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Filial caregiving for the disabled elderly: the role of contextual interactions

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Abstract (max of 150 words: 150 words). The economic literature extensively outlines a future decline in family support for the disabled elderly. However, the existing literature overlooks the existence of contextual interactions in the family, ignoring that factors reducing the caregiving supply from some potential caregivers may simultaneously increase the propensity of others becoming involved in caregiving, through an intrafamily offset mechanism. Thus, contextual interactions are likely to moderate the impact of changes in the family network on filial caregiving. Using French cross-sectional data from the 2008 Disability and Health Survey, our empirical analysis confirms the importance of considering contextual interactions when investigating filial caregiving: children become involved in care more often when they have fewer siblings, when siblings participate in the labour market or when they live far away from the parent. Gender differences in contextual interactions also indicate that changes in the family network are likely to reduce the existing gender inequalities in filial caregiving.

Keywords: long-term care; informal care; filial care; gender inequalities; contextual interactions

JEL Classification: C35, D64, I12, I18, J11, J14

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1. Introduction

According to the European Commission, the demand and supply of long-term care are expected to follow two opposite trends[1]. On the one hand, population ageing is known to be associated with a rising number of people requiring assistance (Lecroart et al. 2013; OECD 2015). On the other hand, the long-term care supply could be affected by reduced family support (Colombo et al. 2011). In the economic literature, this gap is extensively outlined as an important policy-making issue.

These demographic, social and economic changes appear to be an area of concern for policy makers because family support is currently the main source of long-term care for the disabled elderly in Europe (Colombo et al. 2011). A decline in informal care provision would lead to either an increase in unmet long-term care needs or an increase in the demands for home-care services or nursing home entries and, thus, to additional pressure on public expenditures.

Contrary to common belief, the decrease in family support does not receive consistent support from the few papers investigating the expected evolution of informal care provision, which is described in more detail below. The heterogeneity in the projection results may be explained by differences in the empirical approaches adopted (micro or macro), the time horizons considered, the demographic and socioeconomic changes investigated or the care outcomes analysed (family network or actual care provision). Nevertheless, they have in common the overlooking of the existence of contextual interactions, in the sense of Manski (2000). In other words, these papers implicitly assume that individual caregiving behaviours do not depend on either the presence or the characteristics of other potential informal caregivers. This is an important limitation because demographic and socioeconomic changes reducing either the number of possible caregivers or their propensity to provide care may simultaneously increase the probability of other family members becoming involved in caregiving. Specifically, if one group compensates for the reduced participation of the other group, the decline in family support, taken for granted, may be overestimated.

In this paper, we investigate to what extent accounting for the presence of contextual interactions among family members tends to moderate the expected decrease in family support for the disabled elderly living in the community. We address this issue by focusing on filial caregiving for disabled parents, the type of informal care that is the most likely to be impacted by changes in the family network (Pickard 2008). First, we aim to analyse the role of contextual interactions in the supply of filial caregiving by addressing the following questions: To what extent would a higher proportion of disabled individuals living with a partner relieve children of their caregiving participation? Do children become involved more often in care provision when they have fewer siblings, when the latter live far away from the parent or when they participate in the labour market? Answering these questions would help us to understand whether the decrease in informal care provision due to changes in the family

[1] This gap is explicitly expressed in the definition of long-term care given by the European Commission (2017): *"With the rising life expectancy, more people now reach an age where declining physical and mental health make them dependent on help from others. (…) The availability of informal social care by family members can be expected to decline (…)."*

network will be as critical as expected. Second, we are also interested in identifying gender differences in contextual interactions: Do daughters and sons react the same way to the characteristics of their siblings? Does a child respond similarly to the characteristics of their brothers and sisters? Addressing these questions should help us to quantify the impact of changes in the family network on the existing gender inequalities in care provision.

Using the French cross-sectional Disability and Health Survey (*Enquête Handicap Santé Ménages, HSM*), we estimate a reduced micro-econometric model that quantitatively assesses the extent to which each child's involvement in caregiving depends on the family network and the characteristics of the other potential caregivers (siblings, partner of the disabled parent). The estimation results are used to assess the impacts on various care outcomes of four key factors, usually put forward to support the assumption of a future decline in family caregiving: the presence of a partner, the number of children, the labour force participation of daughters and the geographical distance between parents and children. Because our model accounts for gender differences in children's caregiving behaviours, our approach also enables us to assess the expected evolution of gender inequalities in informal care provision.

The article is organised as follows. **Section 2** outlines the demographic, social and socioeconomic changes likely to affect informal care provision and discusses the results of studies attempting to project informal care provision for future generations of disabled elderly. **Section 3** outlines our empirical strategy. **Section 4** presents the data used and some descriptive statistics. In **Section 5,** we describe the results. Finally, **Section 6** presents conclusions.

2. Background

2.1 The contribution of informal care to long-term care provision

In the French context investigated in this paper[2], national statistics show that informal care is more frequently used, more intensive and more varied than professional home care (Fontaine 2011). A few figures illustrate the key role played by family support. Among the 3.65 million disabled individuals aged 60 or over living at home in France, 80% receive informal care, whereas only 50% receive formal care. The median informal caregiving time these individuals receive is 1 h 40 min per day, whereas the median formal caregiving time is only 0 h 35 min per day (Soullier and Weber 2011). In addition, informal care covers a larger field than does formal care; according to estimates from the French Disability and Health Survey (*Enquête Handicap Santé Ménages, HSM*), disabled elderly receiving informal care are assisted with an average of 4 daily living activities compared to 2 activities for formal care users. Informal care provision is thus a pillar of the French welfare system. It is worth noting that this conclusion remains applicable to all European countries, despite the diversity of the long-term care systems and family norms characterising each country (Colombo et al. 2011).

[2] For a comparison of informal care provisions among European countries, see Colombo et al. (2011), Fontaine et al. (2007) and Pickard (2011).

In this context, a decline in informal care provision would put pressure on long-term care systems. A greater use of formal home-care services or easier access to nursing homes could help disabled seniors compensate for a decline in family support. Nevertheless, these alternatives are costly for disabled elderly and would require either greater public coverage of the cost associated with long-term care provision or a higher mutualisation of the private expenses. In the French context, a significant increase in public expense per disabled elderly is very unlikely given the expected growth in the number of elderly dependents in the decades to come[3]. Stimulating the market of private long-term care insurance may be another option. Nevertheless, the development of this market seems restricted by various factors, such as limited consumer rationality or the existence of various market failures (Brown and Finkelstein 2007; Grignon and Bernier 2012). Because financing alternatives to informal care provision is complicated, better understanding the impact of societal changes on the future of informal care provision is crucial to anticipate the evolution of our long-term care systems.

2.2 The expected evolution of available informal care resources: demographic trends

The care needs of the ageing population are expected to increase in a context in which potential family support is threatened by demographic changes leading to a reduction in family size.

First, the increase in the number of divorces and separations tends to reduce the probability of relying on a partner in case of disability. In France, less than 5% of couples that formed in 1950 had broken up ten years later, whereas 25% of the couples that formed at the end of the 1980s had separated after the same time (Vanderschelden 2006). Will these less permanent relationships induce an increase in the number of elderly people living without a partner? Not necessarily, because of the increased number of successive unions among generations born after the 1950s (Cassan et al. 2001; Vanderschelden 2006). More importantly, divorces and separations are not the main cause of celibacy after the age of 60; rather, the last partner's death is (Cassan et al. 2001). Thus, the evolution of life expectancy among men and women seems to be crucial when investigating the future of informal resources. Since the 1990s, most industrialised countries have experienced a reduction in the gender gap in life expectancy (Meslé 2004). In France, women lived 8.2 years longer than men in 1994 but only 6.2 years longer in 2014 (DREES 2015). The increased life expectancy of men could decrease the amount of time spent by women as widows and increase their likelihood of being helped by their husbands (Lecroart et al. 2013).

The second demographic trend put forward to justify a decline in family support is the decrease in lifetime fertility observed in France between the end of the sixties and the beginning of the nineties. In France, the average lifetime fertility of the generation aged 80 at the time of the HSM survey in 2008 (those born in 1928) was equal to 2.65 children per woman. For the generation born 30 years later (in 1958), the average lifetime fertility was approximately 0.5 children lower and equal to 2.14 children per woman. The effect of the decrease in lifetime fertility on potential care resources depends critically on the evolution of

[3] Approximately 0.72 additional percentage points of GDP will be necessary in 2060 to finance the current public long-term care system (Renoux et al. 2014).

the distribution of family size. Having two children instead of three or more is likely to affect informal care resources less dramatically than having no children instead of one. In the French context, we observe a strong stability in the proportion of women having no children or one child when we compare the generation of women born in 1930 with those born in 1960. The most remarkable change comes from the important decrease in the families with 3 or more children in favour of families with 2 children only (Toulemon, 2001).

Given these demographic changes, several papers provide projections of the potential informal care resources available for disabled elderly in the future. In France, Bontout et al. (2002) compare the evolutions of the number of disabled elderly and of the number of individuals aged 50-79 years (as a proxy for the number of potential caregivers) by the 2040s. They predict an important decrease in the number of potential caregivers per disabled elderly. A 53% increase in the number of disabled elderly is expected in 2040, whereas the number of people aged 50-79 should rise by only 11%. Colombo et al. (2011) provide a similar conclusion at the worldwide level by comparing the expected evolution of the number of individuals aged 80 and over and the number of individuals aged 15-80 years. The very old disability ratio should rise from 4% in 2010 to 12% in 2050. These results support the fear of an important decline in informal care resources per disabled elderly. However, they must be placed in perspective because they do not address the evolution of the number of individuals facing the dependency of a partner or a parent; thus, they underestimate the true increase in the number of potential caregivers[4].

Carrière et al. (2008), Froment et al. (2013) and Gaymu et al. (2008) propose more accurate projections of the family network of disabled elderly. Their results are much less alarmist. Focusing on several selected European countries, Gaymu et al. (2008) confirm that the increase in life expectancy and the reduction in the gender gap will dominate the effect of divorces and separations by the 2030s. Among women aged 85 and over, the proportion of individuals living with a partner should increase from 7% in 2000 to 23% in 2030, on average, in the European countries studied. The increase is smaller but still significant among men aged 85 and over (from 46% in 2000 to 58% in 2030). Regarding children, it is worth noting that the decline in lifetime fertility is associated with a reduced number of large families. However, the shares of elderly both without any surviving children and with one child are nevertheless expected to remain unchanged (Gaymu et al. 2008). As a result, even if children are expected to have fewer siblings in the future, the number of children being alone to provide care may not increase dramatically. In addition, the increase in the proportion of elderly people living with a partner should allow adult children with a disabled elderly parent to rely more frequently on the other parent to provide informal care.

Finally, contrary to widespread belief, Gaymu et al. (2008) conclude that "*over the next 25 years, whatever trend in health, the pool of potential family carers (partners and children) will increase*"[5] (pp. 26-27). Carrière et al. (2008) in Canada and Marbot and Roy (2015) in France provide similar conclusions. Predictions from the French dynamic microsimulation model DESTINIE show a decrease from 11% to 7% among men and from 17% to 10%

[4] For instance, in relative terms, the number of individuals aged 50-79 will increase less than the number of individuals aged 50-79 and facing the disability of a parent or a partner.

[5] The authors show that future trends depend on age, sex, country, projection horizon and evolution of healthy life gain.

among women in the share of people living without a partner or children between 2010 and 2040.

However, projecting the family network of future generations of disabled elderly does not enable one to predict the evolution of their family support, for at least two reasons. First, individual caregiving behaviours may depend on potential informal care resources at the family level. To ensure a minimum level of care, a reduction in family size may drive other potential caregivers to increase their individual propensities to provide care. Second, it is necessary to consider socioeconomic changes in factors impacting the propensity to provide care among potential caregivers, such as the increase in labour market participation among children, the increasing geographical distance between children and parents, or changes in the health status of potential caregivers.

2.3 The expected evolution of the propensity to provide informal care: socioeconomic trends

In addition to the evolution of family size, the economic literature outlines socioeconomic trends likely to be associated with a decrease in the propensity to provide care among potential caregivers.

The higher share of potential caregivers participating in the labour market, especially among women, is the first evolution that is expected to reduce the actual use of potential informal care resources. A clear increase in the female employment rate by age over the last decades can be observed in France (INSEE 2014). This rate rose from 60% among women aged between 25 and 49 in 1975 to more than 80% in 2013 and from 40% among women aged between 50 and 64 to approximately 60% during the same period.

The literature also suggests an increase in the opportunity cost associated with informal care provision due to the higher geographical distance between parents and children. The existing literature about the location choices of children indicates that factors mainly associated with labour market participation, i.e., high socioeconomic status of children and a high rate of college graduation, are significant drivers of intergenerational distance (Chan and Ermisch 2015; Konrad et al. 2002). Thus, the higher share of women participating in the labour market could also affect their informal care provision through the increased geographical distance from their parents. Pezzin and Schone (1999a) also highlight a strong negative effect of divorce on the probability of elderly parents (especially men) co-residing with an adult child in old age: the normalisation of divorce could contribute to increasing the parent-child geographical distance. In the French context, we are not aware of empirical evidence of the evolution of geographical distance between parents and non-co-residing children. However, we can observe a decrease in the proportion of elderly living with a relative other than a partner (generally a child) from 31% in 1982 to 11% in 2011 (Trabut and Gaymu 2016).

Finally, the evolution of disability-free life expectancies (DFLE) is expected to impact the propensity to provide care, especially among partners of disabled seniors. As previously noted, elderly should be more often part of a couple, but the partner's ability to provide care will depend strongly on his or her health status and disability level. Empirically, we do not

observe robust evidence suggesting a clear trend in the evolution of DFLE. In France, recent data cast doubt on the optimistic hypotheses formulated a few years ago about this topic, especially for women (Cambois et al. 2012), who could be confronted with an unexpected expansion of disability in mid-adulthood (50-65 years) that may result in a decrease in their propensity to provide care.

Considering these evolutions, several papers aim to project how family support could be affected. Pickard (2008) realised projections of the supply of informal care provided by children by the 2040s in England, assuming constant probabilities of providing care by age, gender and marital status. Jenkins et al. (2003) propose similar projections in Australia, but condition the caregiving behaviour to labour market participation (in addition to gender, age and living arrangement), thus dealing with the increase in the employment rate among potential caregivers. Both projections confirm a significant decrease in informal care provision despite differences in the methodological approaches adopted. However, they do not consider the family dimensions underlying individual caregiving behaviour, especially the existence of contextual interactions between potential caregivers. They assume that the care decisions of all family members are independent and that family support consists of the sum of independent individual behaviours. Each factor reducing the care provision of one family member leads to a decrease in the overall family support. In fact, the labour market participation of a given child may potentially increase his or her siblings' propensity for providing care and lead to overestimating the expected decline of family support. In contrast, if contextual interactions among family members induce mimetic behaviours between potential caregivers, the decrease in family support could be more important than expected. The independence assumption receives little support from the few papers investigating the interactions among potential caregivers (for instance, see Fontaine et al. 2009).

Contrary to Jenkins et al. (2003) and Pickard (2008), who investigate the evolution of informal care at the individual level, Carrière et al. (2008) study this topic at the family level in Canada and partially account for interactions between potential caregivers. They predict the decrease in the use of informal care to be very moderate (from 65% in 2011 to 61% in 2051) among disabled persons aged 65 years or over, living in private households and needing assistance. However, their microsimulation model does not account for the effects of labour market participation and geographical proximity to children on the expected evolution of family support.

This paper does not propose new projections of the potential or effective family support expected by the next generations of disabled elderly. It instead aims to complement the previous literature, and potentially orientate future projection projects, by investigating more accurately the association between the family network and care arrangements among children when contextual interactions are considered.

3. Analytical framework and empirical strategy

3.1 Key features of the empirical model

Before outlining the econometric model, four main characteristics defining our approach must be discussed. First, we adopt a reduced form model that aims to identify contextual but not endogenous interactions. As previously mentioned, contextual interactions refer to the fact that individual behaviours vary with the (assumed exogenous) characteristics of other individuals of a group. In our context, contextual interactions refer to the effect of the labour market participation of siblings on individual involvement in caregiving, for instance. Contextual interactions must be distinguished from endogenous interactions, which refer to the fact that individual behaviours vary with the behaviours of other individuals in the family (Manski 2000). Even if endogenous interactions are likely to be important components of the family dimension underlying individual caregiving behaviours, their empirical identification is not addressed in this article. Theoretically, such an approach would require us to either adopt an instrumental variables approach (Bommier 1995; Jellal and Wolff 2002; Wolff 2006) or to specify a structural model imposing a specific interaction process among potential caregivers.

The first solution is not a viable option, given the limited information available about the children's characteristics in our data: gender, age, participation in the labour market, marital status, the number of children and the distance from the parent. None of these observed individual characteristics may reasonably act as a valid instrument of individual caregiving because they may have a direct impact on the caregiving behaviours of other family members through contextual interactions.

Several studies have explored a structural approach to identify endogenous interactions through the definition of a specific family decision-making process (Engers and Stern 2002; Hiedemann and Stern 1999). Nevertheless, these models present a major limitation with regard to the investigation that we wish to conduct here: to manage the estimation of these structural models, care arrangements involving multiple informal caregivers are not considered as potential outcomes. Byrne et al. (2009), Checkovich and Stern (2002) and Fontaine et al. (2009) specify game-theory models allowing for multiple caregivers. However, they either assume that there are no contextual interactions or restrict the analysis to two-child families to identify the parameters of the model. Here, we want (i) to study families with 1 to 5 children, (ii) to specify a model that allows for multiple informal caregivers and (iii) not to impose a structure on the model that may unnecessarily drive some of the estimates. Consequently, we choose not to explicitly model the endogenous interactions between potential informal caregivers.

Second, we focus solely on the care provided by the children. For a given family with a disabled parent, an equation is estimated for each child regarding her[6] decision to provide the

[6] We adopt the following rule, mentioned by Checkovich and Stern (2002), regarding the use of personal pronouns referring to elderly parents and their children: "*Elderly parents and […] children are referred to as "she" consistently throughout this paper. However, both men and women are included in this study as elderly parents and their […] children, and statements apply to both sexes unless otherwise indicated*."

parent with informal care. We choose not to model the partner's caregiving decision similarly if such a partner exists. The partner's decision to provide care is mainly driven by normative motives and leaves very little opportunity for economic trade-offs. This is especially true when she co-resides with the disabled parent and does not participate in the labour market, which is the most common situation. In addition, our data provide very little information on the individual characteristics of the partner. Of course, a key determinant of the children's caregiving behaviours is whether the disabled parent lives with a partner. Thus, we separately estimate our model on the sub-sample of elderly parents living with a partner and on the sub-sample of elderly parents living without a partner[7]. In addition, for the sub-sample of elderly parents living with a partner, we introduce a dichotomous explanatory variable measuring the partner's involvement in caregiving into the model and consider this partner's decision to provide care to be exogenous. If children are likely to adjust their caregiving behaviours based on the partner's ability to provide informal care, adjustments from the partner towards the children's caregiving decisions are more difficult to imagine, particularly because we focus on the decision to provide care regardless of the intensity of the care provision. Nevertheless, we must keep in mind that the partner's caregiving decision might be driven by several unobserved characteristics about which the data used here do not provide information (the partner's health status, for instance). By focusing on the care provided by the children, we also exclude any care provided by other relatives, friends or neighbours. Indeed, we do not possess systematic information on characteristics of individuals other than the partners and children. Furthermore, other caregivers are primarily involved when the elderly cannot count on either their partners or children for assistance. Approximately 80% of individuals receiving informal care from a partner or a child do not receive informal care from other caregivers. This figure is equal to 93% of the individuals who are helped by both their partner and children.

Third, we only consider each child's decision on whether to be involved in caregiving. We ignore both the intensity and the type of care provided by each child to simplify the estimation of the model. Isolating the different forms of informal care (care for daily life tasks, moral support or co-residence) would multiply the number of equations to be estimated, whereas considering the care intensities would lead to dealing with censored variables, such as caregiving times, or ordered polytomous variables, such as caregiving frequencies. An additional issue would concern the potential selection bias from the missing data on the care intensities, particularly the time devoted to care. Focusing on the individual's involvement in caregiving is already very informative, given that only 16.3% of the children in our sample are involved in care.

Fourth, given the variety of decisions related to informal care provision, one model cannot capture all possible aspects of an individual's and a family's long-term care decisions. Here, we give specific attention to the trade-off between informal and formal care by simultaneously modelling each child's decision regarding informal care provision and the

[7] Of the individuals living without a partner, we considered their marital status (single, married, divorced or separated, widowed) but did not observe significant effects on care arrangements at the 10% level. We also tested the impact of the amount of time a disabled parent was widowed on the probability of the children providing informal care, but we did not observe any significant effect at the 10% level. Thus, these ideas have been left out.

elderly's decision regarding the use of formal care (defined at the family level). It is very important to understand the extent to which informal care and formal care act as substitutes to address the impact of changes in the family network on care arrangements. Would a potential reduction in family support be associated with an increase in the use of formal home-care services? Other decisions made by children, such as labour supply or place of residence, are likely to be made simultaneously with the decision regarding informal care provision. When the elderly parent becomes dependent, a child can choose to stop working and to live closer to or with her. Consequently, the labour supply and geographical proximity variables should also be modelled jointly (Pezzin and Schone 1997, 1999b) or instrumented (Stern 1995) to avoid possible endogeneity biases. Modelling these variables jointly would increase the number of equations and require a computationally intensive estimation process. Moreover, the data do not enable us to instrument these variables. For the sake of simplicity, we treat the children's labour market participation[8] and their geographical proximity as exogenous decisions.

3.2 Econometric model

For a given family k, belonging to our sample of K families, with a disabled parent and N_k children, $1 + N_k$ equations are simultaneously estimated, where one corresponds to the use of formal care for the disabled parent and N_k correspond to the informal care provisions of children.

For the disabled parent, the value of using formal home care (y_{0k}^*) is assumed to depend on some observed characteristics: her own characteristics (P_{0k}), the family composition (C_{0k}), and the characteristics of her children (E_{0k}). It also depends on an error term u_{0k}.

$\forall k \in \{1, \dots, K\}$,

$$\boldsymbol{y_{0k}^* = \alpha + P_{0k}\beta + C_{0k}\delta + E_{0k}\gamma + u_{0k}} \qquad \#(1)$$

We observe an indicator y_{0k} of whether the parent uses formal home care; y_{0k} is equal to 1 if the disabled parent from family k uses formal home care $(y_{0k}^* > 0)$, and 0 otherwise.

For each child i, $i \in \{1, \dots, N_k\}$, the value of providing the parent with informal care (y_{ik}^*) is assumed to depend on some observed characteristics: her own characteristics (E_{ik}), the family composition (C_{ik}), the characteristics of her siblings (S_{ik}), and the characteristics of the disabled parent (P_{0k}). It also depends on an error term u_{ik}.

$\forall k \in \{1, \dots, K\}, \forall\, i \in \{1, \dots, N_k\}$,

$$\begin{aligned} y_{ik}^* = {} & (\alpha_S + [\alpha_D - \alpha_S]D_{ik}) + P_{0k}(\beta_S + [\beta_D - \beta_S]D_{ik}) + C_{ik}(\delta_S + [\delta_D - \delta_S]D_{ik}) \\ & + E_{ik}(\gamma_S + [\gamma_D - \gamma_S]D_{ik}) + S_{ik}(\theta_S + [\theta_D - \theta_S]D_{ik}) + u_{ik} \end{aligned} \qquad \#(2)$$

[8] According to the questionnaire of the HSA survey (*Handicap Santé Aidants*, a complementary part of the HSM survey focusing on several informal caregivers of the disabled elderly surveyed), 11% of caregiving children declare that providing care has impacted their professional life. However, less than 2% declare that they left the workforce because of their caregiving activities.

We observe an indicator y_{ik} of whether child i provides the elderly parent with informal care; y_{ik} is equal to 1 if child i from family k provides the parent with care in daily life tasks ($y_{ik}^{*} > 0$), and 0 otherwise.
The effect of any explanatory variable on the decision made by a given child is assumed to depend on her gender (D_{ik}). This explains why there are two sets of estimated parameters in each child's equation (α_S, β_S, γ_S, δ_S and θ_S for sons and α_D, β_D, γ_D, δ_D and θ_D for daughters). However, the effect of any explanatory variable on the decision made by a given child is assumed to be independent of every other characteristic of this child. This specification also allows one to capture contextual interactions, especially through the parameters θ_S and θ_D.

Some unobserved explanatory factors in the decision to provide care or not (family values or care needs of the elderly, for instance) are likely to be shared by the siblings, leading the residuals of the informal care equations to be positively correlated at the family level. Moreover, some unobserved explanatory factors of the decision of whether a given child provides her parent with informal care may be negatively correlated with the elderly's decision of whether to use formal home care, specifically if informal and formal care are substitutable. The error terms u_{ik}, $i \in \{0, \dots, N_k\}$ of the model are thus assumed to be correlated within a family and distributed according to a multivariate normal distribution $N(0, \Sigma)$, with:

$$\forall i \in \{0, \dots, N_k\}, \qquad \Sigma_{\mathrm{i,i}} = 1 \qquad \#(3)$$

$$\forall i \in \{1, \dots, N_k\}, \qquad \Sigma_{\mathrm{0,i}} = \Sigma_{\mathrm{i,0}} = \rho_{IC,FC} \qquad \#(4)$$

$$\forall (i,j) \in \{1, \dots, N_k\}^2, i \neq j, \qquad \Sigma_{\mathrm{i,j}} = \rho_{IC,IC} \qquad \#(5)$$

Because the propensity of children to provide their elderly parent with informal care may change radically depending on whether the elderly parent may rely on a partner, two models are computed: one on elderly individuals living with a partner and another on individuals living without a partner. These two models are estimated on disabled elderly having 1 to 5 children. Thus, our econometric specification incorporates up to six binary outcomes, and the likelihood function involves up to 6-dimensional integrals; therefore, the model is estimated by maximum simulated likelihood using the GHK simulator (Greene 2003; Stern 1997). For an extensive discussion of the maximum simulated likelihood estimation and the use of the GHK simulator in this context, please refer to Arnault (2015), pp. 119-124. The simulation of the likelihood function and the optimisation were performed using STATA 14.

4. Data

We use cross-sectional data from the French Disability and Health Survey conducted in ordinary households (*Enquête Handicap Santé Ménages*, HSM). The HSM survey was conducted in France by the National Institute of Statistics and Economics Studies (INSEE) and the Health and Solidarity Ministerial Statistical Department (DREES) in 2008. In addition to the main information related to the socioeconomic and demographic characteristics of the individuals surveyed and each of their children, the HSM survey collects information regarding their disability level and the amount of care that they received to assist them in

performing their main daily life activities. The questionnaire enables us to identify the children who regularly provide their elderly parent with informal care due to health problems or a disability.

The initial sample from the HSM survey consists of 29931 individuals living at home. We restrict the sample to disabled individuals aged 60 or older. We use a broad definition of disability for a given parent based on difficulties in activities of daily living (ADL) or instrumental activities of daily living (IADL).

Seven ADL tasks are considered in the survey: bathing, dressing and undressing, cutting food, eating and drinking, using the toilet, lying down and getting up from bed, and sitting down in and getting up from a chair. Eleven IADL tasks are considered: shopping, preparing meals, performing common household chores, performing less common chores, completing common administrative processes, taking medication, moving around, leaving home, using transportation, finding a route, and using a telephone. For each ADL or IADL task, the individuals are asked the following question: "Do you have any difficulty doing the following activity alone?" Elderly parents are considered disabled if they answer "yes" for at least one ADL or IADL task. We also exclude individuals whose variables of interest have missing values and those with more than 5 children to maintain a reasonable number of equations to estimate. All the selection criteria are summarised in **Figure 1**. Our final sample includes 3209 disabled elderly and 7708 children.

Figure 1 here

The questionnaire enables us to specify the support provided by each child (or family member) for her parent. The elderly parent must answer the following question:
"*Are there any non-professionals (family, friends…) who regularly help you accomplish certain daily life tasks (cleaning, meals, bathing, company…) or who aid you financially or practically or who give you moral support due to a health problem or disability, including people who live with you?*"
We consider that a child provides informal care ($IC = 1$) if the parent reports being helped with at least one of the following activities: (1) personal care (bathing, dressing, meals); (2) household chores (cleaning, making meals); (3) managing the budget, completing paperwork and administrative processes; (4) going to the doctor, taking care of health problems; (5) shopping, buying medicine; (6) ensuring you have someone with you, company; (7) checking what you do; and (8) other activities (e.g., reading for the blind, translation for the deaf).
We adopt a restrictive definition of informal care: children providing only financial help or moral support are not considered informal caregivers.

We consider that a parent receives formal care ($FC = 1$) if she declares that she receives help from a nurse or a nursing service, a nurse's aide, a home caregiver, a home helper, a personal care assistant, a home carer, a specialised transportation service for the disabled or a social caregiver to perform daily life tasks. Other paramedical professionals, such as physical therapists or speech-language pathologists, are not treated as formal caregivers because they are usually more likely to provide rehabilitation services (i.e., medical care) for disabled elderly rather than formal home care in the usual sense.

Table 1 here

Table 1 highlights the key role of children (especially daughters) as informal caregivers, particularly when the disabled parent cannot rely on a partner. Among individuals living with a partner, 19.4% have at least one caregiving child. Among the group of disabled elderly living without a partner, this figure reaches 43.0%. The average participation rate of children in informal caregiving is also greater among the group of disabled elderly living without a partner (22.6% against 10.4%). Additionally, the average participation rate of daughters is always greater than that of sons.

In our econometric specification, each child's decision to provide informal care is assumed to depend on her own characteristics (E_{ik}), including age, birth rank, family situation, geographical distance and labour market position[9]; the characteristics of the disabled parent (P_{0k}), including age, gender, monthly income, highest diploma, being the owner of her main residence, living area density, number of restrictions in ADL or IADL, self-assessed health, having a proxy who helps her respond to the survey, receiving care from a partner; the family composition (C_{ik}), including the number of children and the number of sisters; and, finally, the characteristics of her siblings (S_{ik}), including a set of dummy variables indicating whether the child has at least one retired or unemployed sister (respectively brother), one homemaker sister, one sister (resp. brother) still at school, one sister (resp. brother) having neither a partner nor a child, one sister (resp. brother) co-residing with the parent or one sister (resp. brother) living in the same district as the parent[10].

The parent's decision to use formal care is assumed to depend on a similar set of covariates, including her own characteristics (P_{0k}), the family composition (C_{0k}), and the characteristics of her children (E_{0k}). **Table 2** and **Table 3** report the descriptive statistics of the main covariates.

Table 2 and Table 3 here

5. Results

Complete estimation results are reported in **Table 4**. We aim to investigate the role of contextual interactions through the four following factors likely to affect future filial care provision and the use of formal home care: (i) the increase in the proportion of elderly living with a partner; (ii) the decrease in lifetime fertility; (iii) the increase in the proportion of women participating in the labour market; and (iv) the increase in geographical distance between parents and children.

Table 4 here

[9] We recall that we distinguish all the parameters according to the child's gender and that both geographical distance and labour participation are assumed to be exogenous.

[10] We also consider alternative specifications measuring siblings' characteristics through quantitative variables, such as the number of unemployed brothers (respectively sisters) and the number of brothers (resp. sisters) with neither a partner nor a child. Contextual interactions are, in this case, always less or not significant.

5.1 Impact of the parent's marital status

In France, despite the clear increase in the number of divorces and separations, the growing number of successive unions and the longer life expectancy, especially of men, contribute to increase the number of disabled elderly living with a partner.

The impact of the parent's marital status on filial caregiving can be measured by comparing the intercepts in the equations of informal care for elderly parents living with and without a partner. The intercept values in columns (1) and (2) (parent with a partner) of **Table 4** are lower than those in columns (4) and (5) (parent without a partner): consistent with the existing literature on the topic, the model predicts that the individual of reference has a greater propensity to provide a single disabled parent with informal care. For daughters and sons, the decision whether to provide informal care is also negatively affected by the ability of the parent's partner to provide her with informal care. Children have a lower propensity to provide the disabled parent with informal care when the parent's partner is already involved.

In **Table 5**, we predict[11] the marginal effect of living with a partner on several care outcomes. In light of the uncertainties inherent in the evolution of DFLE, we condition the predicted probabilities on the partner's ability to provide informal care.

Table 5 here

The participation rate of daughters remains higher than that of sons, irrespective of whether the parent lives as part of a couple. If the elderly parent lives with a partner who provides care rather than living alone, the participation rate of children in informal care decreases by half (from 0.20 to 0.11), as does the parent's probability of receiving care from at least one child (from 0.41 to 0.21). The presence of the parent's partner is therefore a key factor when investigating filial caregiving. As a result, the expected increase in the number of disabled elderly living with a partner could help relieve children of the obligation of providing care in the next few decades.

This expected increase could also be associated with a moderate increase in the gender gap in involvement in caregiving because the decline in care involvement is slightly higher for sons than for daughters in relative terms. The use of formal care also appears as a substitute to the care provided by a partner, meaning that the expected increase in the number of disabled elderly living with a partner is likely to be associated with a decrease in the demand for long-term care services at home.

The partner's inability to provide care is nevertheless a factor that could moderate our conclusions. When the disabled parent lives with a partner who is not declared as a caregiver, the decrease in filial caregiving is indeed less important. It also plays a decisive role in the use of formal home-care services: disabled elderly who live with a non-helping partner have, on average, the same probability of using formal home care as those who are single.

[11] The principle of our predictions is described in more detail in the **Appendix**.

5.2 Impact of a decrease in the number of children

The decrease in lifetime fertility is expected to reduce the number of potential informal caregivers among children. According to **Subsection 2.2**, children have fewer siblings, and this will worsen in the future.

Because some changes in family composition also impact several children's characteristics that are controlled for in the model, the coefficients associated with family size cannot be interpreted easily *ceteris paribus* in **Table 4**.

Table 6 here

Alternative specifications controlling for the number of siblings but not for their characteristics (**Table 6**) confirm the sensitivity of children's involvement in caregiving to the size and gender composition of the family. The lower the number of siblings, the higher a child's likelihood of providing care, irrespective of the child's gender and the marital status of the parent. The decrease in informal care resources due to the reduction in family size would therefore be partly offset by increased involvement in caregiving among children.

Contextual interactions also differ according to the gender composition of the family. When the parent lives without a partner, daughters are affected only by the presence of sisters and not by potential brothers, whereas sons are not sensitive to the gender composition of the family.

Predictions from **Table 7** confirm that not accounting for these contextual interactions leads to overestimating the negative impact of a reduction in family size on the care received by the disabled elderly.

Table 7 here

Three columns of predicted probabilities can be observed in **Table 7.** The average predicted probabilities in the sample are provided in the first column. The second one displays the average predicted probabilities after a reduction in family size[12] if the other family members did not adjust their behaviour, i.e., if the values of the predictors of their informal care participation were not affected by the reduction in family size. In the last column, the same average predicted probabilities are presented after accounting for the adjustments made by the other family members. Comparing the last two columns allows one to assess the role of contextual interactions when investigating the decrease in family size.

According to **Table 7**, the reduction in family size would strongly reduce the predicted probability of having at least one caregiving child for a disabled parent living without a partner (from 0.40 to 0.27) if the remaining children did not adjust their behaviour. Nevertheless, once adjustments of other family members to such a reduction in family size are

[12] We model the reduction in family size by dropping the youngest child in families having at least two children. Dropping the youngest child rather than the eldest enables us to predict the effect of a reduced number of children with the parent's age at first birth held invariant.

taken into account in the predictions, the decrease in the probability of having at least one caregiving child is significantly lower (from 0.40 to 0.34). This result suggests that the smaller number of children is partly compensated by a higher involvement of the remaining ones. This result is confirmed by the predicted participation rates of children: they would almost remain the same[13] after a reduction in family size if the remaining children did not adjust their behaviour. In contrast, they are expected to increase once adjustments are considered: if the number of children decreases, the remaining children should participate more often in caregiving.

Conditional on receiving care from at least one child, we also observe a 10% increase in the propensity of having exactly one caregiving child for an elderly parent living without a partner (from 0.77 to 0.87). Thus, the children involved will more often support the burden of informal care alone. The increase in the participation rate of children is predicted to be higher for sons (from 0.13 to 0.17) than for daughters (from 0.24 to 0.27) in relative terms. As a consequence, a reduction in family size should decrease the share of daughters among caregiving children (from 0.66 to 0.61) and reduce the gender gap in filial caregiving. It is not expected to have any significant effect on formal care use.

5.3 Impact of an increase in the number of women participating in the labour market

We predict the effect of an increase in the number of women participating in the labour market. An increase in the female employment rate could have consequences for both the parent's likelihood of receiving informal care and the gender gap in care provision among children.

Table 4 confirms that being employed rather than retired or unemployed significantly reduces the child's propensity to provide care. Daughters whose parent is alone are the only exception: their involvement does not depend on their labour market participation. This result does not prejudge the absence of an interaction between informal care provision of daughters and their labour market supply because we do account for the intensity of care provision in our model. When the disabled parent cannot rely on a partner, the limited ability of daughters to reduce their caregiving involvement according to their labour market participation indicates that they are likely to be the main caregivers in the family.

If we observe contextual interactions in regard to the siblings' labour market position, they are nevertheless characterised by gender differences. The caregiving participation of sons is influenced by their sisters' situation in the labour market, but less so by their brothers' one. Having a retired or unemployed sister significantly decreases a son's propensity to become involved, whereas having a retired or unemployed brother does not have a significant effect. This result is observable regardless of the elderly parent's marital status. In contrast, daughters' involvement is not significantly affected by the labour market participation of their siblings, regardless of both the disabled parent's marital status and the siblings' gender.

[13] In fact, they would slightly decrease because the youngest children (dropped in each family) tend to have a greater propensity to provide their parent with informal care than the other children.

To illustrate the role of contextual interactions, we predict the care arrangements of a two-child family with the following characteristics: one elderly mother[14] with a daughter — aged 55, living in the same district as the mother, with a partner and children — and a son — aged 52, living in the same district as the mother, with a partner and children, and participating in the labour market. We compare the two hypothetical scenarios according to whether the daughter participates in the labour market.

Table 8 here

According to **Table 8**, the daughter's participation in the labour market would decrease her own propensity to provide informal care if the parent lives with a caregiving partner (from 0.28 to 0.19). If the parent lives without a partner, it would not significantly affect the daughter's propensity to provide her with informal care. In a scenario without contextual interactions, i.e., if the son does not adjust his caregiving behaviour, having a daughter who participates in the labour market reduces the average probability of receiving filial care. This result illustrates the usual message stating that an increase in the number of women participating in the labour market threatens informal care provision.

In contrast, after accounting for contextual interactions and irrespective of whether the parent has a partner, the daughter's participation in the labour market would increase the chances of her brother providing his elderly parent with informal care. Consequently, for an elderly parent being helped by a partner, the model predicts that her probability of having at least one caregiving child would not be dramatically reduced by a higher participation of the daughter in the labour market. Better, the same probability for an elderly parent living without a partner would even slightly increase (from 0.49 to 0.52).

Finally, irrespective of whether the parent lives with or without a partner, the daughter's participation in the labour market tends to increase the probability of observing care arrangements involving both children. The increase in labour market participation of women is also predicted to decrease the share of daughters among caregiving children (from 0.71 to 0.49 for a disabled parent living in a couple and from 0.72 to 0.64 for a parent living alone). Therefore, it should reduce the gender inequalities in informal care provision and lead to informal caregiving being shared more often between children.

5.4 Impact of an increase in the geographical distance between parents and children

The literature also suggests an increase in the opportunity cost associated with informal care provision due to higher geographical distance between parents and children, which should reduce the actual use of potential informal care resources. Thus, we finally assess the impact of geographical proximity between parents and children on care arrangements.

[14] The mother has been attributed with the average (or modal) values of our global sample for all observable characteristics: she is aged 77.6, earns less than 1100€ per month, has a primary degree, owns her main residence, lives in a town with more than 20 000 inhabitants, has 6 limitations in ADL or IADL and declares bad or very bad health. In the case in which she lives with a partner, the partner provides her with informal care.

Table 4 confirms the strong positive effect of geographical proximity to the parent on the child's propensity to provide care regardless of the parent's marital status and the child's gender.

The caregiving provision of children whose parents are in a couple does not appear to be significantly associated with the geographical proximity between their siblings and the parents' household. Only sons are less likely to become involved when they have a brother who co-resides with the parents or lives in the same district. In contrast, contextual interactions are much more prominent when the disabled parent is single. In that case, a child's probability of providing informal care decreases with the geographical proximity between her siblings and her parent's dwelling. As a result, contextual interactions are likely to moderate the expected decrease in filial caregiving due to the higher geographical distance between parents and children.

To quantify these effects, we finally predict the care arrangements of the same two-child family as in **Subsection 5.3**: one elderly mother with a daughter — aged 55, living with a partner, having children and participating in the labour market — and a son — aged 52, with the same characteristics. We compare the different hypothetical scenarios in which each child lives in the same district as the disabled parent or does not.

Table 9 here

According to **Table 9**, the fact of living far away from a single parent strongly decreases each child's propensity to provide her with informal care (from 0.24 to 0.04 for the son and from 0.43 to 0.14 for the daughter). Without accounting for adjustments in the caregiving behaviour of other family members, it would also strongly reduce the parent's probability of receiving informal care from at least one child. Such a decrease would be higher (from 0.52 to 0.32) if the daughter moved far away rather than the son because her probability of providing care is greater, all other things being equal. In fact, this effect is much attenuated after accounting for the adjustments of other family members (from 0.52 to 0.43). Indeed, if the daughter moves far away, the son's probability of providing his parent with informal care is expected to grow from 0.24 to 0.39. Consequently, the share of daughters among caregiving children would significantly decrease from 0.64 to 0.27, again suggesting a reduction in the gender inequalities in informal care provision. In summary, the son would compensate for the higher geographical distance between the daughter and her disabled parent by becoming involved in informal caregiving. This result is observed only for a disabled parent living without a partner and does not hold for daughters: they would not increase their participation in informal care if their brother moved far away from the parent.

6. Conclusion

In developed countries, there is a broad consensus about the future decline in family support for disabled elderly. Several demographic and socioeconomic changes, such as the decrease in lifetime fertility, the higher geographical distance between parents and children or

the higher share of women participating in the labour market, are often described as factors likely to reduce either the number of potential informal caregivers or the children's propensity to provide informal care. If this is true, and depending on its magnitude, this decrease would put considerable pressure on our welfare systems because informal care is currently the main source of long-term care for disabled elderly.

This expected decline is nevertheless questionable because it relies on an analytic framework that ignores the existence of contextual interactions. This is a strong limitation in view of our results in the French context, which highlight the sensitivity of children's involvement in caregiving with respect to the family network and the characteristics of other potential caregivers. Specifically, we provide evidence that children are more often involved in caregiving when they have fewer siblings, when the siblings live far away from the parent or when they participate in the labour market. Thus, each child's decision about whether to become involved in caregiving is based not only on her own opportunity costs but also on those of her siblings. Because the one group tends to compensate for the declining involvement of the other, this intrafamily offset mechanism suggests that the decrease in family support expected in the next decades is likely to be overestimated.

In addition, we show that the magnitude of contextual interactions among siblings highly depends on two factors: the disabled parent's ability to rely on a partner and the gender composition of the siblings. First, our result confirms that living with a partner reduces the children' propensity to become involved in caregiving. However, this result holds only if the partner is able to provide care. Therefore, the evolution of disability-free life expectancy appears to be a critical demographic factor to be considered when predicting children's future involvement in caregiving. Second, we observe that the presence of a helping partner modifies the way children interact with each other. When the disabled parent may not rely on a partner, contextual interactions are more critical, especially for daughters, and children tend to behave and coordinate with each other to ensure that at least one child provides their parent with informal care. The presence of a partner capable of providing informal care seems to relax this coordination constraint among siblings and, therefore, the role of contextual interactions.

Finally, our estimates highlight significant gender differences in contextual interactions affecting family support. If sons are very sensitive to the characteristics of their siblings in general and of their sisters in particular, daughters' involvement in informal caregiving is less affected by the presence and characteristics of siblings, and not at all by the characteristics of their brothers. Sons seem to have a higher propensity than daughters to adjust their caregiving behaviours to the family context. This result provides a new illustration of the gender inequalities in family support, in the sense that the duty to provide a disabled parent with informal care seems to lie more heavily upon daughters. Our predictions also suggest that the decrease in lifetime fertility, the higher geographical distance between parents and children and the higher share of women participating in the labour market would lead to an increase in men's involvement in caregiving and thus to a reduction in the gender inequalities between sons and daughters.

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Compliance with ethical standards

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Conflict of interest The authors declare that they have no conflicts of interest.

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Appendix: Assessing the average effect of contextual interactions from the estimates of the model

By simultaneously modelling the involvement in caregiving of each child and the disabled parent's use of formal care, our estimates allow us to assess the effect of contextual interactions on several care outcomes…

(i) … at the child level, on the average individual probability of providing the disabled parent with informal care (all / daughters only / sons only);

(ii) … at the parent level, on the average probability of receiving care from at least one child, on the average probability of receiving care from exactly one child (conditional on receiving care from children), on the share of daughters among caregiving children and on the use of formal care.

First, we assess the effect of living with a partner by predicting the care outcomes in each family of our sample under three scenarios: the disabled parent is single (H_0), she lives with a non-helping partner (H_1) and she lives with a helping partner (H_2) (**Table 5**). To do so, we compute the probability of every possible care arrangement under each scenario for each family, leaving unchanged the other observed characteristics. As an illustration, let us consider the case of a two-child family k. Under scenario H_0, we compute the following probabilities $P_k^{y_0 y_1 y_2}$, where y_0 is equal to 1 if the disabled parent uses formal home care, 0 otherwise; y_1 is equal to 1 if child 1 provides informal care, 0 otherwise; y_2 is equal to 1 if child 2 provides informal care, 0 otherwise[15]. Then, we express the probability of interest as a combination of those previously computed. In a two-child family, the probability of receiving informal care from at least one child is equal to $P_k^{010} + P_k^{001} + P_k^{011} + P_k^{110} + P_k^{101} + P_k^{111}$. We repeat the same calculations for scenarios H_1 and H_2. Finally, we compare the average probabilities estimated under the three scenarios. For two-child families, 8 care arrangements are possible; therefore, we have 8 probabilities to estimate. In general, for N_k-child families ($N_k \in \{1, \dots, 5\}$), we have 2^{N_k+1} probabilities to estimate. The difficulty is not the number of probabilities to estimate for each family; rather, it is the fact that these probabilities have more than two dimensions for families with two or more children. Consequently, these probabilities do not have analytic expressions, and we must simulate them. For N_k-child families ($N_k \in \{2, \dots, 5\}$), given the set of estimated parameters $\hat{\theta}$, we simulate the 2^{N_k+1} probabilities using the GHK simulator. For a brief discussion of the GHK simulator, please refer to Arnault (2015). We derive 30 draws from a standard uniform density with the STATA program **mdraws** from Cappellari and Jenkins (2006), using Halton sequences with antithetics. Then, the truncated normal distribution values are generated by applying classical inversion formulas (Stern 1997), and the GHK simulator is constructed with the STATA function **mvnp()** from Cappellari and Jenkins (2006).

[15] For instance, P_k^{000} is the probability that the disabled parent does not receive formal care and that children 1 and 2 do not provide the parent with informal care; P_k^{010} is the probability that the parent does not receive formal care and that child 1, but not child 2, provides the parent with informal care.

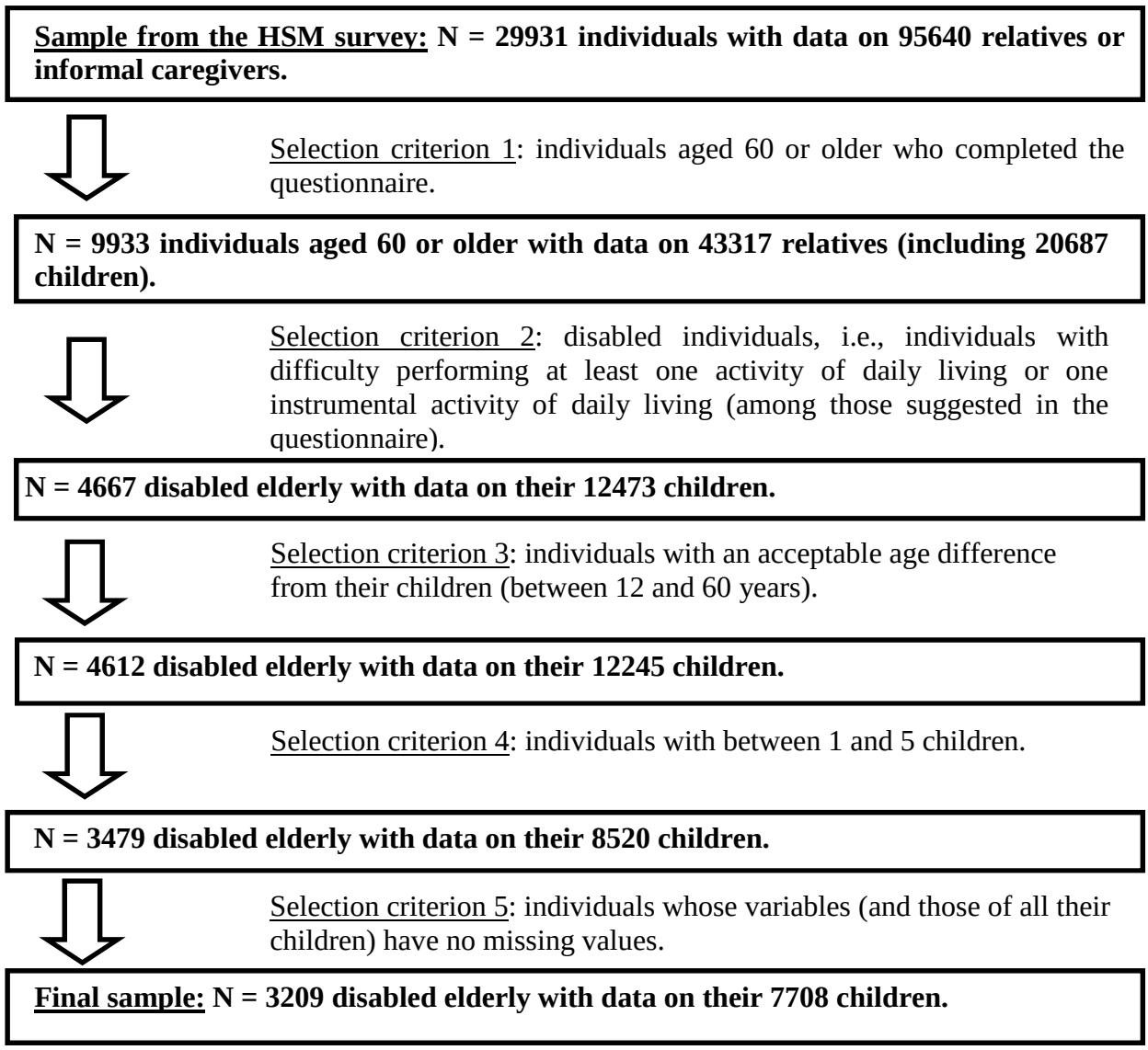
We adopt the same strategy to assess the role of contextual interactions in the effect of a reduction in family size (**Table 7**). Specifically, we simulate the care outcomes for each family with at least two children after removing the youngest child and by considering two alternative assumptions: (i) ignoring contextual interactions, i.e., considering that other family members do not adjust their behaviour to the removal of the youngest child, and (ii) accounting for contextual interactions thanks to the model estimates. The comparison of the simulated probabilities enables us to assess the role of contextual interactions when analysing the impact of a reduction in family size.

To investigate the role of contextual interactions associated with the increase in women's participation in the labour market (**Table 8**), we consider a family of reference, with a disabled mother[16] and two children, a daughter — aged 55, living in the same district as the mother, with a partner and children — and a son — aged 52, living in the same district as the mother, with a partner and children, and participating in the labour market. Then, we simulate the care outcomes depending on whether the daughter participates in the labour market. As before, these simulations are performed by considering two alternative assumptions: (i) ignoring contextual interactions, i.e., considering that the brother does not adjust his behaviour to the daughter's participation in the labour market and (ii) accounting for contextual interactions thanks to the model estimates. We use the same family of reference to investigate the effect of the geographical distance between parents and children and the role of contextual interaction (**Table 9**), except that the daughter is now assumed to participate in the labour market.

[16] The mother has been attributed the average (or modal) values of our global sample for all observable characteristics: she is aged 77.6, earns less than 1100€ per month, has a primary degree, owns her main residence, lives in a town with more than 20 000 inhabitants, has 6 limitations in ADL or IADL and declares bad or very bad health. In the case in which she lives with a partner, the partner provides her with informal care.

Figures and Tables

Figure 1 – Selection process of the final sample



Source: HSM Survey 2008.

Table 1 – Care arrangements observed in the sample

	Parent Living with a partner (N=1619)	Parent Living without a partner (N=1590)
% of individuals with at least one caregiving child	19.4%	43.0%
Average participation rate of children	10.4%	22.6%
Average participation rate of daughters	13.6%	28.4%
Average participation rate of sons	7.0%	16.7%
% of individuals using formal care	41.6%	62.4%

Content: Among daughters whose disabled parent lives with a partner, 13.6% provide her with informal care. This figure reaches 28.4% among daughters whose disabled parent lives without a partner.

Sample: HSM Survey 2008, N=3209 disabled individuals in France aged 60 or older and having 1 to 5 children.

Table 2 - Descriptive statistics of the main characteristics of the elderly parents

Parent's and family's characteristics		Parent living with a partner (N=1619)	Parent living without a partner (N=1590)
Age		74.9	80.4
Gender	*Female*	56.4%	86.7%
Monthly income[17]	*Less than EUR 1100*	45.8%	54.3%
	More than EUR 1100	45.7%	35.8%
	Missing	8.5%	9.9%
Highest diploma	*No diploma*	34.7%	42.9%
	Lower than BAC	39.2%	42.1%
	Higher than BAC	26.1%	15.0%
Homeowner	*Yes*	75.6%	55.8%
Living area density	*Less than 20 000 inhab.*	41.1%	38.8%
	More than 20 000 inhab.	58.9%	61.2%
Number of ADL & IADL limitations		6.0	6.1
Self-assessed health	*Bad / Very Bad*	65.5%	56.5%
Is helped by a proxy respondent	*Yes*	33.3%	30.2%
Receives care from partner	*Yes*	65.8%	-
Number of children	1	24.2%	29.7%
	2	33.4%	30.3%
	3	23.3%	20.6%
	4	11.8%	13.0%
	5	7.2%	6.4%

Content: Among the disabled elderly, 56.4% of women live with a partner.

Sample: HSM Survey 2008, N=3209 disabled individuals in France aged 60 or older who have 1 to 5 children.

Table 3 - Descriptive statistics of the main characteristics of the children

		Parent living with a partner (N=3957 children)		Parent living without a partner (N=3751 children)	
Children's characteristics		Daughters (N=2025)	Sons (N=1932)	Daughters (N=1904)	Sons (N=1847)
Age		46.5	46.2	52.7	52.2
Family situation	*Without partner, without*	10.7%	13.3%	10.9%	13.0%
Geographical	*Co-residence with the parent*	5.8%	6.3%	11.5%	9.1%
	Same district	57.2%	53.6%	56.8%	54.7%
	Outside the region	37.0%	40.1%	31.7%	36.1%
Labour market	*Work*	71.2%	84.2%	56.6%	66.9%
	Retired /Unemployed	11.0%	12.2%	24.8%	28.0%
	Homemaker	13.8%	<0.1%	14.3%	<0.1%
	At school / another situation	4.0%	3.6%	4.3%	5.1%

Content: Among the 2025 daughters of disabled elderly living with a partner, 71.2% are working. Among the 1904 daughters of elderly dependents living with a partner, only 56.6% are participating in the labour market.

Sample: HSM Survey 2008, N=3209 disabled individuals in France aged 60 or older who have 1 to 5 children (N=7708 children).

[17] The EUR 1100 income threshold is chosen because the average monthly amount of the retirement pension in France reached EUR 1095 on December 31, 2007 and EUR 1122 on December 31, 2008 (French National Old-Age Insurance Fund, CNAV).

Table 4 – Estimates of the models

		Individuals living with a partner (N=1619)			Individuals living without a partner (N=1590)		
		(1) IC daughter	(2) IC son	(3) FC	(4) IC daughter	(5) IC son	(6) FC
Intercept		**-6.76*** (2.17)	**-10.76*** (2.75)	**-15.93*** (1.68)	**-3.23*** (1.89)	**-6.31*** (2.25)	**-12.06*** (1.688)
Parent's characteristics							
Age (log)		0.878 (0.639)	**1.748**** (0.820)	**3.436*** (0.383)	0.153 (0.599)	0.721 (0.689)	**2.771*** (0.393)
Gender	Male	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
	Female	**0.246*** (0.094)	-0.011 (0.113)	**0.535*** (0.075)	0.134 (0.115)	**0.429*** (0.148)	0.015 (0.103)
Monthly income	Less than EUR 1100	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
	More than EUR 1100	-0.070 (0.101)	0.068 (0.121)	0.060 (0.081)	0.016 (0.085)	-0.129 (0.101)	**0.189**** (0.082)
	Missing	-0.169 (0.168)	-0.247 (0.204)	-0.107 (0.135)	0.045 (0.125)	0.180 (0.140)	-0.078 (0.122)
Highest diploma	No diploma	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
	Lower than BAC	**-0.207**** (0.100)	0.010 (0.123)	**0.229*** (0.086)	0.104 (0.081)	**0.263*** (0.093)	**0.148*** (0.079)
	Higher than BAC	**-0.275**** (0.131)	-0.089 (0.164)	**0.319*** (0.101)	-0.198 (0.124)	0.132 (0.147)	0.117 (0.113)
Living area	Less than 20 000 inhab.	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
	More than 20 000 inhab.	0.045 (0.094)	0.143 (0.116)	**-0.195*** (0.075)	0.108 (0.076)	0.136 (0.088)	**-0.219*** (0.073)
Owner	No	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
	Yes	-0.057 (0.100)	-0.171 (0.119)	0.016 (0.084)	-0.022 (0.076)	0.017 (0.087)	-0.039
Number of ADL & IADL limitations (log)		0.081 (0.059)	**0.239*** (0.075)	**0.624*** (0.052)	**0.311*** (0.055)	**0.279*** (0.063)	**0.573*** (0.052)
Self-assessed health	Very good / good / fair	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
	Bad / very bad	**0.395*** (0.104)	**0.334**** (0.131)	0.071 (0.078)	-0.023 (0.080)	-0.109 (0.091)	0.021 (0.076)
Has a proxy respondent	No	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
	Yes	**0.205**** (0.104)	**0.508**** (0.231)	-0.017 (0.087)	**0.185**** (0.094)	**0.201*** (0.112)	**-0.354*** (0.099)
Child's characteristics							
Age (log)		0.237 (0.333)	0.158 (0.415)	-	0.137 (0.339)	0.120 (0.403)	-
Working status	Employed	*Ref.*	*Ref.*	-	*Ref.*	*Ref.*	-
	Retired, unemployed	**0.301**** (0.118)	**0.226*** (0.137)	-	0.020 (0.091)	**0.272*** (0.102)	-
	Homemaker	**0.218*** (0.114)	-	-	-0.003 (0.105)	-	-
	At school, other	**-0.518**** (0.214)	-0.119 (0.240)	-	-0.237 (0.168)	-0.022 (0.166)	-
Family situation	Has partner or children	*Ref.*	*Ref.*	-	*Ref.*	*Ref.*	-
	Neither partner nor child	**0.408*** (0.132)	0.235 (0.170)	-	**0.374*** (0.114)	**0.226*** (0.132)	-
Geographical distance	Co-residence	**1.845*** (0.178)	**1.726*** (0.232)	-	**1.797*** (0.138)	**1.898*** (0.171)	-
	Same district	**0.845*** (0.107)	**0.938*** (0.160)	-	**0.902**** (0.090)	**1.012*** (0.113)	-
	Outside the district	*Ref.*	*Ref.*	-	*Ref.*	*Ref.*	-

Table 4 – Estimates of the models (continued)		**Individuals living with a partner (N=1619)**			**Individuals living without a partner (N=1590)**		
		(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
		IC daughter	**IC son**	**FC**	**IC daughter**	**IC son**	**FC**
Birth order	Neither youngest nor	*Ref.*	*Ref.*	-	*Ref.*	*Ref.*	-
	Youngest child	0.144 (0.108)	**0.351**** (0.155)	-	0.125 (0.102)	0.160 (0.121)	-
	Eldest child	-0.089 (0.109)	0.073 (0.155)	-	0.077 (0.099)	0.034 (0.118)	-
Family's characteristics							
The parent's partner provides care	No	*Ref.*	*Ref.*	*Ref.*	-	-	-
	Yes	**-0.380***** (0.097)	**-0.299**** (0.120)	**-0.767***** (0.085)	-	-	-
Number of children	At least 1	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
	At least 2	-0.009 (0.193)	-0.213 (0.252)	0.059 (0.102)	-0.139 (0.160)	**-0.372*** (0.198)	-0.020 (0.099)
	At least 3	**-0.272**** (0.128)	-0.236 (0.158)	**0.222**** (0.096)	-0.111 (0.113)	0.036 (0.127)	0.155 (0.102)
	At least 4	-0.127 (0.130)	-0.118 (0.169)	-0.156 (0.112)	**-0.207*** (0.106)	-0.033 (0.121)	-0.107 (0.112)
Has at least a sister (IC) / daughter (FC) (ref: no)		-0.012 (0.146)	-0.025 (0.213)	0.048 (0.118)	0.051 (0.131)	**0.368**** (0.159)	-0.187 (0.121)
Has at least a sister (IC) / daughter (FC) …							
… retired / unemployed (ref: no)		-0.051 (0.151)	**-0.353*** (0.198)	-0.138 (0.115)	-0.004 (0.108)	**-0.270**** (0.128)	-0.013 (0.094)
… homemaker (ref: no)		-0.143 (0.136)	0.144 (0.159)	**-0.293***** (0.110)	0.098 (0.117)	0.064 (0.133)	**-0.204**** (0.102)
… still in school or in another situation (ref: no)		0.193 (0.200)	0.018 (0.265)	0.143 (0.176)	**0.378**** (0.178)	0.192	0.123 (0.165)
… having neither a partner nor a child (ref: no)		0.093 (0.165)	-0.225 (0.230)	0.058 (0.128)	-0.184 (0.147)	0.141	-0.121 (0.119)
… co-residing with the parent (ref: no)		-0.027 (0.213)	0.339 (0.278)	**-0.907***** (0.191)	**-0.721***** (0.171)	**-1.344***** (0.239)	**-1.112***** (0.129)
… living in the same district as the parent (ref: no)		0.049 (0.119)	0.199 (0.160)	-0.030 (0.091)	-0.088 (0.102)	**-0.402***** (0.119)	-0.067 (0.092)
Has at least a brother (IC) / son (FC) …							
… retired / unemployed (ref: no)		-0.221 (0.148)	0.105 (0.188)	0.141 (0.113)	0.105 (0.106)	-0.067 (0.120)	**-0.217**** (0.095)
… still in school or in another situation (ref: no)		0.191 (0.200)	-0.210 (0.324)	0.016 (0.188)	0.197 (0.172)	**0.569***** (0.186)	-0.092 (0.152)
… having neither a partner nor a child (ref: no)		0.207 (0.163)	**0.379*** (0.210)	-0.115 (0.125)	0.139 (0.144)	-0.259 (0.191)	0.156 (0.123)
… co-residing with the parent (ref: no)		0.043 (0.204)	**-0.761**** (0.348)	-0.200 (0.171)	-0.185 (0.179)	**-0.590**** (0.263)	**-0.490***** (0.151)
… living in the same district as the parent (ref: no)		0.175 (0.111)	**-0.240*** (0.143)	0.006 (0.081)	0.142 (0.097)	-0.017 (0.106)	-0.080 (0.085)
Correlations							
$\rho_{IC,FC}$			**-0.099*** (0.051)			**-0.239***** (0.040)	
$\rho_{IC,IC}$			**0.605***** (0.047)			**0.369***** (0.043)	

Note: The standard errors are in parentheses. *, **, *** indicate a significant difference from 0 at the 10%, 5% or 1% level, respectively. *Ref.* designates the reference group for the corresponding variable.
Sample: HSM Survey 2008, 3209 disabled individuals in France aged 60 or older who have 1 to 5 children.

Table 5 - Predicted probabilities related to care arrangements, based on the presence of a partner

	All disabled elderly of the sample (N=3209)		
	Lives without a partner	Lives with a non-helping partner	Lives with a helping partner
For a child			
Participation rate	0.20	0.16	0.11
Participation rate of sons	0.14	0.11	0.07
Participation rate of daughters	0.25	0.21	0.14
For a disabled elderly			
Having at least one caregiving child	0.41	0.31	0.21
Having exactly one caregiving child, conditional on receiving care from children	0.91	0.85	0.90
Share of daughters among caregiving children	0.65	0.67	0.67
Using formal home care	0.61	0.61	0.38

Content: For a disabled parent living without a partner, the predicted probability of having at least one caregiving child is equal to 0.41. The same probability is equal to 0.31 if the disabled parent lives with a non-helping partner and 0.21 if the disabled parent lives with a helping partner.

Note: See **Appendix** for a description of the prediction methodology.

Sample: HSM Survey 2008, 3209 disabled individuals in France aged 60 or older.

Table 6 – Estimates of the alternative specifications

	Individuals living with a partner (N=1619)			**Individuals living without a partner (N=1590)**		
	(1) IC daughter	**(2) IC son**	**(3) FC**	**(4) IC daughter**	**(5) IC son**	**(6) FC**
Alternative specification 1						
Number of children of the parent	**-0.09**** (0.04)	**-0.18***** (0.05)	0.03 (0.03)	**-0.10***** (0.03)	**-0.11***** (0.03)	**-0.07***** (0.03)
Alternative specification 2						
Parent having at least 1 child	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
Parent having at least 2 children	0.05 (0.17)	-0.17 (0.21)	0.05 (0.09)	-0.11 (0.14)	**-0.51***** (0.16)	-0.14 (0.09)
Parent having at least 3 children	**-0.22*** (0.12)	**-0.29**** (0.15)	**0.18**** (0.09)	-0.04 (0.10)	0.04 (0.12)	0.12 (0.10)
Parent having at least 4 children	-0.09 (0.12)	-0.13 (0.16)	**-0.20*** (0.11)	**-0.19*** (0.10)	-0.09 (0.44)	**-0.25**** (0.11)
Alternative specification 3						
Number of children of the parent	**-0.09*** (0.05)	**-0.21***** (0.06)	0.05 (0.04)	-0.05 (0.04)	**-0.09*** (0.05)	0.00 (0.04)
Number of sisters (IC) / daughters (FC)	-0.01 (0.06)	0.07 (0.08)	-0.05 (0.04)	**-0.11**** (0.05)	-0.05 (0.06)	**-0.14***** (0.05)
Alternative specification 4						
Parent having at least 1 child	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
Parent having at least 2 children	0.11 (0.18)	0.03 (0.23)	0.07 (0.10)	0.15 (0.14)	-0.23 (0.18)	-0.06 (0.09)
Parent having at least 3 children	**-0.21*** (0.12)	**-0.34**** (0.15)	**0.19**** (0.09)	-0.02 (0.11)	0.05 (0.12)	0.15 (0.10)
Parent having at least 4 children	-0.08 (0.12)	-0.14 (0.15)	**-0.20*** (0.11)	-0.16 (0.10)	-0.09 (0.11)	**-0.22**** (0.11)
No sister (IC) / daughter (FC)	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
At least a sister (IC) / daughter (FC)	-0.07 (0.10)	0.17 (0.15)	-0.06 (0.09)	**-0.16*** (0.09)	0.00 (0.12)	**-0.31***** (0.09)

Note: To preserve space, we report only estimates associated with the family composition in the table. In all of these alternative specifications, we control for the parent's characteristics and the child's characteristics. We do not control, however, for siblings' characteristics.

Sample: HSM Survey 2008, 3209 disabled individuals in France aged 60 or older who have 1 to 5 children. The standard errors are in parentheses. *, **, *** indicate a significant difference from 0 at the 10%, 5% or 1% level, respectively. *Ref.* designates the reference group for the corresponding variable.

Table 7 - Predicted probabilities related to care arrangements based on a reduction in family size

		All disabled elderly having at least two children (N=2344)		
		Average predicted probabilities	**Average predicted probabilities after a reduction in family size (less the youngest child)**	
			If the other family members **do not** adjust their behaviour	If the other family members **do** adjust their behaviour
If the disabled parent lives **without** a partner	**For a child**			
	Participation rate	0.18	0.17	0.23
	Participation rate of sons	0.13	0.12	0.17
	Participation rate of daughters	0.24	0.22	0.27
	For a disabled elderly			
	Having at least one caregiving child	0.40	0.27	0.34
	Having exactly one caregiving child, conditional on receiving care from children	0.77	0.89	0.87
	Share of daughters among caregiving children	0.66	0.64	0.61
	Using formal home care	0.59	0.59	0.62
If the disabled parent lives **with a helping** partner	**For a child**			
	Participation rate	0.10	0.09	0.11
	Participation rate of sons	0.07	0.05	0.08
	Participation rate of daughters	0.13	0.11	0.14
	For a disabled elderly			
	Having at least one caregiving child	0.21	0.14	0.17
	Having exactly one caregiving child, conditional on receiving care from children	0.78	0.90	0.88
	Share of daughters among caregiving children	0.67	0.67	0.62
	Using formal home care	0.38	0.38	0.37

Content: For a disabled elderly living without a partner and having at least two children, the predicted probability of having at least one caregiving child is equal to 0.40. The same probability would be equal to 0.27 after dropping the youngest child if the other family members did not adjust their behaviour. It would be equal to 0.34 after dropping the youngest child and accounting for the adjustments made by other family members.

Note: See the **Appendix** for a description of the prediction methodology.

Sample: HSM Survey 2008, 2344 disabled individuals in France aged 60 or older who have at least two children.

Table 8 - Predicted probabilities according to the daughter's participation in the labour market

		Predicted probability when the daughter is retired or unemployed	**Average predicted probability when the daughter participates in the labour market**	
			If the other family members **do not** adjust their behaviour	If the other family members **do** adjust their behaviour
If the disabled parent lives **without** a partner	**For a child**			
	Participation rate	0.30	0.30	0.34
	Participation rate of the son	0.17	0.17	0.24
	Participation rate of the daughter	0.44	0.43	0.43
	For a disabled elderly			
	Having at least one caregiving child	0.49	0.48	0.52
	Having exactly one caregiving child, conditional on receiving care from children	0.75	0.75	0.69
	Share of daughters among caregiving children	0.72	0.72	0.64
	Using formal home care	0.72	0.72	0.73
If the disabled parent lives **with a helping** partner	**For a child**			
	Participation rate	0.20	0.15	0.19
	Participation rate of the son	0.12	0.12	0.20
	Participation rate of the daughter	0.28	0.19	0.19
	For a disabled elderly			
	Having at least one caregiving child	0.32	0.25	0.31
	Having exactly one caregiving child, conditional on receiving care from children	0.71	0.71	0.67
	Share of daughters among caregiving children	0.71	0.62	0.49
	Using formal home care	0.49	0.49	0.55

Content: For our two-child family of reference, whose disabled parent lives without a partner, the predicted probability of having at least one caregiving child is equal to 0.49 when the daughter is retired or unemployed. The same probability would be equal to 0.48 if the daughter had a job and the other family members did not adjust their caregiving behaviour. It would be equal to 0.52 if the daughter had a job, after accounting for the adjustments of other family members in their caregiving behaviour.

Note: See the **Appendix** for a description of the prediction methodology.

Sample: HSM Survey 2008, one two-child family of reference with the "average" disabled parent of our sample and two children: a daughter — aged 55, living in the same district as the mother, with a partner and children — and a son — aged 52, living in the same district as the mother, with a partner and children, and participating in the labour market.

Table 9 - Predicted probabilities according to the distance from the parent, without adjustment of other family members

		Predicted probability when both children live in the same district as the parent	Predicted probability (without adjustment of other family members)			Predicted probability (with adjustment of other family members)		
			Daughter lives far away	Son lives far away	Both children live far away	Daughter lives far away	Son lives far away	Both children live far away
If the disabled parent lives **without** a partner	**For a child**							
	Participation rate	0.34	0.19	0.24	0.09	0.26	0.21	0.10
	Participation rate of the son	0.24	0.24	0.04	0.04	0.39	0.04	0.10
	Participation rate of the daughter	0.43	0.14	0.43	0.14	0.14	0.38	0.11
	For a disabled elderly							
	Having at least one caregiving child	0.52	0.32	0.44	0.17	0.43	0.39	0.19
	Having exactly one caregiving child, conditional on receiving care from children	0.69	0.79	0.91	0.89	0.79	0.91	0.84
	Share of daughters among caregiving children	0.64	0.37	0.91	0.76	0.27	0.90	0.54
	Using formal home care	0.73	0.73	0.73	0.73	0.75	0.75	0.77
If the disabled parent lives **with a helping** partner	**For a child**							
	Participation rate	0.19	0.12	0.11	0.04	0.09	0.09	0.03
	Participation rate of the son	0.20	0.20	0.04	0.04	0.15	0.04	0.02
	Participation rate of the daughter	0.19	0.04	0.19	0.04	0.04	0.15	0.03
	For a disabled elderly							
	Having at least one caregiving child	0.31	0.25	0.20	0.08	0.20	0.17	0.06
	Having exactly one caregiving child, conditional on receiving care from children	0.67	0.88	0.84	0.84	0.87	0.83	0.87
	Share of daughters among caregiving children	0.49	0.17	0.84	0.53	0.22	0.80	0.55
	Using formal home care	0.55	0.55	0.55	0.55	0.56	0.54	0.55

Content: For our two-child family of reference, whose disabled parent lives without a partner, the predicted probability of having at least one caregiving child is equal to 0.52 when both children live in the same district as the elderly parent. The same probability would be equal to 0.32 if the daughter lived far away, 0.44 if the son lived far away and 0.17 if both children lived far away and the other family members did not adjust their caregiving behaviour.

Note: See the **Appendix** for a description of the prediction methodology.

Sample: HSM Survey 2008, one two-child family of reference with the "average" disabled parent of our sample, and two children: a daughter — aged 55, living with a partner, having children and participating in the labour market — and a son — aged 52, with the same characteristics.