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The dual effect of labour market participation on care provision for elderly parents

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Abstract
This paper focuses on the trade-off between work and informal care among women aged 50 to 65. The existing literature provides heterogeneous results on the effect of labour supply on care provision for elderly parents. In particular, existing empirical studies do not allow to conclude to a negative effect of working on informal care provision whereas the standard microeconomic framework predicts a clear substitution between the two activities. To explain these results, we refer to sociology literature that provides evidence of a positive effect of working on the propensity to provide care. We then propose a reformulation of the traditional microeconomic model and derive two testable implications. Using data from SHARE, a European multidisciplinary database of micro-data on health, socio-economic status and family network, we estimate an endogenous switching model. Our main finding confirms the results of the qualitative survey and suggests that the effect of paid work on time devoted to care may be decomposed into (i) a discrete positive effect, in which labour market participation positively affects the propensity to provide care, and (ii) a continuous negative effect, in which each worked hour reduces the time devoted to parental care. Simulations suggest that participation in the labour market reduces involvement in care for an elderly parent only for those working more than 26 hours per week. The overall effect of labour market position is finally relatively modest and does not appear, among women, as a major determinant of informal care provision.

Key words: Long-term care; informal care; labour supply; time allocation; endogenous switching model

JEL Classification: C34, I12, J14, J22

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1 Introduction

Population ageing will be a major challenge in Europe in the coming decades, especially because of the questionable sustainability of public pension systems. To contain the dependency ratio, the Stockholm European Council (2001) has set a target for Member States to raise the employment rate to a European average of 67%, with specific objectives for the senior population. The Stockholm European Council "has agreed to set an EU target for increasing the average EU employment rate among older women and men (55-64) to 50 % by 2010"[1]. This target of 50% was subsequently renewed by the Community Lisbon Program (2005). In parallel, the growing proportion of elderly in the population is likely to increase the demand for long-term care. To allow the frail elderly to live in the community without excessively increasing public long-term care expenditures, most EU members more or less explicitly encourage family members to provide care for elderly people. Because seniors play a major role in caring for dependent elderly people, it is appropriate to ask whether a policy aimed at extending the work lives of seniors is compatible with a policy aimed at supporting informal care for elderly people. Would informal care decrease if the senior employment rate rises? Conversely, would shifting the burden of care for elderly people to families hamper growth in senior employment?

Using data from the second wave of the Survey of Health, Ageing and Retirement in Europe (SHARE, 2006-2007)[2], Figure 1 illustrates, at the national level, the relationship between the employment rate for women aged 50 to 65 with one living parent[3] and the proportion of "intensive" caregivers, defined as those who devote more than one hour a day to parental care or who co-reside with their parent. A decreasing relationship appears between labour force participation and the provision of informal care. At one end are Northern European countries and Switzerland, which show a high employment rate and a low proportion of intensive caregivers. At the other end are the Southeast and Eastern European countries, which are characterised by a low employment rate and a high proportion of intensive caregivers. Continental European countries lie somewhere in between.

The link we generally observe between the two activities may result, at the individual level, from a direct causal relationship. From this perspective, the two opposite causality directions are *a priori* possible and involve endogeneity issues in the econometric analysis of the relationship between work and care. On the one hand, informal care provision may be considered a determinant of labour supply. In this case, the negative correlation between the two activities should be interpreted as evidence of a negative effect of care provision on the labour supply: those who provide care are constrained to reduce their working time or leave the labour market. On the other hand, we may consider the labour market position a determinant of informal

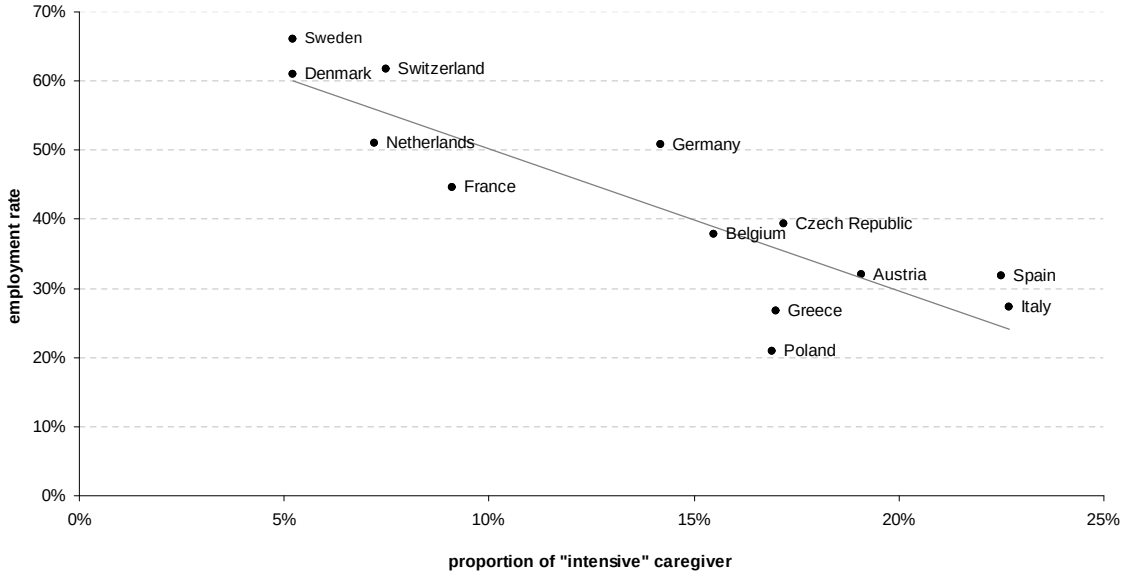
[1] In 2001, the European employment rate of this population was 37.7% (Eurostat).

[2] See Section 5 for a description of the data.

[3] In this paper, we focus on caregiving provided by women to their parent living without a spouse; that is, a situation in which children play a major role in care provision.

care provision. Because they have lower opportunity costs, non-workers may have a higher incentive to provide informal care than workers. Identifying the mechanism of causality between the two activities is a key issue for policymakers because the effects of public policies depend on the way the two activities interact at the individual level. For instance, policymakers may decide to provide publicly funded formal care to alleviate the burden of informal caregivers and reduce the associated negative effects on their labour supply. This public policy may succeed in reducing the adverse effect of informal care on labour supply only if the interaction mechanism is based, even partially, on a pathway of causation from the informal care provision to the working time. If this is not the case, providing publicly funded formal care would have no effect on the labour supply of potential caregivers. Moreover, policy aimed at increasing the employment rate could lead to adverse effects on informal care provision only if the labour market position is a determinant of the individual decision to provide care.

Figure 1. Employment rate and proportion of "intensive" caregivers by country (women only)



Population: Women aged 50 to 65 with one living parent.
Source : Eurostat and SHARE, wave 2 (2006-2007)

In this paper, we focus the analysis on a specific pathway of causation by addressing the question of whether the increase in labour supply among the women population leads to a decline in time devoted to informal care for an elderly parent among the women population. Identifying the causal effect of labour supply on family support is indeed of particular interest among the women population because they are traditionally the main source of informal care and because they are characterised by a rising employment rate. This increase in the female labour market participation is one of the most important changes to have taken place in the economy during the last century and may potentially lead to a decline in family support if working reduces time devoted to informal care.

However, as we will see in the next section, previous literature aiming to identify the effect of labour market position on care provision leads to ambiguous results whereas the standard microeconomic framework implies a strict negative effect. To overcome this contradiction, we propose here a simple reformulation of the standard microeconomic model by taking into account a potential positive effect of worker status on the propensity to provide parental care. We then estimate the reduced parameters of the model to test the reformulation we propose. Our estimation results are consistent with our expectations. Our main finding suggests that the effect of paid work on time devoted to informal care may be decomposed into a discrete positive effect, with labour market participation positively affecting the propensity to provide care, and a continuous negative effect, with each worked hour reducing the time devoted to parental care. The overall effect of labour market position is finally relatively modest and does not appear, among women, as a major determinant of informal care provision.

The rest of this article is organised as follows. Section 2 reviews the previous literature. Section 3 and Section 4 present our theoretical framework and the empirical strategy we use to test the implications of our microeconomic model. Section 5 outlines the data. Section 6 presents the estimation results. Finally, Section 7 concludes.

2 Previous literature

To study the individual time allocation between informal care and paid work, the literature usually refers to a microeconomic model formalised by Johnson and La Sasso (2000). The model is similar to the standard labour supply, except that the adult child (say, a daughter) is assumed to be altruistic toward her parent[4] and decides to allocate her time between paid work, leisure and informal care. According to this model, working and providing informal care for an elderly parent appear to be two strictly competing activities; every exogenous shock that positively affects one activity leads to a reduction of time devoted to the other activity. Since the mid-1980s, several studies have empirically investigated the relationship between labour and caregiving behaviour and tested the strictly negative interactions between the two activities implied by the standard microeconomic model[5].

A first body of literature addresses whether the provision of informal care induces adverse effects on the labour supply, as expected with regard to the standard microeconomic model. To answer this question, this literature considers the care provision a determinant of labour supply. Results obtained from this empirical literature appear consistent with the theoretical model; we generally observe a negative and significant effect

[4] Through this assumption, the daughter's well-being is positively associated with the amount of informal care she provides to her parent.

[5] See Fontaine (2011) for a more detailed survey of the empirical literature related to the trade-off between informal care and work.

of caregiving on the labour supply[6]. It is worth mentioning that all studies using an IV approach demonstrate that the failure to accommodate for the endogeneity of the care provision in the labour outcome equation leads to an overestimation of the real impact of an exogenous variation of caregiving (see Wolf and Soldo, 1994; Ettner, 1995; Ettner, 1996; Jonhson and Lo Sasso, 2000; Crespo, 2006; Heitmueller, 2007; Bolin et al., 2007). Specifically, the literature provides evidence of a positive correlation between the care variable and the residual of the labour outcome equation. This positive correlation, interpreted in terms of simultaneity bias, tends to suggest a positive reversal causality—that is, a positive effect of the labour supply on the propensity to provide care. As noted, for instance, by Ettner (1995) and Heitmueller (2007), this empirical result appears inconsistent with the standard conceptual framework, which suggests the existence of a negative reversal causality and thus a decline, in absolute terms, of the impact of the care variable when endogeneity is controlled.

A second part of literature aims to directly identify the reverse causation pathway, which we investigate in this paper, by asking how an exogenous shock on the labour supply impacts the provision of care. The results obtained are much more ambiguous and generally inconsistent with the standard microeconomic model. Using personal interview data from 460 persons with a non-co-residential parent, Spitze and Logan (1989) examine the impact of work hours on several parent care outcomes (frequency of interactions, patterns of help and attitude toward the relationship). Using OLS estimation, they do not find a significant effect of employment on caregiving or interaction with the parent. Börsch-Supan et al. (1992), who use data from Massachusetts (the 1986 HRCA Elderly Survey and the 1986 HRC-NBER Child Survey), estimate a Tobit model and identify a significant positive effect of employment (treated as exogenous) on time spent with parents. Fontaine (2011) finds a similar result when the endogeneity of working time is taken into account through the estimation of a Bivariate Tobit Model. In particular, using data from SHARE, the estimation results suggest that among individuals aged 50 to 65, one more hour of work per week significantly increases the time devoted to parental care by five minutes. Stern (1995) adopts an IV approach with panel data using two waves (1982 and 1984) of the NLTC Survey. In the second year, the author estimates how a child's probability of being the primary caregiver is affected by his or her work status. By restricting the sample to parents receiving no care in the first year, he uses the labour force status of the first year as an instrument of the labour force status of each child for the second year. After controlling for endogeneity, the results suggest that work status does not significantly affect the care provision. Carmichael and Charles (2010) use a similar approach from 15 waves (1991-2005) of the British Household Panel Survey (BHPS). They find no significant effect of working less than 20 hours per week and a negative effect of working more than 20 hours a week (in t) on the probability of becoming a caregiver (in t+1). Moreover, among those employed, they do not find a significant effect of working time (in t) on the probability of becoming a caregiver (in t+1).

[6] See Bolin et al., 2007; Carmichael and Charles, 1998, 2003a, 2003b; Casado-Marin et al., 2008; Crespo, 2006; Ettner, 1995, 1996; Heitmueller, 2007; Johnson and Lo Sasso, 2000; Kolodinsky and Shirey, 2000; Mac Lanahan and Manson, 1990; Muurinen, 1986; Stone et al., 1987; Stone and Short, 1990; Wolf and Soldo, 1994.

Boaz and Muller (1992), Pavalko and Artis (1997), Spiess and Schneider (2002) and Berecki-Gisolf (2008), who jointly estimate the two opposite pathways of causation[7], confirm the main message of the literature: an exogenous increase in the care provision negatively and generally significantly affects the labour supply, whereas an exogenous variation of the labour supply has an unclear, but generally not significant, effect on care provision, except above a certain threshold of working time. Boaz and Muller (1992) use a sample from the National Informal Caregivers Survey (NICS), which only includes active caregivers. They use a two-step estimation and find that, conditional on being a caregiver, time devoted to care significantly reduces the probability of working full-time but not the probability of working part-time. Symmetrically, working full-time significantly reduces the care provision, whereas working part-time does not affect the time devoted to care. Pavalko and Artis (1997), who use panel data from the National Longitudinal Survey of Mature Women, find that women aged 50 to 64 who begin providing care significantly reduce their hours of paid employment. In contrast, work status does not significantly impact the propensity to begin providing care. Berecki-Gisolf et al. (2008) and Spiess and Schneider (2002) obtain similar results from the Australian Longitudinal Study on Women's Health (ALSWH) and the European Community Household Panel (SCHP). Spiess and Scheinder (2002) find, however, that being employed reduces the probability of providing care more than 14 hours per week.

Thus, the effect of working time on caregiving time is empirically quite ambiguous, whereas the standard theoretical model suggests a clear negative effect. How can this ambiguity be explained? One possible explanation may be found in the sociology literature. In addition to the substitution effect from the time constraint, the sociology literature proposes another mechanism of interaction leading to a partial complementarity between the two activities. The existence of this mechanism, which is not taken into account in the standard microeconomic model, may explain the inconsistency of the estimation results with the theoretical predictions. Moreover, if the magnitude of this mechanism depends on the sample considered, this could also explain the variation in the estimation results between studies.

Due the agent's preferences, at least three effects may lead to a partial complementarity between the two activities. The first one is the "protection effect". Using results from a qualitative survey conducted in France among women providing support to an elderly parent, Le Bihan and Martin (2006) suggest that working is a protective activity for the caregivers. It allows them to avoid being completely absorbed by their caregiving activity. Therefore, non-workers may have a lower propensity to provide informal care for fear of being unable to limit their involvement as the needs of the elderly parent increase. Among the children, we can assume that this effect is more relevant for daughters than for sons if the duty to provide care to an elderly parent lies more heavily upon daughters than sons. Two other effects can also occur: the "respite

[7] Pezzin and Schone (1999) and Borsch-Supan et al. (1992) estimate structural models to identify how the two endogenous outcomes related to work and care react to changes in exogenous variables. These models do not allow them to directly identify the causality between the two variables. However, the estimation of the structural parameters suggests, in both cases, that the trade-off between labour supply and parental caregiving decisions is relatively modest.

effect" and the "productivity effect". The "respite effect" suggests that working may offer the caregiver a way of freeing herself or himself from the emotional demands associated with the care provided for a relative (Carmichael and Charles, 1998). This effect is apparent in the declaration of a daughter who provides care to her elderly mother: "*And it's true that being at work, it helps to decompress and we are confronted with people who have had the same problem. So you can get advice. (...) Fortunately, there was the job! Oh yes! If there had not been the work ...* " (from Le Bihan and Martin, 2006). According to the "productivity effect", some occupations may facilitate the development of know-how that can be used in caregiving (personal care for a nurse, help with paperwork for bank employee). Through these three effects, participating in the labour market appears to increase the propensity to provide informal care. Thus, they introduce into the analysis a kind of complementarity between the two activities.

To the best of our knowledge, these effects have not previously been integrated within a microeconomic model, although their existence may explain the lack of robustness of results related to the effect of working time on caregiving time. In particular, the coexistence of (i) a discrete positive effect of worker status, derived from the exitence of the protection effect, the respite effect or the productivity effect and (ii) a continuous negative effect of working time on the propensity to provide care may induce a nonmonotonic overall effect consistent with the estimation results obtained by Carmichael and Charles (2010) or Boaz and Muller (1992). Below a certain threshold of working time, the average overall effect on time devoted to informal care would be non-significant, because the discrete positive effect from worker status is, on average, equivalent in absolute value to the continuous negative effect of working time. Above a certain threshold, the effect would be negative because the negative continuous effect of working time is higher in absolute value than the discrete positive effect of the worker status. In the following sections, we propose and empirically validate a simple reformulation of the standard microeconomic model, taking into account both effects and allowing to endogenously identify a threshold beyond which working is associated with negative effects on the provision of informal care.

3 Microeconomic framework

To study the effect of labour market position on care provision, we assume that an adult child (for instance, a daughter) decides to allocate her time to paid work, informal care and leisure. We assume the daughter is characterised by the utility function (1) and the two constraints (2) and (3)[8]:

$$U = \alpha.\ln(C) + \beta.\ln(L) + (\gamma + s.y_W).\ln(IC) \quad (1)$$

$$C \leq w.W + R \quad (2)$$

$$W + IC + L \leq 1 \quad (3)$$

The daughter's utility depends positively on the private consumption of a composite commodity C, leisure time L and caregiving time provided to the parent IC. Furthermore, α, β and γ are three positive parameters, w is the daughter's wage rate, W is time allocated to paid work and R is the daughter's non-labour income. For convenience, the price of the composite commodity has been normalised to one. Constraint (2) states that consumption cannot exceed the daughter's financial resources. Constraint (3) ensures that the time allocated to work, parental care and leisure cannot exceed the total amount of available time, which is normalised to one.

Compared to the standard microeconomic model formalised by Johnson and La Sasso (2000), the originality of the utility function specified in (1) is based on the component $s.y_W$, where s is a parameter assumed to be positive and y_W is a dummy variable equal to 1 if the daughter participates in the labour market and 0 otherwise. This component allows us to translate into a microeconomic framework the positive effect of participation in the labour market on the marginal utility of providing care, which is identified in the sociology literature through the "protection effect", the "respite effect" and the "productivity effect":

$$\frac{\partial U}{\partial IC}(y_W = 1) - \frac{\partial U}{\partial IC}(y_W = 0) = \frac{s}{IC} > 0 \quad (4)$$

Conditional on her working time, the daughter chooses time devoted to informal care such that the marginal utility associated with care provision is equal to the marginal utility associated with leisure. Taking into account the possible existence of corner equilibrium (if the utility associated with the first hour devoted to parental care does not offset the utility lost from reducing leisure time), the optimal caregiving time, conditional on working time, is defined by:

$$IC(y_W, W) = \max\left(0, IC^*(y_W, W)\right)$$
$$\text{with } IC^*(y_W, W) \text{ such as } \frac{\partial U}{\partial IC^*} = \frac{\partial U}{\partial L}.$$

[8] In Appendix A, we outline a model incorporating individual heterogeneity.

Let IC^{0*} be the (latent) optimal time devoted to informal care conditional on not participating in the labour market ($y_w = 0$) and $IC^{1*}(W)$ the optimal time devoted to informal care conditional on participating in the labour market and working W hours. Using the utility function specified in (1), the optimal caregiving times, conditional on labour market position, are equal to:

$$IC^{0*} = \frac{\gamma}{\beta + \gamma} \tag{5}$$

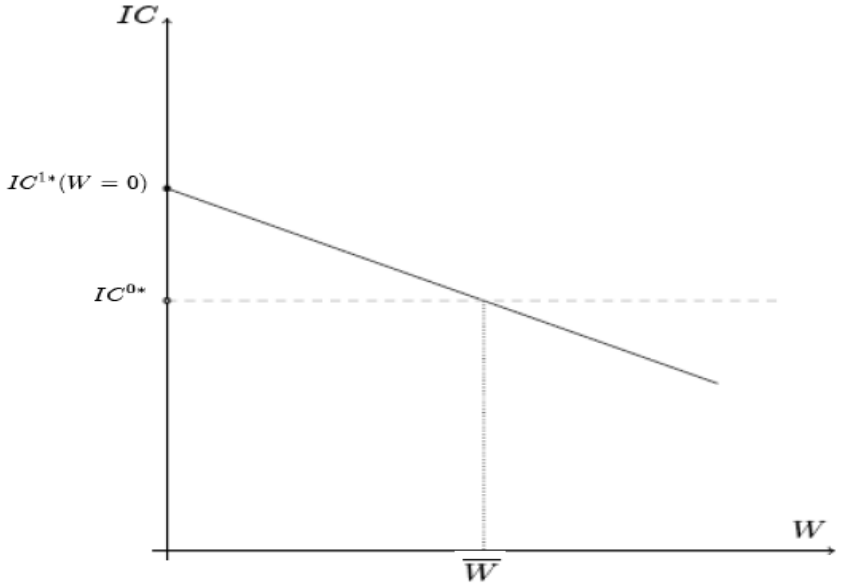
$$IC^{1*}(W) = \frac{\gamma + s}{\beta + \gamma + s} - \frac{\gamma + s}{\beta + \gamma + s} W \tag{6}$$

We can easily deduce from the expressions (5) and (6) two testable implications of our microeconomic framework. First, worker status tends to increase the propensity to provide care through the "protection effect", the "respite effect" or the "productivity effect" (Implication 1): $IC^{1*}(W = 0) > IC^{0*}$. Second, each hour spent working tends to decrease the time devoted to informal care (Implication 2): $\partial IC^{1*}(W)/\partial W < 0$.

Whereas Implication 2 is true even if $s = 0$, Implication 1 is true only if $s > 0$. Specifically, if $s = 0$, as suggested by the standard microeconomic model, the worker status has no effect, by itself, on the propensity to provide care: $IC^{1*}(W = 0) = IC^{0*}$. Thus, comparing the time devoted to informal care conditional on not participating in the labour market (IC^{0*}) and time devoted to informal care conditional on participating in the labour market, after controlling for the effect of working time ($IC^{1*}(W = 0)$), allows us to directly test the existence of a positive association between participation in the labour market and the care provided to an elderly parent.

Figure 2 summarises the expected effect of labour market position on the time devoted to parental care. The light point represents the optimal caregiving time conditional on not participating in the labour market, whereas the dark curve represents the optimal caregiving time conditional on participating in the labour market. When the individual works less than $\overline{W}$, the positive effect of worker status is greater than the negative effect of working time. In contrast, the labour supply reduces the optimal caregiving time for individual who work more than $\overline{W}$ hours per week because, in this case, the positive effect of being a worker is completely offset by the negative impact of working time.

Figure 2. Expected effect of the labour market position on optimal caregiving time



4 Empirical strategy

To test both implications of our theoretical framework, we introduce individual (observed and unobserved) heterogeneity in the previous microeconomic model. Hence, we specify the optimal caregiving time conditional on labour supply and other individual characteristics. By incorporating individual heterogeneity, equations (5) and (6) may be rewritten in reduced form as follows (see Appendix A):

$$IC_i^{0*} = b_{IC0}^0 + \sum_{k=1}^{K} b_{ICk}^0 . x_{ik} + \varepsilon_{ICi}^0 \tag{7}$$

$$IC_i^{1*}(W_i) = b_{IC0}^1 + \sum_{k=1}^{K} b_{ICk}^1 . x_{ik} + \alpha W_i + \varepsilon_{ICi}^1 \tag{8}$$

with the observed caregiving time IC defined as follows:

$$IC_i = \begin{cases} IC_i^0 = \max(0, IC_i^{0*}) \text{ if } y_{Wi} = 0 \\ IC_i^1 = \max(0, IC_i^{1*}) \text{ if } y_{Wi} = 1 \end{cases} \tag{9}$$

As specified, the model composed by expressions (7), (8) and (9) falls in the general class of switching models (Maddala and Nelson, 1975). As suggested in Appendix A, assuming that participation in the labour market, in itself, impacts the propensity to provide care causes individual characteristics to have different effects on the optimal caregiving time according to the labour market position.

The model allows us to decompose the effect of labour supply on time devoted to parental care into the following:

(i) the effect of working time on time devoted to parental care (conditional on being a worker) estimated by:

$$\frac{\partial \widehat{E}_i(IC_i^1)}{\partial W_i}$$

(ii) the effect of worker status, $\widehat{\Delta y_{Wi}}$, independent of the effect of time spent working. To estimate this effect, we can simulate for each woman in the sample the difference between her expected caregiving time conditional on being worker, assuming a working time equal to 0, on the one hand, and her expected caregiving time, conditional on being a non-worker, on the other hand:

$$\widehat{\Delta y_{Wi}} = \widehat{E}_i(IC_i^1/W_i = 0) - \widehat{E}_i(IC_i^0)$$

According to our microeconomic framework, we expect $\dfrac{\partial \widehat{E}_i(IC_i^1)}{\partial W_i}$ to be negative and $\widehat{\Delta y_{Wi}}$ to be positive.

The estimation of equations (7), (8) and (9) may potentially suffer from two endogeneity biases. First, the decision to participate in the labour market may be endogenous if some unobserved factors associated with this decision also affect the decision to provide care. For similar reasons, the working time variable W in equation (8) is likely to suffer from endogeneity because caregiving time and working time are presumably chosen simultaneously. To control the endogeneity of both outcomes related labour supply, we jointly estimate the two following reduced equations with equations (7), (8) and (9):

$$y_{wi} = \begin{cases} 1 & \text{if} \quad \lambda_{y_W 0} + \sum_{k=1}^{K_{y_W}} \lambda_{y_W k}.x_{ik} + \varepsilon_{y_W i} > 0 \\ 0 & \text{otherwise} \end{cases} \tag{10}$$

$$W_i = \begin{cases} \lambda_{W0} + \sum_{k=1}^{K_W} \lambda_{Wk}.x_{ik} + \varepsilon_{Wi} & \text{if} \quad y_{wi} = 1 \\ 0 & \text{if} \quad y_{wi} = 0 \end{cases} \tag{11}$$

and we assume that the residuals of the model are distributed according to a multivariate normal distribution:

$$(\varepsilon_{ICi}^0, \varepsilon_{ICi}^1, \varepsilon_{y_W i}, \varepsilon_{Wi}) \sim N(0, \Omega)$$

$$\text{with} \quad \Omega = \begin{pmatrix} \sigma_{IC0}^2 & \rho_{IC0,IC1}.\sigma_{IC0}.\sigma_{IC1} & \rho_{IC0,y_W}\sigma_{IC0} & \rho_{IC0,W}.\sigma_{IC0}.\sigma_W \\ \rho_{IC0,IC1}.\sigma_{IC0}.\sigma_{IC1} & \sigma_{IC1}^2 & \rho_{IC1,y_W}\sigma_{IC1} & \rho_{IC1,W}.\sigma_{IC1}.\sigma_W \\ \rho_{IC0,y_W}\sigma_{IC0} & \rho_{IC1,y_W}\sigma_{IC1} & 1 & \rho_{y_W,W}.\sigma_W \\ \rho_{IC0,W}.\sigma_{IC0}.\sigma_W & \rho_{IC1,W}.\sigma_{IC1}.\sigma_W & \rho_{y_W,W}.\sigma_W & \sigma_W^2 \end{pmatrix}$$

Note that, because IC^0 is not observed simultaneously with IC^1 and W, the correlation coefficients $\rho_{IC0,IC1}$ and $\rho_{IC0,W}$ are not estimable. However, this does not imply that these correlation coefficients are equal to zero (Maddala, 1983; Pezzin et Schone, 1999).

To specify the likelihood function, we distinguish 4 situations according to the decision whether to provide care and whether to participate in the labour market. Let S_1 be the sub-sample of women who provide a positive quantity of informal care and participate in the labour market; S_2 is the sub-sample of women who provide a positive quantity of informal care but do not participate in the labour market; S_3 is the sub-sample of women who do not provide care but participate in the labour market; and finally, S_4 is the sub-sample of women who do not provide care and do not participate in the labour market.

Let φ_k be the normal density function of dimension k. For woman i in S_1, the probablity of providing $ic_i > 0$ hours of informal care and working $w_i > 0$ hours per week is equal to:

$$\begin{aligned} P(IC_i^1 &= ic_i^1, W_i = w_i, y_{Wi} = 1) \qquad (12)\\ &= P(\varepsilon_{ICi}^1 = ic_i^1 - b_{IC0}^1 - \sum_{k=1}^{K} b_{ICk}^1.x_{ik} - \alpha.w_i, \varepsilon_{Wi} = w_i - \lambda_{W0} - \sum_{k=1}^{K_W} \lambda_{Wk}.x_{ik}, \varepsilon_{y_W i} < \lambda_{y_W 0} + \sum_{k=1}^{K_{y_W}} \lambda_{y_W k}.x_{ik}) \\ &= \int_{-\infty}^{\lambda_{y_W 0} + \sum_{k=1}^{K_{y_W}} \lambda_{y_W k}.x_{ik}} \varphi_3 \left(ic_i^1 - b_{IC0}^1 - \sum_{k=1}^{K} b_{ICk}^1.x_{ik} - \alpha.w_i, w_i - \lambda_{W0} - \sum_{k=1}^{K_W} \lambda_{Wk}.x_{ik}, \varepsilon_{y_W i} \right) d\varepsilon_{y_W i} \end{aligned}$$

For woman i in S_2, the probablity of providing $ic_i > 0$ hours of informal care and not working ($y_{Wi} = 0$) is equal to:

$$\begin{aligned} P(IC_i^0 &= ic_i^0, y_{Wi} = 0) \qquad (13)\\ &= P(\varepsilon_{ICi}^0 = ic_i^0 - b_{IC0}^0 - \sum_{k=1}^{K} b_{ICk}^0.x_{ik}, \varepsilon_{y_W i} < -\lambda_{y_W 0} - \sum_{k=1}^{K_{y_W}} \lambda_{y_W k}.x_{ik}) \\ &= \int_{-\infty}^{-\lambda_{y_W 0} - \sum_{k=1}^{K_{y_W}} \lambda_{y_W k}.x_{ik}} \varphi_2 \left(ic_i^0 - b_{IC0}^0 - \sum_{k=1}^{K} b_{ICk}^0.x_{ik}, \varepsilon_{y_W i} \right) d\varepsilon_{y_W i} \end{aligned}$$

For woman i in S_3, the probablity of not providing care ($ic_i = 0$) and working $w_i > 0$ hours per week is equal to:

$$\begin{aligned} P(IC_i^1 &= 0, W_i = w_i, y_{Wi} = 1) \qquad (14)\\ &= P(\varepsilon_{ICi}^1 < -b_{IC0}^1 - \sum_{k=1}^{K} b_{ICk}^1.x_{ik} - \alpha.w_i, \varepsilon_{Wi} = w_i - \lambda_{W0} - \sum_{k=1}^{K_W} \lambda_{Wk}.x_{ik}, \varepsilon_{y_W i} < \lambda_{y_W 0} + \sum_{k=1}^{K_{y_W}} \lambda_{y_W k}.x_{ik}) \\ &= \int_{-\infty}^{\lambda_{y_W 0} + \sum_{k=1}^{K_{y_W}} \lambda_{y_W k}.x_{ik}} \int_{-\infty}^{-b_{IC0}^1 - \sum_{k=1}^{K} b_{ICk}^1.x_{ik} - \alpha.w_i} \varphi_3 \left(\varepsilon_{ICi}^1, w_i - \lambda_{W0} - \sum_{k=1}^{K_W} \lambda_{Wk}.x_{ik}, \varepsilon_{y_W i} \right) d\varepsilon_{ICi}^1 d\varepsilon_{y_W i} \end{aligned}$$

Finally, for individual i in S_4, the probablity of not providing care ($ic_i = 0$) and not working ($y_{Wi} = 0$)

is equal to:

$$
\begin{aligned}
P(IC_i^0 &= 0, y_{Wi} = 0) \qquad (15)\\
&= P(\varepsilon_{ICi}^0 < -b_{IC0}^0 - \sum_{k=1}^{K} b_{ICk}^0.x_{ik}, \varepsilon_{y_W i} < -\lambda_{y_W 0} - \sum_{k=1}^{K_{y_W}} \lambda_{y_W k}.x_{ik})\\
&= \int_{-\infty}^{-\lambda_{y_W 0} - \sum_{k=1}^{K_{y_W}} \lambda_{y_W k}.x_{ik}} \int_{-\infty}^{-b_{IC0}^0 - \sum_{k=1}^{K} b_{ICk}^0.x_{ik}} \varphi_2\left(\varepsilon_{ICi}^0, c_{y_W i}\right) d\varepsilon_{ICi}^0 d\varepsilon_{y_W i}
\end{aligned}
$$

The model is estimated via simulated maximum likelihood, using the Geweke-Hajivassiliou-Keane (GHK) algorithm. By writing the multivariate normal distributions as the product of conditional univariate distributions, the GHK algorithm allows to approximate by simulation the integrals of multivariate normal density functions that appear in the likelihood function through the expression (14) (Greene, 2003; Stern, 2000). The simulated probability replace in the likelihood function the exact probability associated to the combination of outcomes of the sub-population (14)[9]. The likelihood function is then maximised using standard optimization techniques.

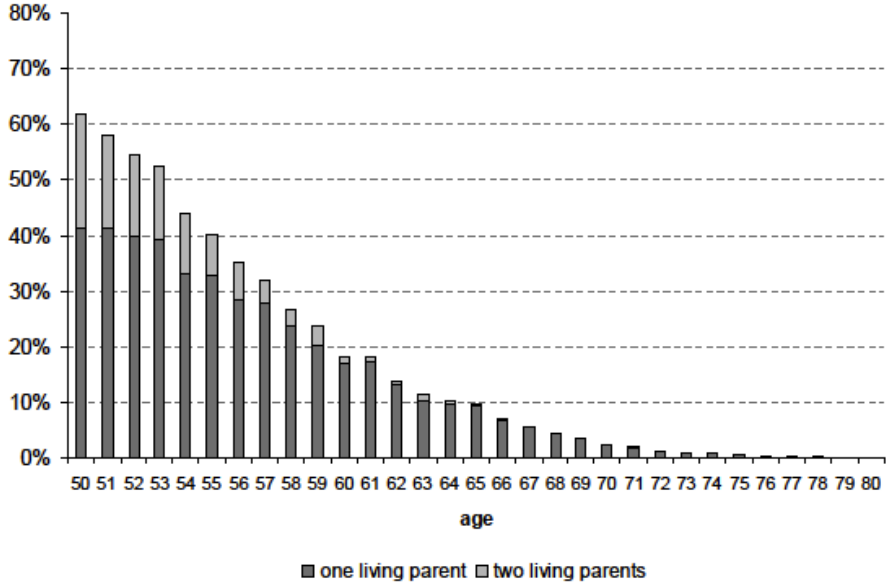
5 The data: SHARE

For our analysis, we use the second wave (2006-2007) of the Survey of Health, Ageing and Retirement in Europe (SHARE). SHARE follows the design of the US Health and Retirement Study (HRS) and the English Longitudinal Study of Ageing (ELSA). It is a multidisciplinary database of micro-data on health, socio-economic status and social and family networks of more than 30,000 individuals aged 50 or over. For the purpose of this study, we focus the analysis on care provided by daughters for their elderly parents. We could have focused on care provided by women to their dependent spouse, but such care generally involves elder caregivers who are already retired.

We restricted the sample to women with a single living parent because adult children are generally the main providers of informal care in this family configuration. Moreover, we only considered women aged 50 to 65 not only because the probability of working over the age of 65 is close to zero but also because the proportion of those with at least one living parent is very low (Figure 3). Because of a lack of information on intra-household caregiving, we had to exclude women living with an elderly parent. Therefore, our empirical analysis is partially truncated because co-residence is a potential mode of support from adult children to their disabled elderly parents. The reader should keep in mind that our estimation results are conditional on having chosen to live apart from the parent. The final sample includes 2,253 observations.

[9] The model is estimated using STATA. Note that for the sub-populations S_1 and S_2, associated probabilities include integrals of one dimension that do not require the use of a simulation procedure. For the sub-population S_4, we use the standard bivariate cumulative function provided by STATA.

Figure 3. Proportion by age of women with at least one living parent



To study the effect of paid work on the provision of informal care, we use two variables: the number of hours worked per week (W) and the number of hours devoted to parental care per week (IC). Time devoted to care combines three activities, namely personal care, practical household help and help with paperwork. One can assume that the interaction between care and labour supply differs according to the type of care. For instance, it may be easier to combine work and help with paperwork because this type of care can be provided remotely. In contrast, personal care requires time to be spent with the care receiver and may be emotionally more binding. However, the data do not allow us to distinguish between the time devoted to each type of care. We thus consider overall caregiving time without distinguishing the type of care. Note also that our definition of caregiving does not take into account moral support provided by children. We adopt a broad definition of working time. We use the information on the number of hours a week the respondent usually works, regardless of her basic contracted hours. Alternatively, it may be possible to use information on contracted hours; however, in this case, we should exclude from the analysis the self-employed (for whom the information on contracted hours is not available).

Conditional on our definitions of caregiving and working time, 41% of the women in our sample are employed, and 33% provide care for an elderly parent (Table 1). Moreover, a Chi-square test leads us to reject the independence hypothesis at the 1% level. In particular, the proportion of caregivers, regardless of time devoted to care, is higher among women who participate in the labour market than among those who do not participate in the labour market.

Table 1. Worker and caregiver distributions (women only)

		Caregiver 0	Caregiver 1	
Worker	0	926 (41.1%)	408 (18.1%)	1334 (59.2%)
	1	581 (25.8%)	338 (15.0%)	919 (40.8%)
		1507 (66.9%)	746 (33.1%)	2253 (100%)

The optimal time allocation is assumed to depend on three groups of variables. The first corresponds to individual socio-demographic characteristics, including age, education level, marital status, number of children, health status and non-labour income. We do not use wages as an explanatory variable of labour supply even if the information is available for workers. As emphasised by Ettner (1995), the imputation of wage rates for non-workers involves identification issues because the variables that influence the potential wage rate are likely to directly impact the choice of participation in the labour market and work hours. Following Ettner (1995) and Dimova and Wolff (2010), we therefore include determinants of the wage rate (such as age or education level) in the model rather than the wage itself.

The second group of variables corresponds to the parent's characteristics. In our estimations, we control not only for the parent's gender, age and health status but also for the geographical proximity between the daughter and her parent. To measure parental health status, we use a variable indicating how the adult daughter evaluates the general health status of her parent. No information is available on the parent's level of incapacity, although it may be partially captured by the parent's age variable. Moreover, we do not know if the parent lives in the community or in a nursing home or if he or she receives formal care. This lack of information may lead the residuals of the model to be correlated, for instance, if the availability of professional care (in an institution or in the community) encourages the adult daughter to increase her working time (to finance the professional care) and reduce her caregiving time.

Finally, the third group of explanatory variables corresponds to the siblings' characteristics. Our estimations include as explanatory variables the number of siblings, the proportion of sisters among siblings and the birth rank of the respondent. The proportion of sisters allows to take into account that daughters are more likely to provide care than sons. Siblings' characteristics may reveal the existence of contextual interactions if these characteristics (regardless of their care provision) directly influence individual caregiving behaviour. However, because we do not control for the siblings' caregiving behaviour (which is not observable in our data), these characteristics may also reveal the presence of endogenous interactions if the siblings' characteristics act as proxies of the siblings' care provision (Manski, 2000 ; Fontaine et al., 2009). However, the model is unable to disentangle these two mechanisms.

Table 2 reports the distribution of each variable used among sub-samples (according to the working and caregiving behaviours) and for the overall sample.

Table 2. Distribution of the variables used

in %

	$W>0$ $IC>0$	$W>0$ $IC=0$	$W=0$ $IC>0$	$W=0$ $IC=0$	all
n	338	581	408	926	2253
Working time per week (in hr, average)	33.1	34.3	.	.	13.8
Caregiving time per week (in hr, average)	4.2	.	9.8	.	2.4
Country dummies					
Austria	2.6	2.6	3.9	5.0	3.8
Germany	9.5	9.1	7.4	6.1	7.6
Sweden	20.1	15.0	8.6	5.1	10.5
Netherlands	13.0	9.0	9.8	6.4	8.7
Spain	0.6	4.8	2.7	6.4	4.4
Italy	3.3	6.2	12.0	10.0	8.4
France	8.6	12.6	10.5	10.7	10.8
Denmark	16.3	9.8	6.6	4.8	8.1
Greece	3.0	6.7	7.1	13.9	9.2
Switzerland	1.8	2.4	1.0	1.6	1.8
Belgium	12.7	7.8	14.5	9.4	10.4
Czech Republic	5.9	9.6	11.0	7.9	8.6
Poland	2.7	4.5	4.9	12.9	7.7
Individual characterisitics					
Age (average)	53.5	53.3	56.7	56.4	55.2
Education level					
Pre-primary or primary educ.	7.1	11.0	20.1	30.5	20.6
Lower secondary educ.	15.4	15.8	24.3	20.4	19.2
Upper secondary educ.	32.5	34.9	32.3	35.2	34.2
Post secondary educ.	45.0	38.2	23.3	13.9	26.5
Healt status					
"Poor"	0.3	2.6	6.4	10.5	6.2
"Fair"	14.8	12.2	22.0	26.0	20.1
"Good"	34.3	46.0	41.9	37.5	40.0
"Very good"	33.4	23.6	19.4	18.6	22.2
"Excellent"	17.2	15.7	10.3	7.4	11.5
Marital status					
Not married	27.8	29.6	23.3	21.6	24.9
Married	72.2	70.4	76.7	78.4	75.1
Number of children					
0	7.4	7.4	5.6	5.1	6.1
1	14.8	18.8	18.6	15.9	17.0
2	77.8	73.8	75.8	79.0	76.9
Monthly non labour income (average)	574.9	240.6	552.3	510.4	458.1
Have responsability for supervising other employees					
No	90.5	87.8	.	.	95.4
Yes	9.5	12.2	.	.	4.6
Self-employed					
No	89.0	85.0	.	.	93.6
Yes	11.0	15.0	.	.	6.4
Siblings characteristics					
Number of siblings					
0	11.2	9.1	14.9	8.5	10.2
1	30.5	28.1	31.1	24.2	27.4
2	25.4	25.7	24.2	25.4	25.3
3 or more	32.9	37.1	29.8	41.9	37.1

(continued...)

Table 2. (Continued)

in %

	$W>0$ $IC>0$	$W>0$ $IC=0$	$W=0$ $IC>0$	$W=0$ $IC=0$	all
Proportion of sisters among siblings (average)	42.9	51.4	50.7	49.9	49.4
Eldest child					
No	63.6	66.6	60.3	58.9	61.8
Yes	36.4	33.4	39.7	41.1	38.2
Parent characteristics					
Gender					
Woman	89.6	83.7	88.0	86.4	86.5
Man	10.4	16.4	12.0	13.6	13.5
Age (average)	84.3	82.5	86.1	84.9	84.4
Health status					
"Poor"	21.6	14.8	30.9	25.5	23.1
"Fair"	37.0	34.6	37.0	32.8	34.7
"Good"	27.5	32.4	22.1	28.8	28.3
"Very good"	7.4	12.9	7.1	8.3	9.1
"Excellent"	6.5	5.3	2.9	4.5	4.8
Geographical proximity					
Same building	4.2	3.4	6.9	4.4	4.4
Less than 1km away	19.1	11.0	22.7	19.9	14.9
Between 1 and 5 km away	25.3	18.4	25.0	19.6	20.9
Between 5 and 25 km away	23.5	23.7	24.4	23.8	28.8
Between 25 and 100 km away	15.6	17.7	11.7	15.8	15.9
Between 100 and 500 km away	10.0	15.2	7.3	13.2	12.5
More than 500 km away	1.4	3.9	1.2	4.3	3.3
More than 500 km away in another country	0.9	6.7	0.9	5.0	4.4

6 Results

We first estimated a model allowing for the residuals of the selection equation ($\varepsilon_{y_W i}$) to be correlated with the residuals of the three other equations (ε_{Wi}, ε^0_{ICi} and ε^1_{ICi}). From this perspective, even if the non-linearity of the model guarantees the identification of the parameters, the literature strongly suggests reinforcing the identification by adopting exclusion restrictions. In particular, we need to identify at least one variable that impacts the probability of participating in the labour market but not working time (conditional on being a worker). Unfortunately, we did not succeed in identifying a reasonable exclusion restriction[10]. Thus, we decided to impose $\rho_{y_W,W} = 0$ prior to the estimation[11]. In the caregiving equations, we excluded the non-labour income variable as an explanatory variable, assuming that non-labour income does not affect caregiving time conditional on labour supply[12]. The non-labour income is also used as an identifying instrument of the effect of working time (W) on caregiving time (IC^{1*}). In addition, we use as identifying instruments two dummy variables, respectively equal to 1 if the respondent is self-employed (0 otherwise) and equal to 1 if the respondent declare having any responsibility for supervising the work of other employees (0 otherwise). These two variables are assumed to have a positive effect on working time but no effect on the propensity to provide care conditional on labour supply.

Columns (1) and (2) of Table 3 report the estimation results for the caregiving time equation depending whether or not the daughter participates in the labour market. The propensity to provide care appears negatively associated with age, regardless of the labour market position and it is positively associated with educational level, the effect being significant only among non-workers. Moreover, time devoted to parental care is positively influenced by the individual's health status. Note that this variable may suffer from an endogeneity bias because we do not control for reverse causality (i.e., the impact of caregiving behaviour on health status). However, the estimation results remain unchanged when we remove this variable from the model. Regarding the family network, being married does not affect the propensity to provide care among women who participate in the labour market, whereas it decreases significantly the propensity to provide care among non-workers. Moreover, the number of children tends to decrease the propensity to provide care, but the effect is not significant regardless of the labour market position.

Care provision is also affected by siblings' characteristics, but the effects differ according to the labour market position. In particular, the number of siblings does not have any significant effect among workers whereas it reduces significantly time devoted to care among non-workers. As expected, the proportion of

[10] As suggested by literature, we attempted to use to female unemployed rate by age group and country. In our sample, the variable is however not significantly associated with the labour market participation.

[11] We have estimated a model without exclusion restrictions and allowed $\rho_{y_W,W}$ to be different from 0. The results are very similar to those obtained here. In particular, $\rho_{y_W,W}$ does not appear significant. However, in this case, the identification is only due to the normality assumption.

[12] Our microeconomic model shows that, conditional on working time, caregiving time is not affected by non-labour income. We have estimated a model without exclusion restrictions. In this model, the non-labour income is not significantly associated with IC^{0*} and IC^{1*}.

sisters among siblings tends to reduce the propensity to provide care but the effect is however not significant, regardless of the labour market position. Moreover, being the elder child has a positive effect on the propensity to provide care, but the effect is only significant among women participating in the labour market.

Regardless of the parent's characteristics, our estimation provides results consistent with the existing literature. In particular, the child's care provision depends positively on the parent's age and negatively on the parent's health status. Our results also indicate that mothers receive significantly more informal care than fathers[13] and that daughters living farther from their parent are characterised by a lower propensity to provide care than are daughters living in closer proximity[14].

Columns (3) and (4) of Table 3 report the estimation results for the labour market participation equation and the working time equation. As expected, age and non-labour income reduce both the probability of working and working time. Moreover, educational level positively impacts labour supply. Individuals declaring a "fair" or a "poor" health status show a lower propensity to participate in the labour market. The positive effect of being in "poor" health on working time is rather unexpected. As previously mentioned, this result may suffer from an endogeneity bias if working time has a negative impact on health status. Being married reduces the labour supply, whereas the number of children is not significant. As expected, women who are self-employed and whose work involves any responsibility in supervising other employees are characterised by a higher working time. Furthermore, despite the absence of the caregiving time as explanatory variable, siblings and parent's characteristics do not appear significantly associated with labour supply. The only exception is the positive effect of the geographical proximity: women living farther from their parent have a higher probability to participate in the labour market than daughters living in closer proximity.

[13] In their structural model, Byrne et al. (2009) identify three mechanisms by which the parent's gender may influence the care provision. All else being equal, mothers and fathers may differ according to (i) health status, (ii) the burden associated with providing care and (iii) the effectiveness of providing care. Their results provide some evidence that (i) fathers experience a significantly greater health status than mothers (the caregiving marginal utility is thus higher for the child when he/she provides care for his/her mother than for his/her father), (ii) care provided for mothers is less burdensome than care provided for fathers, and (iii) care provided for mothers is less effective than care provided for fathers.

[14] The fact that geographical proximity can be endogenous was examined by Stern (1995). The endogeneity bias appears to be very limited.

Table 3. Estimated coefficient

	(1) IC^{0*}	(2) IC^{1*}	(3) y^*_W	(4) W^*
Constant	13.87***	7.41**	0.89***	35.16***
	(4.67)	(3.04)	(0.25)	(2.48)
Country dummies	Yes	Yes	Yes	Yes
Child characterisitics				
Age				
Age-50	-0.57**	-0.40***	-0.14***	-0.48***
	(0.24)	(0.15)	(0.01)	(0.17)
Education level				
Pre-primary or primary educ.	-1.17	0.79	-0.09	-0.78
	(1.83)	(1.34)	(0.12)	(1.38)
Lower secondary educ.	Ref.	Ref.	Ref.	Ref.
Upper secondary educ.	0.11	0.24	0.31***	1.09
	(1.70)	(0.99)	(0.09)	(1.05)
Post secondary educ.	6.32***	1.64	0.80***	2.36***
	(1.99)	(1.04)	(0.10)	(1.13)
Healt status				
"Poor"	-5.42**	-9.98**	-1.00***	4.97*
	(2.52)	(4.41)	(0.18)	(2?68)
"Fair"	-3.54**	-0.90	-0.46***	0.06
	(1.59)	(1.02)	(0.09)	(1.09)
"Good"	Ref.	Ref.	Ref.	Ref.
"Very good"	0.98	1.31*	-0.03	-0.84
	(1.66)	(0.79)	(0.09)	(0.84)
"Excellent"	0.80	-0.81	-0.08	1.71*
	(2.19)	(0.97)	(0.12)	(1.02)
Marital status				
Not married	Ref.	Ref.	Ref.	Ref.
Married	-2.76*	-0.35	-0.47***	-2.86***
	(1.46)	(0.74)	(0.08)	(0.81)
Number of children				
0	Ref.	Ref.	Ref.	Ref.
1	-0.55	-0.37	0.02	-0.27
	(2.91)	(1.38)	(0.15)	(1.43)
2	-1.75	-0.39	-0.07	-1.71
	(2.66)	(1.24)	(0.14)	(1.28)
Log of the monthly non labour income	.	.	-0.18***	-0.50**
			(0.01)	(0.16)
Have responsability for supervising other employees				
No	.	.	.	Ref.
Yes				5.69***
Self-employed				(1.05)
No	.	.	.	Ref.
Yes				2.78***
				(0.99)

(continue...)

Table 3. Continue...

		(1)	(2)	(3)	(4)
		IC^{0*}	IC^{1*}	y_W^*	W^*
Siblings characteristics					
Number of siblings					
	0	Ref.	Ref.	Ref.	Ref.
	1	-2.26	0.80	0.14	-0.50
		(2.24)	(1.24)	(0.14)	(1.34)
	2	-3.83	0.56	0.20	0.27
		(2.36)	(1.25)	(0.15)	(1.34)
	3 or more	-6.13***	0.26	0.21	-1.32
		(2.27)	(1.24)	(0.14)	(1.32)
Proportion of sisters		-0.14	-1.11	-0.10	-0.90
Eldest child		(1.71)	(0.88)	(0.10)	(0.92)
	No	Ref.	Ref.	Ref.	Ref.
	Yes	1.21	1.45**	-0.06	0.47
		(1.39)	(0.74)	(0.08)	(0.78)
Parent characteristics					
Gender					
	Woman	Ref.	Ref.	Ref.	Ref.
	Man	-2.63*	-2.78***	-0.07	-0.31
		(1.82)	(0.98)	(0.10)	(0.96)
Age					
	Age-75	0.54***	0.41***	-0.01	0.01
		(0.14)	(0.07)	(0.01)	(0.08)
Health status					
	"Poor"	Ref.	Ref.	Ref.	Ref.
	"Fair"	-2.66*	-2.94***	0.09	0.77
		(1.49)	(0.88)	(0.09)	(0.97)
	"Good"	-8.84***	-3.51***	0.16	0.84
		(1.69)	(0.93)	(0.10)	(1.01)
	"Very good"	-10.69***	-5.30***	0.03	2.10
		(2.52)	(1.30)	(0.13)	(1.30)
	"Excellent"	-12.31***	-3.87***	0.09	1.27
		(3.51)	(1.50)	(0.17)	(1.62)
Geographical proximity					
	Same building	2.37	-0.75	0.22	0.74
		(2.65)	(1.69)	(0.18)	(1.92)
	Less than 1km away	Ref.	Ref.	Ref.	Ref.
	Between 1 and 5 km away	-6.47***	-3.64***	0.09	1.04
		(1.79)	(1.06)	(0.12)	(1.23)
	Between 5 and 25 km away	-9.24***	-5.72***	0.14	1.22
		(1.81)	(1.03)	(0.11)	(1.18)
	Between 25 and 100 km away	-12.65***	-7.04***	0.26**	1.47
		(2.16)	(1.12)	(0.12)	(1.23)
	Between 100 and 500 km away	-15.44***	-8.88***	0.28**	0.66
		(2.48)	(1.28)	(0.13)	(1.34)
	More than 500 km away	-26.06***	-9.84***	0.07	3.08
		(4.80)	(2.37)	(0.22)	(2.23)
	More than 500 km away in another coutry	-22.26***	-12.99***	0.02	1.41
		(4.89)	(2.28)	(0.19)	(1.79)
	Hours of work (W)	.	-0.17***	.	.
		.	(0.06)	.	.
$\rho_{IC0,y_W} = 0.20$ (0.35) ; $\rho_{IC1,y_W} = 0.13$ (0.37) ; $\rho_{IC1,W} = 0.18$ (0.26)					

Standard errors are in parentheses.
*,**,*** significantly different from 0 at the 10%, 5% and 1% level

We now turn to the effect of working time on caregiving time among daughters participating in the labour market. The results are consistent with our microeconomic framework: working time has a negative effect on the propensity to provide care. Specifically, the estimation results suggest that an exogenous shock leading to one hour of additional work reduces, on average, the optimal caregiving time by 3 minutes. This effect is significant at the 1% level.

From the estimation results, Table 4 reports the simulated effect of being a worker on time devoted to care. The results also appear consistent with the microeconomic model proposed. On average, participation in the labour market increases time devoted to care by one hour and 19 minutes per week.

Table 4. Discrete effect of the worker status

(1) mean of $\widehat{E}_i(IC_i^1/W_i = 0)$	4.71 (4 hours and 43 minutes)
(2) mean of $\widehat{E}_i(IC_i^0)$	3.40 (3 hours and 24 minutes)
(1)-(2) $\widehat{E}_i(IC_i^1/W_i = 0) - \widehat{E}_i(IC_i^0)$	1.31 (1 hour and 19 minutes)

The overall effect of labour market position can ultimately be summarised as follows: for women who work less than approximately 26 hours per week, the labour supply has a positive effect on the time devoted to providing care to an elderly parent because the positive discrete effect of being a worker is higher than the negative continuous effect of time spent working. In contrast, the labour supply reduces caregiving time for women who work more than 26 hours per week because, in this case, the positive effect of being a worker is completely offset by the negative impact of working time.

7 Conclusion

This paper examines the effect of labour market position on informal care provision among women aged 50 to 65, a population that plays a key role in informal care for the disabled elderly but who are also characterised by an increasing labour market participation. Our empirical approach presents some limitations. First, some potentially important variables are missing from the data, such as the use of formal care, the parent's disability level and the parent's place of residence. In particular, some women in our sample may have a parent living in a nursing home. Second, we excluded from the analysis women co-residing with their elderly parents because of a lack of information concerning their caregiving behaviour. Further research might consist of estimating labour and care behaviours simultaneously with intergenerational household formation.

Nevertheless, our empirical analysis allows to highlight a time allocation process that is not as simple as the allocation proposed by the standard microeconomic framework. Although the previous literature suggests

a negative impact of care on work consistent with the standard model, an exogenous increase in the labour supply has an unclear effect on the propensity to provide care. Our main contribution explains this last result by distinguishing the effect of worker status from the effect of working time. Specifically, we find that the effect of paid work on time devoted to care may be decomposed into (i) a discrete positive effect of labour market participation on the propensity to provide care and (ii) a continuous negative effect, with each hour worked reducing the time devoted to parental care.

"*But for my morale, it was better to work, it helped me. The work helps too! But it was heavy!*" (from Le Bihan and Martin, 2006). This declaration, from a daughter providing care to her elderly mother, perfectly illustrates the duality we identify of the effect of labour market participation on care provision. On the one hand, working tends to reduce the burden associated with providing care, but, on the other hand, performing both activities may be "heavy" and may require sacrifices.

Our empirical approach allows us to identify, by simulation, a threshold (equal to approximately 26 hours per week in our sample) beyond which working is associated with negative effects on the provision of informal care. The threshold we identify endogenously is higher than the threshold chosen by Carmichael and Charles (2010) in their study and provides evidence that full-time employment constrains informal care provision. This result is important for policymakers because it suggests that the increase in female labour market participation rate observed in many European countries, among a population that is traditionally the main provider of informal care, could lead to a decrease in family support. However, this decline must be nuanced for two reasons. First, it appears quite small. The participation in the labour market does not lead to a massive withdrawal of women in the provision of informal. From this point of view, the labour market position plays only a secondary role in caregiving behaviour. Moreover, this decline could be offset by an intra-family reorganisation of informal support that could potentially lead other siblings to increase their involvement in care. Further research is however needed to investigate this potential intra-family reorganisation.

Appendix A: Reduced micro-econometric model

This appendix outlines a specification of the microeconomic model of Section 3, incorporating observed and unobserved individual heterogeneity.

Let us consider, for each individual i, the following utility function:

$$U_i = \alpha.\ln(C_i + Z_{Ci}) + \beta.\ln(L_i + Z_{Li}) + (\gamma + s.y_{Wi}).\ln(IC_i + Z_{ICi}) \tag{16}$$

where Z_{Ci}, Z_{Li} and Z_{ICi} are 3 individual exogenous components that impact the marginal utilities associated with consumption, leisure and informal care.

Hence, by incorporating individual heterogeneity into the utility function, equations (5) and (6), which define the optimal latent caregiving time conditional on working time, are now equal to

$$IC_i^{0*} = \frac{\gamma + \gamma.Z_{Li} - \beta.Z_{ICi}}{\beta + \gamma} \tag{17}$$

$$IC_i^{1*}(W_i) = \frac{(\gamma + s) + (\gamma + s).Z_{Li} - \beta.Z_{ICi}}{\beta + \gamma + s} - \frac{\gamma + s}{\beta + \gamma + s} W_i \tag{18}$$

We define Z_{Ci}, Z_{Li} and Z_{ICi} as three linear functions of K observed exogenous characteristics (x_{ik}, $k = 1, ..., K$) and three random terms (u_{Ci}, u_{Li}, u_{ICi}) such as:

$$Z_{Ci} = \theta_C + \sum_{k=1}^{K} \delta_{Ck}.x_{ik} + u_{Ci} \tag{19}$$

$$Z_{Li} = \theta_L + \sum_{k=1}^{K} \delta_{Lk}.x_{ik} + u_{Li} \tag{20}$$

$$Z_{ICi} = \theta_{IC} + \sum_{k=1}^{K} \delta_{ICk}.x_{ik} + u_{ICi} \tag{21}$$

where θ_C, θ_L, θ_{IC}, δ_{Ck}, δ_{Lk} and δ_{ICk} ($k = 1, ..., K$) are structural parameters.

Subsequently, equations (17) and (18) can be rewritten as follows:

$$IC_i^{0*} = b_{IC0}^0 + \sum_{k=1}^{K} b_{ICk}^0.x_{ik} + \varepsilon_{ICi}^0 \tag{22}$$

$$IC_i^{1*}(W_i) = b_{IC0}^1 + \sum_{k=1}^{K} b_{ICk}^1.x_{ik} + \alpha W_i + \varepsilon_{ICi}^1 \tag{23}$$

where b_{IC0}^0, b_{IC0}^1, b_{ICk}^0, b_{ICk}^1 and α correspond to the reduced parameters we want to estimate, defined

as functions of the structural parameters:

$$\begin{aligned}
b^0_{IC0} &= \frac{\gamma + \gamma.\theta_L - \beta.\theta_{IC}}{\beta + \gamma} \\
b^1_{IC0} &= \frac{(\gamma + s) + (\gamma + s).\theta_L - \beta.\theta_{IC}}{\beta + \gamma + s} \\
b^0_{ICk} &= \frac{\gamma.\delta_{Lk} - \beta.\delta_{ICk}}{\beta + \gamma} \\
b^1_{ICk} &= \frac{(\gamma + s).\delta_{Lk} - \beta.\delta_{ICk}}{\beta + \gamma + s} \\
\alpha &= -\frac{\gamma + s}{\beta + \gamma + s}
\end{aligned}$$

and

$$\begin{aligned}
\varepsilon^0_{ICi} &= \frac{\gamma}{\beta + \gamma} u_{Li} - \frac{\beta}{\beta + \gamma} u_{ICi} \\
\varepsilon^1_{ICi} &= \frac{\gamma + s}{\beta + \gamma + s} u_{Li} - \frac{\beta}{\beta + \gamma + s} u_{ICi}
\end{aligned}$$

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