aiming at elderly people's health and welfare, it is necessary to identify all the processes behind the utilisation of different components of health- and elderly care. Here, however, we shall concentrate on one of these issues, viz., whether informal and formal care and assistance are substitutes or complements.

A suitable theoretical framework for our analysis is the extension of Grossman's demand-for-health model [18] in order to include the provision of informal care developed by Van Houtven and Norton [1]. Their model is a static model of a game between parent and child: the parent chooses the amount of formal care (medical care in the model) given the amount of informal care provided by the child. Comparative static analysis of the optimal parental choice yields theoretical results which suggest when informal care is a substitute or a complement to formal care conditional on the qualitative content of formal care.

The model incorporates health as a utility-providing good. It is a function of a set of choice variables, which may be interpreted as a production function. Further, the child is able to directly influence the level of parental health by his or her choices of informal care, which introduces a strategic component into the process of making decisions (extensions of the demand-for-health model, which incorporate health-related decisions in a family context, were developed by Bolin *et al*. [19-20]). Formally, the Van Houtven and Norton model produces predictions in terms of a second-order derivative: the derivative of the marginal product of formal

care (in the production of health) with respect to informal care. However, the model does not say anything about how each particular type of formal- and informal care corresponds to a specific functional form and parameterisation of the production function. Thus, whether or not formal care and informal care are complements or substitutes is an empirical question (which Van Houtven and Norton also pointed out in their paper). However, the general validity of the model – that the utilisation of formal- and informal care, respectively, is endogenously decided – should be taken into account in the empirical analysis.

There may be other motives for providing informal care, though, than those directly implied by the Van Houtven and Norton model. For instance, strategic effects imposed by the family-structure and/or effects on future bequests of current informal care provision. Thus, the processes, which generate the observed utilisation of informal- and formal care, respectively, are likely to differ between those who are cohabiting and those who live as singles [19-20]. [1]

Surveys and available time-use studies consistently estimate informal care and assistance to be in the range of 80 percent plus of all hours of care and assistance provided [14, p. 108]. So, the production of informal care is extensive. As long as the partner is alive, he or she is most often the informal caregiver, while adult children may take the main responsibility for assisting their single-living parents with basic activities of daily living. Thus, partners and children provide, respectively, 18 and 38 percent of all informal care provided in Austria, 32 and 28 percent in Germany, and 23 and 38 percent in Spain. For Sweden, there is no comparable information on partners; children account for 46 percent of all informal care provided, though [14, table A.6]. It should be observed, however, that definitions might differ among countries.

The objective of our present study was to examine the relationship between informal and formal care and assistance and to what extent the relationship differs across Europe according to a north-south gradient. There is substantial evidence that there are cultural differences between northern and southern Europe, which motivate such a focus. Southern European countries are commonly referred to as “strong-family-ties countries” and their northern European counterparts as “weak-family-ties countries” [21]. The strength of family ties is usually discussed in terms of cultural patterns of family loyalties, allegiances, and authority, but it also concerns demographic patterns of intra-generational co-residence and patterns of support for

the elderly.[2] Kohli *et al*. [22] also associate the ”weak-strong” dichotomy to a European North-South gradient. Here, the Scandinavian countries are found to have the “weakest” family ties, the Mediterranean countries the “strongest”, whereas the continental countries lie somewhere in between. These patterns are also reflected by the fact that public spending on long-term care varies to a large extent between northern and southern European countries. For instance, spending on long-term care for females is typically highest in northern countries, such as Sweden and Denmark, who spend €19,867 and €22,336 per capita, respectively. Central European countries, such as Germany and Belgium spend less, €5,921 and €5,667, respectively. The lowest amounts are typically spent in southern European countries, such as Italy, who spends €4,764 per capita [23]. In 2000, public spending on long-term care as a percentage of GDP has been reported to be 2.74 in Sweden, 1.32 in Austria, 1.31 in the Netherlands, 0.95 in Germany, and 0.16 in Spain [14].

Moreover, cultural differences may be reflected also by a north-south gradient in the overall design of the welfare systems of Europe. Health-care systems, commonly referred to as national health services, are found in the Nordic countries and the UK; social-insurance systems are found in central Europe; whereas the systems established in the late 1970s and early 1980s in southern European countries may be seen as a “third way” [24, pp. 5-7]. True, there are differences in the design of organising and financing long-term and health care among countries and within countries that may not follow a north-south gradient [14, 25]. If these differences have an impact of their own on the relation between formal and informal care, they may, of course, weaken our possibilities to detect a north-south gradient. It still seems to be a fruitful research issue to explore in this paper, however.

In our analyses, we made use of a recently developed cross-national database, SHARE (Survey of Health, Ageing, and Retirement), containing comparable information at the individual level from 11 European countries. Moreover, SHARE contains detailed information on the utilization of both informal and formal care. We considered informal care and assistance, supplied by children or grandchildren, and its respective effects on five different types of formal care, for those living as singles.[3] In brief, we found (1) that informal care reduces the probability of utilisation of formal care provided in the household, and (2) that informal care increases the probability and the amount of utilisation of other types of formal care. Thus, our results suggest that informal and formal care both provided in

the household are substitutes, while informal care provided in the household and formal care provided in hospitals or doctors' offices are complements. Moreover, the relationships seem to differ among the three European regions of study.

The paper proceeds as follows. First, the data will be presented. Second, the empirical methods used in the paper are described. Third, the results are presented. The paper concludes with a discussion of the policy-implications of our results, interpreted in the modified Grossman framework, provided by Van Houtven and Norton [1].

DATA

The Survey of Health, Ageing and Retirement in Europe (SHARE) is a multidisciplinary and cross-national micro database containing approximately 22,000 Europeans over the age of 50 years of age and their spouses. The first wave of data was collected in 2004. It contains representative samples from the non-institutionalised population in respective participating country. The countries represent northern Europe (Denmark and Sweden), central Europe (Austria, France, Germany, Switzerland, Belgium, and the Netherlands), and southern Europe (Spain, Italy and Greece). Data from Belgium was not available at the time of writing. The database comprises information on health-related variables, for instance, self-reported health, physical functioning, cognitive functioning, psychological health, well-being, life satisfaction, and health care seeking behaviour, labour market variables, for instance, current work activity, job characteristics, opportunities to work past retirement age; economic variables, for instance, sources and composition of current income, wealth and consumption. Other variables include education, housing, and social support variables, for instance, assistance within families, informal care, transfers of income and assets, and social networks.

SHARE follows the design of the U.S. Health and Retirement Study (HRS) and the English Longitudinal Study of Ageing (ELSA). Response rates in SHARE ranged from 38% in Switzerland to 69% in France and the average response rate was 55%. A description of methodological issues can be found in Börsch-Supan & Jörges [26].

In our analyses, the sample was restricted to those who (1) lived as singles, (2) had at least one child, and (3) belonged to the age-group 50+. This left us with 3,559 observations. Single parents could be divorced, widowed, never married,

or married but living separately. For singles 50+, children are the main providers of informal care. Based on SHARE data, it is estimated that children, including grandchildren, adopted, fostered and step children, provide 83% of all informal care for this group.[4]

Dependent variables

Formal care

We analysed formal care employing 9 separate dependent variables – 5 categorical variables indicating whether or not the respondent had *any* formal care utilisation, and 4 variables indicating the *amount* of utilisation – all for the past 12 months. The categorical variables were: (1) formal care provided in the household environment[5]; this variable was defined as having received any of the following categories of care: (a) professional or paid nursing or personal care, (b) professional or paid home help concerning domestic tasks that you could not perform yourself due to health problems, and (c) meals-on-wheels; (2) a doctor (GP or specialist) visit, (3) a GP visit, or (4) a specialist visit; (5) a hospital night. The variables indicating the amount of utilisation were: the number of (1) doctor visits, (2) GP visits, (3) specialist visits, and (4) hospital nights. Unfortunately, nursing home care was not included, since SHARE only covers the non-institutionalised population. In Table 1 and 2, descriptive statistics on formal care by country are shown.

Explanatory variables

Informal care

Informal care is comprised of the following components: (1) personal care, e.g. dressing, bathing or showering, eating, getting in or out of bed, and using the toilet, (2) practical household help, e.g. with home repairs, gardening, transportation, shopping, and household chores, and (3) help with paperwork, such as filling out forms, and settling financial or legal matters. They obviously consist of assistance as well as care, but for simplicity, all help will be named informal care in the following.[6]

In the survey, the respondent was first asked about the frequency of which he/she received informal care during the past 12 months. The alternatives given were: (1) almost every day, (2) almost every week, (3) almost every month, and (4) less often. Next, the respondent was asked to give an estimate of the number of hours of informal care received on a typical day/in a typical week/in a typical month/in the

last twelve months.[7] In order to make the answers comparable between respondents, we created a variable indicating for each respondent the *number of hours past year* that he/she received informal care. This variable was constructed as follows: If the respondent answered that he/she received informal care almost every day, we multiplied the number of hours received on a typical day by 365. If the respondent answered almost every week, the number of hours per week were multiplied by 52. In a similar vain, if the respondent answered almost every month, the number of hours per months were multiplied by 12. Finally, if the respondent answered that he/she received informal care less often than each month, he/she was asked to give an estimate of the total number of hours of informal care received past year. This estimate was kept as it was. Table 3 shows descriptive statistics on informal care.

Time diaries have been considered as the 'gold standard' for measurement of time provided for informal care [27]. Such diaries are not feasible in large surveys, such as SHARE, since they are too time-consuming. The recall method, used in SHARE, has been found to be a valid method, if it can be assumed that respondents take into account joint production, i.e. the possibility of performing several informal care tasks at the same time, when completing the recall questionnaire [27]. Robinson [28] found evidence that respondents corrected for such joint production when completing a recall questionnaire. It should also be observed that the data here relates to received (as opposed to provided) care and assistance.

Other explanatory variables

In Table 4, a description of our independent and dependent variables is given. The mean age of the respondents was 64 years, and 55 percent were women. Moreover, the typical respondent was born in the country in which the interview took place (92%) and had on average 10 years of education. Four variables were used to capture the health status of the respondent. On average, the respondents had 1.53 health conditions (out of 14 listed)[8], 1.5 symptoms (out of 11 listed)[9], and 1.47 limitations (out of 10 listed)[10]. Self-reported health averaged 2.68 on a 1-5 scale were 1 indicated excellent health and 5 bad health. Smokers constituted 20 percent of the sample, and 28 percent reported being former smokers. The regressions also included country dummies, where Sweden was the omitted reference category. In the interacted models the country dummies were replaced with regional dummies.

EMPIRICAL METHOD AND SPECIFICATION

Probit models were used to analyse the probability of having had (1) care provided in the household environment, (2) a doctor visit, (3) a GP visit, (4) a specialist visit, or (5) a hospital night, respectively. When estimating the quantities, conditional on strictly positive utilisation, OLS was used; in all cases the dependent variable was logged in order to reduce the influence of outliers. Formally, we may write the parent's utilisation of formal care as:

$$FH_{ij} = f_j(IH_i, H_i, X_i, I_i, \varepsilon_{ij}), \qquad j = 1,\ldots,9 \qquad (1)$$

where FH_{ij} denotes utilization of formal care of type j by parent I and IH_i hours of informal care. In equation (1), H_i denotes health status, X_i socio-economic and demographic characteristics, C_i the country, and ε_{ij} an unobserved error term. The country dummies are included to capture some of the unobserved factors at the country level, such as the institutional framework, that vary between different European countries and that may affect formal health care utilisation.

The notion that informal- and formal care are used as inputs, either as substitutes or as complements, into the production of health investments suggests a high likelihood of there being unobserved variables, which affect both informal- and formal care. In order to take this into account, instrumental variables methods were employed. We followed the strategy used by Van Houtven & Norton [1] of employing different child characteristics as instruments of informal care.

Variables assumed to affect the amount of informal care received from children and grandchildren, but not directly the amount of formal care by the parent were used as instruments. Thus, we used variables indicating the number of children, whether the oldest child lived more than 100 kilometres away, and the age of the oldest child.[11] The number of children averaged 2.42 in the sample and the mean age of the eldest child was 37 years. Of these, 58 percent were employed. Further, the instruments described above were chosen since they passed tests of over-identification and relevance. Results from these tests are presented in Table 6.

In cases where the dependent variable was continuous, we used the 2SLS regression method. In cases where the dependent variable was dichotomous, we

used the Amemiya Generalized Least Squares (AGLS) estimator, which estimates a probit model with a continuous endogenous explanatory variable.[12]

RESULTS

In Table 5, the results from our regressions are summarised. Results are shown using both the OLS/probit model and the instrumental variables OLS/probit model. In Table 5, only the marginal effects/coefficients of hours of informal care are presented in order to preserve space (the full results are available on request). Table 6 then summarises the results from the various econometrics tests employed in the instrumental-variables regressions.

Formal home care

In the first row of Table 5, the results from the regressions on formal *home care* are shown. First, using the ordinary probit model, a positive and significant relationship was obtained between hours of informal care and the probability of having received any formal home care, suggesting that informal- and formal care are complements. Second, using the instrumental variables probit estimator, we obtained a negative and significant correlation between informal- and formal care, suggesting that the two are substitutes.

Testing for the appropriateness of the employed instruments, we (1) rejected the null hypothesis that the instruments have no joint effect ($F = 30.59$, $p < 0.01$), and we (2) were not able to reject the null hypothesis that the instruments were jointly valid; the instruments which were excluded from the main regression passed the test for over-identifying restrictions ($p = 0.94$). We also tested the null hypothesis that informal care is exogenous [29]. The predicted residual from the first-stage regression was significant at the 1% level when included along with hours of informal care in the formal home care regression and, hence, the null hypothesis was rejected at the 1% level. The preferred specification is, hence, the one treating informal care as endogenous. The estimated marginal effect of informal care, -0.06, suggests that a 10 percent increase in informal care hours leads to a 0.6 percentage points decrease in the probability of using formal home care.

Other formal care

Next, we turn to the results from the regressions of other types of formal care than formal care provided in the household. As shown in Table 5, when estimated without taking the potential endogeneity of informal care into account, the results showed a positive and significant correlation between hours of informal care and (1) the probability of having any (a) specialist visits, and (b) hospital nights; and (2) the number of (a) doctor visits, and (b) GP visits. In the other cases, the effect was statistically insignificant.

When employing the IV-Probit/2SLS estimators, however, the effect of informal care was not statistically significant in any of the regressions on doctor visits or hospital nights. Testing for the appropriateness of the employed instruments we (1) rejected the null hypothesis that the instruments had no joint effect, and (2) were not able to reject the null hypothesis that the instruments were jointly valid; the instruments, which were excluded from the main regression in all cases, passed the test for over-identifying restrictions. We were not able, however, to reject the hypothesis that informal care was exogenous. Consequently, the preferred specification is the one treating informal care as exogenous in the regressions. It seems, thus, as if informal care complements formal care in the case of doctor visits and hospital nights. The estimated effect of informal care on doctor visits, 0.03, suggests that a 10 percent increase in hours of informal care leads to a 0.3 percent increase in the number of doctor visits among people having at least one visit. Concerning hospital nights, the estimated marginal effect of 0.01 suggests that a 10 percent increase in annual hours of informal care is associated with 0.1 percentage points decrease in the probability of having at least one annual hospital night.

Interactions effects

We also considered whether the results obtained above differed across different parts of Europe. For this purpose, the participating countries were first divided into three sub-groups, according to a north-south gradient. The first group consisted of the Nordic countries Sweden and Denmark (Nordic). The second group was comprised of countries in central Europe: Germany, France, Netherlands, Austria, Switzerland (Central). In the third group, the southern European countries Spain, Italy, and Greece (Southern) were included. In order to investigate whether the effects differed between these country groups, we created interaction variables between the amount of informal care received and country group. The same regressions as before were estimated

including these interaction terms as explanatory variables. The omitted reference category was the country group southern Europe (and, hence, the interaction between southern Europe and informal care). The results are presented in Table 7 and 8. Again, we restrain the presentation – in this case to the estimated effects of the interaction terms and hours of informal care.[13]

We found that for the probability of having had a doctor, a GP, or a specialist visit, none of the interaction terms were statistically significant, suggesting that the effects did not differ significantly across Europe. Since the results in the previous section showed that exogeneity of informal care could not be rejected in the case of doctor visits and hospital nights, informal care was here treated as an exogenous variable.

In the case of formal home care, the interaction term between living in central Europe and informal care was statistically significant and positive. This suggests that the negative effect of informal care on formal home care is significantly lower for people in central Europe, compared to those residing in southern Europe. No differential effect was found for those living in the Nordic countries. The IV-probit model was used here, since the results from the previous section showed that the exogeneity of informal care was rejected in the case of formal home care.[14]

Regarding the quantities of formal health care, we found few significant interaction terms (Table 8). However, for those living in central Europe we found that the positive effect of informal care on the number of GP visits was significantly larger compared to those living in southern Europe. Finally, living in northern Europe was associated with a significantly smaller effect of informal care on the number of specialist visits.

70+ only

Since utilization of both informal and formal care is much more common among people aged 70 and above, our results may have been weakened by the fact that a substantial fraction of our sample did not utilize either type of care. In Table 9, the results from a sensitivity analysis including only people aged 70 and above are presented. Table 10 shows the results of the specification tests from the IV-regressions; instruments used were exactly the same as the ones used above.[15]

As shown in Table 9, the results were robust to changes in the sample. The effects that were significant for the full sample were also significant for the

restricted sample, even though the sample size was roughly halved. Moreover, in the specifications treating informal care as exogenous, the magnitude of the effect of informal care was virtually unchanged in all but one of the regressions. In the case of formal home care, the effect increased from 0.01 to 0.02.

In Table 10, it is revealed that the exogeneity of informal care was only rejected in the regressions on formal home care and having any doctor visit. The former result was similar to the result obtained for the full sample. Treating informal care as endogenous in the case of formal home care resulted in a marginal effect of –0.09. This estimate was 50 percent greater than the corresponding marginal effect obtained for the full sample, i.e. –0.06. In the case of having any doctor visit, the instrumental-variables estimate, which was the preferred one, was positive and insignificant.

In sum, the results were very similar. The most dramatic change was that the negative relationship between informal care and formal home care became roughly 50 percent greater when restricting the analysis to the older age group.

DISCUSSION

The results of our study emphasise the importance of testing and accounting for the potential endogeneity of informal care. Thus, not doing so resulted in a statistically significant and *positive* correlation between informal care and formal home care, while the sign of the correlation was reversed when endogeneity was taken into account. In the case of doctor visits and hospital nights, we were unable to reject the hypothesis that informal care is exogenous, though.

The magnitude of the effects obtained in our study might appear relatively small. In the case of formal home care, the estimated marginal effect of informal care, -0.06, suggests that a 10 percent increase in informal care hours leads to a 0.6 percentage points decrease in the probability of using formal home care. Put differently, an increase in the annual hours of informal care by 13.2, from the mean of 132 (corresponding to an increase by 10 percent), would lead to a 13.4 percent likelihood of using formal home care from the mean of 14. Moreover, the estimated effect of informal care on doctor visits, 0.03, suggests that a 10 percent increase in hours of informal care leads to a 0.3 percent increase in the number of doctors visits among people having at least one visit. In other words, an increase in hours of

informal care by 13.2 would only raise the number of doctor visits to approximately 8.60 from the mean 8.35. Finally, concerning hospital nights, the estimated marginal effect of 0.01 suggests that a 10 percent increase in annual hours of informal care is associated with 0.1 percentage points decrease in the probability of having at least one annual hospital night. In this case, a 10 percent increase in hours of informal care would lead to a 15.9 percent likelihood of having a hospital night from the mean of 16. It should be remembered, however, that even though the effects appear small, there might obviously still be a substantial impact in the case where future changes in the amount of informal care provided are large.

When comparing our results with those of Van Houtven & Norton [1], we restrict the comparison to those aged 70 and above. Using data from the US Health and Retirement Study (with which SHARE data is consistently comparable), Van Houtven & Norton [1] analysed the interrelations between formal care and informal care, given by children to their single-living 70+ parents. Similar to our findings, informal care was found to be a substitute to formal home care; the hypothesis that informal care was exogenous in the regression on formal home care was also rejected. The marginal effect obtained by Van Houtven & Norton in the latter case, -0.09, was actually identical to the one obtained in the present study, when we restricted the analysis to those aged 70 and above.

When it came to doctor visits and hospital stays, however, the effects differed by sign. While Van Houtven & Norton [1] found a significant and negative relationship between informal care and physician visits, conditional on having any visit, we obtained the opposite result. Moreover, Van Houtven & Norton found informal care to be a substitute to hospital nights (given that the individual had any hospital night), whereas in our study informal care showed a significant and positive relationship with the probability of having any hospital care but no significant effect on the number of hospital nights. It should be noted that Van Houtven & Norton found informal care to be endogenous in determining formal home care, nursing home care, physician visits, and hospital care, while we rejected the exogeneity of informal care only in the case of formal home care.

We found some evidence of the north-south gradient, which is commonly claimed in the literature, due to cultural, and hence institutional, differences between northern and southern European countries [22]. Regarding formal home care, our results suggested that the negative effect of informal care on the

former was significantly less in magnitude in central Europe compared to southern Europe. Also, the effect was less in magnitude in northern Europe, but the interaction effect was not statistically significant in this case. These results suggest that in regions with "strong" family ties, i.e. southern Europe, informal care to a greater extent substitutes for formal home care. This may reflect strong norms regarding family responsibilities, for instance, where family members are expected to supply the major part of home care.

A few caveats are in order. First, the lack of SHARE data on nursing-home care means that the total effect on the utilization of formal care resulting from changes in informal care remains to be settled. This is especially unfortunate, since nursing-home care constitutes a large share of the health- and social-care sectors in most European countries. It might be noted, though, that Van Houtven & Norton [1] found informal care to be a substitute for nursing home care in a US setting. Second, it should, of course, be remembered that the results in this study concerns a sample of singles and that the policy implications, hence, only concern this group. In SHARE, 72 percent of the sample was married or living in registered partnerships, so our sub-sample represents a minority. Single-living elderly is an important group to analyse for policy purposes, however, since they lack the support from a spouse and are more exposed to the will of their children. Moreover, the number of single households is increasing in most European countries. Finally, the net effect of changes in the amount of informal care on long-run *expenditures* is not straightforward to assess. Some of the additional doctor visits that an informal care-giver invoke may be of a preventive nature, leading to less expenditures in the long run. Further analyses on this issue should opt for a dynamic perspective, for instance, by making use of the longitudinal SHARE data that eventually will be made available.

Variation in informal care across countries partly reflects variation in the availability of professional home-care services. Thus, the latter provides some of the desired variation in informal care needed to identify its effect on formal care. Admittedly, there is only imperfect information on the variation in accessibility of professional home- care services, leading to some unobserved heterogeneity. This might bias the results, if unobserved accessibility was correlated with the usage of both informal and formal care. Some of this unobserved heterogeneity would be picked up by the country dummies, however. Moreover, we controlled for the

influence of unobserved heterogeneity by performing IV-regressions, where we also could check the endogeneity of informal care.

Policy-makers, not only in Europe, face a number of challenging issues with regard to future provision of health- and social care to the elderly. While the demand for care is likely to increase, there are at the same time demographic and socio-economic trends that are likely to decrease the availability of informal care. During the past decades, the average number of children per women has decreased in all European countries [30]. Consequently, future generations will have a smaller network to rely upon regarding the provision of informal care. Moreover, increased participation of women in the labour market may further reduce the availability of informal care. In Greece, for instance, the female percent of the labour force increased from 28 to 37 percent just between 1980 and 1998 [31]. Going further back in time, changes are obviously even more dramatic. Another trend, possibly affecting the supply of informal care, is the tendency in many European countries to raise their statutory retirement age [32]. This means that an increasing number of people in their 50s and 60s will still be working and, hence, have less time to act as informal care-givers. In addition, factors such as lower marriage rates, greater geographic mobility, and declines in intergenerational co-residence are factors contributing to changes in the supply of informal care over time, since most informal care-givers are spouses or children [33].

Norms and legislations surrounding informal care vary greatly across European countries. While in most countries, children are legally obligated to take care of their elderly parents, this is not the case in Sweden, for instance. The existence and extent of formalised support programmes for informal care-givers also vary. In several countries, the social-insurance system compensates informal care-givers taking time off work to care for their elderly parents. The extensiveness of these programmes, however, varies to a large extent; in France, for instance, 3 days per year are compensated, whereas in Italy, up to 25 days per day are compensated [34]. As a result of the demographic and socio-economic trends, norms will probably change, too. In this paper, we analysed whether informal- and formal care are substitutes or complements among elderly in Europe and whether this relationship differs across Europe. The analysis was conducted using a newly developed dataset on Europeans older than 50 years of age. To our knowledge, the paper is the first to study informal and formal care across Europe using a nationally representative data set and the first

to examine differences among the European countries, especially following a north-south gradient. Further studies should aim at improving our understanding also of the differences in effects between Europe and the US.

Even though informal care will never be able to solve the problems of the projected increases in public and private spending on health- and social care for the elderly, the knowledge contributed by this study produces essential pieces of information. Informal care always comes with a cost, however, with lower degree of market participation and lower wages [15-17]. In many European countries, dependency ratios are high while birth rates, labour market participation rates, and economic growth rates are low. In those countries, there is an obvious conflict of targets, introducing a trade-off between increasing the amount of informal care and increasing labour market participation. The most optimistic scenario, of course, would be one in which the health status of the old and the very old becomes substantially improved, which would ease the tension. So far, however, there is no clear evidence that this policy-makers' dream will come true [35-37].

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TABLES

Table 1. Descriptive statistics on formal care. Probability of having a doctor visit, GP visit, specialist visit, hospital visit, and home care.

Country	Any doctor visit		Any GP visit		Any specialist visit		Any hospital visit		Any home care*	
	Mean	sd	Mean	sd	Mean	sd	Mean	sd	Mean	sd
Austria	0.89	0.32	0.85	0.36	0.39	0.49	0.23	0.42	0.09	0.29
Germany	0.93	0.26	0.90	0.30	0.51	0.50	0.18	0.38	0.08	0.28
Sweden	0.76	0.43	0.67	0.47	0.29	0.46	0.18	0.39	0.12	0.33
Netherlands	0.87	0.34	0.81	0.39	0.40	0.49	0.10	0.30	0.24	0.43
Spain	0.93	0.26	0.87	0.34	0.38	0.49	0.15	0.36	0.13	0.34
Italy	0.89	0.32	0.84	0.37	0.41	0.49	0.14	0.35	0.06	0.24
France	0.95	0.21	0.89	0.31	0.43	0.50	0.17	0.37	0.23	0.42
Denmark	0.82	0.38	0.80	0.40	0.15	0.35	0.15	0.36	0.23	0.42
Greece	0.85	0.36	0.70	0.46	0.35	0.48	0.10	0.30	-	-
Switzerland	0.90	0.30	0.84	0.36	0.34	0.48	0.14	0.34	-	-
Total	0.88	0.33	0.81	0.39	0.37	0.48	0.16	0.36	0.14	0.35

* Information on home care was unavailable for Greece and Switzerland

Table 2. Descriptive statistics on formal care. Number of doctor visits, GP visits, specialist visits, and hospital visits, conditional on having at least one doctor visit last year.

Country	Number of doctor visits		Number of GP visits		Number of specialist visits		Number of hospital nights	
	Mean	sd	Mean	sd	Mean	sd	Mean	sd
Austria	8.97	12.63	6.79	9.61	5.30	11.50	14.10	17.06
Germany	9.80	11.53	7.13	9.48	5.11	7.01	19.23	21.34
Sweden	4.33	4.71	3.21	3.19	3.46	4.61	7.59	10.04
Netherlands	5.70	6.00	3.92	3.94	3.96	5.04	10.41	10.89
Spain	12.73	15.10	10.59	12.69	5.50	10.08	9.80	11.42
Italy	13.22	16.91	11.66	15.82	4.50	5.19	11.39	12.75
France	7.68	5.57	6.48	4.56	3.16	3.80	11.72	14.12
Denmark	5.19	6.68	4.52	5.77	3.52	3.95	20.30	46.91
Greece	8.86	10.60	7.43	9.73	6.01	7.10	10.73	13.05
Switzerland	5.39	7.08	4.42	6.79	3.03	3.18	8.12	8.23
Total	8.35	11.02	6.70	9.39	4.59	7.31	13.23	20.91

Table 3. Descriptive statistics on informal care.

Country	Annual hours of informal care		Any informal care		Annual hours of informal care given > 0	
	Mean	sd	Mean	sd	Mean	sd
Austria	121.78	469.53	0.38	0.48	324.15	722.97
Germany	152.78	667.72	0.40	0.49	382.39	1015.61
Sweden	50.08	329.50	0.42	0.49	119.60	502.03
Netherlands	56.02	219.55	0.42	0.49	132.42	322.77
Spain	206.37	1110.48	0.19	0.39	1091.38	2374.96
Italy	242.26	1295.64	0.21	0.41	1141.54	2638.88
France	145.49	735.60	0.33	0.47	444.86	1237.28
Denmark	52.95	218.43	0.40	0.49	131.68	329.67
Greece	232.09	711.78	0.38	0.49	614.68	1053.70
Switzerland	19.93	73.57	0.29	0.46	67.96	123.98
Total	132.33	680.52	0.35	0.48	374.86	1105.26

Table 4. Variables and descriptives of the sample in total.

Variable	Description	Mean	Sd
Dependent variables			
Any home care	1 if having received any of the following forms of home care during the last 12 months: 1) Professional or paid nursing or personal care 2) Professional or paid home help, for domestic tasks that you could not perform yourself due to health problems 3) Meals-on-wheels	0.14	0.35
Any doctor visit	1 if having any doctor visits past 12 months	0.88	0.33
Any GP visit	1 if having any GP visits last 12 months	0.81	0.39
Any specialist visit	1 if having any specialist visits last 12 months	0.37	0.48
Any hospital nights	1 if having any hospital nights during past 12 months	0.16	0.36
Number of doctor visits	Number of doctor visits past 12 months	8.35	11.02
Log of doctor visits	Log of number of doctor visits past 12 months	1.63	0.97
Number of GP visits	Number of GP visits past 12 months	6.70	9.39
Log of GP visits	Log of number of GP visits last 12 months	1.40	0.96
Number of specialist visits	Number of specialist visits past 12 months	4.59	7.31
Log of specialist visits	Log of number of specialist visits last 12 months	1.04	0.89
Number of hospital nights	Number of hospital nights past 12 months	13.23	20.91
Log of hospital nights	Log of number of hospital nights last 12 months	1.93	1.15
Explanatory variables			
Annual hours of informal care	Total annual number hours of informal care	132.33	680.52
Log of annual hours of informal care	Ln (1 + total hours of informal care received past 12 months)	0.65	1.76
Age	Age in years	64.43	10.34
Age squared	Age^2	4258.64	1387.92
Female	1 if female	0.55	0.50
Years of education	Total number of years of education	10.01	4.52
Country of birth	1 if born in country	0.92	0.27
Health conditions	Number of health conditions out of 14 listed	1.53	1.43
Self-reported health	Self-reported health on a scale from 1 to 5 (1=excellent, 5=bad)	2.68	1.06
Symptoms	Number of symptoms out of 11 listed	1.50	1.61

Mobility	Number of limitations with mobility. arm function & fine motor function (out of 10 described).	1.47	2.12
Smoker	1 if current smoker	0.20	0.40
Former smoker	1 if former smoker	0.28	0.45
Frequency of alcohol consumption	Frequency of alcohol consumption during past 6 months (1-7 where 1=almost every day and 7=not at all)	4.32	2.27
Physical activity I	Frequency of vigorous physical activity. such as sports. heavy housework. or a job that involves physical labour? (1-4, 1=more than once a week, 4=hardly ever, or never).	2.50	1.33
Physical activity II	Frequency of engagement in activities that require a low or moderate level of energy such as gardening. cleaning the car. or doing a walk? (1-4, 1=more than once a week, 4=hardly ever. or never).	1.55	1.00
Austria	1 if interviewed in Austria	0.10	0.31
Italy	1 if interviewed in Italy	0.13	0.33
Spain	1 if interviewed in Spain	0.10	0.29
Netherlands	1 if interviewed in Netherlands	0.14	0.34
Germany	1 if interviewed in Germany	0.14	0.35
Greece	1 if interviewed in Greece	0.09	0.29
Switzerland	1 if interviewed in Switzerland	0.05	0.21
France	1 if interviewed in France	0.07	0.26
Denmark	1 if interviewed in Denmark	0.08	0.27
Sweden	1 if interviewed in Sweden	0.11	0.31
Instruments			
Number of children	Number of children (natural children, fostered, adopted, and those of spouse/partner)	2.42	1.28
Child 100 km	1 if the oldest child lives more than 100 kilometres away	0.18	0.39
Age oldest child	Age of the oldest child	37.37	11.24

Table 5. Effect of logged hours of informal care received past 12 months on formal care.

Dependent variable	Probit/OLS marginal effect/coefficient of informal care (se)	N	Ivprobit/ 2SLS marginal effect/coefficient of informal care (se)	N
Any home care	0.01 (0.00)**	2.856	-0.06 (0.03)*	2.856
Any doctor visit	0.00 (0.00)	3.559	0.01 (0.02)	3.545
Log of doctor visits (cond > 0)	0.03 (0.01)**	3.115	0.07 (0.06)	3.107
Any GP visit	0.00 (0.00)	3.559	0.02 (0.03)	3.545
Log of GP visits (cond > 0)	0.02 (0.01)**	2.909	0.04 (0.06)	2.902
Any specialist visit	0.01 (0.00)**	3.559	0.04 (0.04)	3.545
Log of specialist visits (cond > 0)	0.01 (0.01)	1.423	-0.02 (0.11)	1.420
Any hospital nights	0.01 (0.00)**	3.559	0.00 (0.02)	3.559
Log of hospital nights (cond > 0)	0.02 (0.02)	561	-0.06 (0.11)	560

* significant at 5%; ** significant at 1%

The regressions control for age, age squared, gender, whether born in country, years of education, number of health conditions, number of health symptoms, self-reported health, limitations on activity, smoking, drinking, sports activities, and other physical activities. In the instrumental variables regressions, two variables indicating the number of children and the whether the oldest child lived more than 100 kilometres away were used as instruments. An exception was the regressions on having any hospital nights, where the age of the oldest child was used instead of the variable indicating the number of children. The reason was that the specification using number of children as excluded instrument did not pass the test of overidentifying restrictions. Full results are available upon request.

Table 6. Specification test of the instrumental variables regression.

Dependent variable	F-test of joint significance of excluded instruments	Test of exclusion restrictions (p-value of null of valid exclusion restrictions)*	Test of null of exogeneity (p-value of null of exogeneity. Wu-Hausman test).
Any home care	F(2. 2873) = 12.97	0.94	< 0.01
Any doctor visit	F(2. 3519) = 20.00	0.17	0.57
Log of doctor visits (cond > 0)	F(2. 3081) = 18.34	0.43	0.58
Any GP visit	F(2. 3519) = 20.00	0.36	0.53
Log of GP visits (cond > 0)	F(2. 2876) = 20.99	0.90	0.80
Any specialist visit	F(2. 3519) = 20.00	0.37	0.43
Log of specialist visits (cond > 0)	F(2. 1394) = 5.71	0.66	0.73
Any hospital nights	F(2. 3533) = 28.02	0.37	0.79
Log of hospital nights (cond > 0)	F(2. 534) = 6.86	0.54	0.45

* significant at 5%; ** significant at 1%

In the probit regressions, the validity of the exclusion restrictions was tested by including all but one of the instruments in the structural equation that controls for endogeneity and testing their joint significance with a Wald test [42-43]. The test result does not depend on which instrument is left out. With valid exclusion restrictions, these should not be significant predictors of formal care after controlling for informal care.

Table 7. Interaction terms. Effects of informal care on formal care. Probit coefficients (se).

	Any home care	Any doctor visit	Any GP visit	Any specialist visit	Any hospital nights
Hours of informal care	-1.05	-0.011	-0.006	0.045	0.049
	(0.40)**	(0.43)	(0.31)	(2.72)**	(2.62)**
Hours * Nordic	0.69	0.033	0.053	0.002	0.031
	(0.46)	(0.84)	(1.52)	(0.07)	(0.93)
Hours * Central	0.89	0.016	0.026	-0.039	-0.002
	(0.39)*	(0.51)	(0.98)	(1.87)	(0.08)
Central	0.17	0.210	0.391	0.054	0.300
	(0.38)	(2.51)*	(5.37)**	(0.85)	(3.65)**
Nordic	0.61	-0.350	-0.107	-0.641	0.216
	(0.50)	(3.59)**	(1.24)	(7.49)**	(2.11)*
Observations	2892	3559	3559	3559	3559

* significant at 5%; ** significant at 1%

Table 8. Interaction terms. Effects of informal care on formal care. OLS coefficients (se).

Interactions	# doctor visits	# GP	# specialist visits	# hospital nights
Hours of informal care	0.03	0.00	0.05	0.04
	(0.01)*	(0.01)	(0.02)**	(0.03
Hours * Central	0.01	0.04	-0.03	0.01
	(0.02)	(0.02)*	(0.02)	(0.04)
Hours * Nordic	-0.02	-0.01	-0.07	-0.10
	(0.02)	(0.02)	(0.03)*	(0.06)
Central	-0.17	-0.24	-0.15	0.31
	(0.04)**	(0.05)**	(0.06)*	(0.15)*
Nordic	-0.60	-0.53	-0.19	0.10
	(0.05)**	(0.06)**	(0.09)*	(0.18)

* significant at 5%; ** significant at 1%

Table 9. Sensitivity analysis. Effect of logged hours of informal care received past 12 months on formal care among people aged 70 and above.

Dependent variable*	Probit/OLS marginal effect/coefficient of informal care (se)	N	Ivprobit/ 2SLS marginal effect/coefficient of informal care (se)	N
Any home care	0.02** (0.00)	1,395	-0.09* (0.04)	1,390
Any doctor visit	-0.00 (0.00)	1,769	0.03 (0.02)	1,755
Log of doctor visits (cond > 0)	0.03** (0.01)	1,609	0.00 (0.06)	1,605
Any GP visit	0.00 (0.00)	1,769	0.03 (0.02)	1,755
Log of GP visits (cond > 0)	0.02* (0.01)	1,525	-0.00 (0.06)	1,522
Any specialist visit	0.01* (0.00)	1,769	0.05 (0.04)	1,760
Log of specialist visits (cond > 0)	0.01 (0.01)	720	0.00 (0.09)	718
Any hospital nights	0.01** (0.00)	1,769	0.03 (0.03)	1,764
Log of hospital nights (cond > 0)	0.02 (0.02)	336	0.05 (0.11)	336

* significant at 5%; ** significant at 1%

The regressions control for age, age squared, gender, whether born in country, years of education, number of health conditions, number of health symptoms, self-reported health, limitations on activity, smoking, drinking, sports activities, and other physical activities. In the instrumental variables regressions, two variables indicating the number of children and the whether the oldest child lived more than 100 kilometres away were used as instruments. An exception was the regressions on having any hospital nights, where the age of the oldest child was used instead of the variable indicating the number of children. The reason was that the specification using number of children as excluded instrument did not pass the test of overidentifying restrictions. Full results are available upon request.

Table 10. Sensitivity analysis. Specification test of the instrumental variables regression.

Dependent variable	F-test of joint significance of excluded instruments	Test of exclusion restrictions (p-value of null of valid exclusion restrictions)*	Test of null of exogeneity (p-value of null of exogeneity. Wu-Hausman test).
Any home care	F(2, 2873) = 10.58	0.71	< 0.01
Any doctor visit	F(2, 3519) = 16.84	0.81	0.06
Log of doctor visits (cond > 0)	F(2, 3081) = 15.35	0.37	0.84
Any GP visit	F(2, 3519) = 21.01	0.01	0.17
Log of GP visits (cond > 0)	F(2, 2876) = 15.34	0.96	0.69
Any specialist visit	F(2, 3519) = 21.01	0.81	0.26
Log of specialist visits (cond > 0)	F(2, 1394) = 6.64	0.32	0.91
Any hospital nights	F(2, 3533) = 24.84	0.42	0.52
Log of hospital nights (cond > 0)	F(2, 534) = 4.81	0.54	0.80

* significant at 5%; ** significant at 1%

In the probit regressions, the validity of the exclusion restrictions was tested by including all but one of the instruments in the structural equation that controls for endogeneity and testing their joint significance with a Wald test [42,43]. The test result does not depend on which instrument is left out. With valid exclusion restrictions, these should not be significant predictors of formal care after controlling for informal care.

NOTES

[1] In addition, it could be argued that the supply of informal care is increasing in the amount of the expected future bequest. For instance, parents could make future bequests conditional on the supply of informal care. Empirical findings support this view; wealthy parents are more frequently visited than poorer parents [38]. Moreover, some evidence has been obtained for exchange motives, i.e. financial transfers between parents and care-giving children when the parents are still alive [39-41].

[2] Reher [21] argues that the Muslim domination in southern Europe emphasized vertical relationships between generations, where children's care of their parents in old age and intra-generational co-residence are seen as a manifestation of a "strong family". The Reformation and Germanic tradition in northern Europe instead, according to Reher [21] contributed to the development of a weak family characterized by people who do not rely on their children in old age and by youths who detach themselves from their parents at relatively early ages.

[3] Children here included natural, fostered, and adopted children.

[4] This figure, naturally, varies between the included countries. The lowest fraction, 54%, is found in Denmark and the highest, 93%, is found in Italy.

[5] In the case of formal homecare it should be noted that Switzerland and Greece had missing observations at the time of writing.

[6] Moreover, due to the survey design, it was not possible to assess the frequency and intensity of the different categories of informal care separately.

[7] It should be noted that the interviewer was asked to round up the answers to full hours.

[8] The conditions considered were (1) heart attack, including myocardial infarction or coronary thrombosis or any other heart problem including congestive heart failure, (2) high blood pressure or hypertension, (3) high blood cholesterol, (4) a stroke or cerebral vascular disease, (5) diabetes or high blood sugar, (6) chronic lung disease such as chronic bronchitis or emphysema, (7) asthma, (8) arthritis including osteoarthritis or rheumatism, (9) osteoporosis, (10) cancer or malignant tumour including leukaemia or lymphoma but excluding minor skin cancers, (11) stomach or duodenal peptic ulcer, (12) Parkinson disease, (13) cataracts, (14) hip fractures or femoral fracture.

[9] The list of symptoms included (1) pain in back, knees, hips or any other joint, (2) heart trouble or angina, chest pain during exercise, (3) breathlessness, difficulty breathing, (4) persistent cough, (5) swollen legs, (6)

sleeping problems, (7) falling down, (8) fear of falling down, (9) dizziness, faints or blackouts, (10) stomach or intestine problems, including constipation, air, diarrhoea, (11) incontinence or involuntary loss of urine.

[10] The list of limitation included (1) walking 100 metres, (2) sitting for about two hours, (3) getting up from a chair after sitting for long periods (4) climbing several flights of stairs without resting, (5) climbing one flight of stairs without resting (6) stooping, kneeling, or crouching, (7) reaching or extending your arms above shoulder level, (8) pulling or pushing large objects like a living room chair, (9) lifting or carrying weights over 10 pounds/5 kilos, like a heavy bag of groceries, (10) picking up a small coin from a table.

[11] One may suspect that the location of children is endogenous, since children with sick parents may locate closer to their parents or vice versa. In Charles & Sevak [2], however, no evidence was found for the hypothesis that children's location respond endogenously to parents' health.

[12] The computations were performed using the IVPROB programme in STATA, which provides asymptotically efficient standard errors. In the first-stage regression, the endogenous explanatory variable is treated as linear functions of the instruments and the exogenous variables. In the second stage, the prediction from the first stage is included as an explanatory variable in the main equation, instead of the suspected original endogenous variable.

[13] Note that no country dummies were included in these regressions.

[14] In order to instrument for the interaction terms as well, the first-stage regression now included the interactions (a) between children characteristics and living in central Europe and (b) between children characteristics and living in northern Europe. The instruments, again, passed the relevant econometric tests. The results of the tests are available on request.

[15] The instruments passed the test of over-identifying restrictions in all cases but one. In the case of GP visits, the validity of the exclusion restrictions was rejected.