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Impact of formal care consumption on informal care use in Europe: What is happening at the beginning of dependency?

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ABSTRACT

Little is known about care use decisions at the beginning of the disability process, when older people are vulnerable. This article investigates the impact of formal care (FC) consumption on informal care (IC) utilization in Europe in a population of frail older people. We use data from the Sarcopenia and Physical Frailty IN older people: multi-component Treatment strategies (SPRINTT) study, which involves a sample of 1515 elderly (70+) people surveyed in 11 European countries. We explore the impact of home-based FC use on IC use at the extensive and intensive margins. The use of FC is instrumented with a dichotomous variable reproducing the eligibility criteria for public home-based FC in each country. We show that receiving home-based FC positively and significantly affects the probability of using IC. Therefore, we conclude that home-based FC and IC are complementary at the beginning of the dependency process.

1. Introduction

In most European countries, long-term care (LTC) policies since the early 1990s have been encouraging the use of informal care (IC) to try to contain LTC spending [1]. Currently, 13% of people over 50 years of age provide LTC care to a disabled older relative in OECD countries [2]. In most countries, informal caregivers have become central actors in the LTC delivery process. For instance, it is estimated that they provide more than 70% of the total care received by patients with Alzheimer's disease in Sweden [3] and in France [4]. However, the supply of IC is expected to decline in the future for several reasons: the ageing of caregivers (who are usually the spouses of dependent elderly individuals), the increased mobility among families and increasing participation of women, who are often the principal IC providers, in the labour market [2,5].

In the meantime, the needs for LTC services will increase. By 2050, more than a quarter of the populations of European countries will be over the age of 65. People reaching the age of 65 have, on average, 20 years of life expectancy but can expect to be healthy during only half of this time. Therefore, they have to prepare for a decade with potential disabilities, while their expectations for home-based (versus institution-based) ageing are growing. Unsurprisingly, this situation contributes to

increase the demand for alternatives to IC. In 2017, over 2/3 of 65+ elderly individuals used LTC services, which can include help in carrying out activities of daily living (ADLs) (e.g., getting dressed, eating), help with housework (cooking, shopping, housekeeping), and social help (e.g., going out, interacting with others).

Faced with these challenges, European countries have started to increase the provision of formal (i.e., professional) home-based services. The Nordic countries, the Netherlands, and Germany have started to shift their LTC spending away from residence-based care towards home-based care in so-called de-institutionalization policies. In addition, governments have implemented reforms to increase public spending on LTC services to encourage a substitution of IC by formal care (FC). For instance, in 2015, in Germany, the Pflegestärkungsgesetz laws introduced a 3.7 billion EUR per year increase in funds dedicated to supporting improved services for dependents until 2034. Such strategies supporting home-based LTC are being promoted by several international organizations, such as the European Commission, the OECD and the WHO, and are a core component of the European Pillar of Social Rights [1,5,6]. These strategies advocate an increase in the provision of affordable and quality home-based formal LTC services for elderly people and assume that increasing the use of home-based FC can lead to

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a decrease in the use of IC and help sustain the networks of informal caregivers [5].

LTC policies primary focus on disabled individuals, but recent reforms are increasingly targeting the frail older people. According to the seminal work by Fried et al. [7], frailty is a health state related to a loss of muscle mass (sarcopenia) that negatively impacts older individuals resting metabolic rate, strength, power, and capacity to perform physical efforts. The combination of these factors leads to a decrease in walking speed, activity levels, and overall energy expenditure, promoting a vicious circle of chronic under-nutrition, loss of muscle mass and strength, and ultimately leading to disability and dependency. In Europe, prior work has estimated that approximately 20% of the population is frail [8]. Using a Markovian modelling structure, Arrighi et al (2017) [8] explored the transitions between the robustness, frailty, and dependency states in the European population and provided evidence of inequalities in the dependency process. Richer and better educated individuals have a lower risk of becoming frail and/or disabled, while their chances of recovering from dependency and frailty are higher compared to poorer and less educated elders. These results suggest that frail elderly individuals are likely to need affordable FC services.

LTC services are mainly financed by public spending, which represents 80% of total spending, while private insurance represents only less than 2% of total spending [9]. In Europe, the 2018 Ageing Report underlines that policies encouraging the substitution of IC by FC will drive large increases in LTC spending [9]. Under the “*shift to formal care scenario*”, which assumes “*a 10-year progressive shift into the formal service sector of 1 percent per year of the dependent population who have been relying on cash benefits or informal care only*”, LTC spending will represent 3% of the GDP of EU countries by 2070 (vs. 1.6% in 2016). In other words, this political strategy will drive a 2 percentage point (pp) increase in LTC spending. Furthermore, under the “*coverage convergence scenario*”, which assumes “*an expansion of publicly financed formal care provision into the groups of population that relied on informal care until then*”, predictions anticipate a 2.2 pp increase in LTC spending. Therefore, it is crucial to explore whether these strategies can successfully reduce the use of IC among elderly individuals facing the loss of their autonomy. In other words, it is necessary to explore whether increasing the use of FC services among older people can contribute to reducing the use of IC [10].

Over the past ten years, this question has been widely addressed in the economic literature [11–14]. The theoretical model introduced by Stabile and colleagues [12] makes it possible to understand the economic mechanisms driving the decisions of households to use IC when they receive public allowances dedicated to the use of formal services. Their results suggest that the impact of increasing home-based FC services on IC use differs according to individuals’ satisfaction with the level of publicly funded FC services. In this model, LTC use decisions are made by a representative household composed of the disabled person and her/his informal caregiver. The caregiver maximizes a common utility function that depends on the consumption of formal (public and private) services, IC, leisure, and the disabled person’s optimal level of autonomy; this optimization process also depends on temporal and budgetary constraints. This model provides clear predictions regarding the impact of FC use on IC use. In summary, the impact depends on the quantity of needs that are satisfied by formal public services. There are two scenarios. First, if (i) the household is satisfied by the level of public formal services provided, then the model predicts that an increase in FC provision will lead to a decrease in the use of IC (through a relative price effect). In contrast, if (ii) the household is not satisfied with the level of public services provided by the government, then the impact of an increase in public provision will be comparable to an income effect: it will lead to an increase in the use of both formal and informal services. Intuitively, an increase in public FC services makes it possible to reach a higher level of autonomy, which increases the household’s willingness to use formal and informal services.

To summarize, complementarity between IC and FC is likely to

happen if people have a strong preference for functioning improvement services that goes beyond what is provided by the public sector. Then an income effect might lead to an increased provision of IC following an increase in publicly-funded care. Though such circumstances may seem unlikely for dependent elders - who most likely will consume up all the public offer after experiencing the relative price effect (such that IC and FC would be substitute) - the income effect is more likely to be observed among people at the beginning of the dependency process, who receive little allowances.

However, while the conclusions of the theoretical model are clear, recent empirical works found mixed evidence when focusing on older individuals in Europe. In particular, two articles using the first waves of the Survey on Health, Ageing and Retirement in Europe (SHARE) find opposite results. On the one hand, Bonsang (2009) [15] provides evidence of substitution between FC and IC use when older individuals are at the beginning of the dependency process. These results are in line with Van Houtven and Norton (2004) [11] and Bolin et al (2008) [13] suggesting, using respectively HRS and SHARE data, that FC and IC are substitutes. Bolin et al. [13] also noted that the results could vary according to the north-south gradient [13]. On the other hand, Carrino et al (2018) [16] found evidence of complementarity between FC and IC in four European countries (Austria, Belgium, France and Germany). All articles rely on strong identification strategies using instrumental variable (IV) approaches. Indeed, FC and IC are likely to be simultaneously determined; thus, a source of exogenous variation is necessary to identify the effect of one on the other. In this respect, the empirical approaches followed in the previous studies differ. Van Houtven and Norton [11], Bolin et al. [13] and Bonsang [15] modelled FC as a function of IC instrumented by family characteristics (e.g., the proportion of daughters and the distance to the nearest child). Carrino et al. [16] identified the effect of FC on IC using the eligibility rules of public dependency allowances in four European countries as an instrument for FC use. Both articles provide evidence that these instruments are strong.

The objective of this article is to provide complementary evidence on the relationship between IC and FC use in the population at the beginning of the dependency in Europe. Specifically, we use a sample of people over 70 years of age whose level of autonomy was rigorously screened by geriatricians (with exclusion criteria in terms of severe dependency) and for whom we observe different components of the use of IC. Our data allow us to extend prior analyses by Carrino et al. [16] to a greater number of European countries and to a greater number of IC tasks. The paper is organized as follows. We summarize the database used and our empirical strategy in Section 2. Section 3 highlights the findings of this study. We discuss our findings in the Section 4. Finally, we develop the implications for both policymakers and future research in Section 5.

2. Materials and methods

2.1. Description of the sample

We use the baseline data from the Sarcopenia and Physical Frailty IN older people: multi-component Treatment strategies (SPRINTT) project, a randomized controlled trial designed to test the efficacy of a multi-component intervention for the prevention of disability in older people (ClinicalTrials.gov identifier: NCT02582138). The intervention consisted of the provision of a personalized combination of physical activity and nutritional counselling associated with information and communication technology support. The main inclusion criteria were as follows: living at home, being over 70 years of age, and having no sign of dementia and no signs of cognitive or functional dependency (see [17] for additional information). Precisely, participants were required to have a score on the Short Physical Performance Battery (SPPB) test higher than 3/12 (i.e., excluding disabled individuals) and lower than 9/12 (i.e., excluding robust subjects), having completed the 400-meters walk test within 15 minutes, presence of low muscle mass based on the

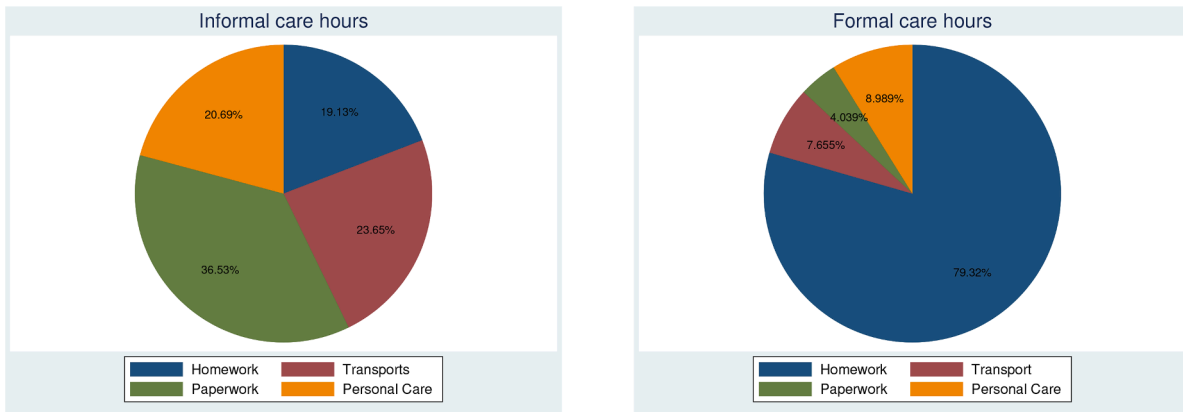


Fig. 1. Distribution of informal and formal care consumption by dimension. *Note:* The left (right) pie-chart represents the distribution of informal (formal) care among informal (formal) care users, i.e. $N = 174$ ($N = 323$). Source: SPRINTT baseline, authors' calculation.

results of a dual energy X-ray absorptiometry (DXA) scan, according to the cut-points indicated by the Foundation for the National Institutes of Health (FNIH) Sarcopenia Project, and having a score at the Mini Mental State Evaluation (MMSE) higher than 24/30 (i.e., excluding subjects who are likely to have cognitive impairment or dementia). Further details concerning the study objectives, design and methodology are provided in previous publications [17].

The SPRINTT sample consists of 1,518 people aged 70+ who were recruited in eleven European countries (Austria, Czech Republic, Finland, France, Germany, Iceland, Italy, Netherlands, Poland, Spain and United-Kingdom) between 2015 and 2017 [17]. We restrict our analysis sample to eight countries with complete information available to reproduce the eligibility criteria for LTC subsidies (thus excluding Finland, Iceland and the Netherlands). After removing observations with missing data, the final size of our analysis sample is 1,172 individuals.

The SPRINTT data include information about the participants socio-demographic characteristics (e.g., age, gender, educational level or family structure). The strength of the data lies in the availability of both subjective and objective health information. Subjective health was assessed through participants' self grading of their health on a 0 to 100 scale at the time of the visit. For each respondent, information on the number of limitations in (instrumental) activities of daily living (ADLs/iADLs) were collected (see Section 2.1.3 for details). We use two synthetic and objective measures of physical and mental health. The first scale (SPPB test), evaluates physical performance through standing balance, gait speed, and the ability to rise from a chair [18], with a lower score indicating frailer elderly individuals. The second scale is the Center for Epidemiologic Studies Depression Scale (CES-D), which identifies symptoms of depression. Theoretically, the possible range of scores is 0 to 60, with higher scores indicating the presence of more symptoms. Due to the inclusion and exclusion criteria, the maximum score in the database is 22.

The SPRINTT data also provide detailed information regarding the respondents use of different types of IC and FC services specifically provided for health-related issues. For both types of care, information regarding the number of times the service was received during the last month and regarding the number of hours per visit was collected (detailed information regarding the items used is presented in Appendix A). Regarding the receipt of FC, close-ended items distinguishing five types of services were used: "nursing", "meals-on-wheels", "paid domestic help", "transport", and "paperwork". A generic variable of FC receipt was created by gathering information on the use of any of these types of services.

Information regarding IC use was collected through an open-ended item, and the responses to this item were re-coded to allow comparison between FC and IC services (at the extensive and intensive margin) across similar domains. We created four classes of LTC services (for both

IC and FC use): "homework", "transport", "paperwork" and "personal care". The first class, "homework", consists of tasks performed at home by a third party and is composed of three main categories: cleaning inside the home/doing laundry, outside maintenance (gardening) and home maintenance (e.g., repair, technology support). The second class, "transport", is associated with the use of transportation/shopping for groceries during the last month. The third class, "paperwork", covers administrative tasks (e.g., financial/legal matters, tax declaration). Finally, the fourth class, "personal care, includes specific tasks related to personal hygiene (bathing/showering) and eating (thus including "meals-on-wheels").

Figure 1 provides a description of the distribution of IC and FC use for each dimension. It shows that if IC dimensions are evenly distributed, this is not the case for FC, where almost 80% of FC hours are dedicated to "homework tasks".

2.1.1. Empirical models

2.1.1.1. Specification. First, we estimate a linear probability model with a continuous endogenous regressor (i.e., the volume of FC received in log hours) to model IC utilization (dependent variable) at the extensive margin. We chose this specification over probit because computing marginal effects using IV probit specification is not straightforward (and the results may vary according to the package used). Yet, our conclusions do not vary when using a probit specification (results available upon request):

$$IC_{i,r} = \beta_0 + \beta_1 \log(THFC_{i,r}) + \beta_2 PC_{i,r} + \beta_3 Health_{i,r} + \beta_4 Region_{i,r} + \epsilon_{i,r} \quad (1)$$

In Eq. (1), $IC_{i,r}$ is a binary dependent variable that takes a value of 1 if individual i declares having received IC from a caregiver at least once during the last month. The r subscript stands for the region; "PC" (personal characteristics) is a vector that gathers the following variables: age, gender, household structure (living with partner, number of children) and income; the "Health" vector includes a set of both physical and mental health (i.e., the SPPB and the CES-D, respectively); "Region" is a vector of the 11 regional dummies corresponding to each clinical site where respondents were recruited; this vector is essential for capturing local economic effects that affect IC and FC consumption. The coefficient β_1 measures the marginal effect of the log of FC consumption the probability of using IC (extensive margin).

Second, we run a linear regression on the conditional sample of care receivers to model the effect of FC use (log hours) on IC utilization at the intensive margin (volume):

$$\begin{aligned} \log(THIC_{i,r}) = & \beta_0 + \beta_1 \log(THFC_{i,r}) + \beta_2 PC_{i,r} + \beta_3 Health_{i,r} + \beta_4 Region_{i,r} \\ & + \epsilon_{i,r} \end{aligned} \quad (2)$$

Table 1
Descriptive statistics of the dependent and independent variables.

	Whole	FC user	Non FC user	Difference
	Sample	(FC)	(NFC)	(FC) - (NFC) ^a
Socio-demographic variables				
Age (mean SD)	79.03 (5.79)	80.64 (5.95)	78.42 (5.61)	***
Male (%)	29.35 (45.55)	25.39 (43.59)	30.86 (46.22)	**
Years of education (mean SD)	10.80 (4.21)	11.23 (4.25)	10.64 (4.18)	**
Number of children (mean SD)	1.86 (1.17)	1.74 (1.15)	1.91 (1.18)	**
No living partner (%)	48.55	61.91	43.46	***
Health variables				
“Strong difficulty” for at least one ADL (%)	21.59	29.10	18.73	***
“Strong difficulty” for at least one iADL (%)	40.27	52.32	35.69	***
“Strong difficulty” for at least one ADL & iADL (%)	14.93	22.60	12.01	***
SPPB [†] (mean SD)	6.71 (1.36)	6.49 (1.38)	6.80 (1.34)	***
CES-D scale [‡] (mean SD)	5.66 (3.90)	6.34 (3.68)	5.41 (3.96)	***
IC use				
Overall (%)	15.27	26.00	11.19	***
Monthly hours of IC (mean SD)	1.63 (7.99)	1.88 (5.10)	1.53 (8.85)	n.s.
Homework (n %)		8.36	3.65	***
Transport (n %)		9.60	2.83	***
Paperwork (n %)		8.72	3.07	***
Personal Care (n %)		3.10	11.79	**
Monthly hours of IC among users (mean SD)	10.99 (18.14)	7.52 (7.85)	14.00 (23.35)	**
Observations	1172	323	849	

[†] SPPB: Short Physical Performance Battery test. [‡] CES-D scale: Center for Epidemiologic Studies Depression Scale. Notes: SD: standard deviation. IC : informal care, FC: formal care. Care use is during the last month. ^a Statistical significance of the difference between the two sub-samples FC and NFC. Results of Student test for continuous variables, and χ^2 test for categorical variables. ***: $p < 0.01$; **: $p < 0.05$; n.s.: non significant. Source: SPRINTT baseline ($N = 1172$), authors' calculations.

In Eq. (2), $THIC_{i,t}$ is a continuous dependent variable representing the conditional number of hours of IC received by individual i during the last month. The coefficient β_1 measures the marginal effect of the log of FC consumption the total hours of informal care (THIC) received.

Notably, given the low level of disability in our population and a monthly statement of IC and FC consumption, the number of hours of IC and FC received is relatively small, and our distributions are singular (see Appendix B). Overall, 174 individuals (15.27% of the sample) and 323 individuals (27.56% of the sample) used at least one type of IC and FC, respectively. Consequently, the distributions of hours of FC and IC received are asymmetrical and right skewed, especially for the monthly hours of IC used. In order to improve model fit and smoothen extreme values, we use the logarithm of the $THIC$ and total hours of formal care (THFC) used ($\log(1 + THIC)$ and $\log(1 + THFC)$, respectively, to deal with the zero mass point).

2.1.2. Identification strategy

Prior work has shown that both IC and FC consumption occur simultaneously [15,16,19]. In addition, the use of FC is likely to be associated with unobserved preferences, such as a lower sensitivity to disability-related stigma [20] and a willingness to preserve savings [21]. To address this challenge, we implemented a two-part instrumental variable (IV) model. We use an IV introduced by Carrino et al. [16],

which measures whether or not elderly individuals are eligible for public LTC allowances in their country. Across countries, LTC allowances consist of a financial support that can be either cash or benefits, which amount may varies according to the final eligibility score. This IV should theoretically be correlated with the receipt of FC through a price effect (the allowance decreases the relative price of FC compared to IC) and should only indirectly impact IC use through its effect on FC use (exclusion restriction). Because it is defined by exogenous administrative rules, the IV should not be correlated with older people's preferences.

To construct the IV, we reviewed all the rules used at the national/regional level in each country and used several pieces of information dealing with the respondents' ADL and iADL limitations to match these guidelines. Each country uses these criteria to decide whether the individual is eligible for a financial allowance through the LTC scheme (see Appendix C for a complete description by country). In each item, the respondents self-reported their own level of physical difficulty among 5 levels (i.e., “no difficulty”, “little difficulty”, “some difficulty”, “a lot of difficulty” and “unable to do”). Information on both the psychological and cognitive states of the respondents, as well as their social and family environment, which is sometimes useful in particular countries, was collected.

We based our IV construction on the work by Brugiavini et al. [22], who extensively describe the legislative structure of the LTC scheme for Austria, the Czech Republic, France, Germany, Spain and the United Kingdom. We further detail the legislative structure and eligibility index construction for Italy (3 specific levels) and Poland in the supplementary material. Simply put, to establish eligibility for the LTC scheme, the individual must reach a minimum score based on dependency criteria chosen at the national/regional level. Each index has its own special characteristics concerning the variables used, the weight of each difficulty and the scoring threshold to be reached. Once the eligibility index is constructed by site, we obtain a binary variable that takes the value of 1 if the individual is eligible for the LTC scheme in her region and otherwise 0.

The validity of an IV relies on the exclusion restriction rule. In our case, the exclusion restriction of the instrument could be violated if eligibility rules for public LTC allowances also have an impact on IC receipt that would not be mediated by higher FC receipt. However, we think that our IV is valid for several reasons. Our IV is created using exogenous eligibility rules, which are not influenced by individuals IC and FC provision levels. In other words, the cutpoints defining eligibility rules for public allowances are not defined by individuals specific needs and are not likely to specifically influence individuals decisions to use IC.

Prior work by Rice et al. [23] in the United States provide three main reasons supporting the assumption that macro-level LTC policy is not demand-driven (see page 279 for an extended discussion). First, the demand for services is responsive to State policies rather than the reverse, as reflected in most countries by under-enrolment rates for public allowances in the elderly population [20,23]. Second, individual preferences for care are not reflected by State-level policies, which historically have been in favor of nursing home care (which are often associated with disutility). Third, there is no evidence supporting the idea that frail elders would migrate to countries or regions with greater LTC generosity, showing that country/region LTC policies do not reflect demand for services.

To summarize, our identification of the indirect effect of eligibility on IC use relies on two mechanisms. First, we exploit non-linearity in the eligibility rules that creates discontinuity in the probability of using formal care. Second, we exploit inter-countries differences in eligibility rules, such that two individuals in two different countries with identical health status may not have the same probability of using formal care.

Table 2
Use of informal care among formal care users, by eligibility status.

	FC user		Difference
	Eligible	Non eligible	
Socio-demographic variables			
Age (mean SD)	82.09 (5.95)	80.00 (5.85)	***
Male (%)	21.21	27.23	n.s
Years of education (mean SD)	10.85 (4.04)	11.39 (4.33)	n.s
Number of children (mean SD)	1.64 (1.08)	1.80 (1.18)	n.s
No living partner (%)	69.69	58.48	n.s
IC use			
Overall (%)	44.44	17.86	***
Help for homework (%)	17.17	4.46	***
Help for transport (%)	17.17	6.25	***
Help for paperwork (%)	12.24	7.17	n.s
Help for personal care (%)	6.06	17.94	**
Monthly hours of IC (mean SD)	3.07 (6.14)	1.36 (4.48)	***
Monthly hours of IC among users (mean SD)	7.06 (7.69)	8.05 (8.11)	n.s
Observations	99	224	

Notes: SD: standard deviation. IC : informal care. IC use is during the last month. Results of Student test for continuous variables, and χ^2 test for categorical variables. ***: $p < 0.01$; **: $p < 0.05$; n.s: non significant. Source: SPRINTT baseline ($N = 1172$), authors' calculations.

3. Results

3.1. Descriptive statistics

Table 1 shows the differences in observable characteristics between FC and non-FC users in our sample (descriptive statistics by country are detailed in Appendix D). FC users are generally older and more socially isolated (they are less likely to have a living partner). The two subgroups also differ substantially in terms of health, with more ADL/iADL limitations, greater depression scores and lower physical performance among FC users.

Table 2 distinguishes eligible and non-eligible individuals to the LTC scheme among FC users. These results show that our instrument is well balanced across socio-economic variables. Indeed, eligible and non-eligible elderly people are quasi-similar in terms of socio-demographic variables. Eligible people are older but age is directly correlated to the disability status and ADL/iADL limitations. Second, eligible and non-eligible older people's IC consumptions are significantly different at the extensive margin. In addition, IC use is almost twice higher among FC users (44.44% vs. 17.86%). These descriptive results tend to suggest a positive correlation between FC and IC. Decomposing by IC task, we note however that "help for personal care" among FC users is significantly higher (17.94% vs. 6.06%) among those not eligible for the public allowance. This singularity can be explained by a limited public supply for this type of care, leading non-eligible individuals to use IC to meet their needs.

3.2. Results of the econometric models

The results of our naive and IV estimations at the extensive and intensive margins are shown in Table 3. In the naive OLS model, the volume of FC received is significantly and positively associated with an increase in the probability of IC receipt (panel A); however, the effect is low: a 10% increase in the quantity of FC is significantly (at the 1% level) associated with a 0.42 percentage points (pp.) increase in the probability of using IC. The Durbin-Wu-Hausman test shows that the null hypothesis that FC is exogenous is rejected at the 1% significance level in the

extensive margin equation (respectively, 5% level in the intensive margin equation).

The results of the first steps of the IV regression confirm that the individual's eligibility status with regard to the LTC programme is a good predictor of FC use, with an estimated coefficient significant at the 1% level for the extensive margin (panel A) and at the 5% level for the intensive margin (panel B). The second step of the IV model reveals several interesting findings. The model confirms that FC and IC are complementary: a 10% increase in FC utilization is associated with a 3.9 pp. increase in the probability of using IC. The effect is significant at the 1% level and is much higher than in the naive OLS model. Other independent variables influence IC use in the expected way. The probability of using IC increases non-linearly with age. IC use increases with the number of children, which is expected given that close family members are more inclined to provide assistance. Finally, wealthier subjects (those in a higher income quartile) are significantly less likely to use IC. At the intensive margin, the volume of FC consumption (THFC in log) does not significantly impact the volume of IC hours received (in log). In the IV linear regression, males (single elderly individuals) are more likely (less likely) to consume higher volumes of IC.

3.3. Sensitivity analyses

3.3.1. Specific tasks

We replicate our models to investigate whether the results change according to the type of LTC service used by considering the four classes of IC. Figure 2 represents the impact of FC utilization (extensive margin) on domestic tasks, transport, administrative tasks and personal care. Our findings are not impacted by the type of FC service used, as we observe significant complementarity between IC and FC consumption.

3.3.2. Results excluding France

In France, public allowances can also be used to compensate informal caregivers when they are not the spouse. Therefore, one could argue that because both IC and FC are function of the dependency level, the instrument affects IC directly, and not only through IC. However, if France allows public allowances to compensate IC, it is very unlikely that it directly impacts IC levels. Indeed, payments cannot be provided to spouses, who are often the primary IC provider, especially at the beginning of the disability process. Moreover, the generosity of home-based services in European countries is low compared to needs for people with low disability levels [24]. To confirm that this did not impact our results, we checked that results remained consistent when excluding France (see Appendix E). We show that a 10% increase in FC utilization (in volume) is associated with a 4.4 pp. increase in the probability of using IC, which is similar to the result obtained in the overall sample.

3.3.3. Robustness to alternative specifications

Following [15] and [16], we tested the robustness of our results by controlling for a global index of disability - a disability index - that gathers information on both subjective and objective health measures (see Appendix E). This index makes it possible to address the multi-collinearity between several health dimensions included simultaneously in the model. We used the subjective health index from the SPRINTT questionnaire described in Section 2. We reversed the scale and performed a linear regression of subjective health on a set of clinical health measures, including all the ADLs and iADLs (as dummies). All variables had the expected sign and their effect on subjective health was significantly different from zero. From the linear regression, we computed the predicted latent variable and used its standardized value as a disability index [15], which was included as an additional control in our models. We observe that i) the disability index is a significant predictor of FC receipt, ii) the inclusion of the disability index in the second step of our IV model slightly reduce the effect of FC on IC use: a 10% increase in FC utilization is associated with a 2.4 pp. increase in the

Table 3
Results for the probability of using informal care (extensive margin).

PANEL A: Any informal care received						
VARIABLES	OLS		IV 2SLS		IV 2SLS	
	marg.eff	SE	marg.eff	SE	marg.eff	SE
Log of hours of formal care	0.042***	(0.012)			0.399***	(0.118)
Eligibility to the public allowance (IV)			0.359***	(0.086)		
Age	0.067	(0.041)	-0.109	(0.141)	0.109	(0.067)
Age squared	-0.000	(0.000)	0.001	(0.001)	-0.001*	(0.000)
Male	-0.001	(0.024)	-0.118*	(0.070)	0.038	(0.035)
Years of education	-0.001	(0.003)	0.033***	(0.009)	-0.013**	(0.006)
No living partner	0.041*	(0.024)	0.125*	(0.069)	-0.008	(0.038)
Number of children	0.020**	(0.009)	-0.023	(0.025)	0.030**	(0.014)
Subjective health	-0.001*	(0.000)	-0.001	(0.001)	-0.001	(0.001)
SPPB [†]	-0.035***	(0.008)	-0.036*	(0.021)	-0.015	(0.013)
CES-D Scale [‡]	0.008***	(0.003)	0.019**	(0.008)	-0.001	(0.005)
Income (Ref: € < 10000)						
€ [10000 – 15000[	-0.026	(0.041)	-0.085	(0.090)	-0.005	(0.050)
€ [15000 – 25000[	-0.048	(0.041)	0.042	(0.100)	-0.067	(0.051)
≥ € 25000	-0.084**	(0.043)	0.366***	(0.127)	-0.223***	(0.075)
Missing	-0.066*	(0.038)	0.070	(0.096)	-0.099**	(0.050)
Regional dummies		YES		YES		YES
Observations		1172			1172	
Durbin-Wu-Hausman test						21.00***
Weak-instrument test						26.11***

PANEL B: Conditional amount (log of total monthly hours) of informal care received						
VARIABLES	OLS		IV 2SLS		IV 2SLS	
	marg.eff	SE	marg.eff	SE	marg.eff	SE
Log of hours of formal care	0.005	(0.068)	-	-	0.039	(0.310)
Eligibility to the public allowance (IV)	-	-	0.414**	(0.203)	-	-
Age	-0.126	(0.332)	0.082	(0.394)	-0.129	(0.303)
Age squared	0.001	(0.002)	-0.000	(0.002)	0.001	(0.002)
Male	0.302**	(0.151)	-0.084	(0.232)	0.304**	(0.147)
Years of education	-0.001	(0.018)	0.036	(0.026)	-0.002	(0.021)
No living partner	-0.255*	(0.152)	0.075	(0.202)	-0.257*	(0.142)
Number of children	-0.033	(0.053)	-0.090	(0.071)	-0.030	(0.060)
Subjective health	-0.003	(0.003)	0.003	(0.004)	-0.003	(0.002)
SPPB [†]	-0.029	(0.130)	0.178	(0.177)	-0.038	(0.153)
CES-D Scale [‡]	-0.006	(0.016)	0.035	(0.025)	-0.008	(0.023)
Income (Ref: € < 10,000)						
€ [10000 – 15000[	-0.332*	(0.189)	-0.239	(0.311)	-0.336*	(0.187)
€ [15000 – 25000[	-0.677***	(0.191)	0.043	(0.333)	-0.676***	(0.178)
≥ € 25000	0.085	(0.270)	0.775*	(0.404)	0.099	(0.320)
Missing	-0.012	(0.217)	-0.051	(0.346)	-0.013	(0.203)
Regional dummies		YES		YES		YES
Observations		174			174	
Durbin-Wu-Hausman test						10.07***
Weak-instrument test						4.26***

[†] SPPB: Short Physical Performance Battery test. [‡] CES-D scale: Center for Epidemiologic Studies Depression Scale. *Note:* Robust standard errors. Significance: 10%(*), 5% (**), 1% (***). *Source:* SPRINTT baseline (N = 1172), authors' calculations.

probability of using IC ($p < 0.01$) iii) the disability index has a positive effect on IC receipt, significant at the 1% level (0.009).

Finally, we used a second instrument based on the generosity of countries in LTC spending (% of GDP dedicated to LTC spending, collected from OECD 2019). Germany, France and the United Kingdom are included in a “generous” group (i.e. countries that spend more than the OECD average) while Italy, Spain, Poland, the Czech Republic and Austria are included in the “less generous” group. Appendix E shows a positive but insignificant correlation between our generosity variable and FC use (0.194). The overidentifying restriction test ($\chi^2 = 1.15; p = 0.2815$) does not reject the null hypothesis that instruments are exogenous, thus giving us confidence in validity of our main instrument. Besides, adding a second instrument related to the LTC system generosity does not particularly change the coefficient associated with FC use (the marginal effect is 0.384 vs 0.399 in our main model, and is significant at the 1% level).

4. Discussion

Our paper provides new findings on the relationship between the two types of care in a population of 70+ frail European individuals. Using an IV strategy that exploits local (exogenous) variations in the eligibility rules for FC use, we show the presence of a positive and significant effect of access to FC on the probability of receiving IC. A 10% increase in FC increases the level of IC received by 0.4 pp. These results suggest that elderly people tend to consider FC and IC to be complementary when they are at the beginning of their dependency process.

This complementarity can be explained by the low affordability and quality of the services provided to elders with low disability levels in most European countries. Frail individuals may not be satisfied with the current levels of publicly provided LTC services, and the income effect associated with an increase in the generosity of the public LTC allowance will lead them to seek other sources of services (private sector or IC), as predicted in Stabile et al. (2006) [12]. Indeed, the LTC policies

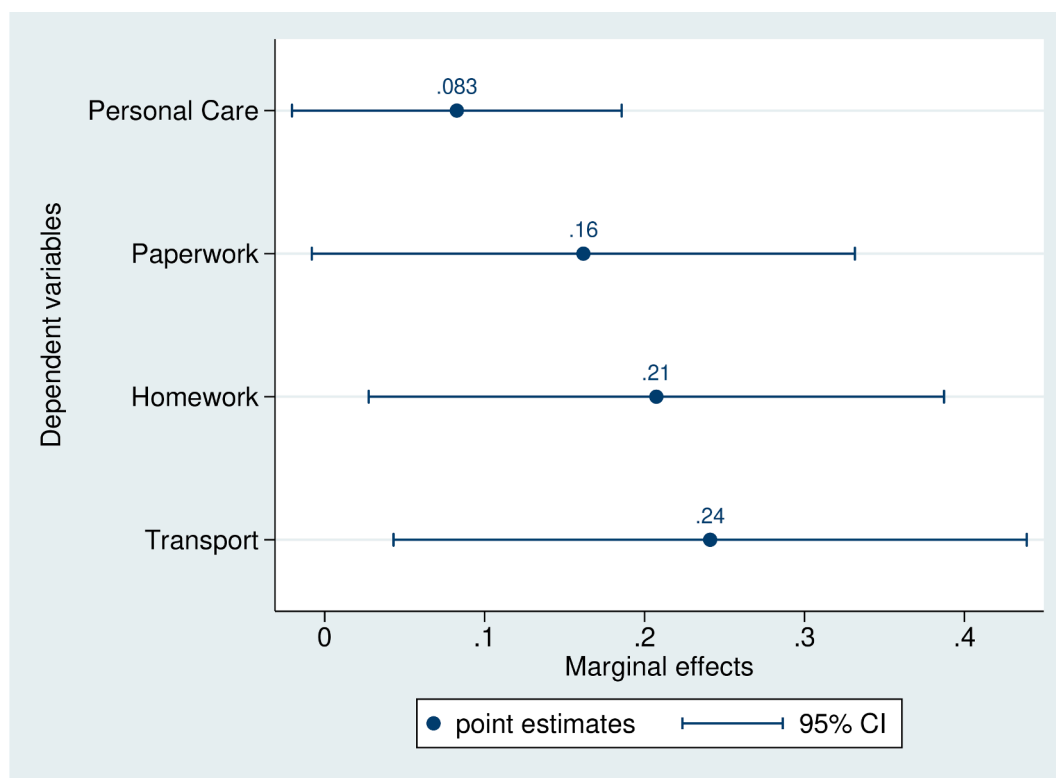


Fig. 2. Marginal impact of formal care utilization on informal care by informal care dimensions (extensive margin). Source: SPRINTT baseline ($N = 1172$), authors' calculations. We do not control for regional fixed effects because some regions are perfectly correlated with the outcome. This would entail loss of observations. This choice does not affect our results.

implemented over the past 10 years have not targeted frail elderly people. The home-based services provided to frail elderly individuals are usually scarce and fragmented [25]. In most European systems, the frail elderly fail to be detected [26], while the generosity of programmes tends to focus on the most disabled elderly individuals [22]. Indeed, recent work shows that there is a lot of heterogeneity in the capacity of European public systems to cover LTC needs among frail older people [24]. Nordic countries (Sweden, Iceland, Finland), the Netherlands and Luxembourg are countries where the generosity of LTC systems is the highest: for people earning the median income with no net wealth, over 90% of total LTC costs are covered by public social protection systems. Many European countries cover more generously the needs of the severely disabled older people than the needs of the frail older people, who are not disabled yet and have low/moderate needs. This is for instance the case of Germany, Ireland, Belgium, and Spain. Finally, several European countries (like France for instance) cover more generously institution-based care than home-based care needs. Because of data limitations, we were not able to fully capture these differences in our analyses. Further work should explore to what extent differences in the entitlement to publicly-funded care by wealth levels can contribute to influence frail older persons' LTC use decisions.

The main strengths of our study are i) the quality, relevance and originality of the data based on the SPRINTT trial and ii) the identification strategy relying on a robust instrumental variable. Despite these, our work is not exempt from limitations. Our IV estimates may suffer from weak instrument problems in the models exploring the intensive margin and in the sensitivity analyses exploring some specific components of IC use (housework, paperwork, and personal care). When instruments are weak, point estimators are biased, and Wald tests are unreliable [27–29]. For all models considered in this article, we implement the Anderson-Rubin test [30] and report the first stage of our IV estimation, allowing us to assess the strength of our instrument. While the results obtained for the extensive margin are strong, the results

regarding the intensive margin and some IC use components must be interpreted with caution. Furthermore, while our instrument is a significant predictor of FC consumption, the weak instrument test that we conducted does not reach the threshold of 10 recommended by Staiger and Stock [27].

This result may be explained by our relatively low sample size of IC users: with a larger sample, we would obtain larger scores, as observed in our main regression. In addition, a larger sample size is necessary to confirm the positive effect of FC on IC use at the intensive margin. Our results should be interpreted as preliminary as the size of our sample makes any interpretation or generalization difficult. Similarly, the sample size does not allow us to make our estimates by country and type of financing of formal care. Results recently reported by Courbage et al. [31] tend to confirm that the effect of public benefits on IC depends on the typology of public coverage for LTC such that access to proportional benefits negatively influences IC receipt while access to cash benefits exerts a positive effect.

5. Policy recommendations

Our results have important policy implications. Current policies aim to increase ageing in place by targeting both formal and informal caregivers. In particular, policymakers encourage the use of FC through subsidies for eligible people. One aim of this policy is to decrease the burden on informal caregivers. However, the effectiveness of such policies depends on the complementarity or substitutability between IC and FC. Complementarity between IC and FC tends to suggest that healthy ageing policies may not have the expected results. In fact, they may contribute to increasing the use of IC, which could ultimately lead to a higher burden on informal caregivers and a dramatic increase in LTC spending among frail elderly people. Our interpretation of this effect is based on the fact that currently, the supply of LTC services for frail elderly individuals is too fragmented and too scarce, which limits the

satisfaction associated with the use of FC. Therefore, we think that LTC policies that contribute to increasing the supply of LTC services should also focus on the quality of these services, which is currently too low for elderly individuals who are at the beginning of their dependency process.

A review of current policy measures implemented in OECD countries reveals that three promising policy options can be implemented to address this challenge. The first option is to focus LTC policies on the introduction of re-ablement measures, which consist of “supporting elders towards independence” by teaching them how to perform ADLs again instead of providing them with services that replace these activities [32]. Recent work [33,34] underlines the efficacy of these measures, which have been implemented in Nordic countries (Denmark, Norway) and former Commonwealth countries (Australia, Canada, New Zealand, the United Kingdom and the United States). Re-ablement services provide people-centred help, which focuses on increasing satisfaction. The provision of such services is likely to reduce the use of IC since they (by definition) meet the expectations of elderly individuals.

The second option is to increase the coordination and integration of public programmes to provide more exhaustive services to frail elderly individuals. This option is promoted by WHO in its Guidelines on Integrated Care for Older People (ICOPE) initiative ([6]). Some countries such as the Netherlands and Germany have already implemented universal LTC systems that provide integrated services to elderly people at all stages of the dependency process. In the Netherlands, Tenand et al. (2020) [35] show for instance that the LTC program, built to meet the specific needs of each individual, seems effective at restricting socio-economic inequity in home care. The creation of such a system is currently being debated in countries such as France, which implemented several measures in its 2015 dependency reform to coordinate the action of different LTC providers (Conseils départementaux, Caisses nationales d'assurance vieillesse, Caisse nationale de solidarité, and Agences régionales de santé).

The third option is to reduce the fragmentation of home-based care supply and to increase the integration of medical and non-medical services. In many European countries (such as France, Italy, Portugal and Spain), most LTC service spending is still centred on institution-based care, while the supply of home-based services is low [2]. Despite increasing needs, the LTC supply has remained low since 2011 because of the low attractiveness of LTC jobs and the large turnover rates in the LTC workforce. This situation certainly contributes to reducing frail elderly individuals satisfaction with FC, leading them to rely more on IC use. Therefore, policymakers should implement measures to improve the quality of LTC jobs, focusing, for instance, on wage increases, access to benefits, and improvements in working conditions.

In conclusion, our article provides a clearer perspective on the potential impact of policies that support the use of home-based FC on IC use. Further work will explore the extent to which these policies can also contribute to reducing the risk of autonomy loss among older individuals.

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Appendix A. Details on the IC and FC items in the SPRINTT data

A1. Information related to informal care received

This information is collected in three stages. First, the individual indicates whether or not she receives unpaid IC. The question is as follows: “During the last month, did you receive any unpaid assistance from a caregiver (family member, a friend or a neighbour)?” (yes, no).

Then, an open-ended IC item provides more detailed information on the specific tasks received: “If yes, please indicate the reason”.

Finally, we obtain information on three specific items through the following item: “For each of the activities below, please indicate the number of times help was received and for how much time, on average, help was provided”.

- Help with personal care: getting dressed, bathing, eating, using the toilet, etc. (visit(s) per week; average time per visit)
- Help with housework: repairs, gardening, transport, shopping, meals preparation, etc. (visit(s) per week; average time per visit)
- Help with paperwork: administrative work, financial or legal matters, etc. (visit(s) per week; average time per visit)

A2. Information related to formal care consumption

The item is as follows: “During the last month, please indicate for each service listed below the number of times it was received because of health problems or their consequences and, on average, the number of hours/items for a typical visit”.

- Paid domestic help (number of visit(s); hour(s) per visit)
- Meals-on-wheels (number of visit(s); meals delivered per visit)
- Transport - paid through public funding (number of visit(s); km/miles (average))
- Help with paperwork (number of visit(s); hour(s) per visit)

Appendix B. Distribution of informal and formal care consumption (volume)

Figure B.1

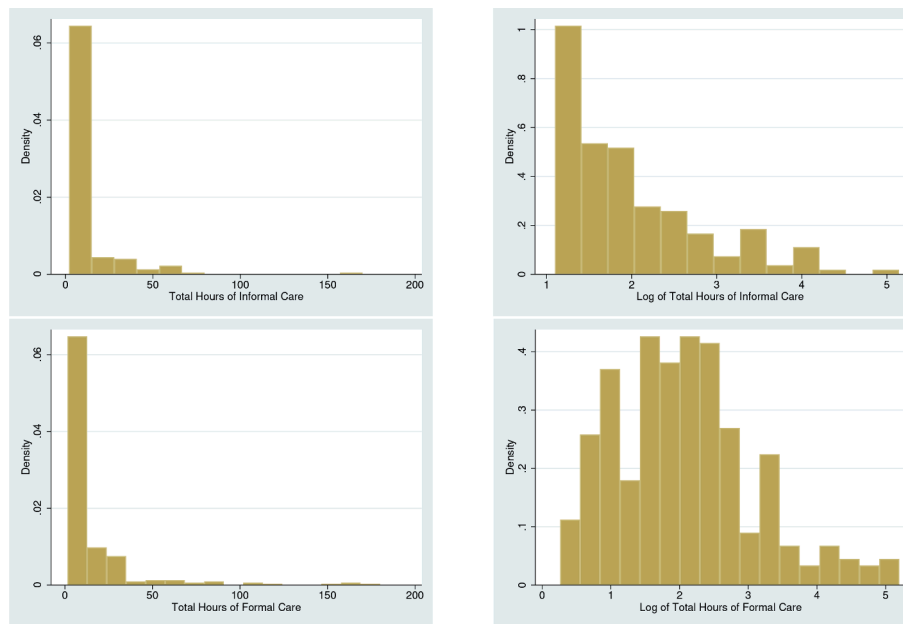


Fig. B.1. Distributions of total hours of both IC and FC received. *Note:* We represent the distribution of informal (formal) care among informal (formal) care users, i.e. $N = 174$ ($N = 323$). In line with previous studies (e.g., [15,16,19]), a unit was added to the natural hours of formal care before the log transformation to avoid the problem of zero hours. Source: SPRINTT baseline ($N = 1172$), authors' calculations.

Appendix C. Eligibility index criteria - a general overview

Table C.1

Table C.1

ADL's/iADL's items and variables available in SPRINTT.

ADLs/Non-ADLs items	Because of your health, do you have any difficulty in...
<p># ADL's</p> <ul style="list-style-type: none"> ✓Bathing & hygiene ✓Dressing yourself ✓Using the toilet ✓Transferring <p>✓Continence</p> <p>✓Feeding</p> <p>✓Moving indoor</p> <p>X Hygiene for post-surgery conditions</p> <p># Non-ADL's</p> <ul style="list-style-type: none"> ✓Communication/Relationship 	<ul style="list-style-type: none"> Bathing or showering? Dressing yourself? Using the toilet (including getting on and off)? Moving in and out of a bed? Moving in and out of a chair? Controlling bowel and bladder (without occasional "accidents")? Feeding yourself? Walking across a small room? - Using the telephone ? Participating in community activities ? Visiting with relatives or friends? Taking care of a family member? Shopping for groceries? Lifting or carrying [...] a bag of groceries? Preparing your own meals? Doing light housework (such as washing, dishes, dusting, etc.)? Doing your personal laundry? Getting in and out of a car? Moving from one place to another? Taking your medications by yourself? Managing your money, such as paying bills? MMSE scale with total score and specific items ("orientation", "recall", "registration", "language", "attention/calculation") Climbing one flight of stairs Climbing several flights of stairs?
<ul style="list-style-type: none"> ✓Shopping for groceries <ul style="list-style-type: none"> ✓Cooking ✓Housework ✓Doing laundry ✓Moving outdoor <ul style="list-style-type: none"> ✓Responsibility for own medications ✓Behaviorial/cognitive impairment 	
<ul style="list-style-type: none"> ✓Other mobility limitations 	

Note 1: ✓: item available in SPRINTT data; X: item not available in SPRINTT data. *Note 2:* The Mini-Mental State Examination (MMSE) is a 30-point questionnaire that is used extensively in clinical and research settings to measure cognitive impairment. It is commonly used in medicine to screen for dementia.

Appendix D. Descriptive statistics for overall sample and each country

Table D.1

Table D.1

Descriptive statistics by country on variables used.

	Whole sample	Austria	Czech Republic	France	Germany	Italy	Poland	Spain	UK
Formal/informal care									
Informal care user (%)	15.27	6.12	14.16	12.34	24.59	13.90	17.02	18.63	9.09
Formal care user (%)	27.56	20.40	32.74	33.77	36.06	36.32	10.64	9.32	6.06
Socio-economic characteristics									
Age	79.03	78.45	80.98	79.01	81.34	78.20	78.96	78.87	77.24
Male (%)	29.35	30.61	16.81	24.67	35.24	31.16	40.42	26.71	27.27
Years of education	10.80	12.02	12.03	12.34	10.12	10.26	14.25	7.99	11.33
No living partner (%)	48.55	48.97	77.88	59.09	77.87	36.77	39.36	34.16	45.45
Number of children	1.87	1.63	1.55	2.04	1.61	1.81	1.55	2.50	2.09
Health indicators									
ADL	0.34	0.05	0.32	0.29	0.71	0.29	0.36	0.42	0.09
iADL	0.73	0.49	0.72	0.47	0.82	0.60	0.88	1.37	0.33
Subjective health	63.03	60.10	64.37	66.49	62.87	62.29	62.76	60.45	70.72
SPPB	6.71	6.82	6.41	6.89	6.66	6.80	6.65	6.52	7.00
CES-D Scale	5.67	4.10	4.95	5.81	5.21	5.84	6.67	6.37	2.81
Observations	1172	49	113	134	122	446	94	161	33

Appendix E. Sensitivity analyses

Tables E.1, E.2, E.3.

Table E.1

Results for the probability of using any informal care - without France (extensive margin).

VARIABLES	Any informal care received			
	OLS		IV 2SLS	
	marg.eff	SE	marg.eff	SE
Log of hours of formal care	0.040***	(0.013)	0.439***	(0.141)
Age	0.082*	(0.048)	0.177**	(0.086)
Age squared	-0.000	(0.000)	-0.001**	(0.001)
Male	0.003	(0.026)	0.052	(0.040)
Years of education	-0.002	(0.003)	-0.018**	(0.008)
No living partner	0.037	(0.026)	-0.021	(0.045)
Number of children	0.018*	(0.010)	0.026*	(0.015)
Subjective health	-0.001**	(0.000)	-0.001	(0.001)
SPPB [†]	-0.035***	(0.009)	-0.022*	(0.012)
CES-D Scale [‡]	0.008**	(0.003)	-0.001	(0.005)
Income (Ref: < € 10000)				
€ [10000 – 15000[	-0.027	(0.043)	0.000	(0.054)
€ [15000 – 25000[	-0.058	(0.043)	-0.046	(0.057)
≥ € 25000	-0.079*	(0.047)	-0.223**	(0.087)
Missing	-0.056	(0.040)	-0.089	(0.057)
Regional dummies		YES		YES
Observations		1018		1018
Durbin-Wu-Hausman test				18.29***
Weak-instrument test				22.21***

[†] SPPB: Short Physical Performance Battery test. [‡] CES-D scale: Center for Epidemiologic Studies Depression Scale. *Note 1:* Significance: 10%(*), 5% (**), 1% (***). *Source:* SPRINTT baseline (N = 1018), author’s calculation.

Table E.2

Robustness checks for all IC - disability index (extensive margin).

VARIABLES	Any informal care received			
	OLS		IV 2SLS	
	marg.eff	SE	marg.eff	SE
Log of hours of formal care	0.041***	(0.011)	0.240***	(0.089)
Age	0.059	(0.042)	0.088*	(0.051)
Age squared	-0.000	(0.000)	-0.001*	(0.000)
Male	0.006	(0.024)	0.025	(0.028)
Years of education	-0.002	(0.003)	-0.008*	(0.004)
No living partner	0.037	(0.024)	0.006	(0.031)
Number of children	0.020**	(0.009)	0.027**	(0.011)
Disability index	0.012***	(0.002)	0.009***	(0.002)
Income (Ref: < € 10 000)				
€ [10000 – 15000[	-0.032	(0.041)	-0.011	(0.045)
€ [15000 – 25 000[€	-0.054	(0.040)	-0.058	(0.044)
≥ € 25 000	-0.093**	(0.042)	-0.158***	(0.056)
Missing	-0.081**	(0.038)	-0.088**	(0.041)
Regional dummies		YES		YES
Observations		1172		1172
Durbin-Wu-Hausman test				8.15***
Weak-instrument test				11.59***

Note 1: Robust standard errors. Significance: 10%(*), 5% (**), 1% (***). *Source:* SPRINTT baseline (N = 1172), author’s calculation.

Table E.3
Robustness checks for all IC - generosity in LTC spending as second instrument (extensive margin).

VARIABLES	Any informal care received			
	IV 2SLS		IV 2SLS	
	First step		Second step	
	marg.eff	SE	marg.eff	SE
Log of hours of formal care	-	-	0.384***	(0.121)
Age	-0.126	(0.139)	0.098	(0.066)
Age squared	0.001	(0.001)	-0.001	(0.000)
Male	-0.092	(0.074)	0.041	(0.037)
Years of education	0.033***	(0.010)	-0.012**	(0.005)
No living partner	0.148**	(0.072)	0.002	(0.038)
Number of children	-0.026	(0.026)	0.036**	(0.014)
SPPB [†]	-0.052**	(0.022)	-0.007	(0.014)
CES-D Scale [‡]	0.020**	(0.008)	-0.003	(0.005)
Eligibility to allowance (IV)	0.384***	(0.092)	-	-
Generosity in LTC spending (IV)	0.194	(0.154)	-	-
Income (Ref: < € 10 000)				
€ [10 000 – 15 000[	-0.135	(0.098)	-0.015	(0.044)
€ [15 000 – 25 000[	0.018	(0.110)	-0.113**	(0.054)
≥ € 25 000	0.338**	(0.135)	-0.291***	(0.096)
Missing	0.034	(0.105)	-0.134**	(0.055)
Regional dummies		YES		YES
Observations		1172		1172
Durbin-Wu-Hausman test				8.15***
Weak-instrument test				21.43***
Overtidentification test				0.2815

[†] SPPB: Short Physical Performance Battery test. [‡] CES-D scale: Center for Epidemiologic Studies Depression Scale. *Note 1:* Robust standard errors. Significance: 10%(*), 5% (**), 1% (***). *Source:* SPRINTT baseline (N = 1172), author's calculation

Supplementary material

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.healthpol.2022.04.007.

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