



# Does informal care delay nursing home entry? Evidence from Dutch linked survey and administrative data

Julien Bergeot <sup>a,\*</sup>, Marianne Tenand <sup>b,c</sup>

<sup>a</sup> Department of Economics, Ca'Foscari University of Venice, Italy

<sup>b</sup> Erasmus School of Health Policy & Management (ESHPM), Erasmus University Rotterdam, Erasmus Center for Health Economics Rotterdam (EsCHER), The Netherlands

<sup>c</sup> CPB Netherlands Bureau for Economic Policy Analysis, The Netherlands

## ARTICLE INFO

### Keywords:

Long-term care  
Nursing home care  
Informal care  
Instrumental variables  
Bivariate probit

## ABSTRACT

We assess whether informal care receipt affects the probability of transitioning to a nursing home. Available evidence derives from the US, where nursing home stays are often temporary. Exploiting linked survey and administrative data from the Netherlands, we use the gender mix of children to retrieve exogenous variation in informal care receipt. We find that informal care increases the chance of an admission within a three-year period for individuals with severe functional limitations, and increases the costs incurred on formal home care. For individuals with mild limitations, informal care substantially decreases total care costs, whereas its effect on nursing home admission is unclear. Further, informal care results in lower post-acute care use and hospital care costs, and does not increase mortality. Promoting informal care cannot be expected to systematically result in lower institutionalization rate and care costs, but it may nonetheless induce health benefits for its recipients.

## 1. Introduction

Nursing homes are costly. Besides, most people do not consider them the ideal place to end their days (Nieboer et al., 2010). In line with this, developed countries promote ageing in place, whereby individuals can receive care at home. Delaying a nursing home (NH) entry is also commonly perceived as a way of reducing long-term care (LTC) costs, at a time when public LTC spending is on the rise. In 2017, it amounted to 1.7% of GDP on average in the OECD countries (Hashiguchi and Llana-Nozal, 2020; OECD, 2020). To contain further increases, policy makers also foster the combination of professional LTC and the provision of care by relatives, with partners and adult children being frequently in the front-line (Brunel et al., 2019; Zigante, 2018). Not only informal care is expected to reduce the demand of unskilled formal home care (Bonsang, 2009), but it is also often framed as a way of delaying a NH admission, or altogether preventing it (Zigante, 2018).

Is informal care effective at keeping older individuals longer out of nursing homes? From a theoretical perspective, it is not clear. The risk of a NH admission increases as health and functional status deteriorate (Headen, 1993); thus, if informal care slows down the depreciation of cognitive and functional capabilities (Coe et al., 2019), it can be expected to delay NH admissions. For example, informal care might lead to a reduction of depressive symptoms (Barnay and Juin, 2016), the onset of which is strongly associated with the evolution of functional status (Ormel et al., 2002; Taylor and Lynch, 2004). On the other hand, there may be competing channels through which receiving informal care increases the chance of a NH admission. If individuals benefit from the regular help of a relative for a broad range of activities, they may 'unlearn' how to do them (Bonsang and Bordone, 2013), and hence

\* Correspondence to: Department of economics, San Giobbe, Cannaregio 873, 30121 Venice, Italy.

E-mail address: [jul.bergeot@unive.it](mailto:jul.bergeot@unive.it) (J. Bergeot).

<https://doi.org/10.1016/j.jhealeco.2023.102831>

Received 5 July 2021; Received in revised form 31 May 2023; Accepted 14 October 2023

Available online 20 October 2023

0167-6296/© 2023 The Author(s). Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

become more likely to transition to a NH. Furthermore, informal caregivers may be more likely than other relatives not involved in care provision to correctly assess the frailty of their relative and push for a NH admission. Determining which effects predominate requires an empirical investigation.

This paper assesses how informal care receipt by Dutch older people affects their subsequent NH care use. The Netherlands was for a long time characterized by a high institutionalization rate, fostered by generous public funding of NH care: the share of 65+ residing in institutional care exceeded 7% in 2005 (OECD, 2020). However, in the recent years, Dutch policy makers have promoted ageing in place and encouraged informal care support. Whether the promotion of informal care contributes to containing the institutionalization rate, down to 4.2% in 2017 (OECD, 2020), depends on the extent to which informal support does affect NH admissions.

Evidence of the causal effect of informal care receipt on NH use is scarce and only available in the US context (Van Houtven and Norton, 2004; Charles and Sevak, 2005; Sasso and Johnson, 2002; Newman et al., 1990). To identify a causal effect, these studies use characteristics of one's children as instrumental variables for informal care receipt. All in all, they find that receiving informal care reduces the probability of a NH admission and reduces the length of stays.<sup>1</sup> However, the US stands out for its highly specific health care system. That evidence from US data from the 1980s-1990s is valid for other countries with a different institutional setting is questionable.

We use the Health Monitor, a survey conducted in 2016 on a sample representative of the community-dwelling 65+ Dutch population. With respect to our research, this survey offers four major advantages. First, respondents report whether they receive help with daily activities from their relatives. Second, the Health Monitor is conducted on a large sample, which makes it possible to study outcomes with a relative rare occurrence (e.g., a NH admission). Third, it contains information on functional limitations, along which the effects of informal care may differ. We are thus able to look separately at individuals with mild limitations and those with severe limitations. Fourth, we link the Health Monitor with administrative data, such that we can precisely track NH admissions and mortality between 2017 and 2019, as well as post-acute care use, spending on home care and health care services. Population registers allow us to also retrieve information on respondents' children.

To address the potential endogeneity of informal care in NH use, we estimate a bivariate probit model. Furthermore, we exploit the randomness of the gender mix among children and use it as an instrument for informal care receipt, thereby strengthening identification. We use statistical tests recently proposed in the literature to investigate the validity of the instrument (Kédagni and Mourifié, 2020) and the robustness of the bivariate probit estimates (Altonji et al., 2005).

Using a similar approach, we then assess how informal support affects post-acute care use, mortality, and total health care costs, which encompass nursing home care and substitute home care services as well as medical care spending. In doing so, we shed light on whether a change in the probability of a NH admission has negative spillovers for the care recipient and society, in terms of adverse health effects or higher home care costs. Available evidence on such spillover effects is mixed. Bom et al. (2022) compare Dutch NH residents before and after their admission using an event study approach. They find that a NH admission leads to an increase in loneliness, depression and anxiety and to a loss of control over one's life, but only in the first months following the admission. Further, there is no support that NH admissions increase mortality, neither in the US (Werner et al., 2019), nor in the Netherlands (Bakx et al., 2020) nor in South Korea (Kim and Lim, 2015). Some studies find that a NH admission allows savings on total health care expenditures (Kim and Lim, 2015; Werner et al., 2019), while others (Bakx et al., 2020) do not find support therefor.

We find that, for individuals with severe limitations, informal care receipt *increases* the probability of a NH admission within 3 years. In addition, informal care is found to increase skilled home care costs and total health care costs within 2 years. Mortality is suggested to decline, although the effect is not statistically significant. For individuals with mild limitations, informal care similarly reduces the chance of using post-acute care. Spending on institutional care, but also on skilled home care and health care at large, is found to decrease when older adults with mild limitations receive informal care. Although our results suggest that informal care reduces their chance of a NH admission for this group, the estimates may be driven by functional form assumptions. By contrast, the other bivariate probit estimates appear extremely robust.

We contribute to the existing literature in three main ways. We are the first to document the causal impact of informal care on NH admissions in a European country, disentangling between expected permanent admissions and post-acute care use. By contrast with the US, NH stays in many European countries are mostly made on a permanent basis (Fizzala, 2017; Bom et al., 2023) and the public coverage of LTC is more generous. We therefore expect our results to have a higher contemporaneous policy relevance for European countries than available studies. Second, we add to the literature that quantifies the spillover effects of informal care on formal LTC and health care use (Bonsang, 2009; Balia and Brau, 2014; Bolin et al., 2008; Coe et al., 2019). Third, we find the effects of informal care receipt to vary with the severity of the recipients' functional limitations, which calls for investigating systematically into such a heterogeneity in future research.

Our results imply that fostering informal care receipt does not necessarily result in savings on public health care spending. Yet this does not mean that the monetary and non-monetary benefits of a timely access to NH care fall short of the extra costs.

---

<sup>1</sup> We provide a more detailed literature review that includes *indirect* evidence on the link between informal care receipt and NH use in Appendix A.

## 2. Institutional background

### 2.1. Informal care in the Netherlands

Historically, the Dutch LTC system was classified as one with generous public coverage of LTC services (Kraus et al., 2011). Reliance on informal care was relatively limited, despite the availability of public support to family caregivers.<sup>2</sup> The role assigned to informal care has however changed in the recent years. Coming along with the fostering of ageing in place and cost containment, a ‘normative reorientation’ (Maarse and Jeurissen, 2016) towards a higher role of the support provided by the community has been promoted since the 2015 reform of the LTC system. More than in the past, relatives are expected to take an active role in supporting older adults, especially those whose limitations are not yet severe enough to give them access to NHs.

In 2016, one quarter of the Dutch adults provide informal care (‘mantelzorg’) in a broad sense (including help with activities of daily living, supervision and emotional support) to a relative or friend in the community (De Klerk et al., 2017). Informal caregiving is most frequent among the 45-64 years-old, who are likely to have elderly parents (in-law) with care needs: 8% provide intensive care (more than 8 hours a week), and more than 30% provide non-intensive care. From the perspective of care recipients, in 2019, 11.2% of the 65+ report receiving care from their children.<sup>3</sup>

### 2.2. Publicly-subsidized long-term care

LTC in the Netherlands is financed through three different schemes, providing coverage for institutional care and home care. In what follows, we highlight what the features of the LTC system imply for the empirical study of the effect of informal care on subsequent NH admission and use of substitute formal care options.<sup>4</sup>

We identify six relevant features. First, a NH admission can only follow from a positive eligibility decision. Such a decision is based on a formalized needs assessment, entrusted to an independent agency. Whether someone is eligible depends on whether they have reached a certain cutoff in terms of health and functional limitations, which corresponds to a need of permanent supervision.<sup>5</sup> Second, having informal caregivers should not affect entitlements for such care, but may trigger an application for a need assessment because they can request a need assessment on behalf of their relative. Third, the Dutch system offers well-funded alternatives to a NH admission, including post-acute care provided in institutions and skilled home care covered by the Health Insurance Act as well as social services organized by municipalities (e.g., domestic help, meals-on-wheels, house adaptation, short stays). Fourth, public coverage of formal LTC and health care is fairly generous in the Netherlands, such that the use of purely private care options is extremely limited. This implies that mapping out the use of LTC and health care and the effect of informal care thereon can be achieved by leveraging information on publicly-funded care use.<sup>6</sup>

Fifth, the decentralization of home-based care may generate regional differences in the trade-off between institutional and home-based care, which may correlate with differences in the availability and perception of informal care provision. Finally, the out-of-pocket costs of a NH stay relative to home-based care increase with income and wealth, creating a stronger financial incentive for richer individuals to remain in the community. These two points justify that we control for income and wealth as well as the region of residence when assessing the impact of informal care on NH admission and substitute care use.

## 3. Data and samples

### 3.1. Data sources

Our analysis relies on a large-sample health survey combined with exhaustive administrative register data. The Health Monitor (*Gezondheidsmonitor*) is a cross-sectional survey conducted every four years, jointly by the Municipal Health Services (GGDs) and Statistics Netherlands (CBS). The Health Monitor includes self-reported information on physical and mental health, chronic conditions, functional limitations and mobility restrictions, as well as socio-demographic characteristics (such as age, gender and education). Wave 2016 includes questions about informal care receipt and was conducted between September and December of 2016. One questionnaire is designed specifically for the 65+ population. The target population consists of individuals living in a private household in January 2016.

We then link the Health Monitor to several administrative datasets, based on a unique pseudonymized individual identifier, which we further link with the identifiers of their legal parents to retrieve information on the respondents’ children in the population registers. Appendix C provides further details on each dataset. Table 1 provides an overview of the information retrieved from the Health Monitor and the administrative data.

<sup>2</sup> For example, non-professional caregivers can benefit from advice and counselling, but also from legal entitlements to compensated leave for caregiving purposes (Zigante, 2018). Individuals eligible for LTC services can opt either for in-kind care or for LTC vouchers, which can be used to hire and pay for non-contracted care providers or the relatives involved in informal care provision.

<sup>3</sup> Authors’ own computation based on the SHARE survey, wave 8.

<sup>4</sup> Appendix B provides a more extensive description of the system.

<sup>5</sup> See Bakx et al. (2020) for a detailed description.

<sup>6</sup> In 2019, only 4% of nursing home residents went in a non-regular (for-profit) nursing home, according to the estimates of Bos et al. (2020). Still, these residents can benefit from publicly paid care and thereby be spotted in the administrative data (Tenand et al., 2020b).

**Table 1**  
Content of datasets used.

Source	Variables
<i>Care use and mortality</i>	
Administrative data	Nursing home stays (2016–2019) Mortality (2016–2019) Post-acute care costs (2015–2018) Health care costs (2015–2018) Skilled home care costs (2015–2018) Indicator of social care support (2015–2018)
<i>Explanatory variables and instruments</i>	
Survey data	Informal care receipt Self-assessed health Self-reported health issues/diseases Self-reported functional limitations Education
Administrative data	Date of birth Gender Migrant background Marital status (31-10-2016) Household composition (31-10-2016) Household income (2016) Household wealth (01-01-2016) Health care spending (2015) Number of children alive (31-10-2016) Gender of children Own address (31-10-2016) and distance to closest child (2011) LTC purchasing region

NOTES: 31-10-2016 is the mid-point of the survey collection period.

### 3.2. Informal care receipt

Regarding informal care, the survey respondents are asked whether they currently receive any such care. They are provided with the following definition of informal care: ‘Informal care is care that you receive from a relative or an acquaintance of yours, such as a your partner, parents, child, neighbours or friends, if you have been sick for a long time, in need of help or handicapped. This care may encompass doing house chores, grooming and dressing, keeping company, transport, arranging finances, etc. Informal care is not paid. A volunteer from a non-profit association is not considered an informal caregiver’.<sup>7</sup> We consider an individual receives informal care if they report informal care receipt at the time of the survey.

It is worth noting that existing studies focus on care provided by the offspring. Therefore, the scope of our estimate is partly different from the literature because we identify the effect of informal care receipt irrespective of who the provider is, thus not only care from children.

### 3.3. Nursing home care use and additional outcomes

Our main outcome of interest is nursing home care use. The administrative data record any NH admission, duration of stay and intensity of care provided. The data further allow us to distinguish NH stays from other institutional care (e.g., palliative care, care received in handicap centres). We define NH care use as a dummy equal to 1 if the individual has ever been admitted to a NH between January, 1st 2017 and December, 31st 2019.

Our second outcome is mortality, which is relevant for two reasons: first, it is a competing risk to that of a NH admission (Headen, 1993), such that a lower NH admission rate may arise with higher mortality. Second, mortality effects, all other things equal, are informative of the costs of informal care receipt in terms of individual welfare. We define a dummy variable indicating whether the individual died by the end of 2019. We also assess how informal care receipt affects the probability to use post-acute care in 2017 or 2018. In addition, we estimate how informal care weighs on the use of potential formal substitutes to institutional care, namely (i) municipal social care,<sup>8</sup> and (ii) district nursing care (which we refer to as skilled home care), in any of the two years following the survey.

<sup>7</sup> Authors’ translation. See Appendix C.3 for the original wording (in Dutch) and additional information.

<sup>8</sup> Municipalities may provide *basic* social care, such as domestic help and meals-on-wheels, and *tailored* services, like housing adaptation and day- or temporary stays in nursing homes. Our data only report whether individuals receive *tailored* care. Basic social care is broadly accessible, such that we expect the vast majority of individuals with limitations to be eligible for it.

Finally, we investigate the effect of informal care receipt on care costs incurred over 2017 and 2018.<sup>9</sup> The use of administrative records allows us to compute (i) the cost of old age institutional care,<sup>10</sup> (ii) skilled home care costs and (iii) health care costs, also zooming into hospital spending. We estimate the effect of informal care receipt on each type of formal care but also on total care costs. In doing so, we examine the claim that stimulating care provision by relatives enables savings on formal LTC and medical care.

### 3.4. Control variables

We control for a rich set of individual characteristics that may correlate with both informal care receipt and care use or mortality.<sup>11</sup> We include age, gender and marital status. To control for potential cultural differences relating to informal care and the propensity of formal care use, we include one's migrant background.

Health status is captured by three types of variables. First, the Health Monitor provides self-assessed overall health. Second, it includes self-reported information on more objective measures of health. Third, health care costs in 2015, i.e. the year before the survey, are retrieved from the administrative data and provide additional information on the health status of the respondents.<sup>12</sup> We do not include costs incurred in the year of the survey because informal care receipt might also affect medical care use (Van Houtven and Norton, 2008, 2004), raising endogeneity issues.

In addition, we control for household wealth and household disposable income.<sup>13</sup> We also control for home-ownership by a dummy, as Dutch homeowners are less likely to move to a nursing home than renters, because of a stronger attachment to their residence or more freedom to adapt their house (Rouwendaal and Thomese, 2013).

We also include a set of dummies indicating in which of the 32 LTC purchasing regions the individual lives, so as to capture potential differences in the supply of nursing home care beds across regions.

Finally, in our baseline analysis, we control for characteristics of the children that correlate with informal care receipt: the number of children and the distance to children 5 years before the survey. We use a lagged distance, more likely to be exogenous to formal care use than *contemporaneous* distance (Hiedemann et al., 2018).

### 3.5. Study samples: individuals with severe or mild limitations

The Health Monitor surveyed 242,888 individuals aged 65 or older. We focus on individuals who are potential informal care recipients, by selecting individuals reporting functional limitations or a poor health. Functional limitations are defined following the OECD 7 item list (Lafortune and Balestat, 2007), which includes 2 hearing items, 2 sight items and 3 mobility items.<sup>14</sup> Individuals with limitations represent 57% of the at-home 65+ Dutch population.

Less than 1% of the survey respondents cannot be found in the administrative data. We also delete the few individuals who were in institutional care already during the survey collection period. Given that our empirical strategy exploits children's characteristics, we further exclude individuals with no children alive recorded in the administrative data at the time of the survey (13% of observations). Finally, we drop individuals with missing information on contemporary informal care receipt (9% of observations). After these selection steps, the sample consists of 113,386 individuals.<sup>15</sup>

We posit that informal care has differential impacts on subsequent health, NH admissions and care trajectories depending on initial health capital. Informal care, which is generally unskilled, may be less efficient at preserving the health capital of individuals with high care needs than that of individuals with only mild limitations. The nature of informal care may also vary with the severity of limitations, with informal support to individuals with severe limitations being more likely to take the form of personal care and assistance with activities of daily living. Empirically, the relationship between informal and formal care receipt is found to differ according to the level of limitations (Bonsang, 2009; Balia and Brau, 2014). Furthermore, a caregiver may have a different attitude towards a NH admission whether their parent has severe care needs or only mild limitations.

With these hypotheses in mind, we investigate the effect of informal care receipt on two sub-populations: individuals with severe limitations and individuals with only mild limitations. The former are defined as individuals being unable to perform at least 1 of the 2 hearing items, 1 of the 2 sight items or 1 of the 3 mobility items, or reporting poor or very poor health. Mild limitations refer to any limitation among the 7 OECD items, whatever its severity.

<sup>9</sup> Care costs consists of both public spending and private spending (co-payments for LTC, deductible for health care) incurred on care.

<sup>10</sup> Old age institutional care encompasses NH care strictly speaking as well as palliative care. We compute the duration of each stay with a given care package (ZZP) with the daily national tariff for such a stay. Institutional care costs are derived summing over all stays at the individual level. We also define the costs on nursing home care as a sub-category.

<sup>11</sup> Table 2 shows how the covariates are defined.

<sup>12</sup> Health care costs are those incurred under the Health Care Insurance Act (ZVW). We exclude costs on district nursing care, also funded via this Act, as we use them as a separate outcome, or alternatively as a control variable in some specifications.

<sup>13</sup> We deduct the value of the main residence from the wealth variable, which is equal to all assets minus debts of the household. Income is equalised using the OECD square root equivalence scale, which reflects an economies of scale parameter of 0.41 for a two-adult household (OECD, 2011).

<sup>14</sup> Additional details on the items are provided in Appendix D.2.

<sup>15</sup> Details on sample selection are provided in Appendix D.1, Table D.1.

### 3.6. Descriptive statistics

The descriptive statistics are displayed in Table 2. Column 1 provides the mean characteristics for the full sample, while Columns 3 and 4 display these statistics for the sub-samples of those who receive informal care and those who do not receive any, respectively. In addition, we show the descriptive statistics among individuals with severe and mild limitations in Columns 7 and 9 respectively, so as to provide benchmarks for the estimation results.

As Panel A suggests, a NH admission is a rare event, as only 3.4% of the non-institutionalized 65+ with limitations have been admitted by the end of 2019; this proportion is 6.2% among individuals with severe limitations (Column 7). We also observe in Columns 3 and 5 that the admission rate is much higher among individuals who receive informal care at the time of the survey than among those who do not (13.0% against 1.8%). Unconditional old-age institutional care costs represent only a small fraction of total care costs (€1,084 on average over 2017–2018, against €16,319), which justifies that we assess the effect of informal care on care costs at large.

Regarding informal care receipt, 14.2% of the population declare receiving some (Panel B); this share is much higher among individuals with severe than among those with mild limitations (27.0% versus 4.5%).

As expected, the share of daughters is close to 50%, with substantial cross-individual variation (Panel C). The distribution of the covariates is displayed in Panel D. The figures confirm that individuals who receives informal care are older, with a more deteriorated health through the occurrence of functional limitations, chronic illness, poor self-declared health or higher health care costs. Women receive more often informal care, but this might also be due to the fact that being a widow(er) increases the chances of receiving informal care, and that widowhood is more frequent among women. On the contrary, individuals with higher income or wealth appear less likely to receive informal care.

## 4. Empirical approach

### 4.1. A recursive bivariate probit model for binary outcomes

We present our estimation method for binary outcomes, namely the probability of being admitted to a NH, mortality, any post-acute care use and home care use. We explain the model taking the probability of a NH admission as the outcome, but the same approach is used for all other binary outcomes.

We define  $y_i^*$  a latent variable capturing the propensity to use NH care in the years following the survey for individual  $i$ . We assume it can be expressed as:

$$y_i^* = X_{i2016}^y \beta_1 + \beta_2 IC_{i2016} + v_i \quad (1)$$

where  $IC_{i2016}$  is the dummy for informal care receipt.  $X_{i2016}$  is a vector of control variables observed at the time of the survey.  $y_i^*$  cannot be observed, but we observe whether individuals have entered a NH ( $y_i = 1$ ), or not ( $y_i = 0$ ). We assume the following observational scheme:

$$\begin{cases} y_i = 0 & \text{if } y_i^* \leq 0 \\ y_i = 1 & \text{if } y_i^* > 0 \end{cases}$$

Further, we assume that the latent variable  $IC_{i2016}^*$  captures the propensity to receive informal care and can be expressed as:

$$IC_{i2016}^* = X_{i2016}^{IC} \gamma_1 + u_i \quad (2)$$

where  $X^{IC}$  and  $u_i$  are respectively observed and unobserved determinants of informal care receipt for individual  $i$ . We assume that:

$$\begin{cases} IC_{i2016} = 0 & \text{if } IC_{i2016}^* \leq 0 \\ IC_{i2016} = 1 & \text{if } IC_{i2016}^* > 0 \end{cases}$$

$\beta_2$  in Eq. (1) is our main parameter of interest: it represents the effect of informal care receipt on the propensity to use NH care in the subsequent years. However, estimating Eq. (1) may result in biased estimates:  $IC_{i2016}$  may be endogenous if some of the unobserved determinants of informal care receipt, like health issues or preferences over alternative care options, also affect the propensity to use NH care, and generate unwarranted correlation between  $v_i$  and  $IC_{i2016}$  (Jones, 2000).

In order to address endogeneity, we jointly estimate Eqs. (1) and (2) through a maximum likelihood estimation of a recursive bivariate probit model. The estimation relies on the parametric assumption that the error terms of the two equations jointly follow a bivariate normal distribution with means of 0 and a correlation denoted  $\rho$ . The average treatment effect (ATE) of informal care on NH use, which is our *treatment* parameter of interest, is defined as:

$$ATE^{bin} = E [P(y = 1 | IC = 1, X^y)] - E [P(y = 1 | IC = 0, X^y)] \quad (3)$$

Without exclusion restrictions, i.e. when the two sets of regressors  $X^y$  and  $X^{IC}$  perfectly overlap, the parameters  $\beta_1$ ,  $\beta_2$ ,  $\gamma_1$  and  $\rho$  underlying the ATEs are not point identified (Mourifié and Méango, 2014; Han and Vytlačil, 2017). We achieve the point identification using an exclusion restriction, i.e. an instrument  $Z_i$  that affects  $y_i^*$  only via its impact on informal care receipt. We present this instrument in Section 4.3.

**Table 2**  
Descriptive statistics.

Sample	Full sample						With severe limitations		With mild limitations	
	All		With IC		Without IC		All		All	
	Mean (1)	Std. (2)	Mean (3)	Std. (4)	Mean (5)	Std. (6)	Mean (7)	Std. (8)	Mean (9)	Std. (10)
<b>Panel A: Outcomes</b>										
Any nursing home use (2017–2019)	0.034		0.130		0.018		0.062		0.013	
Dead by the end of 2019	0.101		0.265		0.074		0.163		0.055	
Any post-acute care use (2017–2018)	0.035		0.078		0.028		0.056		0.019	
Any skilled home care use (2017–2018)	0.176		0.436		0.133		0.281		0.098	
Any social care use (2017–2018)	0.153		0.428		0.107		0.274		0.062	
Total care costs (2017–2018)	16 319	28 101	38 031	44 729	12 726	22 323	24 567	35 729	10 135	18 313
Costs of old-age institutional care (2017–2018)	1084	9437	4846	20 046	462.0	5880	2093	13 119	328.0	5047
Costs of skilled home care (2017–2018)	1941	7289	7753	14 268	979.7	4660	3797	10 234	550.1	3149
Health care costs (2017–2018)	13 293	21 137	25 431	29 983	11 284	18 534	18 676	25 730	9256	15 728
<b>Panel B: Informal care receipt</b>										
Informal care receipt	0.142		1		0		0.270		0.045	
<b>Panel C: Characteristics of children</b>										
Proportion of daughters	0.492	0.352	0.507	0.341	0.489	0.354	0.493	0.351	0.491	0.352
Number of children	2.418	1.137	2.689	1.428	2.373	1.075	2.497	1.254	2.359	1.037
Closest child is co-resident	0.081		0.076		0.082		0.079		0.082	
Closest child in the same municipality	0.569		0.628		0.559		0.594		0.550	
Closest child in a different municipality	0.349		0.295		0.357		0.325		0.366	
<b>Panel D: Covariates</b>										
Is a woman	0.527		0.656		0.506		0.589		0.482	
Never married or separated	0.072		0.054		0.075		0.081		0.066	
Widow	0.243		0.413		0.215		0.310		0.193	
Married or in a registered partnership	0.663		0.507		0.689		0.585		0.722	
Age: [65-70[	0.256		0.121		0.278		0.200		0.298	
Age: [70-75[	0.252		0.154		0.268		0.214		0.281	
Age: [75-80[	0.218		0.189		0.223		0.212		0.223	
Age: [80-85[	0.160		0.231		0.148		0.194		0.135	
Age: [85-90[	0.082		0.194		0.064		0.124		0.051	
Age: [90-95[	0.025		0.089		0.014		0.045		0.009	
Age: 95+	0.003		0.018		0.001		0.008		0.000	
Origin: Dutch	0.889		0.883		0.890		0.873		0.901	
Origin: Western country	0.088		0.089		0.087		0.092		0.085	
Origin: non-Western country	0.022		0.027		0.021		0.033		0.013	
Education: none	0.035		0.058		0.031		0.055		0.020	
Education: primary/intermediate secondary	0.549		0.612		0.538		0.593		0.515	
Education: higher secondary	0.200		0.158		0.207		0.170		0.222	
Education: higher	0.160		0.105		0.169		0.113		0.195	
Education: missing	0.054		0.064		0.053		0.066		0.046	
Income: quartile 1	0.293		0.399		0.276		0.373		0.233	
Income: quartile 2	0.272		0.285		0.270		0.283		0.265	
Income: quartile 3	0.235		0.182		0.244		0.201		0.261	
Income: quartile 4	0.197		0.132		0.208		0.141		0.239	
Wealth: quartile 1	0.223		0.155		0.234		0.179		0.255	
Wealth: quartile 2	0.283		0.342		0.273		0.344		0.237	
Wealth: quartile 3	0.270		0.307		0.264		0.284		0.260	
Wealth: quartile 4	0.222		0.194		0.227		0.191		0.246	
Is a homeowner	0.602		0.471		0.624		0.502		0.677	
Hearing limitations: no	0.855		0.739		0.874		0.682		0.984	
Hearing limitations: yes	0.125		0.241		0.106		0.293		0	
Hearing limitation: missing	0.018		0.018		0.018		0.023		0.015	
Sight limitations: no	0.876		0.770		0.894		0.721		0.993	
Sight limitations: yes	0.114		0.217		0.097		0.266		0	
Sight limitations: missing	0.008		0.011		0.008		0.011		0.006	
Mobility limitations: no	0.693		0.272		0.763		0.297		0.990	
Mobility limitations: yes	0.298		0.720		0.228		0.696		0	
Mobility limitations: missing	0.008		0.007		0.008		0.006		0.009	

(continued on next page)

Table 2 (continued).

Sample	Full sample						With severe limitations		With mild limitations	
	All		With IC		Without IC		All		All	
Sub-sample	Mean (1)	Std. (2)	Mean (3)	Std. (4)	Mean (5)	Std. (6)	Mean (7)	Std. (8)	Mean (9)	Std. (10)
Health: poor/very poor	0.084		0.252		0.056		0.197		0	
Health: average	0.402		0.553		0.377		0.504		0.326	
Health: good/very good	0.506		0.184		0.559		0.290		0.668	
Health: missing	0.006		0.009		0.005		0.007		0.005	
Chronic illness: no	0.411		0.162		0.452		0.259		0.524	
Chronic illness: yes	0.574		0.823		0.533		0.724		0.462	
Chronic illness: missing	0.014		0.014		0.014		0.015		0.013	
Costs on GP care in 2015	215.5	141.3	283.7	209.8	204.2	122.8	245.5	169.9	192.9	110.0
Costs on drug care in 2015	665.6	2164	1276	4013	564.6	1649	955.6	3056	448.2	1039
Costs on auxiliary care in 2015	283	807.9	642.1	1330	224.7	665.7	426.2	1018	177.3	581.5
Costs on hospital care in 2015	2778	7911	5214	13 453	2375	6469	3747	9938	2051	5850

SAMPLE: Health Monitor, 65+ respondents living in the community, with at least one child alive and functional limitations (N=113,386).

NOTES: Statistics are computed using survey weights. IC stands for informal care receipt. Costs are expressed in current euros. Standard deviations are omitted for dummy variables.

#### 4.2. A control function approach for continuous outcomes

To investigate the effect of informal care on care costs, we use a control function approach that consists of a two-stage estimation procedure (Wooldridge, 2014, 2015). Details are provided in Appendix F. We use a Poisson quasi maximum likelihood estimator (also called pseudo Poisson maximum likelihood or PPML) to model the second stage, i.e. care costs as a function of informal care. This estimator is a consistent estimator of the average effect of informal care receipt on the expected value of the outcome and behaves well irrespective of the proportion of zeros on the outcome and the form of heteroskedasticity (Santos Silva and Tenreiro, 2011). This estimator also requires an instrumental variable to identify a causal effect. We use the same instrument as for the bivariate probit.

#### 4.3. Instrumenting informal care by the proportion of daughters

The instrument must satisfy two conditions: (i) it must be relevant, i.e. correlate with informal care receipt; (ii) it must be as good as random, i.e. affect the propensity to use care, or die, only via its impact on informal care receipt and be uncorrelated with omitted variables (exclusion restriction).

The economic literature has proposed a number of instruments for informal care receipt. Drawing on previous studies (Bonsang, 2009; Van Houtven and Norton, 2004; Charles and Sevak, 2005; Sasso and Johnson, 2002), we use the gender mix of children. The relevance condition is supported by the positive relationship between informal care receipt and the proportion of daughters. In previous studies, daughters have been found to be more likely to provide informal care than sons (Byrne et al., 2009; Carmichael and Charles, 2003).<sup>16</sup> In Table 3, we show the – positive – coefficient from a probit regression of informal care receipt on the proportion of daughters. In addition, we have run instead a linear regression and computed the F-statistics on the excluded instrument. These results confirm that the proportion of daughters is a relevant instrument, relatively more so in the sample of individuals with severe limitations (F-stat = 31.6) than in the sample with mild limitations (F-stat = 16.5). Among individuals with severe limitations, the predicted probability of informal care receipt (when controlling for covariates) among individuals is less than 26% for individuals with no daughter, but exceeds 28% for those who have only daughters. A similar relationship is found among individuals with mild limitations.<sup>17</sup>

Regarding the exclusion restriction, there is no evidence that in the Netherlands the gender of births could be manipulated. The proportion of daughters – conditional on the number of children – is therefore expected to be random and have no direct effect on care use and mortality. Further, we implement the test proposed by Kédagni and Mourifié (2020). The authors derive necessary and sufficient conditions to detect “all observable violations” from the statistical independence assumption,<sup>18</sup> when the outcome is binary and the instrument is not. To implement the test, we randomly split each sample in groups of equal size due to computational constraints.<sup>19</sup> We provide the test statistic at the 95% confidence level in Table 4. A negative value indicates that the test does not detect violations from the instrumental variable assumptions. The test results indicate no violations, for both nursing home and post-acute care use. We are therefore confident that the proportion of daughters is a valid instrument.

<sup>16</sup> The main reasons evoked in the literature are a lower opportunity cost for women (Byrne et al., 2009; Carmichael and Charles, 2003), a higher effectiveness in caregiving, a lower disutility of caregiving (Byrne et al., 2009) and gender norms (Barigozzi et al., 2020).

<sup>17</sup> In Appendix G.1, we display graphically the predicted probability of informal care receipt as a function of the proportion of daughters.

<sup>18</sup> This assumption states that the instrument is independent to potential outcomes. It is a weaker assumption than the random assignment assumption.

<sup>19</sup> To implement the test, we use the replication file available on the authors' website and the `clrbound` Stata package by Chernozhukov et al. (2015).



**Table 3**  
First stage coefficients of the proportion of daughters on informal care receipt.

Population	Full population		Individuals with severe limitations		Individuals with mild limitations	
	(1)	(2)	(3)	(4)	(5)	(6)
Proportion of daughters	0.102*** (0.016)		0.107*** (0.027)		0.103*** (0.019)	
F-stat	49.6		31.6		16.5	
Pseudo $R^2$	0.275		0.179		0.152	
Control variables	Yes		Yes		Yes	
Region fixed effects	Yes		Yes		Yes	
N	113,386		48,588		64,798	

SAMPLE: Health Monitor, 65+ respondents living in the community, with at least one child alive and functional limitations (N=113,386).

NOTES: Estimated coefficients of the proportion of daughters obtained from a probit regression of informal care receipt and including covariates. The first stage F-statistic is computed from a OLS regression, while the pseudo  $R^2$  is obtained from the probit regression.

**Table 4**  
Test statistics from the generalized instrumental variable inequality test.

	Severe limitations		Mild limitations		
	group 1	group 2	group 1	group 2	group 3
	(1)	(2)	(3)	(4)	(5)
NH use	-0.277	-0.289	-0.048	-0.047	-0.046
Post acute care	-0.283	-0.274	-0.049	-0.051	-0.056

SAMPLE: Health Monitor, 65+ respondents living in the community, with at least one child alive and functional limitations (N=113,386).

NOTES: This Table reports the test statistic at the 95% confidence level from the generalized instrumental variable test proposed by Kédagni and Mourifié (2020). A negative value indicates the test does not detect violations from the instrumental variable assumptions. We have randomly split each sample in groups of equal size. Therefore, each groups is a random sub-sample. The groups do not overlap.

**Table 5**  
Average treatment effect of informal care receipt on the probability to enter a nursing home, depending on the severity of limitations.

Population	Full population		Individuals with severe limitations		Individuals with mild limitations	
	(1)	(2)	(3)	(4)	(5)	(6)
IC can be endogenous	No	Yes	No	Yes	No	Yes
Instruments	-	% daughters	-	% daughters	-	% daughters
ATE	0.039*** (0.002)	0.002 (0.004)	0.058*** (0.003)	0.029*** (0.009)	0.028*** (0.003)	-0.013*** (0.003)
$\rho$		0.285*** (0.039)		0.609*** (0.067)		0.139*** (0.047)
N	113,386	113,386	48,588	48,588	64,798	64,798

SAMPLE: Health Monitor 65+ respondents living in the community, with at least one child alive and functional limitations (N=113,386).

NOTES: ATE stands for the mean average treatment effect of informal care receipt at the time of the survey (IC) on the probability of being admitted to a nursing home between January 1st, 2017 and December 31st, 2019. Estimation of a bivariate probit model, including covariates, under two alternative hypotheses: in Columns (1), (3) and (5), informal care is assumed to be exogenous. In Columns (2), (4) and (6), informal care is allowed to be endogenous and instrumented by the proportion of daughters.

## 5. Results

### 5.1. The effect of informal care receipt on nursing home care use

Table 5 displays the average treatment effect (ATE) of informal care receipt on NH use, for the full population with functional limitations (columns 1 and 2), for individuals with severe limitations (columns 3 and 4) and for individuals with mild limitations (columns 5 and 6). For each population, two estimates are displayed. In columns 1, 3 and 5, informal care receipt is assumed to be exogenous (the correlation of unobserved heterogeneity  $\rho$  is set to 0). In columns 2, 4 and 6, we relax this constraint, and instrument informal care by the proportion of daughters.

The results differ depending on whether informal care receipt is assumed to be exogenous or not. When assuming exogeneity, informal care receipt is predicted to *increase* NH care use whether functional limitations are severe or mild. However, in the even columns,  $\rho$  is statistically significantly different from 0 and positive, which indicates that unobserved factors correlating with

**Table 6**

Average treatment effect of informal care receipt on nursing home use by subgroups.

Population	Individuals with mild limitations	Individuals with severe limitations
IC can be endogenous	Yes	Yes
	(1)	(2)
Women	−0.013*** (0.005)	0.073*** (0.016)
F-stat > 10	Yes	Yes
Men	−0.015*** (0.003)	−0.003 (0.009)
F-stat > 10	No	Yes
Singles	−0.009 (0.022)	0.082*** (0.026)
F-stat > 10	Yes	Yes
Couple	−0.006* (0.004)	0.006 (0.009)
F-stat > 10	No	No
Income below median	−0.012** (0.005)	0.043*** (0.013)
F-stat > 10	Yes	Yes
Income above median	−0.012*** (0.004)	0.013 (0.013)
F-stat > 10	No	Yes

SAMPLE: Health Monitor, 65+ respondents living in the community, with at least one child alive and functional limitations (N=113,386).

NOTES: This table reports the average treatment effect of informal care receipt at the time of the survey (IC) on the probability of being admitted to nursing home care between January 1st, 2017 and December 31st, 2019. Estimation of a bivariate probit model, including covariates, in which informal care is allowed to be endogenous and instrumented by the proportion of daughters.

informal care receipt tend to be positively associated with unobserved determinants of NH care use (think about unobserved health factors). Therefore, our preferred specification is the one allowing for informal care to be endogenous.

Looking at the full population, we find a point estimate very close to 0, but this hides striking heterogeneity. For individuals with severe limitations, informal care receipt is predicted to *increase* the probability of a NH admission by 2.9 percentage points (relative to a 6.3% mean chance of admission). At the 5% we cannot rule out an ATE as low as 1.1%-pt and as high as 4.7%-pt, but we can reject it is null even at the 1% level. Among those mild limitations, informal care is instead predicted to *decrease* the probability of a NH admission by 1.3%-pt (mean is 1.3%).

We briefly comment on the effects of the covariates, for which we report the raw coefficients in Table H.1 (Appendix H.1). As expected, the probability of transitioning into a NH increases with age, the presence of a chronic disease and past health care expenditures, but decreases with better self-reported health. We also find that being in the top income quartile and home-ownership decrease the probability of an admission, while wealth has a non-monotonous effect, as found in [Tenand et al. \(2020a\)](#). Having an immigration background from a non-Western country decreases the probability of transitioning into a NH for individuals with severe limitations.

### 5.2. Heterogeneity by gender, marital status and income

We now investigate whether the effect of informal care on NH use differs across observable characteristics, other than the severity of functional limitations.

First, we hypothesize that informal care receipt may affect health and health care use differently for men and women. Older women are more likely to be widows or have an older and less healthy spouse than men are; women are therefore more likely to be helped by their children, while men more often receive care from their partner ([Byrne et al., 2009](#)). This would imply that women and men tend to be helped with different types of tasks and with varying intensity.

We stratify the sample by gender and by marital status,<sup>20</sup> and estimate the effect of informal care use on NH use. Estimates are presented in [Table 6](#). We find that among individuals with severe limitations, informal care significantly increases NH care use for women but has no effects for men. This could reflect that men are more likely to receive (intensive) care from a partner and stay at home, while women are more likely to be helped by children, with less hours provided. This result is in line with our finding that there is a strong positive effect for those individuals with severe limitations who are single.

We also investigate heterogeneity by income. We find that informal care increases the probability of being admitted to a NH only for those who are below the median income and have severe limitations. For those in the top 50% of the income distribution,

<sup>20</sup> Due to lack of statistical power, we are not able to interact gender with marital status.

**Table 7**  
Average treatment effect of informal care receipt on post-acute care use and mortality.

Population	Full population		Individuals with severe limitations		Individuals with mild limitations	
	(1)	(2)	(3)	(4)	(5)	(6)
IC can be endogenous	No	Yes	No	Yes	No	Yes
Instruments	–	% daughters	–	% daughters	–	% daughters
<i>Panel A: Post-acute care use</i>						
ATE	0.011*** (0.003)	–0.028*** (0.007)	0.006*** (0.002)	–0.032*** (0.003)	0.004* (0.002)	–0.024*** (0.005)
<i>Panel B: Mortality</i>						
ATE	0.051*** (0.003)	–0.013 (0.016)	0.070*** (0.004)	–0.051 (0.038)	0.034*** (0.005)	–0.023 (0.020)
N	113,386	113,386	48,588	48,588	64,798	64,798

SAMPLE: Health Monitor, 65+ respondents living in the community, with at least one child alive and functional limitations (N=113,386).

NOTES: ATE stands for the mean average treatment effect of informal care receipt at the time of the survey (IC) on the probability of being admitted to post-acute care between January 1st 2017 and December 31st 2019 (Panel A), and having used post-acute care January 1st 2017 and December 31st 2018 (Panel B). Estimation of a bivariate probit model, including covariates, under two alternative hypotheses: in Columns (1), (3) and (5), informal care is assumed to be exogenous. In Columns (2), (4) and (6), informal care is allowed to be endogenous and instrumented by the proportion of daughters.

there is no significant effect. These results might be explained by individuals with higher economic resources being more able to adapt their house, as shown by [Diepstraten et al. \(2020\)](#) in the Dutch context.

### 5.3. The effect of informal care on post-acute care use and mortality

Our finding that informal care receipt may foster a NH admission contrasts with available evidence. One hypothesis is that ‘nursing home care’ has a specific definition in the US context and data. The US studies capture the effect of informal care on an outcome that combines two types of stays: admissions with an expected *permanent* nature, and admissions to facilities providing post-acute and rehabilitative care, with an expected *temporary* nature.<sup>21</sup> The estimates of Section 5.1 are evidence of how informal care receipt affects *permanent* admissions.<sup>22</sup>

To better compare our findings with the US literature, we additionally estimate the effect of informal care on the probability of using post-acute care. [Table 7](#) shows the ATEs for the three populations, whether endogeneity of informal care in post-acute care is addressed or not. When correcting for endogeneity, informal care is predicted to *decrease* the probability of using post-acute care, by –2.4%-pt and –3.2%-pt for those with mild and severe limitations respectively (both statistically significant at the 1% level). 3.5% individuals have used post-acute care in 2017 or 2018 (2.0% among individuals with mild limitations and 5.7% among those with severe limitations; cf. [Table 2](#)), such that the effect of informal care proves to be substantial.

This effect has two potential explanations: either informal care receipt lowers the occurrence of adverse health events that necessitate post-acute care; or it results in a lower use of such care when an adverse health event occurs, for example because the presence of informal caregivers makes at-home recovery a more feasible option. Whatever the prevailing mechanism, we can interpret the reduction in post-acute care use as a positive effect of informal care in terms of the health and well-being of the care recipient, under two conditions: first, that avoidable admissions to a rehabilitation facility prove detrimental to the well-being of older patients ([Atwal et al., 2007](#)); second, that informal care does not translate into a higher mortality risk.<sup>23</sup>

We test this second condition empirically. We estimate the causal impact of informal care on 3-year mortality (at 10.2% in the study population). As shown in [Table 7](#), the ATEs are quite imprecisely estimated when we address the endogeneity of informal care, such that we cannot reject a null effect even at the 10% level. However, all point estimates are negative. There is therefore no evidence that informal care receipt results in an increase in mortality. This result points towards informal care receipt having a beneficial effect on recipients through the lower use of post-acute care use. It also alleviates the concern that the enhanced chance of a NH admission among individuals with severe limitations would come at the cost of increased mortality.

<sup>21</sup> The definition in the Health and Retirement Survey (HRS), on which [Charles and Sevak \(2005\)](#), [Sasso and Johnson \(2002\)](#), [Van Houtven and Norton \(2004\)](#) rely, encompasses any overnight stay in ‘a nursing home, convalescent home, or other long-term health care facility’. It is expected to include rehabilitative care and skilled nursing care facilities (SNFs), where elderly patients with a temporary health condition or discharged from a hospital stay can be admitted temporarily. [Hackmann and Pohl \(2018\)](#) leverage register data from four US states and document that the rate of discharges to the community for stays in SNFs is 45%. Using comparable data from the US and the Netherlands, [Bom et al. \(2023\)](#) shows that the probability of *any* NH admission is higher in the US than in the Netherlands even when controlling for disability, but the probability of a prolonged stay (over 100 days) is substantially higher in the Netherlands than in the US.

<sup>22</sup> Appendix E.2 provides additional descriptive statistics on NH stays, showing that, in the Netherlands, only a minority of the 65+ admitted to a NH with an indication for a permanent stay are eventually discharged.

<sup>23</sup> Note that if informal care increases mortality, a reduction in post-acute care use over the period could mechanically arise, even in the absence of a decrease in post-acute care use at a given time.

**Table 8**  
Average treatment effect of informal care receipt on subsequent care costs, depending on the severity limitations.

	Institutional care (1)	Home care (2)	Medical care (3)	Total care (4)
<i>Panel A: Population with severe limitations (N=45,588)</i>				
ATE	312.356 (1180.119)	4,681.022*** (1077.898)	1,909.897 (4441.085)	1,0017.895* (5771.065)
<i>Panel B: Population with mild limitations (N=64,798)</i>				
ATE	-1,042.417*** (283.027)	-812.480*** (177.472)	-7,890.221*** (1392.417)	-6,581.981*** (1536.769)

SAMPLE: Health Monitor, 65+ respondents living in the community, with at least one child alive and functional limitations (N=113,386).

NOTES: The Table reports the average treatment effect (ATE) of informal care receipt on different costs incurred over 2017 and 2018. Costs are expressed in current euros. Estimation of a control function model combining a probit regression and a Poisson regression, instrumenting informal care receipt by the proportion of daughters. All specifications include control variables.

#### 5.4. Effect of informal care receipt on care costs

To better understand the mechanisms at play and bring the societal perspective into the picture, we turn to examining how informal care impacts on health care costs.

Table 8 shows the ATEs of informal care on care costs incurred in 2017 and 2018, among individuals with severe limitations (Panel A) and individuals with mild limitations (Panel B). Total care costs are broken down into three main categories: (1) costs of old-age institutional care, (2) skilled home care and (3) medical care. On average, care costs incurred in 2017–2018 reach €25,000 for individuals with severe limitations and 2.5 times less for individuals with mild limitations, with substantial heterogeneity within each population (cf. Panel A, Table 2).

For individuals with severe limitations, informal care is predicted to increase total care costs. The 90% confidence interval is however wide: it ranges from €500 to €19,500. The increment in skilled home care costs is statistically different from 0 at the 1% level: informal care receipt would increase these costs by about €5,000, or 0.5 of a standard deviation for this population.

The ATE on institutional care is very close to 0, possibly because NH residents maintain a better health when they received prior informal care.<sup>24</sup>

While total health care costs are suggested to increase with informal care, zooming in on hospital care costs (Panel A of Figure H.1, Appendix H.2) reveals a strong negative effect of informal care, which brings further support to the hypothesis that informal care contributes to preserving the health of recipients even at high level of limitations.

For individuals with mild limitations, ATEs are much more precisely estimated and allow to conclude that informal care generates across-the-board cost savings: reduction in costs on nursing home care and skilled home care are of a small magnitude (in line with the low use of such care in this population) while informal care is predicted to significantly decrease subsequent medical care costs. Savings on total costs would amount to €6,500. Informal care provision to individuals with mild limitations seems to preserve their health capital, and ultimately helps reducing health care use.

## 6. Validity and robustness checks

### 6.1. Alternative stratification of the sample

In the baseline, we distinguish between two populations based on the severity of their *functional status*, which is conceptualized as the primary determinant of long-term care needs (World Health Organization, 2002). We have also tested an alternative stratification based on *health status*. Self-reported health is however prone to reporting heterogeneity (Bago d'Uva et al., 2008). To tackle this issue, we draw inspiration from Bonsang (2009): we use a health score predicted based on a regression of self-assessed health on other health indicators and functional limitations.

A detailed explanation can be found in Appendix I.5. There are two discontinuities in the distribution of the health score (Figure I.6), based on which we group the sample into three groups (poor health, intermediary health and good health). As shown in Table I.VI, virtually all individuals in the group with poor health have severe limitations. The group with intermediary health includes 60% of individuals with mild limitations and 40% with severe limitations. Therefore, this group is a mix of the two groups from our baseline stratification. Finally, the group with good health is mainly composed of individuals with mild limitations (84%).

The estimates from the bivariate probit model on these sub-groups are presented in Table 9. In the sample of individuals with a good health (column 1), we run into a problem of weak instrument. We therefore disregard the results for this sample.

For individuals with an intermediary health score, the results are very similar to the estimates we obtain for individuals with mild limitations, for both NH admissions and post-acute care use (column 2). Regarding individuals with a poor health score, the ATE

<sup>24</sup> In a NH, the daily rate is higher when the patient has lower health or functional status, cf. Appendix C.

**Table 9**  
Average treatment effect of IC receipt on binary outcomes with alternative stratification of the sample.

	Good health (1)	Intermediary health (2)	Poor health (3)
Panel A: NH use			
ATE	-0.015*** (0.006)	-0.011* (0.006)	0.065*** (0.024)
Panel B: Post-acute care			
ATE	-0.015** (0.006)	-0.036*** (0.007)	0.005 (0.019)
F-stat > 10	No	Yes	Yes

SAMPLE: Health Monitor, 65+ respondents living in the community, with at least one child alive and functional limitations (N=113,386).

NOTES: Estimation of a bivariate probit model, using the percentage of daughters as instrumental variable, under a different stratification of the sample that is based on a health score. F-statistics on the excluded instrument in the linear regression of informal care receipt on the covariates.

on NH use (column 3, panel A) is about twice larger than our baseline estimate in the group of individuals with severe limitations (0.29). With respect to post-acute care use, we do not find any significant effect and the point estimate is very close to zero.

These additional estimates confirm that informal care receipt increases the chance of a NH admission among individuals with a fairly depleted health capital. Compared with our baseline estimates, they suggest that the combination of a poor health condition with functional limitations enhances the positive effect of informal care receipt on NH admissions. This finding is in line with the hypothesis that informal caregivers facilitate a NH admission when they identify that their relative has a high care need. Informal care is however not effective at preventing post-acute care use for older individuals with poor health. This is expected, as the care provided informally is unlikely to be skilled enough when medical care needs are high, to prevent further health shocks or to allow a recovery at home.

## 6.2. Robustness to the use of alternative instruments

We use the gender mix of children as our baseline instrument, assuming a linear relationship between the proportion of daughters and informal care receipt. We check that our results are robust to alternative functional forms for the gender mix, namely having a daughter or not and the proportion of daughters as a categorical variable. ATEs are very similar (cf. Tables I.I and I.II, Appendix I.2).

We also test alternative instruments, namely the number of children and their geographical distance. Empirically, the more children and the closer they are, the higher the probability of informal care (see Figure G.4 in Appendix G.2). Previous literature have used these variables as instruments for informal care in studying formal home care use or NH admissions (see e.g., [Bonsang, 2009](#); [Stern, 1995](#); [Charles and Sevak, 2005](#)). We replicate the bivariate probit estimations on binary outcomes and the Poisson control function estimations on continuous outcomes with these instruments. As shown in Appendix I.2 (Figures I.4 and I.5), the ATEs are very close to the baseline.

All our instruments impose us to focus on individuals *with* children, such that our estimates should be read as the average treatment effect (ATE) in this population. We expect this not to reduce excessively the policy relevance of our results, because nine out of ten of the 65+ have a child alive. Further, options to stimulate informal care among those *without* children, for whom the spouse is the main source of care and is very often involved if their health makes it possible, are arguably more limited. As stated earlier, we depart from previous studies, which focus on care provided by the offspring. Those studies also mostly rely on a linear two-stage regression, or 2SLS, which is documented to identify a local ATE, or LATE (see below).

## 6.3. Robustness of the bivariate probit estimation

Our main estimates derive from a recursive bivariate probit. A 2SLS estimation is an alternative approach that does not require any distributional assumption on the error terms. However, we did not retain this estimator because of its poor performance when the probability of treatment is low ( $\leq 10\%$ ). It returns very large standard errors, as shown by [Chiburis et al. \(2012\)](#), such that statistical tests become uninformative. Even for a relatively large sample size, the 2SLS estimate remains biased ([Chiburis et al., 2012](#)). In addition, it would provide the ATE among compliers (LATE) rather than the ATE, which in our context would have limited policy relevance ([Angrist and Pischke, 2008](#)).<sup>25</sup>

Finally, the bivariate probit has been shown to be robust to a range of mis-specifications. [Denzer \(2020\)](#) find that the non-linear maximum likelihood recursive bivariate probit estimator dominates in a majority of scenarios, even if the corresponding parametric assumptions are not fulfilled. Nonetheless, [Altonji et al. \(2005\)](#) provided an informal test to assess whether “the source of

<sup>25</sup> Out of completeness, we provide the 2SLS estimates in Table I.4, Appendix I.4. They show large *positive* treatment effects of informal care on NH use, with extremely wide standard errors.

identification is primarily coming from the exclusion restrictions or primarily coming from the functional form restrictions” (Altonji et al., 2005). We present the test in details and the results obtained from its implementation in Appendix I.3.

It is not possible to compare directly the parameters estimated with this test with the bivariate probit estimate. We therefore focus on their sign and relative magnitude. Regarding NH use for individuals with severe limitations, the variation coming from the instrument is positive, whereas the variation induced by the functional form assumptions is negative. This implies that the positive sign of the ATE is not driven by the functional form assumption, which could instead lead to the ATE being underestimated. For individuals with mild limitations, the negative estimate for NH use appears to be mainly driven by functional form assumptions. Indeed, the variation induced by the instrument is positive while the variation induced by the functional form is negative. Regarding post-acute care use, both sources of variation point towards a reduction in use, in both samples.

All in all, these results confirm the robustness of the negative effect of informal care receipt on post-acute care use, which seems driven by arguably exogenous variation. Similarly, our key, novel result that informal care receipt increases the chance of a NH admission for individuals with severe limitations appears very robust. On the other hand, the result that individuals with mild limitations are less likely to enter a NH when receiving informal care, which echoes previous findings from the US literature, is subject to caution.

#### 6.4. Additional robustness tests

##### *Contemporaneous use of home care*

So far, our analysis has left aside the fact that individuals in the community may benefit from skilled home care as well as from social care (cf. Section 2). If informal care and home care are substitute (resp. complement), individuals who receive informal care would tend to receive less (resp. more) formal home care, which could *per se* have an impact on subsequent health and NH admission. Especially when limitations are severe, informal care tends to be associated with formal home care.<sup>26</sup> Therefore, not considering contemporaneous formal care might induce an omitted variable bias in our estimates.

We check the robustness of the baseline estimates to the inclusion of *contemporaneous* social care and skilled home care receipt. The point estimates are roughly unchanged (see Appendix I.1). Although this test does not formally address the potential endogeneity of formal home care, it points towards the positive effect of informal care receipt on NH admissions not being driven by a lower use of skilled home care (among those with severe limitations).

##### *Competing risk model*

Because individuals may die before using NH care, mortality can be considered as a competing risk that reduces the occurrence of NH use (Berry et al., 2010). If informal care receipt would causally affect mortality, our baseline estimate would be biased because it does not account for this additional risk. We have shown earlier that there is no evidence of informal care leading to an increase in mortality. To address the competing risk concern more directly, we conduct a robustness test in which the outcome is a polytomous variable taking the following values: 0 if the individual is alive by the end of 2019 and has never used nursing home care, 1 if they have entered a NH by the end of 2019 (and are either alive or dead by the end of the period), and 2 if they are dead by the end of 2019 and have never used NH care (see Appendix I.5 for more details). The estimated ATEs on the probability of nursing home use are presented in Table I.VII. The point estimates are very similar to those obtained in our baseline model but the standard errors increase by a factor of two to four, leading to statistically insignificant results.

##### *Alternatives to conventional nursing home admissions*

In the Netherlands, there exist options that allow older individuals eligible for nursing home care to remain in the community. They can benefit from at-home care packages (VPT and MPT) or a personal budget (PGB), to pay informal or professional caregivers of their choice. Tenand et al. (2020b) estimate that, in 2017, over half of VPT recipients actually live in a residential setting — other than a regular nursing home.

In the baseline analysis, we disregard these care options. If older people increasingly use private residential settings as an alternative to regular NHs, we may fail to capture part of the NH admissions, and the effect of informal care thereon could be biased. However, we find very similar results to our main analysis when estimating a bivariate probit model with a broader definition of NH use that includes the receipt of MPT, VPT and PGB (see Table I.11, online Appendix I.7). Similarly, we conduct a robustness analysis when we account for these alternatives in the individuals’ stay costs over the 2017–2018 period. Results are virtually unchanged (see Table I.12), which is expected as MPT, VPT and PGB users are a minority (among observations who did not enter a nursing home, only 0.4% of them have used a MPT or a VPT care package) and the unit costs of these options are significantly lower than the unit cost of nursing home care.<sup>27</sup>

<sup>26</sup> Table E.1 in Appendix E.1 maps the combinations of informal care, skilled home care and social support in our study population.

<sup>27</sup> See Appendix I.7 for additional explanations and results on these care options.

### 6.5. Data limitations

Despite their richness, our data have two main limitations. First, the construction of our instruments leverages the linkage between a respondent's identifier and their children's identifiers. This linkage is not perfect, as explained in Appendix C.2. There can be small measurement errors on the number of children. Conditional on our rich set of control variables, we expect the measurement errors to be independent from the outcomes, and see no reason why they would correlate with the effects of informal care we are interested in. Furthermore, there is no reason why measurement errors would be more frequent for daughters than for sons, such that the proportion of daughters is unlikely to be systematically biased.

Second, the costs incurred for the social care provided by municipalities could not be included in total costs. However, these costs represent 5% of the costs we are able to measure (Appendix B).<sup>28</sup>

## 7. Conclusion

Our study provides evidence on the causal effect of informal care on NH admissions with an expected permanent nature. Further, it expands on the existing literature by assessing the downstream effects of informal care on health care expenditures at large and potential health responses. We thereby shed light on a range of costs and benefits for the care recipient and society.

Our estimates suggest that informal care reduces the chance of a NH admission for individuals with mild limitations, but increases it for those with severe limitations. The former result is in line with a grey literature on the benefits of informal care as well as with earlier evidence (Charles and Sevak, 2005; Sasso and Johnson, 2002). Yet this result is subject to caution, as the estimate seems to be driven by functional form assumptions. By contrast, the novel finding that informal care receipt increases the probability to enter a NH among those with high care needs is very robust.

A back of the envelope calculation suggests that informal care contributed to around 10% of the NH admissions of the 65+ with children alive between 2017 and 2019. Had all individuals with severe limitations received informal care, we would have observed 14,000 *more* admissions.<sup>29</sup>

We discuss several explanations for our findings and the discrepancy with earlier evidence. First, the effect of informal care on the recipient's subsequent health and formal care use may differ depending on their initial health capital. Because previous studies aggregate effects over individuals with and without any functional limitations, they may fail to uncover heterogeneity in the impact of informal care. By contrast, we stratify the analysis by the severity of functional limitations. For individuals with already high care needs, caregivers may play a critical role in making their relative aware of their needs and of the available options, claiming a needs assessment and helping with the many administrative and practical tasks involved in moving to a NH. Relatives may play a critical role there, especially as the Dutch needs assessment agency does not perform outreach actions towards potential beneficiaries. The presence of informal caregivers could also play as a signal of a high care need at the stage of the needs assessment, although it is not among the official criteria that assessors should take into account for eligibility decisions in the Netherlands.

A second explanation is that NH in the US (literature) combines post-acute care with care for individuals with permanent round-the-clock care needs, while our data identify the latter separately. Informal care could well prevent health shocks or allow individuals to return to their home after an acute care episode, but not similarly delay permanent admissions. Consistent with this, we document that informal care substantially decreases the probability of post-acute care use, for those with either moderate or high care needs. However, this hypothesis cannot explain the discrepancy between our findings and that of Charles and Sevak (2005), who find that informal care receipt reduces the probability of a stay longer than 100 days.

A third, related explanation is that the US and the Netherlands differ markedly in terms of public funding of LTC, not only for institutional care but also for home care. In the US, the coverage of home-based care services is limited, and was even more so in the 1990s, when the data used in Sasso and Johnson (2002), Charles and Sevak (2005), Van Houtven and Norton (2004) were collected. In the Netherlands, as in Continental and Northern European countries, public coverage on domestic help, personal care and nursing care at home is more comprehensive. It is therefore possible to read available US evidence as: 'at-home support contributes to ageing in place'.<sup>30</sup> By contrast, our setting allows us to show how receiving support from relatives *next to* access to formal home care affects the use of NH care.

We further show that there is no evidence that informal care receipt comes at the cost of a higher 3-year mortality, even while it increases the chance of a NH admission. There is also no evidence of an offsetting increase in medical care costs. For individuals with mild limitations, informal care receipt is suggested to decrease home care and medical care costs, and to result in substantial savings on total health care costs.

What should policy makers read from our study? Acknowledging the lack of medical skills of informal caregivers and the burden that intensive caregiving places on them, many countries engage in the promotion of informal care while working on improving access to skilled home care. Our study is conducted in the context of the Netherlands, which offers comprehensive options for home care support. As such, our study is well grounded to inform the current policy debates on the role of informal care in ageing policies.

One critical implication of our results is that it should not be expected that promoting informal care necessarily results in lower care costs and public savings. Informal care leads to higher total health care costs in the medium run for those with high care needs.

<sup>28</sup> We also ignore institutional care other than elderly care, but after age 65 admissions to handicap centres and psychiatric hospitals are rare.

<sup>29</sup> See Appendix J. for details.

<sup>30</sup> Or put it differently: in the absence of comprehensive and publicly-subsidized home care services, the US elderly with high care needs may have no other option but to enter a costly NH, unless they can rely on informal caregivers.

Yet, this does not mean that the monetary and non-monetary benefits of an earlier access to formal LTC would fall short of these extra costs. Our results are consistent with the interpretation that informal caregivers help to trigger a timely NH admission for individuals with high care needs, as well as to get access to adequate skilled care when staying at home. Further, informal care is suggested to be an effective way of preserving the health capital of individuals with only mild limitations and achieving savings on health care expenditures. From both the perspective of informal care recipients and from that of society more broadly, these are to be counted among the benefits of informal care.

### Access to and use of individual-level data

The results presented in this article are based on calculations by the authors using non-public microdata from Statistics Netherlands (CBS). The datasets used include the *Gezondheidsmonitor Volwassenen en Ouderen 2016*, provided by the GGDs, CBS and RIVM. The *Gezondheidsmonitor* was accessed as part of the project: “Financial and health risks: household decisions and government interventions?”, conducted at the Erasmus University Rotterdam. Under certain conditions and a confidentiality agreement, these microdata are accessible for statistical and scientific research. For further information: [microdata@cbs.nl](mailto:microdata@cbs.nl). Exploitation of the data and publication of the results are made in compliance with the European privacy legislation (GDPR, May 25th, 2018).

### CRedit authorship contribution statement

**Julien Bergeot:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Software, Methodology, Project administration, Writing – original draft, Writing – review & editing. **Marianne Tenand:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Software, Methodology, Project administration, Visualization, Writing – original draft, Writing – review & editing.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Acknowledgements

The authors thank the Editor and two anonymous referees, whose reviews helped improved the paper substantially. They are grateful to the members of the ESHPM long-term care focus group and the participants of the 2021 Irdes-Dauphine Workshop on applied health economics & policy evaluation, the 2021 Netspar International Pension Workshop, the 2020 Journées des Economistes de la Santé Français and the 2020 EuHEA PhD Student-Supervisor Conference. They also thank Eric Bonsang, Olivier Donni, Eddy van Doorslaer, Job van Exel, Roméo Fontaine, Michael Hendren, Marika Knoef, Pierre Koning, Dominique Meurs, Alain Paraponaris, Elsa Perdrix, Gregory Ponthière, Thomas Rapp, Quitterie Roquebert, Arthur van Soest, Lisa Voois, Jérôme Wittwer and Vera Zabrodina for their valuable comments.

### Funding

The authors acknowledge funding from Cepremap and Labex MME DII (ANR-11-LBX-0023-01). Access to the data was in part funded by the Open Data Infrastructure for Social Science and Economic Innovations (ODISSEI). J. Bergeot acknowledges funding from Foundation Médéric Alzheimer and the Réseau Franco-Néerlandais located at the University of Lille. M. Tenand acknowledges funding from the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 844314 (LTCpolicies).

### Appendix A. Supplementary data

Supplementary material related to this article can be found online at <https://doi.org/10.1016/j.jhealeco.2023.102831>.

### References

- Altonji, J.G., Elder, T.E., Taber, C.R., 2005. An evaluation of instrumental variable strategies for estimating the effects of catholic schooling. *J. Hum. Resour.* 40 (4), 791–821.
- Angrist, J.D., Pischke, J.-S., 2008. *Mostly Harmless Econometrics: An Empiricist’s Companion*. Princeton University Press.
- Atwal, A., Tattersall, K., Murphy, S., Davenport, N., Craik, C., Caldwell, K., McIntyre, A., 2007. Older adults experiences of rehabilitation in acute health care. *Scand. J. Caring Sci.* 21 (3), 371–378.
- Bago d’Uva, T., O’Donnell, O., Van Doorslaer, E., 2008. Differential health reporting by education level and its impact on the measurement of health inequalities among older Europeans. *Int. J. Epidemiol.* 37 (6), 1375–1383.
- Bakx, P., Wouterse, B., van Doorslaer, E., Wong, A., 2020. Better off at home? Effects of nursing home eligibility on costs, hospitalizations and survival. *J. Health Econ.*
- Balia, S., Brau, R., 2014. A country for old men? Long-term home care utilization in Europe. *Health Econ.* 23 (10), 1185–1212.
- Barigozzi, F., Cremer, H., Roeder, K., 2020. Caregivers in the family: Daughters, sons and social norms. *Eur. Econ. Rev.* 130, 103589.



- Barnay, T., Juin, S., 2016. Does home care for dependent elderly people improve their mental health? *J. Health Econ.* 45, 149–160.
- Berry, S.D., Ngo, L., Samelson, E.J., Kiel, D.P., 2010. Competing risk of death: an important consideration in studies of older adults. *J. Am. Geriatrics Soc.* 58 (4), 783–787.
- Bolin, K., Lindgren, B., Lundborg, P., 2008. Informal and formal care among single-living elderly in Europe. *Health Econ.* 17 (3), 393–409.
- Bom, J., Bakx, P., van Doorslaer, E., Gørtz, M., Skinner, J., 2023. What explains different rates of nursing home admissions? Comparing the United States to Denmark and the Netherlands. *The Journal of the Economics of Ageing* 25, 100456.
- Bom, J., Bakx, P., Rellstab, S., 2022. Well-being right before and after a permanent nursing home admission. *Health Econ.* 31 (12), 2558–2574.
- Bonsang, E., 2009. Does informal care from children to their elderly parents substitute for formal care in Europe? *J. Health Econ.* 28 (1), 143–154.
- Bonsang, E., Bordone, V., 2013. The effect of informal care from children on cognitive functioning of older parents. *Netspar Discussion Paper*.
- Bos, A., Kruse, F.M., Jeurissen, P.P.T., 2020. For-profit nursing homes in the Netherlands: what factors explain their rise? *Int. J. Health Serv.* 50 (4), 431–443.
- Brunel, M., Latourelle, J., Zakri, M., 2019. Un senior à domicile sur cinq aidé régulièrement pour les tâches du quotidien. *Etudes et Résultats* 1103.
- Byrne, D., Goeree, M.S., Hiedemann, B., Stern, S., 2009. Formal home health care, informal care, and family decision making. *Internat. Econom. Rev.* 50 (4), 1205–1242.
- Carmichael, F., Charles, S., 2003. The opportunity costs of informal care: does gender matter? *J. Health Econ.* 22 (5), 781–803.
- Charles, K.K., Sevak, P., 2005. Can family caregiving substitute for nursing home care? *J. Health Econ.* 24 (6), 1174–1190.
- Chernozhukov, V., Kim, W., Lee, S., Rosen, A.M., 2015. Implementing intersection bounds in Stata. *Stata J.* 15 (1), 21–44.
- Chiburis, R.C., Das, J., Lokshin, M., 2012. A practical comparison of the bivariate probit and linear IV estimators. *Econom. Lett.* 117 (3), 762–766.
- Coe, N.B., Guo, J., Konetzka, R.T., Van Houtven, C.H., 2019. What is the marginal benefit of payment-induced family care? Impact on Medicaid spending and health of care recipients. *Health Econ.* 28 (5), 678–692.
- De Klerk, A., Plaisier, I., Schyns, P., 2017. Voor elkaar? Standvan de informele hulp in 2016. *Sociaal en Cultureel Planbureau*.
- Denzer, M., 2020. Estimating causal effects in binary response models with binary endogenous explanatory variables. *Mimeo*.
- Diepstraten, M., Douven, R., Wouterse, B., 2020. Can your house keep you out of a nursing home? *Health Econ.* 29 (5), 540–553.
- Fizzala, A., 2017. Les durées de séjour en EHPAD. *Dossiers de la DREES*.
- Hackmann, M.B., Pohl, R.V., 2018. Patient vs. Provider incentives in long term care. (25178), National Bureau of Economic Research.
- Han, S., Vytlacil, E.J., 2017. Identification in a generalization of bivariate probit models with dummy endogenous regressors. *J. Econometrics* 199 (1), 63–73.
- Hashiguchi, T.C.O., Llana-Nozal, A., 2020. The effectiveness of social protection for long-term care in old age: Is social protection reducing the risk of poverty associated with care needs? (117), OECD Publishing, Paris.
- Headen, A.E.J., 1993. Economic disability and health determinants of the hazard of nursing home entry. *J. Hum. Resour.* 80–110.
- Hiedemann, B., Sovinsky, M., Stern, S., 2018. Will you still want me tomorrow? The dynamics of families' long-term care arrangements. *J. Hum. Resour.* 53 (3), 663–716.
- Jones, A.M., 2000. Health econometrics. In: *Handbook of Health Economics*. vol. 1, Elsevier, pp. 265–344.
- Kédagni, D., Mourifié, I., 2020. Generalized instrumental inequalities: testing the instrumental variable independence assumption. *Biometrika* 107 (3), 661–675.
- Kim, H.B., Lim, W., 2015. Long-term care insurance, informal care, and medical expenditures. *Journal of Public Economics* 125, 128–142.
- Kraus, M., Czapionka, T., Riedel, M., Mot, E., Willemé, P., 2011. How European nations care for their elderly: A new typology of long-term care systems. (7), European Network of Economic Policy Research Institutes, Assessing Needs of Care in European Nations (ANCIEN).
- Lafortune, G., Balestat, G., 2007. Trends in severe disability among elderly people: assessing the evidence in 12 OECD countries and the future implications. (26), Organisation for Economic Co-operation and Development, OECD Paris.
- Maarse, J.H., Jeurissen, P.P., 2016. The policy and politics of the 2015 long-term care reform in the Netherlands. *Health Policy* 120 (3), 241–245.
- Mourifié, I., Méango, R., 2014. A note on the identification in two equations probit model with dummy endogenous regressor. *Econom. Lett.* 125 (3), 360–363.
- Newman, S.J., Struyk, R., Wright, P., Rice, M., 1990. Overwhelming Odds: Caregiving and the Risk of Institutionalization. *J. Gerontol.* 45 (5), S173–S183.
- Nieboer, A.P., Koolman, X., Stolk, E.A., 2010. Preferences for long-term care services: Willingness to pay estimates derived from a discrete choice experiment. *Social Science & Medicine* 70 (9), 1317–1325.
- OECD, 2011. *Divided We Stand: Why Inequality Keeps Rising*. Organisation for Economic Co-operation and Development, OECD Paris.
- OECD, 2020. *OECD.Stat. Organisation for Economic Co-operation and Development*, URL.
- Ormel, J., Rijdsdijk, F.V., Sullivan, M., van Sonderen, E., Kempen, G.I.J.M., 2002. Temporal and Reciprocal Relationship Between IADL/ADL Disability and Depressive Symptoms in Late Life. *The Journals of Gerontology: Series B* 57 (4), P338–P347.
- Rouwendal, J., Thomese, F., 2013. Homeownership and long-term care. *Housing Studies* 28 (5), 746–763.
- Santos Silva, J., Tenreiro, S., 2011. Further simulation evidence on the performance of the Poisson pseudo-maximum likelihood estimator. *Econom. Lett.* 112 (2), 220–222.
- Sasso, A.T.L., Johnson, R.W., 2002. Does informal care from adult children reduce nursing home admissions for the elderly? *INQUIRY: The Journal of Health Care Organization, Provision, and Financing* 39 (3), 279–297.
- Stern, S., 1995. Estimating family long-term care decisions in the presence of endogenous child characteristics. *J. Human Resources* 551–580.
- Taylor, M.G., Lynch, S.M., 2004. Trajectories of Impairment, Social Support, and Depressive Symptoms in Later Life. *The Journals of Gerontology: Series B* 59 (4), S238–S246.
- Tenand, M., Bakx, P., van Doorslaer, E., 2020a. Equal long-term care for equal needs with universal and comprehensive coverage? an assessment using Dutch administrative data. *Health Econ.* 29 (4), 435–451.
- Tenand, M., Hussen, A., Bakx, P., 2020b. Encourager le maintien à domicile des personnes âgées dépendantes par des modalités alternatives de financement public? l'expérience récente des Pays-Bas. Pre-print, HAL Archives ouvertes.
- Van Houtven, C.H., Norton, E.C., 2004. Informal care and health care use of older adults. *J. Health Econ.* 23 (6), 1159–1180.
- Van Houtven, C.H., Norton, E.C., 2008. Informal care and Medicare expenditures: Testing for heterogeneous treatment effects. *J. Health Econ.* 27 (1), 134–156.
- Werner, R.M., Coe, N.B., Qi, M., Konetzka, R.T., 2019. Patient outcomes after hospital discharge to home with home health care vs to a skilled nursing facility. *JAMA Int. Med.* 179 (5), 617–623.
- Wooldridge, J.M., 2014. Quasi-maximum likelihood estimation and testing for nonlinear models with endogenous explanatory variables. *J. Econometrics* 182 (1), 226–234.
- Wooldridge, J.M., 2015. Control function methods in applied econometrics. *J. Hum. Resour.* 50 (2), 420–445.
- World Health Organization, 2002. *International Classification of Functioning, Disability and Health (ICF)*.
- Zigante, V., 2018. Informal care in Europe – Exploring formalization, availability and quality. European Commission and Directorate-General for Employment, Social Affairs and Inclusion.