The trade-off between work and informal care in Europe

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Abstract

This paper focus on the trade-off between work and informal care among individuals aged 50 to 65. We first outlines the standard microeconomic model used to study how individuals allocate their time between labour, parental care and leisure. From the two first-order conditions of the standard model, we jointly estimate the time devoted to work and care through a bi-tobit model allowing to take into account both the simultaneity of the decisions and the censure which characterizes each variable. The model is estimated using data from SHARE, a European multidisciplinary database of micro data on health, socio-economic status and family network. Estimation results do not appear consistent with the standard microeconomic framework and lead us to reformulate the microeconomic model in order to take into account a potential positive effect of the worker status on the propensity to provide care The reformulation proposed is empirically validated by the the estimation of a double selection model. Our main finding confirms results of qualitative survey and suggests that the effect of paid work on time devoted to care may be decompose into (i) a discret positif effect, the labour market participation affecting positively the propensity to provide care, and (ii) a continuous negative effect, each worked hour reducing time devoted to parental care.

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1 Introduction

Population ageing is considered in Europe as a major challenge in the coming decades, especially because of the sustainability question of public pensions 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%, setting specific objectives for the senior population. According to the Stockholm European Council conclusions, "it 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 of the EU members encourage, more or less explicitly, family members to provide care for elderly people.

Considering that senior 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. Won't informal care decrease if the senior employment rate rises ? Or, looking at it from the opposite side, won't 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], with the proportion of "intensive" caregivers, defined as those who devote to parental care more than one hour a day or who co-reside with their parent. A decreasing relationship appears between the labour force participation and the provision of informal care. At one end, there are Northern European countries and Switzerland, which present a high employment rate and a low proportion of intensive caregivers. At the other end are the countries of Southeast and Eastern European characterized by a low employment rate

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

[2] See section 3 for a description of the data.

[3] We focus in this chapter on caregiving provided by children to their parent living without a spouse. Children caregiving behaviour greatly depends on the presence or absence of a spouse caregiver (see chapter 1).

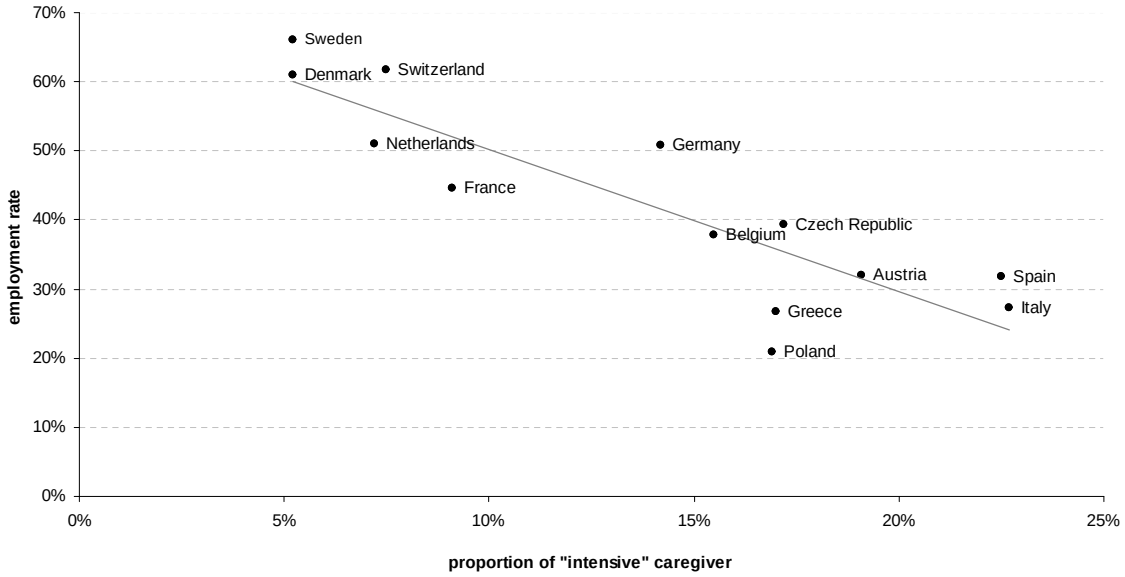
and a high proportion of intensive caregivers. Continental European countries lie somewhere in between.

Figure 2 highlights a similar negative correlation at the individual level : the women labour force participation decreases according to the intensity of care provided for a non-coresiding elderly parent. It appears however that women who provide less than an hour a day of care are more frequently employed than no caregivers. This result suggests that the relationship between work and care is not only based on a pure substitution effect between the two activities.

The aim of this paper is to highlight the individual interaction process between working and caregiving behaviour among the senior population. We first present the standard individual time allocation model between paid work, leisure and parental care. The model produces testable implications. In particular, working time and caregiving time appears as two competing activities : every exogenous shocks affecting positively one activity leads to a reducation of time devoted to the other activity. In order to test the implications of this model, we estimate a bi-tobit model allowing to take into account the simultaneously of the care and work decision and the censure which characterized each variable. Estimation results do not appear consistent with the standard microeconomic framework and lead us to reformulate it in order to take into account a potential positive effect of worker status on the propensity to provide parental care. The estimation of a double selection model provides results consistent with the reformulated microeconomic model. Indeed, our main finding suggests that the effect of paid work on time devoted to care may be decompose into a discret positif effect, the labour market participation affecting positively the propensity to provide care, and a continuous negative effect, each worked hour reducing time devoted to parental care.

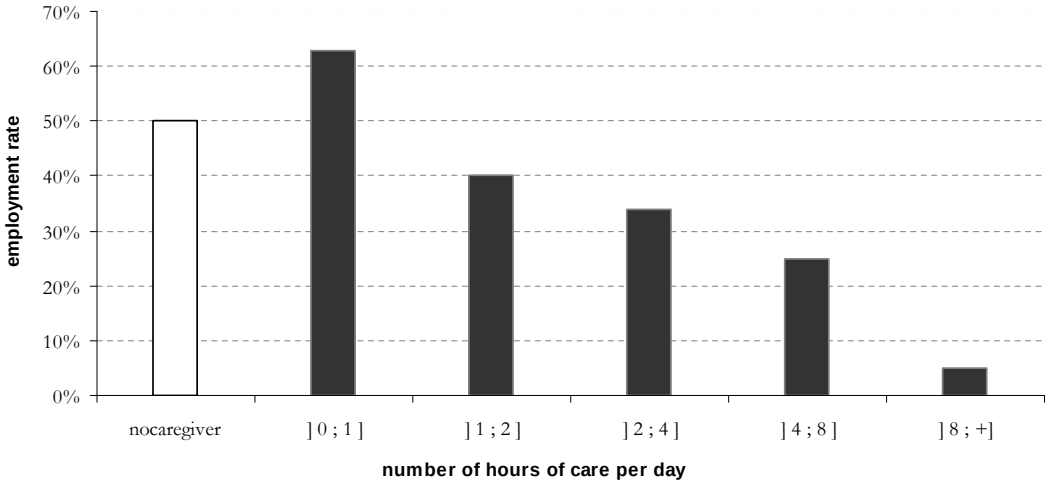
The rest of this article is organized as follows. Section 2 reviews the previous literature. Section 3 outlines the data used in the analysis. Section 4 presents a simple microeconomic model of the trade-off between labour and care. Section 5 empirically tests the implication of the model. Section 6 outlines a reformulation of the standard microeconomic framework. Section 7 provides an empirical validation of this new microeconomic framework. Finally, section 8 concludes.

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



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

Figure 2. Employment rate of women according to the intensity of care



Population : Women aged 50 to 65 and having only one living parent (women co-residing with their elderly parent are excluded because of lack of information on their caregiving behaviour)
Source : SHARE, wave 2 (2006-2007)

2 Previous literature

Since the mid-80s, several empirical studies have analysed the relationship between labour and caregiving behaviour.

The literature is very heterogeneous with regards to the studied population and the measure of the outcomes related to labour supply and care provision. Most studies investigate the interaction between care provision and labour supply on particular samples, restricted the analysis to informal caregivers (Muurinen, 1986 ; Stone et al., 1987 ; Stone and Short,1990 ; Boaz and Muller, 1992), married daughters (Wolf and Soldo, 1994), daughters (Ettner, 1995 ; Pezzin and Schone, 1995 ; Kolodinsky and Shirey, 2000 ; Crespo, 2006), women (Mac Lanahan and Manson, 1990 ; Pavalko and Artis, 1997 ; Carmichael and Charles, 1998 ; Spiess and Schneider, 2002 ; Berecki-Gisolf et al., 2008 ; Casado-Marin et al., 2007), child (Börsch-Supan et al., 1992 ; Stern, 1995 ; Ettner 1996 ; Johnson and Lo Sasso, 2000, Bolin et al., 2007), while others only restricted the sample according to an age criteria, in order to select a population of working-age (Carmichael and Charles, 2003a ; Carmichael and Charles, 2003b ; Heitmueller, 2007 ; Huetmueller and Inglis, 2007, Carmichael and Charles, 2010). Note also that the care receiver differs among the studies. Some studies only consider the care provide to parents, whereas others restricted to single parent or extend the potential care receiver to step-parents, parents in law, spouses, children or non-members of the family.

With regard to the outcome measure, several studies consider binary outcomes (provide care or not, participate to the labour market or not) while others used ordinal outcomes (do not provide care/provide non-intensive care/provide intensive care, do not participate to the labour market/work part-time/work full time), non-ordinal outcomes (do not provide care/provide care outside the household/provide care to a co-resident) or censored outcomes (the time devoted to care or time spent working).

However, with regards to our study, the two main cleavages in the literature concern the causality direction empirically investigated and the way to deal with the endogeneity issues. Existing literature generally focuses on one pathway of causation[4].

[4]Pezzin and Schone (1999) and Borsch-Supan et al. (1992) estimate structural models allowing to identify how the two endogenous outcomes related to work and care react to changes in exogenous variables. These models do

* *Causality direction : from care provision to labour supply*

A large majority of studies focuses on the effect of the care provision on the labour supply. From this point of view the care provision is seen as a determinant of the labour supply.

Muurinen (1986), using a US sample of primary caregivers of terminally-ill patients in a hospice setting, find that the care provision leads to either withdrawal from the labour market or reduced hours of work.

Stone et al. (1987) and Stone and Short (1990) use the US Informal Caregivers Survey (ICS), a supplement to the 1982 National Long Term Care Survey (NLTC) and find that the care activity leads to work accommodations, such as rearrangements of work schedule, reductions in work hours, or taking unpaid leave. These three studies however used sample containing only caregivers. This restriction does not allow to generalize the results to the overall population. Results obtained with more representative samples leads however to similar conclusions.

Using data from the 1987-1988 National Survey of Families and Household (NFSFH), Mac Lanahan and Manson (1990) find that the care provision significantly reduces the probability to work and the conditional hours worked per week.

Kolodinsky and Shirey (2000), using the Panel Study of Income Dynamics (PSID), study the effect of co-residence with an elder parent on the labour supply. They find that the presence and the characteristics of the parents negatively impact the labour market participation and the time spent working.

In Europe, the first empirical studies have been conducted in UK. Using a sample of women aged 21 to 59 from the 1985 General Household Survey (GHS), Carmichael and Charles (1998) show that the impact of the care provision on the labour supply depends on the intensity of care. They find that providing less than 20 hours per week of care increase the probability of employment whereas providing more than 20 hours per week of care decreases the labour market participation.

Using the 1990 General Household Survey, the same authors find that the negative effect of caregiving beyond a certain threshold would be lower for men than for women and that the

not allow to directly identify the causality between the two variables. However, the estimation of the structural parameters suggests in both cases that the trade-offs between labor supply and parental caregiving decisions is relatively modest.

negative effect on employment is greater for those caring for someone living in the same household (Carmichael and Charles, 2003a ; Carmichael and Charles, 2003b).

The main limitation of these empirical studies is the exogeneity assumption of the caregiving behaviour. This assumption is very questionable. Indeed, the labour behaviour may act as a determinant of the care provision. For instance, not working can favour the informal care provision since non-workers generally face lower opportunity costs than workers. This reversal causality may then bias the estimation of the effect of the care provision on the labour supply.

To take into account the potential simultaneity of decisions regarding employment and care, most studies use an instrumental variable approach. The model generally includes two equations : a reduced instrumental equation of the care provision and a structural equation of the labour supply including the instrumented care provision as regressor. The model is then estimated either in two-step or simultaneously by maximum likelihood.

Using data from the National Survey of Families and Households (NSFH), Wolf and Soldo (1994) estimated a two step model. In the first step, they simultaneously estimated a reduced form of the probability to provide parental care and to be employed. In the second step, they estimate the effect of being caregiver on the hours of work, conditionally on the labour market participation. They use a double-selection framework by adding as regressors two correction terms computed from the first step. The first have to be seen as a standard selection term allowing to correct the selection of the workers whereas the second one have to be seen as an augmented regressor allowing to control for the correlation between the care provision and the residual of the work hours equation. They find that the provision of parental care among married daughters does not significantly reduce their propensities to be employed or their conditional hours of work.

Ettner (1995, 1996) adopt a similar empirical strategy but uses a two part model instead of a selection model. From the 1986-1988 panels of the Survey of Income and Program Participation (SIPP), results suggest that coresidence with a disabled parent significantly reduces hours worked among females aged 35 to 64, due primarily to withdrawal from the labour market. However, she finds no significant reduction of work hours due to nonhousehold member caregiving (Ettner, 1995). Ettner (1996), using the same data than Wolf and Soldo (1994) shows that the magnitude of the caregiving impact on the labour supply is larger for women than for men and for coresidence

than for non-coresidential care. However, the effect was significant only for women providing care to parents residing outside the household.

Johnson and Lo Sasso (2000) simultaneously estimate a structural equation of the annual hours of paid work (taking into account the censoring of the variable) and a reduced equation of the care provision, using US panel data from the Health and Retirement Study (HRS). Restricting the sample to men and women aged 53 to 65 and having at least one living parent, they identify a significant negative effect of providing care to parents on the labour supply for both women and men.

Crespo (2006) estimates a bivariate probit model on a sample of women aged 50 to 60 with at least one living parent from the first wave of the Survey of Health, Ageing and Retirement in Europe (SHARE). Results suggest that providing "intensive" informal care to parents negatively impacts the labour market participation.

Heitmueller (2007), from the British Household Panel Study, adopts a standard IV approach and find that providing care to a coresident reduces the propensity to work whereas no significant effect is found for extra-household care provision.

Bolin et al. (2007) adopts the same empirical strategy, using data from the first wave of SHARE. Results suggest than the care provision negatively impact the participation to the labour market and the hours of work among workers.

Casado-Marin et al. (2008) exploit data from the European Community Household Panel (1994-2001). They use treatment evaluation techniques (matching method and differences in differences) to estimate the effects of caregiving on the labour market participation for women aged between 30 to 60. Results suggest that among women who were working before becoming a caregiver, there is no significant reduction in the probability of being employed. However, for those who were not working prior to becoming a caregiver, there is a significant decrease in the chances of entering employment.

To summarize, a large majority of studies provide evidence of a signficant negative effect of caregiving on the labour supply, while others generally identify a negative but no significant effect. Taking into account the endogeneity of the care provision does not change this main result.

However, all the previous mentioned studies using an IV approach show that not accommodating for endogeneity of the care provision in the labour outcome equation overestimate the real impact of an exogenous variation of caregiving (see Wolf and Soldo, 1994 ; Ettner, 1995 ; Ettner, 1996 ; Jonhson et Lo Sasso, 2000 ; Crespo, 2006 ; Heitmueller, 2007 ; Bolin et al., 2007). Specifically, all these studies provide 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) or 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.

* *Causality direction : from labour supply to care provision*

To the best of our knowledge, very few studies aim to identify how an exogenous shock on the labour supply impacts the provision of care.

Using personal interview data on 460 persons with noncoresidential parent, Spitze and Logan (1991) examine the impact of work hours on several parent care outcomes (frequency of interactions, patterns of help and attitude toward the relashionship. They use OLS estimation and do not find significant effect of employment on caregiving or interactions with the parent.

Börsch-Supan et al. (1992), who use data from Massachusetts (1986 HRCA Elderly Survey and 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[5].

Stern (1995) adopts an IV approach with panel data using two waves (1982 and 1984) of the NLTC Survey. The author estimates in the second year how the children's probability to be the primary caregiver is affected by their work status. By restricting the sample to parents receiving no care in the first year he uses as instrument of the labour force status of each child for the second year the labour force status of the first year. After controlling for endogeneity, results suggest that work status does not significantly affect the care provision.

[5]This positive effect appears consistent with the positive correlation between the care provision (as regressor) and the residual of the labour supply outcome.

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 to become caregiver (in t+1). Moreover, among those employed, they do not find a significant effect of working time (in t) on the probability to become caregiver (in t+1).

To summarize, this pathway of causation appears less clear than the opposite one. Only Carmichael and Charles (2010) find a negative effect of labour supply on the care provision (and only for those who work more than 20 hours per week). Others studies find a no significant or a positive effect.

* *When both causality directions are simultaneously investigated*

Finally, Boaz and Muller (1992), Pavalko and Artis (1997), Spiess and Schneider (2002) and Berecki-Gisolf (2008) jointly estimate the two opposite pathway of causation. Overall, these studies confirm the main message of the literature : an exogenous increase of the care provision affects negatively and generally significantly the labour supply whereas an exogenous variation of the labour supply have an unclear but generally not significant effect on the care provision.

Boaz and Muller (1992) use a sample from the National Informal Caregivers Survey (NICS) which only include active caregivers. They use a two-step estimation. They first regress the weekly hours of unpaid help and the work status, measured with an ordinal variable with three modalities (no work, part-time work, full-time work) on all the exogenous variables of the model in order to obtain predicted values uncorrelated with the model's error terms. These predicted values are used to replace the endogenous RHS variables in the second stage equations, which are the structural equations of the model. Results suggest that conditionally on being caregiver, time devoted to care significantly reduces the probability to work full-time but not the probability to work part-time. Symmetrically, working full-time significantly reduces the care provision whereas working part-time does not affect 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 start providing care significantly reduce hours of paid employment. On the contrary, the work status does not significantly impact the propensity to start 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 reduced the probability to provide care more than 14 hours per week.

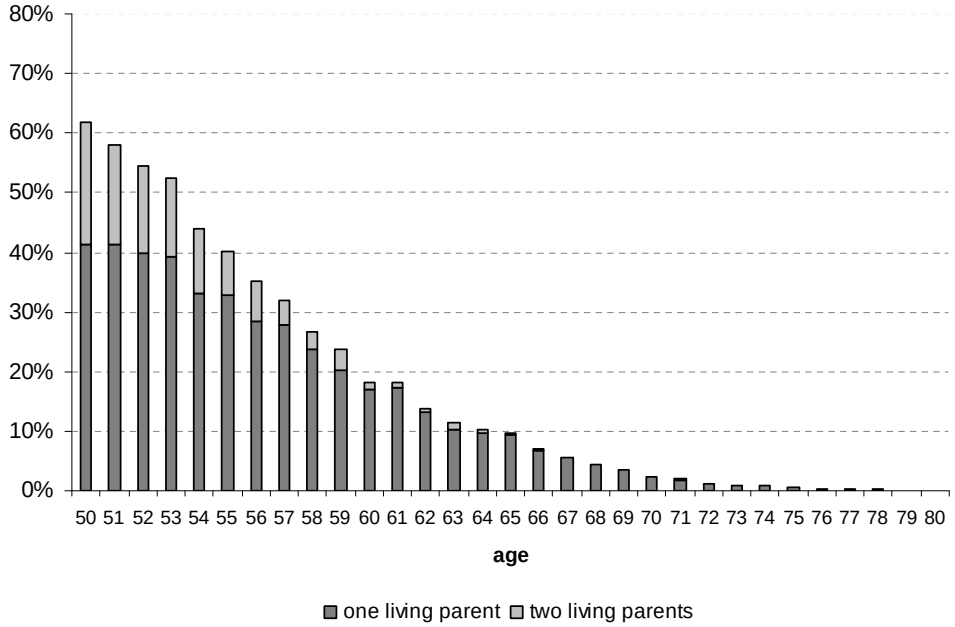
3 Data

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 restricted the sample to people aged 50 to 65, not only because, over 65, the probability to work is close to zero, but also because the proportion of those having at least one living parent is very low (figure 3).

We focus the analysis on care provided for elderly parent. Alternatively, we could have focused on care provided by individuals to their dependent spouse but adverse effects on labour behaviour are less expected given that it generally concerns elder caregivers who are already retired. As previously mentioned, we also restricted the sample to respondents having a single living parent. Moreover, because of a lack of information on intra-household caregiving we had to exclude children living with their elderly parent. The final sample includes 4234 observations.

Figure 3. Proportion by age of individuals having at least one living parent



In order to study the interaction between care and paid work, we use two variables : the number of hours worked per week (W) and the number of hours per week devoted to parental care (IC). Time devoted to care combines three activities : personal care, practical household help and help with paperwork. One can assume that the articulation between care and labour supply differs according to the kind of care. For instance, it can be easier to articulate help with paperwork and work because this kind of care can be provided remotely. On the contrary, personal care can require an personal investment of time and emotional more binding. However, the data does not allow to distinguish time devoted to each kind of care. We then consider global caregiving time without distinguish the kind of care. Note also that our definition of caregiving does not take into account moral support provided by the the child to his/her elderly parent. Concerning working time, we adopt a broad definition. We use here the information on the number of hours a week the child usually work, regardless of his/her basic contracted hours. Alternatively, it could be possible to use the information on contracted hours but in this case, we should exclude from the analysis self-employed for whom the information on contracted hours is not available. Our choice may potentially affects the results because extra-contracted working hours are probably more related to caregiving behaviour than contracted hours.

Conditionally on our definitions of caregiving and working time, 49% of the individuals in the

sample are employed and 29% provide care for their elderly parent (table 1).

Table 1. Worker and caregiver distributions

		Caregiver 0	Caregiver 1	
Worker	0	1573 (37.1%)	579 (13.7%)	2152 (50.8%)
	1	1422 (33.6%)	660 (15.6%)	2082 (49.2%)
		2995 (70.7%)	1239 (29.3%)	4234 (100%)

The optimal time allocation is assumed to depend on three groups of variables. The first corresponds to the individual socio-demographic characteristics : age, education level, marital status, number of children, health status and the non labour income. We do not use the wages as explanatory variable even if the information is available for workers. As emphasized 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 work hours. Following Ettner (1995) and Dimova & Wolff (2010), we therefore include determinants of wage rate in the working time equation, such as age or education level, rather than the wage itself.

The second group of variables corresponds to the parent's characteristics. In our estimations, we control for the parent's gender, age and health status but also for the geographical proximity between the child and the parent. To measure the parental health status we only have a variable indicating how the child evaluate the general health status of his/her parent. In particular, no information is available on the parent's incapacity level, even though 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 and if he or she receives formal care. This lack of information may lead to a negative coefficient correlation between the residuals of the two equations if, for instance, professional care (in institution or in the community) encourages the child to increase his/her working time (to finance the professional care) and reduces the caregiving time.

Finally, the third group of explanatory variables corresponds to the siblings' characteristics. Our estimations include as explanatory variables the number of brothers, the number or daughters and the birth rank of the respondent. We distinguish the number of siblings according to their gender in order to take into account that daughters are more likely to provide care than sons.

Table 2 reports the distribution of each variables used among sub-samples (according to the working and caregiving behavior) 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	660	1422	579	1573	4234
Working time per week (in hr, average)	36.9	38.5	.	.	18.7
Caregiving time per week (in hr, average)	3.8	.	8.8	.	1.8
Country dummies					
Austria	2.4	2.4	3.5	4.6	3.4
Germany	8.6	7.7	8.8	6.7	7.6
Sweden	10.2	12.2	9.0	5.2	10.3
Netherlands	12.1	9.4	10.5	6.7	9.0
Spain	1.1	5.3	2.6	6.0	4.5
Italy	3.9	6.1	11.7	11.0	8.3
France	8.9	11.2	11.1	11.4	10.9
Denmark	15.5	9.4	7.6	5.1	8.5
Greece	4.1	11.9	6.7	11.1	9.7
Switzerland	2.1	2.3	1.2	1.5	1.8
Belgium	11.8	9.1	13.6	10.7	10.8
Czech Republic	6.2	8.7	9.5	7.7	8.1
Poland	3.0	4.4	4.2	12.4	7.1
Individual characterisitics					
Gender					
Man	47.6	57.6	29.0	40.4	45.7
Woman	52.4	42.4	71.0	59.6	54.3
Age (average)	53.7	53.7	57.2	56.9	55.3
Education level					
Pre-primary or primary educ.	7.3	11.1	18.3	27.1	17.4
Lower secondary educ.	14.4	16.0	23.0	19.8	18.1
Upper secondary educ.	35.8	36.4	33.2	37.1	36.1
Post secondary educ.	42.6	36.4	25.6	16.1	28.3
Healt status					
"Poor"	<1	2	6	11	6
"Fair"	13	12	21	25	18
"Good"	39	43	43	39	41
"Very good"	31	27	20	17	23
"Excellent"	17	15	11	8	12
Marital status					
Not married	23.9	21.9	21.9	19.4	21.3
Married	76.1	78.1	78.1	80.6	78.7
Number of children					
0	8.8	6.7	7.2	6.4	7.0
1	14.2	16.6	18.5	15.8	16.2
2	77.0	76.7	74.3	77.8	76.8
Monthly non labour income (average)	665.4	318.9	639.8	589.7	517.4
Siblings characteristics					
Number of brothers					
0	33.8	32.2	39.4	28.7	32.1
1	38.0	36.2	37.6	37.4	37.1
2 or more	28.2	31.6	23.0	33.9	30.8

(continue...)

Table 2. Continue...

in %

	$W>0$ $IC>0$	$W>0$ $IC=0$	$W=0$ $IC>0$	$W=0$ $IC=0$	all
Number of sisters					
0	40.1	33.4	38.3	29.7	34.7
1	34.6	35.2	34.7	34.7	34.9
2 or more	25.3	31.4	26.9	35.6	31.4
Eldest child					
No	61.1	62.7	60.4	57.8	60.3
Yes	38.9	37.3	39.6	42.2	39.7
Parent characteristics					
Gender					
Woman	88.0	84.3	88.6	86.6	86.3
Man	12.0	15.7	11.4	13.4	13.7
Age (average)	84.2	83.1	86.4	85.3	84.6
Health status					
"Poor"	22.1	16.0	28.0	24.5	21.7
"Fair"	36.1	32.7	39.0	35.4	35.1
"Good"	30.3	34.9	22.1	27.1	29.5
"Very good"	6.8	11.3	6.9	8.8	9.1
"Excellent"	4.7	5.2	4.0	4.3	4.6
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

4 Standard Microeconomic model

In order to study the individual time allocation between care and paid work, the literature usually refers to a microeconomic model formalised by Johnson and La Sasso (2000). In this model, a child (say a daughter) decides to allocate her time between paid work W, informal care IC and leisure L. We assume the daughter is characterized by the following utility function :

$$U = u(C, L, IC) + \beta.v(IC, IC_0, H) \tag{3.1}$$

The utility function depends on the private consumption of a composite commodity C, leisure time L and caregiving time IC. The daugther is assumed to be altruistic : her well-being depends on her parent's (say a mother) well-being v. We assume that the mother's utility function depends on care provided by her daughter IC, on care provided by others sources IC_0 and on parental health status H. Care provided by others sources and parent health status are supposed to be exogenous[6]. Following Byrne et al. (2009), we consider that time devoted to parental care IC affects the daughter's well-being both directly (burden effect) and indirectly through its effet on the parent's well-being.

The amount of care provided by the daughter IC is chosen by the altruistic daughter, the mother adopting a passive behaviour. The daughter maximizes her utility function subject to the two following constraints :

$$C \leq wW + R \tag{3.2}$$

$$W + IC + L \leq 1 \tag{3.3}$$

where w is the daughter's wage rate and R the daughter's exogenous non labour income. For convenience, the price of the composite commodity has been normalized to one. Constraint (3.2) states that consumption can not exceed the financial resources of the daughter. The constraint (3.3) ensures that time allocated to work, parental care and leisure can not exceed the total amount of time, normalized to one.

[6]We want to focus here the analysis on the interactions between working time and caregiving time. We then assume IC_0 and H as exogenous to simplify the analysis. A more realistic model should at least take into account the effect of time devoted to care on the others members of family's caregiving decisions, the use of formal care and potentially the health status of the parent.

We assume that the well-being of the daughter and mother are increasing in each argument ($u_C > 0, = u_L > 0$, $U_V = \beta > 0$, $v_{IC} > 0$, $v_{IC_0} > 0$ and $v_H > 0$), expect for the caregiving time which directly affects U negatively ($u_{IC} < 0$). We also assume that u and v are continuous, twice differentiable and quasi-concave which implies that $u_{CC} < 0$, $u_{LL} < 0$, $u_{ICIC} < 0$, $v_{ICIC} < 0$, $v_{IC_0IC_0} < 0$ and $v_{HH} < 0$. Following Johnson and La Sasso (2000) and Byrne et al. (2009), we finally assume that $u_{CL} = 0$, $u_{CIC} = 0$ and $u_{LIC} = 0$[7].

Hence, for those caracterized by an interior solution, the first-order conditions which give the optimal time allocation are :

$$\frac{u_L}{u_C} = w \tag{3.4}$$

$$u_{IC} + \beta.v_{IC} = u_L \tag{3.5}$$

The equilibrium condition (3.4) is identical to the standard labour supply model in which workers allocate their time only between work and leisure. Under this condition, workers increase their working time as long as the value of an additional hour of work ($w.u_C$) is higher than the marginal utility of leisure (u_L). By adopting a partial equilibrium perspective, we can specify from this condition a function which associate for each possible exogenous caregiving time the optimal working time. Trough this function, the impact of an exogenous positive variation of IC on W^{opt} is given by :

$$\frac{\partial W^{opt}}{\partial IC} = -\frac{u_{LL}}{u_{LL} + w^2.u_{CC}} < 0 \tag{3.6}$$

Given the assumptions made, this expression is strictly negative : the optimal working time depends negatively on caregiving time.

According to the equilibrium condition (3.5), a daughter allocate her time so that her marginal utility of caregiving is equal to her marginal utility of leisure. As previously, we can specify from this condition a function which associate for each possible exogenous paid working time the optimal time devoted to parental care. Trough this function, the impact of an exogenous positive variation

[7]In fact, $u_{CL} \geq 0$, $u_{CIC} \leq 0$ and $u_{LIC} \geq 0$ are sufficient conditions to obtain a negative relationship between working time and caregiving time.

of W on IC^{opt} is given by :

$$\frac{\partial IC^{opt}}{\partial W} = -\frac{u_{LL}}{u_{LL} + u_{ICIC} + \beta.v_{ICIC}} < 0 \tag{3.7}$$

The sign of this expression is also strictly negative : the optimal caregiving time depends negatively on working time. Then, the model predicts a strictly negative relationship between the two activities : all exogenous shocks that increases time devoted to one activity leads to a reduction in time devoted to the other.

To investigate the effects of some different exogenous variables on the optimal time allocation, the first-order conditions and the blinding constraints are completely differentiated. Some comparative statistics from the model are presented in equations (3.8) below (for individuals characterized by an interior solution) :

$$\frac{dW^{opt}}{dR} = \frac{1}{D}.w.u_{CC}.(u_{ICIC} + \beta.v_{ICIC} + u_{LL}) < 0 \tag{3.8a}$$

$$\frac{dIC^{opt}}{dR} = -\frac{1}{D}.w.u_{CC}.u_{LL} > 0 \tag{3.8b}$$

$$\frac{dW^{opt}}{dIC_0} = -\frac{1}{D}.\beta.v_{ICIC_0}.u_{LL} > 0 \tag{3.8c}$$

$$\frac{dIC^{opt}}{dIC_0} = \frac{1}{D}.\beta.v_{ICIC_0}.(w^2.u_{CC} + u_{LL}) < 0 \tag{3.8d}$$

$$\frac{dW^{opt}}{dH} = -\frac{1}{D}.\beta.v_{ICH}.u_{LL} > 0 \tag{3.8e}$$

$$\frac{dIC^{opt}}{dH} = \frac{1}{D}.\beta.v_{ICH}.(w^2.u_{CC} + u_{LL}) < 0 \tag{3.8f}$$

where $D = -u_{LL}.(u_{ICIC} + \beta.v_{ICIC}) - w^2.u_{CC}(u_{ICIC} + \beta.v_{ICIC} + u_{LL}) < 0$

and v_{ICIC_0}[8], v_{ICH} are assumed to be negative

According to the equations (3.8a)-(3.8b), a positive shock on the non labour income decreases hours of paid work because the consumption increase reduces the marginal utility of consumption, which in turn reduces the value of an additional hour of work. By reducing time spent working, a positive shock on the non labour income increases indirectly time devoted to parental care[9].

[9]Note that in the microeconomic formalization we only model the positive indirect effect, through working time, of the non labour income. Our estimation results show that there is in addition a positive direct effect of non labour income on caregiving time.

Equations (3.8c)-(3.8f) indicate that when alternative sources of caregiving are available to the parent, such as care provided by others relatives or formal caregivers, or when parent is in better health, individuals devote less time to care and more time to paid work.

5 Empirical refutation of the standard Microeconomic model

Previous empirical literature validates only partially this microeconomic framework. Indeed, the empricial literature mainly focuses on one causality direction, the one going from caregiving behaviour to working behaviour. In most studies, this causality actually appears negative and significant. On the contrary, the reversal causality, that is the one going from working behaviour to caregiving behaviour is much less investigated and results obtained appears somewhat contradictory with the implication of the microeconomic model : a large majority of studies provides results suggesting that the labour supply does not affect the care provision. Note also that all studies which estimate the effect of the care provision on the labour supply using an IV approach find a positive correlation between the care variable and the residual of the labour outcome equation. This could suggest, in opposition with the theoretical framework, that factor which positively affect the labour supply induce an increase in the provision of care. In this section, we propose an empirical strategy allowing to simultaneously estimate both reciprocal causalities.

5.1 Empirical strategy

From the two first order conditions of the previous microeconomic model, we specifiy a reduced simultaneous equations model taking into account that working and caregiving time are mutually dependent and left-censored at 0. Indeed, some individuals may prefer not to work if they are characterised by a reservation wage which exceeds the real wage and some others may prefer not to provide care if the first hour devoted to parental care does not offset the utility lost of reducing

leisure time. We estimate the following bivariate-tobit model[10] (Amemiya, 1974) :

$$\textit{model A} \quad W_i^{opt} = \begin{cases} W_i^* \text{ if } W_i^* > 0 \\ 0 \text{ otherwise} \end{cases} \quad \text{and} \quad IC_i^{opt} = \begin{cases} IC_i^* \text{ if } IC_i^* > 0 \\ 0 \text{ otherwise} \end{cases} \tag{3.9}$$

$$\text{with} \begin{cases} W_i^* = x_{Wi}.\beta_W + \alpha_W.IC_i^{opt} + u_{Wi} \\ IC_i^* = x_{ICi}.\beta_{IC} + \alpha_{IC}.W_i^{opt} + u_{ICi} \end{cases}$$

where x_{Wi} (resp. x_{ICi}) and u_{Wi} (resp. u_{ICi}) capture the observable and unobservable exogenous explanatory variables of time devoted to paid work (resp. parental care).

Considered independently, each equation refers to a partial equilibrium. The first equation ($W_i^* = x_{Wi}.\beta_W + \alpha_W.IC_i^{opt} + u_{Wi}$) results from the first-order condition (3.4) which determines the optimal working time conditionally on caregiving time (red curve in figure 4). The second equation ($IC_i^* = x_{ICi}.\beta_{IC} + \alpha_{IC}.W_i^{opt} + u_{ICi}$) results from the first-order condition (3.5) which determines the optimal caregiving time conditionally on working time (blue curve in figure 4). With regard to the previous microeconomic framework, we expect α_W and α_{IC} to be both negative.

Considered simultaneously, both equations specify the optimal time allocation (W_i^{opt}, IC_i^{opt}) in the meaning that they define a situation in which the individual has no incentive to deviate. In such a situation, the working time is optimal given caregiving time, while caregiving time is optimal given working time.

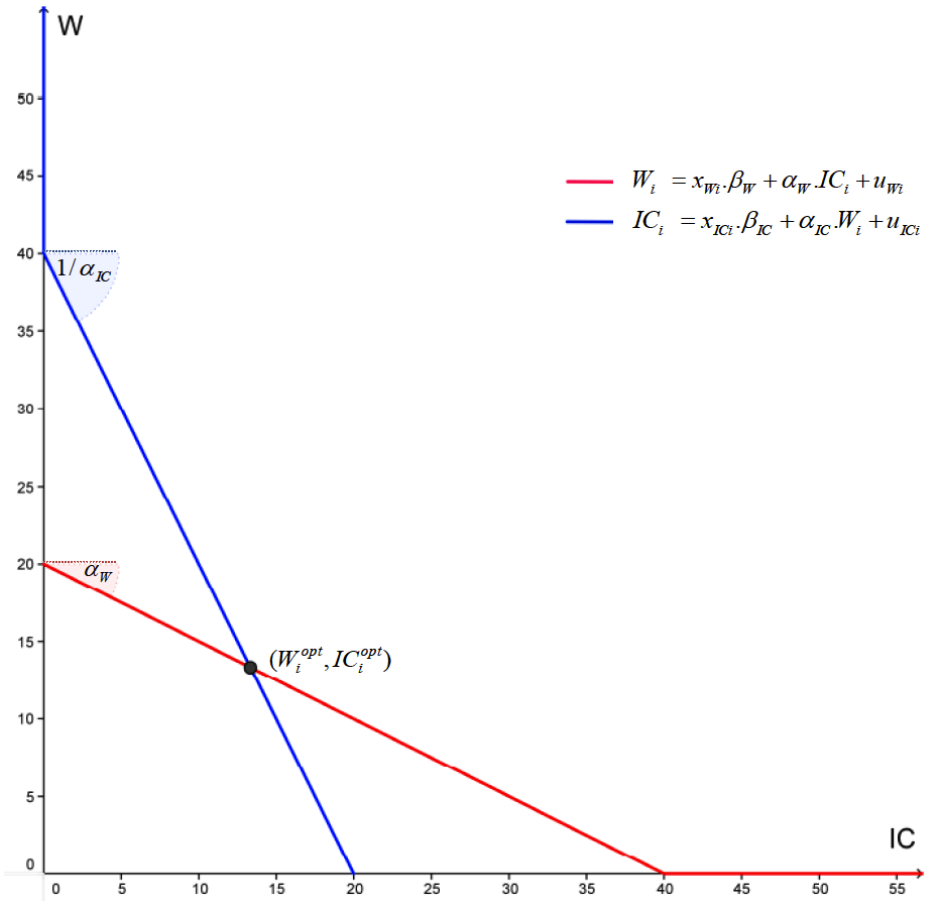
Model A is similar to the model proposed by Amemiya (1974) because we assume that each dependent variable is a function of the other observed dependent variable. It thus differs from the model proposed by Nelson and Olson (1978) where each dependent variable is a function of the other latent dependent variable[11]. The choice of one or the other specification is not neutral. It depends on whether the theoretical economic model itself is simultaneous in the latent or observed dependent variables (Blundell and Smith, 1994). In the model proposed by Amemiya (1974), the

[10] A utility fonction leading to the reduced specification 3.9 is for exemple : $U_i(C_i, L_i, IC_i) = (C_i + Z_{Ci})^{\gamma}.(L_i + Z_{Li})^{\eta}.(IC_i + Z_{ICi})^{\zeta}$ where γ, η and ζ are constant parameters and Z_{Ci}, Z_{Li} and Z_{ICi} are linear functions of individual and family characteristics : $Z_{Ci} = \Omega_C + \sum \delta_{Ck}.x_{Cki} + \nu_{Ci}$, $Z_{Li} = \Omega_L + \sum \delta_{Lk}.x_{Lki} + \nu_{Li}$ and $Z_{ICi} = \Omega_{IC} + \sum \delta_{ICk}.x_{ICki} + \nu_{ICi}$. The coefficients Ω_C, Ω_L, Ω_{IC}, δ_{Ck}, δ_{Lk} and δ_{ICk} represent constant parameters while x_{Cki}, x_{Lki}, x_{ICki}, ν_{Ci}, ν_{Li} and ν_{ICi} represent observed and unobserved (by the econometrician) individual and family characteristics.

[11] In the subsection 5.3, we presente estimation results from the Nelson and Olson specification. The main conclusions are similar.

censoring mechanism acts as a constraint on agent's behaviour, whereas in the model proposed by Nelson and Olson (1978) the censoring mechanism acts as a constraint on the information available to the econometrician but not on the agent's behaviour itself. By choosing the *model A*, we assume, according to the previous theoretical model, that censoring mechanism affects the agent's decision making process. In others words, we consider for example that two non-workers, one characterized by a reservation wage slightly higher than the real wage and the other characterized by a reservation wage much higher than the real wage, will provide *ceteris paribus* the same amount of informal care.

Figure 4. Illustration of the optimal time allocation when $(1 - \alpha_W.\alpha_{IC} > 0)$



Unlike the model proposed by Nelson and Olson (1978), *model A* may nevertheless present a risk of incompleteness in the sense that, for a given vector of exogenous variables (both observed and unobserved) it does not always predict a unique time allocation. This incompleteness stems from the fact that *model A* defines the optimal allocation as the intersection of two non linear

functions, one giving the optimal working time as function of caregiving time and the other giving the optimal caregiving time as function of working time.

As illustrated by figures A1 and A2 in appendix A, this non linearity may potentially leads to several intersection points. In this case, the model predicts multiple equilibria. To overcome this difficulty, it is necessary to impose prior to estimating the model the following "coherence condition" (Maddala, 1983 ; Amemiya, 1974 ; Gourieroux et al., 1980) :

$$1 - \alpha_W.\alpha_{IC} > 0 \tag{3.10}$$

This condition ensures the completeness of the model whatever the individual (observed and unobserved) characteristics. In the subsection 5.3, we partially loosen this constraint by adding to the model a selection rule which allows to select a specific equilibrium in case of multiple equilibria (Krauth, 2006). Results are similar because the model still converges to a situation without multiple equilibria.

Note that the incompleteness characterizing this model is very different from the incompleteness charactering the model estimated by Fontaine et al. (2009) to study the interaction among siblings in their caregiving decisions. The theoretical model was itself incomplet in the sens that it defined the outcome (the observed care arrangement) as as Nash Equilibrium of a game that could potentially be characterized by no Nash equilibrium or by multiple equilibria. Here, things are different. The theoretical model is indeed "complet" because each individual is always characterized by one and only one optimal time allocation. However, the econometric traduction of the theoretical model is incomplet because we define in *model A* the optimal time allocation from the two first order conditions of the microeconomic model wich are necessary but not sufficient conditions to define a equilibirum[12].

Let $P\left((W_i, IC_i) = (W_i^{opt}, IC_i^{opt})\right)$ denoted the probability for a given allocation to be optimal

[12]From this point of view, the estimation of a structural model would allow to compare the utility level associated with each possible equilibrium and then "complete" the model by adding a selection rule choosing the time allocation associated with the highest utility level. However, our reduced estimation does not allow to adopt this procedure.

for the individual i. For positive value of W_i and IC_i, we have :

$$\begin{aligned}
&P\left((W_i, IC_i) = (W_i^{opt}, IC_i^{opt})\right) \\
&\qquad = P\left(u_{Wi} = W_i - x_{Wi}.\beta_W - \alpha_W.IC_i, u_{ICi} = IC_i - x_{ICi}.\beta_{IC} - \alpha_{IC}.W_i\right) \\
&P\left((W_i, 0) = (W_i^{opt}, IC_i^{opt})\right) \\
&\qquad = P\left(u_{Wi} = W_i - x_{Wi}.\beta_W, u_{ICi} < -x_{ICi}.\beta_{IC} - \alpha_{IC}.W_i\right) \\
&P\left((0, IC_i) = (W_i^{opt}, IC_i^{opt})\right) \\
&\qquad = P\left(u_{Wi} < -x_{Wi}.\beta_W - \alpha_W.IC_i, u_{ICi} = IC_i - x_{ICi}.\beta_{IC}\right) \\
&P\left((0, 0) = (W_i^{opt}, IC_i^{opt})\right) \\
&\qquad = P\left(u_{Wi} < -x_{Wi}.\beta_W, u_{ICi} < -x_{ICi}.\beta_{IC}\right)
\end{aligned}$$

We assume that the residuals are distributed according to a bivariate normal density function : $(u_{Wi}, u_{ICi}) \sim N(0, 0, \sigma_W, \sigma_{IC}, \rho)$. Hence, the previous probabilities may be expressed as follow :

$$\begin{aligned}
&P\left((W_i, IC_i) = (W_i^{opt}, IC_i^{opt})\right) \\
&\qquad = (1 - \alpha_W.\alpha_{IC}).\varphi(W_i - x_{Wi}.\beta_W - \alpha_W.IC_i, IC_i - x_{ICi}.\beta_{IC} - \alpha_{IC}.W_i) \\
&P\left((W_i, 0) = (W_i^{opt}, IC_i^{opt})\right) \\
&\qquad = \int_{-\infty}^{-x_{ICi}.\beta_{IC} - \alpha_{IC}.W_i} \varphi(W_i - x_{Wi}.\beta_W, u_{ICi}) du_{ICi} \\
&P\left((0, IC_i) = (W_i^{opt}, IC_i^{opt})\right) \\
&\qquad = \int_{-\infty}^{-x_{Wi}.\beta_W - \alpha_W.IC_i} \varphi(u_{Wi}, IC_i - x_{ICi}.\beta_{IC}) du_{Wi} \\
&P\left((0, 0) = (W_i^{opt}, IC_i^{opt})\right) \\
&\qquad = \int_{-\infty}^{-x_{ICi}.\beta_{IC} - \alpha_{IC}.W_i} \int_{-\infty}^{-x_{Wi}.\beta_W - \alpha_W.IC_i} \varphi(u_{Wi}, u_{ICi}) du_{Wi} du_{ICi}
\end{aligned}$$

where φ the joint density function of the bivariate normale.

The model can then be estimated with the maximum likelihood method. Here, we do not impose the coherence condition $1 - \alpha_W.\alpha_{IC} > 0$ during the estimation procedure but we verify *a posteriori* that it is respected. Similarly, we do not impose the time constraint prior to the estimation but we verify, for each individual, that the estimations do not lead to a cumulated time devoted to work

and care exceeding 168 hours per week.

5.2 Results

Columns (1)-(2) of table 3 reports our estimation results when we include the same explanatory variables in each equation. In this case, the identification of the parameters is only due to the censure characterizing the working and caregiving time. The Appendix B reports estimation results when we reinforce the identification by imposing exclusion restrictions. Specifically, we exclude from the working time equation siblings and parent's characteristics and the number of children that is variables that empirically appear correlated with caregiving time but unrelated to working time (conditionally on the care provision). Symmetrically, we exclude from the caregiving time equation the marital status of the child and some modalities of his/her education level and health status that appear correlated with working time but unrelated to the caregiving time (conditionally on the working time). Results are however very similar.

As expected, the working time is negatively associated with the age and the non labour income but positively associated with the education level (column 1 of table 3). With regard to family network, being in couple significantly reduces the labour supply whereas the number of children is not significant. Moreover, the propensity to work is influenced by the individual health status. Those declaring a "fair" or a "poor" health status present a lower propensity to work. Note that this variable may suffer from an endogeneity bias since we do not control for the reversal causality, i.e. the impact of working behaviour on health status. Results remains however unchanged when we remove this variable from the estimation. Finally, none of the siblings and parent characteristics are significant conditionally on time devoted to care.

Column (2) of table 3 reports the estimation results for the caregiving time equation. Woman, as expected, have a higher propensity to provide care than men. Providing care is also positively associated with the age and the non labour income and negatively associated with the education level. Moreover, those declaring an "excellent" health status have a lower propensity to provide care[13]. Being married has a no significant effect whereas the number of children reduces the propensity to provide care. The care provision is also affected by the siblings' characteristics.

[13] As for the labour supply equation, this result may reveal the endogeneity of the healt status. Indeed, one can assume that the care provision negatively impact the health status of the caregiver.

Table 3. Estimated coefficient from Bi-Tobit model (without excluded variables)

	Not constraint model (n=4234)		Model with α_{IC}=0 (n=4234)		Model with α_{W}=0 (n=4234)	
	(1)	(2)	(3)	(4)	(5)	(6)
	W*	IC*	W*	IC*	W*	IC*
Constant	31.97***	-19.90***	32.85***	1.05	26.34***	-11.38***
	(4.05)	(2.82)	(3.85)	(1.75)	(3.05)	(2.27)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Child characterisitics						
Gender						
Man	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Woman	-17.98***	11.86***	-17.38***	4.21***	-18.34***	8.37***
	(1.11)	(0.86)	(1.05)	(0.50)	(1.01)	(0.67)
Age						
Age-50	-1.42***	0.48*	-1.19***	-0.56***	-1.11**	0.24
	(0.49)	(0.29)	(0.46)	(0.20)	(0.44)	(0.22)
$(\text{Age-50})^2$	-0.30***	0.04**	-0.30***	0.03**	-0.28***	0.03*
	(0.04)	(0.02)	(0.04)	(0.01)	(0.04)	(0.02)
Education level						
Pre-primary or primary educ.	-4.30**	-0.21	-4.81**	-0.71	-3.96***	-0.32
	(2.02)	(1.21)	(1.88)	(0.86)	(1.83)	(0.91)
Lower secondary educ.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Upper secondary educ.	4.44***	-1.69*	4.37***	-0.19	4.19***	-1.03
	(1.65)	(1.01)	(1.53)	(0.72)	(1.50)	(0.77)
Post secondary educ.	13.13***	-2.02*	13.14***	2.05***	12.04***	-1.03
	(1.71)	(1.08)	(1.58)	(0.75)	(1.56)	(0.86)
Healt status						
"Poor"	-32.23***	-2.28	-29.41***	-5.31***	-28.32***	-2.62*
	(3.18)	(1.85)	(2.93)	(1.28)	(2.85)	(1.40)
"Fair"	-9.57***	-0.27	-9.28***	-1.85***	-7.77***	-0.44
	(1.63)	(0.98)	(1.52)	(0.70)	(1.47)	(0.75)
"Good"	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
"Very good"	2.27	-0.70	2.11	0.29	2.16*	-0.41
	(1.40)	(0.88)	(1.30)	(0.63)	(1.27)	(0.67)
"Excellent"	2.58	-2.46**	3.17*	-0.61	2.91*	-1.67**
	(1.75)	(1.12)	(1.62)	(0.80)	(1.60)	(0.84)
Marital status						
Not married	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Married	-3.82***	1.18	-3.98***	-0.33	-3.41***	0.68
	(1.37)	(0.85)	(1.27)	(0.61)	(1.24)	(0.65)
Number of children						
0	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
1	2.82	-2.01	2.87	-0.83	2.50	-1.35
	(2.44)	(1.49)	(2.27)	(1.07)	(2.22)	(1.13)
2	2.11	-2.77*	2.13	-1.50	2.25	-2.00**
	(2.16)	(1.33)	(2.01)	(0.95)	(1.96)	(1.00)
Log of the monthly non labour income	-1.68***	0.77***	-1.65***	0.17*	-1.57***	0.55***
	(0.21)	(0.13)	(0.19)	(0.09)	(0.19)	(0.10)
Siblings characteristics						
Number of sisters						
0	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
1	1.00	-1.40*	0.44	-0.99*	1.17	-1.11*
	(1.32)	(0.80)	(1.22)	(0.58)	(1.20)	(0.61)
2 or more	1.40	-3.12***	0.73	-2.27***	1.95	-2.34***
	(1.40)	(0.88)	(1.31)	(0.63)	(1.27)	(0.66)

(continue...)

Table 3. Continue...

	Not constraint model (n=4234)		Model with α_{IC}= 0 (n=4234)		Model with α_W= 0 (n=4234)	
	(1) W*	(2) IC*	(3) W*	(4) IC*	(5) W*	(6) IC*
Number of brothers						
0	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
1	0.82	-1.13	0.13	-1.14**	0.96	-0.99
	(1.31)	(0.80)	(1.22)	(0.58)	(1.19)	(0.60)
2 or more	-0.93	-1.85**	-1.63	-2.14***	-0.62	-1.56**
	(1.39)	(0.87)	(1.29)	(0.63)	(1.26)	(0.66)
Eldest child						
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	0.77	0.69	0.59	0.79	0.60	0.65
	(1.21)	(0.75)	(1.13)	(0.54)	(1.10)	(0.57)
Parent characteristics						
Gender						
Woman	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Man	-1.31	-2.36**	-1.44	-2.06***	-1.08	-1.82**
	(1.58)	(1.02)	(1.46)	(0.74)	(1.44)	(0.77)
Age						
Age-75	0.16	0.47***	0.12	0.39***	0.00	0.36***
	(0.13)	(0.08)	(0.12)	(0.06)	(0.11)	(0.06)
Health status						
"Poor"	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
"Fair"	-0.43	-3.00***	-0.16	-2.56***	1.29	-2.55***
	(1.54)	(0.90)	(1.46)	(0.04)	(1.40)	(0.68)
"Good"	2.40	-6.85***	1.58	-5.11***	4.54***	-5.54***
	(1.61)	(0.98)	(1.54)	(1.54)	(1.45)	(0.73)
"Very good"	0.00	-9.08***	0.04	-7.11***	3.01	-7.29***
	(2.21)	(1.43)	(2.10)	(1.03)	(2.00)	(1.07)
"Excellent"	-1.66	-6.67***	-1.19	-5.55***	1.23	-5.37***
	(2.81)	(1.78)	(2.62)	(1.18)	(2.54)	(1.33)
Geographical proximity						
Same building	-0.25	1.99	0.53	1.78	-1.51	1.85
	(3.07)	(1.69)	(2.85)	(1.20)	(2.77)	(1.23)
Less than 1km away	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Between 1 and 5 km away	-2.06	-4.76***	-1.55	-3.82***	0.18	-3.88***
	(1.87)	(1.07)	(1.76)	(0.76)	(1.69)	(0.81)
Between 5 and 25 km away	-0.75	-7.56***	-0.63	-6.01***	1.77	-6.07***
	(1.83)	(1.08)	(1.74)	(0.77)	(1.65)	(0.81)
Between 25 and 100 km away	-0.77	-11.02***	-0.23	-8.57***	2.65	-8.52***
	(2.02)	(1.25)	(1.92)	(0.88)	(1.81)	(0.92)
Between 100 and 500 km away	-0.52	-12.88***	-0.46	-10.27***	2.85	-9.99***
	(2.16)	(1.40)	(2.06)	(0.99)	(1.94)	(1.03)
More than 500 km away	-0.44	-18.54***	-0.83	-14.84***	3.47	-14.17***
	(3.46)	(2.64)	(3.27)	(1.93)	(3.13)	(1.93)
More than 500 km away	-1.76	-22.00***	-1.14	-17.14***	1.81	-16.67***
in another coutry	(3.01)	(2.64)	(2.83)	(1.92)	(2.74)	(1.92)
Interactions between work and care						
Hours of care (IC)	-1.98***		-1.00***		.	
	(0.17)		(0.20)		.	
Hous of work (W)		0.64***		.		0.42***
		(0.04)		.		(0.04)
ρ	-0.53***(0.04)		0.15***(0.05)		-0.64***(0.04)	

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

The number of brothers and number of sisters do not have the same impact on the caregiving behaviour : both have a negative and significant impact on the propensity to provide care but, as expected, the propensity to provide care is more affected by the number of sisters than the number of brothers. The siblings' characteristics may reveal the existence of contextual interactions if the siblings' characteristics (regardless their care provision) directly influence individual caregiving behaviour, but may also reveal the presence of endogenous interactions, if the siblings' characteristics act as proxies of the siblings' care provision (Manski, 2000). The model is however unable to disentangle this two mechanisms. Furthermore, being the elder child has a posititif but not significant effect on the propensity to provide care.

Regardless the parent's characteristics, our estimation provides consistent results 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 father[14] and that children living further away from their parents are characterized by a lower propensity to provide care than closer children[15].

Turning now to the trade-off between care and work, estimations results appear partially inconsistent with our *a priori* expectations. More precisely, our results suggest that the care provision has a significant negative impact on the propensity to work ($\widehat{\alpha}_W = -1.98^{***}$). This result is consistent with the standard microeconomic model and the previous empirical litterature. However, the reverse causality suggests that time spent working has a significant positive impact on the propensity to provide care ($\widehat{\alpha}_{IC} = 0.64^{***}$).

To investigate the intensity of these relations, we estimated the two reciprocal marginal effects. We first estimate the effect of a shock providing to each individual incentive to devote to parental care one more hour a week. Table 4 reports the optimal time allocation variation and a decomposition of this variation into an exogenous variation and an endogenous variation. The former

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

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

supposes that the caregiving behaviour is exogenous in the sense that it does not depend on hours worked[16]. In the latter, the additional effect induced by the endogeneity of the caregiving behaviour is tacking into account. On average, the initial shock on time devoted to care produces a final decrease of working time by 28 minutes, whereas the optimal caregiving time, after adjustment, finally increases by 43 minutes. The working time reduction is thus relatively high. At least three reasons may explain this effect. First, the analysis is focused on individuals aged 50 to 65 that is a population for whom the caregiving behaviour may interact with the retirement decision. Some individuals may then leave the labour market in order to provide care for their disabled parent, in particular when others sources of care are not available. Following the decomposition proposed by McDonald and Moffit (1980), we show that 49% of this the working time decrease (that is 13 minutes) comes from the decrease of the probability to work[17]. Second, individual labour behaviour also depends on the labour demand, which is not taken into account in our model. In particular, if individuals may only choose between two work contracts (full time or part-time work), they may be constrained to reduce their working time more than they would in order to provide care for their parent. Finally, the depend variable considered here is the number of hours actually worked per week, not the basic or contractual hours (only relevant for employees). One can suppose that extra-contractual working hours are more affected by caregiving behaviour than contractual hours.

Similarly, Table 5 reports the optimal time allocation variation after a positive exogenous shock on the working time. After adjustment, the caregiving time variation appears relatively small (+5 minutes). Although the magnitude of the effect is relatively small, the positif average effect of working time on caregiving time calls into question the standard microeconomic framework used to think the interactions between time spent working and time devoted to parental care. Without going into specifics at this stage (this is the purpose of the next section), one can argue that this framework is quite restrictive because the interaction between working time and caregiving time does not directly involved the agent's preferences but only the time constraint. In others words, through this model, if individuals were not constraint by time, the two activities would be independent.

[16]Through this effect, we adopt a partial equilibrium perspective. One can see this effect as the working time variation in a situation where the individual is virtually constraint to provide one more hour of care a week. Note that in this situation the time allocation is not optimal for the individual.

[17]The remaining 51% corresponds to the effect on the time spent working conditionally on working. This decomposition is however constraint here by the fact that our model does not separately estimate the effect of caregiving on the probability to work and on the number of hours worked conditionally on working.

Table 4 : Average effect on an exogenous caregiving time variation on the optimal time allocation

	Exogenous variation (1)		Endogenous variation (2)		Global variation (1)+(2)	
ΔIC^{opt}	$+1^{(a)}$	(+1hr)	$-0.29^{(c)}$	(-17 min)	$+0.71^{(e)}$	(+43 min)
ΔW^{opt}	$-1.03^{(b)}$	(-1 hr 4 min)	$+0.58^{(d)}$	(+35 min)	$-0.45^{(f)}$	(-27 min)
with	(a) initial shocks		$(c)\frac{\alpha_W \alpha_{IC}}{1-\alpha_W \alpha_{IC}}.P(W>0)$		$(e)1+\frac{\alpha_W \alpha_{IC}}{1-\alpha_W \alpha_{IC}}.P(W>0)$	
	$(b)\alpha_W.P(W>0)$		$(d)\frac{\alpha_W^2 \alpha_{IC}}{1-\alpha_W \alpha_{IC}}.P(W>0)$		$(f)\frac{\alpha_W}{1-\alpha_W \alpha_{IC}}.P(W>0)$	

Table 5 : Average effect on an exogenous working time variation on the optimal time allocation

	Exogenous variation (1)		Endogenous variation (2)		Global variation (1)+(2)	
ΔW^{opt}	$+1^{(a)}$	(+1hr)	$-0.17^{(c)}$	(-10 min)	$+0.83^{(e)}$	(+50 min)
ΔIC^{opt}	$+0.19^{(b)}$	(+11 min)	$-0.11^{(d)}$	(-7 min)	$+0.08^{(f)}$	(+5 min)
with	(a) initial shocks		$(c)\frac{\alpha_{IC} \alpha_W}{1-\alpha_{IC} \alpha_W}.P(IC>0)$		$(e)1+\frac{\alpha_{IC} \alpha_W}{1-\alpha_{IC} \alpha_W}.P(IC>0)$	
	$(b)\alpha_{IC}.P(A>0)$		$(d)\frac{\alpha_{IC}^2 \alpha_W}{1-\alpha_{IC} \alpha_W}.P(IC>0)$		$(f)\frac{\alpha_{IC}}{1-\alpha_{IC} \alpha_W}.P(IC>0)$	

To extend the comparison of our empirical results with those expected from the standard microeconomic model, we simulate specific shocks on the non labour income, on the parent's health status and on the number of siblings. Consistently with our expectations, findings indicate first that a 1000 Euros increase of the monthly non labour income leads on average to a decrease in time spend working by 4 hours and 45 minutes a week and an increase in caregiving time by 25 minutes a week. Second, a deterioration of parent's health status increases time devoted to care by 35 minutes a week on average whereas working time decreases by 25 minutes a week. Finally, having one more brother reduces caregiving time by 7 minutes a week and increases working time by 5 minutes a week whereas having one more sister reduces caregiving time by 12 minutes a week and increases working time by 8 minutes a week.

5.3 Robustness analysis

To check the robustness of our results, espcecially the positif effect of an exogenous variation of working time on the propensity to provide care, we first partially relax the coherency condition. Situations with multiple equilibria may arise when the two parameters α_W and α_{IC} are both negative and when the product $\alpha_W.\alpha_{IC}$ is higher than 1. Three potential equilibrium may then exist (one interior equilibrium and two corner equilibria, see figure A.1 in appendix A). In this case, we add to the *model A* (3.9) a selection rule which allows to select a particular equilibrium among the three potential equilibria (Krauth, 2006). Four different exogenous selection rules have been tested. The first assumes that each equilibrium has an equal probability (1/3) to be optimal and then chosen by the daughter. The three others assume than one of the three equilibria is always optimal and then always chosen by the child. See Bjorn and Vuong (1985), Fontaine et al. (2009), Krauth (2006), Soetevent & Kooreman (2007) or Tamer (2003) for similar approaches in a simultaneous discrete model. We still impose the coherency condition when the parameters α_W and α_{IC} are both positive because in this case, individuals choose to increase their working and caregiving time until that time devoted to leisure be equal to zero, which seems unrealistic (figure A.2 in appendix A). Results obtained are strictly unchanged in comparison with those report in columns (1)-(2) of table 3 since the likelihood function still converges to the same value (each individual been characterized by a single equilibrium).

We have also compared our results with those obtained by an IV approach. We first estimated the following model :

$$W_i^{opt} = \begin{cases} W_i^* \text{ if } W_i^* > 0 \\ 0 \text{ otherwise} \end{cases} \quad \text{and} \quad IC_i^{opt} = \begin{cases} IC_i^* \text{ if } IC_i^* > 0 \\ 0 \text{ otherwise} \end{cases} \tag{3.11}$$

$$\text{with} \begin{cases} W_i^* = x_{Wi}.\beta'_W + \alpha'_W.IC_i^{opt} + u'_{Wi} \\ IC_i^* = x_{ICi}.\beta'_{IC} + x_{Wi}.\lambda'_W + u'_{ICi} \end{cases}$$

The specification of the working time equation is unchanged compared to model A (3.9). However, contrary to previous model, the second equation is used to instrument the caregiving time. This approach is similar to the one used by Crespo (2007) and Johnson & La Sasso (2000), which only focus on the causal effect of the caregiving time on the working time, that is on the parameter

α'_W . Every variable which could directly or indirectly (through the working time) influence the care provision are included as explanatory variables in the caregiving time equation (the vector x_{ICi} then gathers the excluded instruments). The two equations are jointly estimated by maximum likelihood method, allowing the residuals of the two equations to be correlated. Columns (3)-(4) of table 3 provides the estimation results without excluded instruments, the identification being then only due the censures. Column (3)-(4) of table B1 (appendix B) provides the estimations results with excluded instruments. In both cases, the estimation results are very close from those obtained with the *model A*. In particular, the estimated effect of an exogenous variation of caregiving time is still significant (at the 1% level) and negative[18]. The marginal effect is however slightly higher (in absolute value) : on average, one more hour of caregiving decreases by 32 minutes working time.

The same approach is used to estimate the reverse causality. The model estimated is then the following :

$$W_i^{opt} = \begin{cases} W_i^* \text{ if } W_i^* > 0 \\ 0 \text{ otherwise} \end{cases} \quad \text{and} \quad IC_i^{opt} = \begin{cases} IC_i^* \text{ if } IC_i^* > 0 \\ 0 \text{ otherwise} \end{cases} \tag{3.12}$$

$$\text{with} \begin{cases} W_i^* = x_{Wi}.\beta''_W + x_{ICi}.\lambda'_{IC} + u''_{Wi} \\ IC_i^* = x_{ICi}.\beta''_{IC} + \alpha''_{IC}.W_i^{opt} + u''_{ICi} \end{cases}$$

Estimation results provided by columns (5)-(6) of table 3 without excluded instruments and columns (5)-(6) of table B1 in appendix B with excluded instruments are also very close from those obtained with the *model A* : on average one hour more of working time increases time devoted to care by 7 minutes.

We have also distinguish the interactions according to child's gender. The reciprocal effects are in both cases slightly higher (in absolute value) for women but differences are not significant.

Finally, following the approach used by Boaz and Muller (1992), we have compared our results with those obtained from a specification where we assume that the care provision and the labour supply interact through the latente variables rather than observed variables. We then estimate the

[18]Note also that, similarly to the previous literature, we find a positive correlation between the residuals of the two equations when we do not control for the direct effect of labour supply on the care provision.

following model (Nelson and Olson, 1978) :

$$\textit{model NO} \quad W_i^{opt} = \begin{cases} W_i^* \text{ if } W_i^* > 0 \\ 0 \text{ otherwise} \end{cases} \quad \text{and} \quad IC_i^{opt} = \begin{cases} IC_i^* \text{ if } IC_i^* > 0 \\ 0 \text{ otherwise} \end{cases} \tag{3.13}$$

$$\text{with} \begin{cases} W_i^* = x_{Wi}.\beta_W + \alpha_W.IC_i^* + u_{Wi} \\ IC_i^* = x_{ICi}.\beta_{IC} + \alpha_{IC}.W_i^* + u_{ICi} \end{cases}$$

As Boaz and Muller (1992), we use the two step estimation procedure proposed by Nelson et Olson (1978). We first estimate a reduced form of the two equations and compute the predicted values of both latente variables. These predicted values, which are uncorrelated with the model's error terms, are used to replace the endogenous RHS variables in the second stage equations. To allow the identification of the parameters α_W and α_{IC}, we impose the same exclusion restrictions than those used to estimate the *model A*. Table C1 (appendix C) provides estimation results. Findings are consistent with those obtained from *model A* : a positive exogenous variation of the propensity to provide care decreases the propensity to work whereas a positif exogenous variation of the propensity to work increases the propensity to provide care.

6 Microeconomic model with partial complementarity

The aim of this section is to propose a reformulation of the microeconomic model in order to account for the positif effect (on average) of an positif exogenous working time variation on the optimal caregiving time.

6.1 How explain the positive effect of an exogenous variation of working time on the optimal caregiving time ?

The model proposed by Jonhson and La Sasso (2000) is only based on what the litterature called the "substitution effect" (Carmichael and Charles, 1998). It comes from the time constraint : by devoting increasing time to a given activity, the agent is constraint to reduce the time available for other activities. Through this, working time and caregiving time appear as substitutes. However,

due to the agent's preferences, other effects may lead to a partial complementary between the two activites.

The first one is the "protection effect". Using results from a qualitative survey conducted in France among women providing support to their elderly parent, Le Bihan and Martin (2006) suggests that working is a protective activity for the caregivers. It allows them not to totally be absorbed by their caregiver activity. Unemployed individuals could therefore have a lower propensity to provide informal care for fear of not being able to limit their involvement, as the needs of the elderly parent increase. Among the children, we can asssume that this effect is more relevant for daughters than sons if the duty to provide care to an elderly parent lie more heavily upon daughters than sons.

Two others effect can also occur : the "respite effect" and the "productivity effect".

The "respite effect" illustrates the fact that working may offer to the caregiver a way of freeing oneself from the emotional demands associated with the care provided for a relative (Carmichael & Charles, 1998). This effect clearly appears 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 ... "*[19] (from Le Bihan and Martin, 2006).

According to the "productivity effect", some occupations may allow the development of know-how that can be used in caregiving (personal care for a nurse, help with paperwork for bank employee). More generally, workers may be more inclined to accept a additional constaint on their schedule than retired people who may be more reluctant to loose some freedom on the use of their free time.

Through these three effects, working appears as a factor increasing the propensity to provide informal care. Thus, they introduce into the analysis a kind of complementarity between the two activities. Specifically, theses effects appear related to the worker status and not directly to the time spent working (conditionally on being a worker). To the best of our knowledge, they have never been integrated within a microeconomic model.

[19] *"Et puis c'est vrai que d'être au boulot, ça aide quand même à décompresser et on se trouve confrontée à des personnes qui ont eu le même problème. Donc on peut avoir des conseils à droite et à gauche. (...) Heureusement qu'il y avait le boulot ! Ah oui ! S'il n'y avait pas eu le travail... ".*

6.2 Simple microeconomic formalization

To formally traduce theses effects, we add to the previous utility specification 3.1 a discret component ($s.IC.y_W$) :

$$U^{'} = u(C, L, IC) + \beta.v(IC, IC_0, H) + s.IC.y_W \tag{3.14}$$

where y_W is a dummy variable which is equal to 1 if the individual participate to the labour market, 0 otherwise. s is a coefficient assumed to be positive. Hence, the marginal utility of care is now :

$$\frac{\partial U'}{\partial IC} = u_{IC} + \beta.v_{IC} + s.y_W \tag{3.15}$$

Through this specification, being employed increases the marginal utility of providing care by a constant terms s, whatever the working time[20].

This new framework allows to decompose the effect of labour supply on caregiving time into two components : (i) a positif discret component and (ii) a negative continuous component. The first one illustrates that the worker status tends to increase the propensity to provide care through the protection effect, the respite effect or the productivity effect, regardless the working time. The second one corresponds to the standard substitution effect : each hour spent working tends to decrease time devoted to parental care.

Among those initially not working ($y_W = 0$) , the global effect of an exogenous varaition of working time on the optimal caregiving time is *a priori* indeterminate. It depends on the magnitude of the two components :

$$\frac{dIC^{opt}}{dW} = \frac{-s}{u_{LL} + u_{IC} + \beta.v_{IC}} + \frac{-u_{LL}}{u_{LL} + u_{IC} + \beta.v_{IC}} \gtrless 0$$

[20]Our purpose is here to explain the average positive effect of working time on caregiving time. We thus only reformulate the microeconomic model to acount for this effect. It could however also be possible to add a symetric discret component to the model allowing to disentangle the effect on the propensity to work of (i) being a caregiver and (ii) the effect of time devoted to care conditionally on being a caregiver . We could thus adopt this specification :

$$U^{''} = u(C, L, IC) + \beta.v(IC, IC_0, H) + s.IC.y_W + t.W.y_{IC}$$

Here, working time directly affects the child's utility but only if he/she is caregiver.

Among those initially working ($y_W = 1$), only the negative continuous component is relevant :

$$\frac{dIC^{opt}}{dW} = \frac{-u_{LL}}{u_{LL} + u_{IC} + \beta.v_{IC}} < 0$$

According to this model, our previous estimation results suggest that the effect of worker status is relatively high and offset (on average) the substitution effect. In order to validate this interpretation, the next section aims to disentangle and identify the two distinct effects.

7 Empirical validation of the microeconomic model with partial complementarity

To test the implications of the reformulated microeconomic model,we focus here the empirical analysis on the effect of the labour supply on the care provision. We then adopt an IV approach by expressing the working time equation in a reduced form[21].

7.1 Empirical strategy

In order to disentangle the effect of being a worker and the effect of working time (conditionally on being a worker), we estimate a selection model. In addition to y_{Wi}, we define a dummy variable y_{ICi} which is equal to 1 if the individual i provides informal care, 0 otherwise. From these two variables, we define four sub-samples :

		y_{IC}	
		1	0
y_W	1	S_1	S_2
	0	S_3	S_4

[21] We first estimate a recursive model allowing to simultaneously identify both reciprocal causal effects. The exclusion restrictions involved, in addition to those implied by the selection model, and the size of the sample used in the second step lead to quite unstable marginal effects according to the exclusion restrictions adopted. We then decide not to present the results. Note however that the qualitative results appear very stable.

Hence, we can estimate a specific model on the sub-samples S_1 and S_3 :

$$S_1 \begin{cases} W_i = x_{Wi}.\beta_{1W} + x_{ICi}.\lambda_{1W} + u_{1Wi} \\ IC_i = x_{ICi}.\beta_{1IC} + \alpha'_{IC}.W_i + u_{1ICi} \end{cases} \tag{3.16}$$

$$S_3 \begin{cases} W_i = 0 \\ IC_i = x_{ICi}.\beta_{3IC} + u_{3ICi} \end{cases} \tag{3.17}$$

The effect of occupation on time devoted to parental care may then be decompose into :

(i) the effect of working time on time devoted to parental care conditionnally on being both worker and caregiver, estimated by $\widehat{\alpha'}_{IC}$:

$$\widehat{\alpha'}_{IC} = \frac{\partial E(IC_i/y_{Wi} = 1, y_{ICi} = 1)}{\partial W_i}$$

(ii) the effect of the worker status independently of the effect of time spent working, ΔW_i. In order to estimate this effect, we can simulate for each individual the difference between his expected caregiving time conditionnally on being both worker and caregiver ($\in S_1$), but assuming a working time equal to 0 and his expected caregiving time conditionnally on being caregiver but non-worker ($\in S_3$) :

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

According to our microeconomic framework, we expect $\widehat{\alpha'}_{IC}$ to be negative and $\widehat{\Delta W}_i$ to be on average positive.

To estimate these two effects, we need to take into account the potential individual self-selection which may lead to expected values of the error terms different from 0 in equations 3.18 and 3.19 (Heckman,1979 ; Maddala, 1983) :

$$S_1 \begin{cases} E(W_i/y_{Wi} = 1, y_{ICi} = 1) = x_{Wi}.\beta_{1W} + x_{ICi}.\lambda_{1W} + E(u_{1Wi}/y_{Wi} = 1, y_{ICi} = 1) \\ E(IC_i/y_{Wi} = 1, y_{ICi} = 1) = x_{ICi}.\beta_{1IC} + \alpha'_{IC}.W_i + E(u_{1ICi}/y_{Wi} = 1, y_{ICi} = 1) \end{cases} \tag{3.18}$$

$$S_3 \begin{cases} E(W_i/y_{Wi} = 0, y_{ICi} = 1) = 0 \\ E(IC_i/y_{Wi} = 0, y_{ICi} = 1) = x_{ICi}.\beta_{3IC} + E(u_{3ICi}/y_{Wi} = 0, y_{ICi} = 1) \end{cases} \tag{3.19}$$

We then follow the Heckman procedure by modelling in a first step the selection process. However, contrary to the standard approach, there is here two selectivity variables (Tunali, 1986). We then estimate a bi-probit[22], specifying the propensity to participate to the labour market, y^*_{Wi} and the propensity to be caregiver, y^*_{ICi} under a reduced form :

$$y_{Wi} = \begin{cases} 1 \text{ if } y^*_{Wi} > 0 \\ 0 \text{ otherwise} \end{cases} \text{ and } y_{ICi} = \begin{cases} 1 \text{ if } y^*_{ICi} > 0 \\ 0 \text{ otherwise} \end{cases} \text{ with } \begin{cases} y^*_{Wi} = x_i.\Pi_W + \varepsilon_{Wi} \\ y^*_{ICi} = x_i.\Pi_{IC} + \varepsilon_{ICi} \end{cases}$$

The correction terms wich appear in (3.18)-(3.19) may then be written as follow :

$$\begin{aligned} E(u_{1Wi}/y_{Wi}=1, y_{ICi}=1) = \quad & cov(u_{1Wi}, \varepsilon_{Wi}).\frac{\phi\left(z_{Wi}\right).\Phi\left(Z_{Wi}\right)}{\Phi_2\left(z_{Wi}, z_{ICi}, \rho_{y_W y_{IC}}\right)} \\ + \quad & cov(u_{1Wi}, \varepsilon_{ICi}).\frac{\phi\left(z_{ICi}\right).\Phi\left(Z_{ICi}\right)}{\Phi_2\left(z_{Wi}, z_{ICi}, \rho_{y_W y_{IC}}\right)} \end{aligned}$$

$$\begin{aligned} E(u_{1ICi}/y_{Wi}=1, y_{ICi}=1) = \quad & cov(u_{1ICi}, \varepsilon_{Wi}).\frac{\phi\left(z_{Wi}\right).\Phi\left(Z_{Wi}\right)}{\Phi_2\left(z_{Wi}, z_{ICi}, \rho_{y_W y_{IC}}\right)} \\ + \quad & cov(u_{1ICi}, \varepsilon_{ICi}).\frac{\phi\left(z_{ICi}\right).\Phi\left(Z_{ICi}\right)}{\Phi_2\left(z_{Wi}, z_{ICi}, \rho_{y_W y_{IC}}\right)} \end{aligned}$$

$$\begin{aligned} E(u_{3I\,\mathrm{Ci}}/y_{Wi}=0, y_{ICi}=1) = \quad & cov(u_{3I\,\mathrm{Ci}}, \varepsilon_{Wi}).\frac{-\phi\left(z_{Wi}\right).\Phi\left(Z_{Wi}\right)}{\Phi_2\left(-z_{Wi}, z_{ICi}, -\rho_{y_W y_{IC}}\right)} \\ + \quad & cov(u_{3I\,\mathrm{Ci}}, \varepsilon_{ICi}).\frac{\phi\left(z_{ICi}\right).\Phi\left(-Z_{ICi}\right)}{\Phi_2\left(-z_{Wi}, z_{ICi}, -\rho_{y_W y_{IC}}\right)} \end{aligned}$$

where $z_{Wi} = x_W.\Pi_W$; $z_{ICi} = x_{IC}.\Pi_{IC}$

$$Z_{Wi} = \frac{x_{IC}.\Pi_{IC} - \rho_{y_W y_{IC}}.x_W.\Pi_W}{\sqrt{(1-\rho^2_{y_W y_{IC}})}} \; ; \; Z_{ICi} = \frac{x_W.\Pi_W - \rho_{y_W y_{IC}}.x_{IC}.\Pi_{IC}}{\sqrt{(1-\rho^2_{y_W y_{IC}})}}$$

$(\varepsilon_{Wi}, \varepsilon_{ICi}) \sim N\left(0,0,1,1,\rho_{y_W y_{IC}}\right)$

φ is the univariate standard normal density function

Φ is the univaraite standard normal cumulative function

Φ_2 is the bivariate standard normal cumulative function

[22] Mohanty (2001), Wtzels & Zorlu (2003) or Louinord et al. (2010) use similar double selection models.

The empirical strategy adopted to test both the existence of a positive effect of the worker status and a negative effect of working time on time devoted to parental care may be summarized as follow : (i) estimating the reduced bi-probit model ; (ii) generating from the previous estimation the selection terms ; (iii) estimating jointly equations 3.18, and testing the significativity of α'_{IC} (iv) estimating equation (3.19) and (iv) simulating $\widehat{\Delta W}_i$.

7.2 Results

Columns (1) and (2) of table 6 reports estimation results of the selection equations. The interpretation of the estimation results is here different from the one of the previous model (table 3), because we do not control for the care behaviour on the estimation of the probability to participate to the labour market and for the work behaviour on the estimation of the probability to provide care. The coefficients associated with each exogenous variable capture then both the direct and indirect effects. For exemple, table 3 shows that the child's age has (i) a positive direct impact (conditionally on working time) but (ii) a negative indirect impact on the propensity to provide care (through the negative impact of age on the propensity to work and the positive effect of working time on caregiving time). Table 6 shows that if we consider the probability to provide care the global effect of the child's age is negative. The positive effect of the child's education level on the probability to provide care can be interpreted similarly. Except for the child's age and education level, the effects of all others characteristics on the probability to work or provide care have the same sign that the direct effect highligh in the previous estimations (table 3). However, some variables become no significant while others become significant when we consider the probability to work or provide care instead of working time and caregiving time. In particular, the eldest children are characterized by a higher probability to provide care.

The estimation of the second-step requires identifying instruments. First, even if the selection terms are non-linear combinations of the covariates included in the selection equations, we follow the literature by excluding in the second-step at least one significant variable in the selection equations. From this point of view, we need to identify at least one variable impacting the probability to participate to the labour market and the probability or provide care but not the working time and the caregiving time (conditionally on being both a worker and a caregiver). Second, contrary

to the previous bi-tobit model where the non linearity of the interaction between working time and caregiving time allowed the formal identification of the paramaters without exclusion restrictions, the perfect linearity between working time and caregiving time at the second step of the selection model requires to identify at least one variable affecting the working time but not directlly the caregiving time. The choice of these identifying instruments is not obvious from a theoretical point of view. We then decide to adopt an "empirical" strategy by excluding in the second-step equations covariates which are no statistically significant (but significant either in the selection equations or in the other second-step equation). Table D1 in appendix D reports some evidence allowing to validate the exclusion restrictions. Each excluded variables added one by one in the second step does not affect directly the outcomes and does not change the estimated effect of the instrumental working time on caregiving time, under the hypothesis that the remaining instruments are valid.

Columns (3) and (4) of table 6 provides estimation resuts of the simultaneous estimation of working time and caregiving time when we do not distinguish the effect of working time on caregiving time according to the gender. Columns (5) and (6) of table 6 provide estimations results when we introduce into the interaction a gender dummy variable. Restricting the analysis to those being both a worker and a caregiver slightly changes the estimation results from those obtained from the previous bi-tobit model. We recall that variables which are excluded from the second step of estimation ("-" in the table) appears no significant when they are added one by one in the model (see appendix D).We still find that men are characterized by a higher working time than women, that being married reduce working time while the education level and the health status increases working time. Age and non labour income, which affect the probability to participate to the labour market, do not appear associated with hours worked. Note also that, as we do not control here for the care provision, some parent's characteristics appear significantly associated with working time. Concerning caregiving time, with the exception of the health status and the geographical proximity, the child characteristics do not significantly explain time devoted to parental care (conditionally on being both a worker and a caregiver). However, as previously, caregiving time appears need-driven (Spiess and Schneider, 2002)[23]. Indeed, the intensity of care is still related to the parent's characteristics and the effects appear (qualitatively) similar to those obtained from the bi-tobit model. The only exception if the parent's gender effect which is now no significant : children have

[23] "*In short, the provision of care appears to be determined by the needs of the parents, while the ease with the children can fulfill those needs play only a secondary role.*"(Johnson and Lo Sasso, 2000, pp.27).

a higher probability to provide care to their mother but do not significantly provide more care to their mother when they decide to provide care.

The main change from the bi-tobit model concerns the interactions between the two activities. Conditionally on being a worker and a caregiver, a exogenous shock leading to work one hour more reduces on average the optimal caregiving time by 8 min, the effect being however not significant (P-value=0.52). When we distinguish the effect according to the gender, we find that the decrease is however significant for women. Although no significant for man, both activities appears as two competing activities when we restrict the analysis to those both participating to the labour market and providing care. From this point of view, this results is consistent with the previous microeconomic model.

Table 6. Estimated coefficient from selection model

	Reduced Bi-Probit model (n=4234)		S_1 W>0,IC>0 (n=660)		S_1 W>0,IC>0 (n=660)	
	(1) P(W>0)	(2) P(IC>0)	(3) W	(4) IC	(3) W	(4) IC
Constant	0.92***	0.12	40.30***	9.07**	40.35***	6.83**
	(0.17)	(0.16)	(4.49)	(5.20)	(4.18)	(4.09)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Child characterisitics						
Gender						
Man	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Woman	-0.64***	0.31***	-6.95***	1.76	-6.96***	4.97**
	(0.05)	(0.04)	(1.49)	(1.61)	(1.50)	(2.41)
Age						
Age-50	-0.09***	-0.04**	–	–	–	–
	(0.02)	(0.02)				
$(\text{Age-50})^2$	-0.01***	0.00	–	–	–	–
	(<0.01)	(<0.01)				
Education level						
Pre-primary or primary educ.	-15.37*	-0.07	-4.31*	–	-4.35**	–
	(0.08)	(0.08)	(2.28)		(2.10)	
Lower secondary educ.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Upper secondary educ.	0.19***	0.02	-0.02	–	-0.06	–
	(0.07)	(0.07)	(1.29)		(1.27)	
Post secondary educ.	0.59***	0.27***	1.86	–	1.82	–
	(0.07)	(0.07)	(1.43)		(1.50)	
Healt status						
"Poor"	-1.13***	-0.52***	6.84	-5.17*	6.87	-5.40*
	(0.12)	(0.11)	(5.59)	(2.75)	(5.57)	(2.83)
"Fair"	-0.38***	-0.12**	1.91	-1.69*	1.92	-1.72*
	(0.07)	(0.06)	(1.44)	(0.87)	(1.46)	(0.83)
"Good"	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
"Very good"	0.11*	0.05	-1.14	-0.79	-1.15	-0.79
	(0.06)	(0.06)	(0.95)	(0.62)	(0.95)	(0.61)
"Excellent"	0.10	-0.02	2.42**	-1.11	2.43**	-1.12
	(0.07)	(0.07)	(1.10)	(0.80)	(1.15)	(0.72)
Marital status						
Not married	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Married	-0.15***	0.01	-1.34*	–	-1.30	–
	(0.06)	(0.05)	(0.79)		(0.95)	
Number of children						
0	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
1	0.13	-0.13	0.06	-0.02	0.05	-0.14
	(0.10)	(0.09)	(1.87)	(0.96)	(1.82)	(0.88)
2	0.13	-0.14	-0.04	-0.79	-0.04	-0.86
	(0.09)	(0.09)	(1.60)	(0.71)	(1.51)	(0.70)
Log of the monthly non labour income	-0.07***	0.02***	–	–	–	–
	(0.01)	(0.01)				
Siblings characteristics						
Number of sisters						
0	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
1	0.03	-0.06	0.66	0.48	0.66	0.45
	(0.05)	(0.05)	(0.93)	(0.49)	(1.00)	(0.50)
2 or more	0.06	-0.15***	-0.08	-0.88*	-0.07	-0.83
	(0.06)	(0.06)	(1.09)	(0.53)	(1.13)	(0.57)

continue...

Table 6. Continue...

	Reduced Bi-Probit model (n=4234)		S_1 W>0,IC>0 (n=660)		S_1 W>0,IC>0 (n=660)	
	(1) P(W>0)	(2) P(IC>0)	(3) W	(4) IC	(5) W	(6) IC
Number of brothers						
0	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
1	0.01	-0.08	-1.29	-0.04	-1.29	-0.04
	(0.06)	(0.05)	(0.93)	(0.56)	(0.91)	(0.55)
2 or more	-0.03	-0.19***	-0.33	-0.38	-0.32	-0.43
	(0.13)	(0.06)	(1.25)	(0.62)	(1.24)	(0.63)
Eldest child						
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	0.01	0.10**	0.79	0.02	0.78	0.05
	(0.05)	(0.05)	(0.40)	(0.53)	(0.92)	(0.51)
Parent characteristics						
Gender						
Woman	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Man	-0.05	-0.23***	2.20	–	2.24	–
	(0.07)	(0.07)	(1.45)		(1.53)	
Age						
Age-75	0.00	0.03***	-0.05	0.25***	-0.06	0.25***
	(0.01)	(0.01)	(0.12)	(0.06)	(0.13)	(0.06)
Health status						
"Poor"	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
"Fair"	0.01	-0.09	1.90*	-2.65***	1.90*	-2.71***
	(0.06)	(0.06)	(1.10)	(0.81)	(1.06)	(0.77)
"Good"	0.16**	-0.27***	-0.34	-3.43***	-0.33	-3.44***
	(0.07)	(0.06)	(1.56)	(0.80)	(1.52)	(0.81)
"Very good"	0.04	-0.45***	3.23	-4.06***	3.25	-4.13
	(0.09)	(0.09)	(2.26)	(1.34)	(2.20)	(1.28)
"Excellent"	-0.06	-0.33***	1.69	-4.00***	1.70	-3.99***
	(0.12)	(0.11)	(2.37)	(1.13)	(2.51)	(1.21)
Geographical proximity						
Same building	-0.03	-0.02	2.31	3.02	2.31	2.95
	(0.13)	(0.11)	(1.87)	(1.90)	(1.95)	(1.89)
Less than 1km away	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Between 1 and 5 km away	-0.01	-0.26***	1.64	-2.16**	1.66	-2.20
	(0.08)	(0.07)	(1.46)	(0.85)	(1.53)	(0.81)
Between 5 and 25 km away	0.04	-0.49***	-0.31	-3.02***	-0.29	-3.02***
	(0.08)	(0.07)	(2.03)	(0.89)	(2.15)	(0.88)
Between 25 and 100 km away	0.10	-0.70***	0.28	-4.50***	0.31	-4.46***
	(0.08)	(0.08)	(2.67)	(1.08)	(2.77)	(1.12)
Between 100 and 500 km away	0.07	-0.88***	-1.18	-4.09***	-1.14	-4.06***
	(0.09)	(0.09)	(3.55)	(1.29)	(3.58)	(1.44)
More than 500 km away	0.11	-1.27***	5.13	-5.67**	5.20	-5.53*
	(0.15)	(0.18)	(6.71)	(2.78)	(6.55)	(2.96)
More than 500 km away	0.03	-1.67***	0.98	-4.36	1.07	-4.36
in another country	(0.13)	(0.17)	(6.39)	(2.73)	(6.57)	(3.07)
Interactions between work and care						
Hous of work (W)				-0.14		-0.08
				(0.21)		(0.21)
Hous of work (W)*woman						-0.08*
						(0.05)

continue...

Table n°6. Continue...

	Reduced Bi-Probit model (n=4234)		S_1 W>0,IC>0 (n=660)		S_1 W>0,IC>0 (n=660)	
	(1) P(W>0)	(2) P(IC>0)	(3) W	(4) IC	(5) W	(6) IC
$Cov(u_{Wi},\varepsilon_{ICi})$	0.05					
	(0.03)					
$Cov(u_{1Wi},u_{I\,\mathrm{Ci}})$			0.21		0.19	
			(0.32)		(0.31)	
$Cov(u_{1Wi},\varepsilon_{Wi})$			-5.05***		-5.06***	
			(1.72)		(1.86)	
$Cov(u_{1Wi},\varepsilon_{ICi})$			-0.57		-0.63	
			(5.00)		(5.16)	
$Cov(u_{1I\,\mathrm{Ci}},\varepsilon_{Wi})$				-2.19		-2.17
				(1.61)		(1.57)
$Cov(u_{1I\,\mathrm{Ci}},\varepsilon_{ICi})$				3.63**		3.58*
				(1.83)		(2.00)

Standard errors are in parentheses. At the second step, we calculate standard errors by bootstrap.*,**,*** significantly different from 0 at the 10%, 5% and 1% level

Turning now to the estimation of the discret effet of being a worker on the time devoted to care (table 7), results also appear consistent with the microeconomic model proposed : on average, the participation to the labour market increases by 1 hours and 29 minutes per week time devoted to care among women and by 34 minutes among men.

Table 7. Discret effect of the worker status

men	
(1) mean of $\widehat{E}_i(IC_i/y_{Wi}=1,y_{ICi}=1,W_i=0)$	6.48
(2) mean of $\widehat{E}_i(IC_i/y_{Wi}=0,y_{ICi}=1)$	5.91
(1)-(2) mean of $\widehat{\Delta W}_i$	0.57
women	
(1) mean of $\widehat{E}_i(IC_i/y_{Wi}=1,y_{ICi}=1,W_i=0)$	9.96
(2) mean of $\widehat{E}_i(IC_i/y_{Wi}=0,y_{ICi}=1)$	8.48
(1)-(2) mean of $\widehat{\Delta W}_i$	1.48

The global effect can finally be summarized as follow : among the women caregivers who work less than 9 hours and 25 minutes per week the labour supply has a positive effect on the time they devote to provide care to their elderly parent, the positive discret effect of being worker is indeed higher than the negative continous effect of time spent working ; on the contrary, the labour supply reduces working time for the women caregivers who work more than 9 hours and 25 minutes hours per week because in this case the positive effect of being worker is totally offset by the negative

impact of working time. Among men, the effect of labour supply is positif for those working less than 7 hours and 8 minutes per week and negatif for those working more.

8 Conclusion

This paper examines the trade-off between paid work and parental care among individuals aged 50 to 65, that is individuals having a key role in informal care for disabled elderly but who are also encourage to participate to the labour market. Our empirical analysis puts forward a time allocation process that is not as simple as the allocation suggested by a standard microeconomic framework. First, our findings suggest a negative impact of care on work, confirming the results of previous studies. The main contribution of this study is however the analysis of the reversal causality. From this point of view, our fundings suggest that conditionally on the labour market participation, working time affects negatively caregiving time. However, the labour market participation participating, regardless working time, has a positive impact on the propensity to provide care. This positif effect is not so surprising if we refer to qualitative studies that highlight several effects suggesting that being a worker may favour the care provision (protection effect, respite effect or productivity effect). Our model does not allow to identify which of these effects come into play. However, the protection effect appears more relevant to explain the gender difference we observe. Especially, the positif effect of the worker status appears higher for women than men. Fnntaine et al. (2009) suggest than economic considerations could counteract the duty to provide informal care. If this interpretation is true, the protection effect of employment could be more relevant for women, that is a population who can feel a higher responsability to provide 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 of the effect of the labour market participation on the care provision. On the one hand, working tends to reduce the burden associated with the care provision but on the other hand, performing both activities could be "heavy" and require some sacrifices. From this point of view, our findings suggest that the articulation between working time and caregiving time also involves a important leisure time reduction. As suggested by Le Bihan

and Martin (2006), juggling both the professional carrer and the care provision generally leads to a contraction of family and social time.

Our study presents some limits. First, some potentially important variables are missing in the data used, such as the use of formal care, the parent's disability level or the parent's place of residence. In particular, some individuals in the data set may have a parent living in nursing home. Moreover, we excluded from the analysis individuals co-residing with their elderly parent because of a lack on information concerning their caregiving behaviour. Further research could consist in estimating the labour and care behaviour simultaneously with the intergenerational household formation. The paper is focused on hours worked. Further research should also consider the effect of the care provision on other labour outcome such as the necessity to obtain more flexible working hours, the reduction in careers prospect or the necessity to take some time off.

Appendix A : Illustration of the incompleteness

Let us consider first a case where the *model A* predicts a single equilibrium. Suppose, for example, a daughter for whom : $x_W\beta_W + u_W = x_{IC}\beta_{IC} + u_{IC} = 20$ and $\alpha_W = \alpha_{IC} = -1/2$ (*example 1*). The optimal allocation for such daughter is then defined by the following first order condition :

$$W_i^{opt} = \begin{cases} W_i^* \text{ if } W_i^* > 0 \\ 0 \text{ otherwise} \end{cases} \text{ and } IC_i^{opt} = \begin{cases} IC_i^* \text{ if } IC_i^* > 0 \\ 0 \text{ otherwise} \end{cases} \text{ with } \begin{cases} W_i^* = 20 - \frac{1}{2}.IC_i \\ IC_i^* = 20 - \frac{1}{2}.W_i \end{cases}$$

The first equation ($W_i^* = 20 - 1/2.IC_i$) is represented by the red curve in figure 4 (pp.21). If the daughter does not provide support to her parent, she decides to work 20 hours per week but if she provides support to her parent, each caregiving hour reduce her working time by half an hour per week. Beyond 40 hours of support per week, her reservation wage becomes higher than her real wage, she then prefers not to work. Symmetrically, the second equation ($IC_i^* = 20 - 1/2.W_i$) is represented by the blue curve. Preferences of the daughter are such that she prefers to provide 20 hours of care per week if she does not work, whereas each hour worked encourage her to reduce by half an hour per week her assistance. Beyond 40 hours worked per week, she no longer wishes to provide care, her opportunity cost becoming too high. In such a situation, the equilibrium is represented by the point (W^{opt}, IC^{opt}).

In *example 1*, the model is complete because it allows to predict a unique equilibrium. However, the nonlinearity of the relationship between W and IC can lead to situations in which the model is unable to predict the allocation chosen by the individual. To illustrate this kind of situation, let us consider a daughter characterized by the following first order conditions (*example 2*) :

$$W_i^{opt} = \begin{cases} W_i^* \text{ if } W_i^* > 0 \\ 0 \text{ otherwise} \end{cases} \text{ and } IC_i^{opt} = \begin{cases} IC_i^* \text{ if } IC_i^* > 0 \\ 0 \text{ otherwise} \end{cases} \text{ with } \begin{cases} W_i^* = 40 - 2.IC_i \\ IC_i^* = 40 - 2.W_i \end{cases}$$

In this example, α_W and α_{IC} are both negative and does not respect the coherency condition. Figure A1 illustrates this situation. Unlike *example 1*, where the model allows to define a single equilibrium, the model predict here three potential equilibria. The model is then incomplete.

Figure A1. Exemple 2.

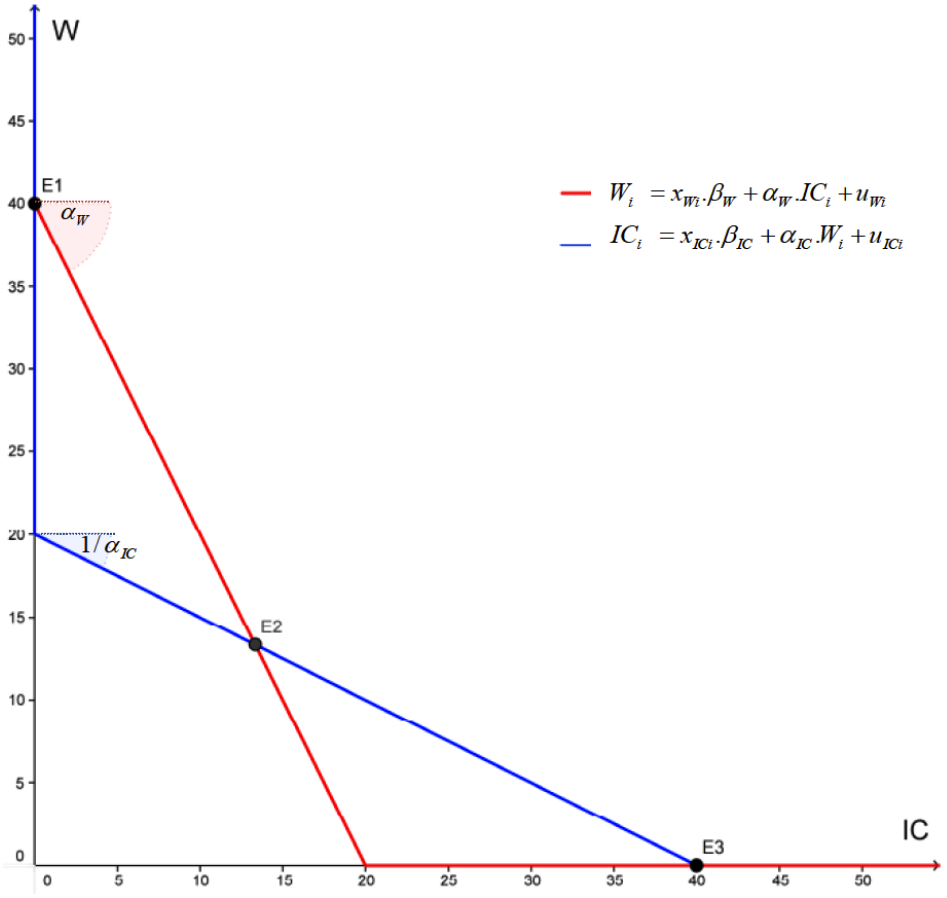
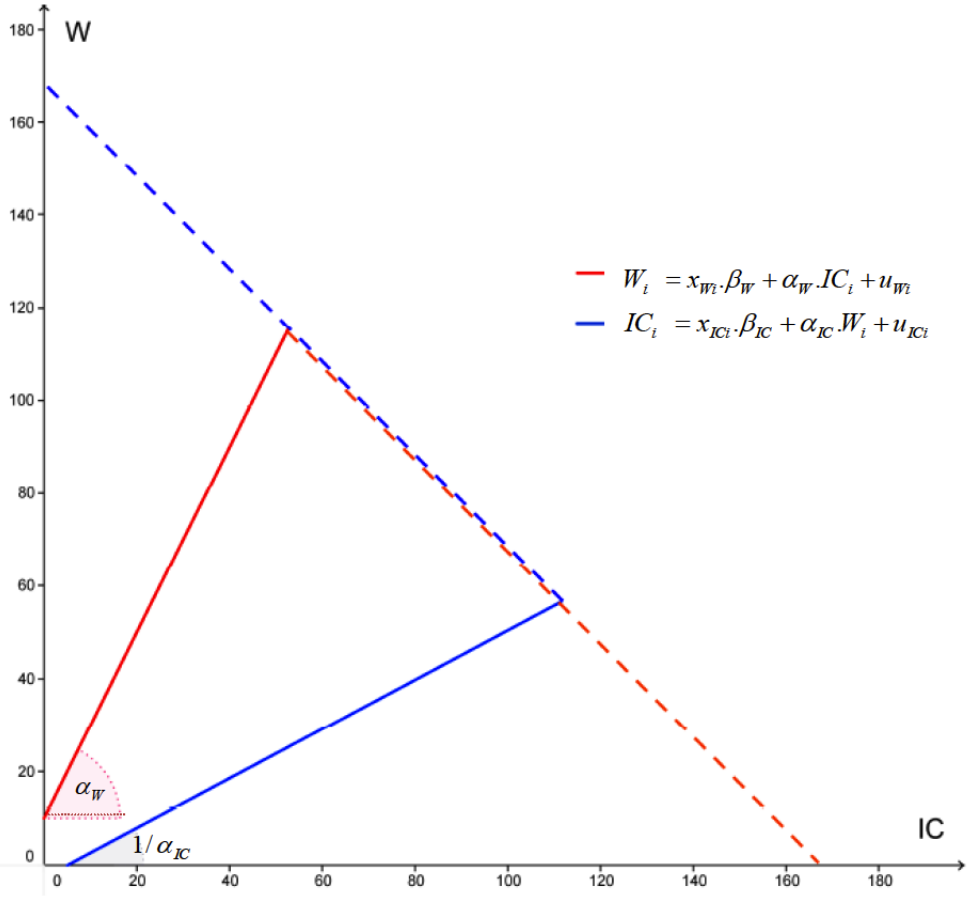


Figure A2 also illustrate a case where the model does not predict a single equilibrium. Here α_W and α_{IC} are both positive and does not respect the coherency condition (example 3). The time constraint leads here to multiple equilibria, each one being characterized by a leisure time equals to zero. Note that without the time constraint, this situation would be characterized by no equilibrium.

Figure A2. Example 3



Appendix B : Estimation results of the Bi-Tobit model with exclusion restrictions

Table B1. Estimated coefficient from Bit-Tobit model (with exclusion restrictions)

	Not constraint model (n=4234)		Model with α_{IC}=0 (n=4234)		Model with α_{W}=0 (n=4234)	
	(1) W*	(2) IC*	(3) W*	(4) IC*	(5) W*	(6) IC*
Constant	35.06***	-20.27***	33.15***	1.66	26.47***	-11.79***
	(2.70)	(2.59)	(3.02)	(1.75)	(3.61)	(2.07)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Child characterisitics						
Gender						
Man	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Woman	-17.92***	11.70***	-17.45***	4.21***	-18.24***	8.36***
	(1.10)	(0.85)	(1.04)	(0.50)	(1.00)	(0.65)
Age						
Age-50	-1.31***	0.44	-1.10**	-0.56***	-1.13**	0.26
	(0.48)	(0.28)	(0.45)	(0.20)	(0.44)	(0.22)
$(\text{Age-50})^2$	-0.30***	0.04**	-0.30***	0.03**	-0.28***	0.03*
	(0.04)	(0.02)	(0.04)	(0.01)	(0.04)	(0.02)
Education level						
Pre-primary or primary educ.	-4.34**	-	-4.82***	-0.71	-4.20**	-
	(1.92)		(1.88)	(0.87)	(1.67)	
Lower secondary educ.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Upper secondary educ.	4.45***	-1.67*	4.43***	-0.18	4.08***	-0.95
	(1.61)	(0.87)	(1.52)	(0.72)	(1.45)	(0.66)
Post secondary educ.	13.29***	-1.96**	13.35***	2.07***	11.86***	-0.91
	(1.65)	(0.95)	(1.56)	(0.76)	(1.51)	(0.77)
Healt status						
"Poor"	-33.27***	-	-29.64***	-5.31***	-29.61***	-
	(3.10)		(2.91)	(1.28)	(2.75)	
"Fair"	-9.99***	-	-9.46***	-1.86***	-8.12***	-
	(1.53)		(1.50)	(0.71)	(1.33)	
"Good"	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
"Very good"	1.89	-	2.16*	0.30	1.78	-
	(1.29)		(1.29)	(0.63)	(1.11)	
"Excellent"	2.17	-2.04**	3.04*	-0.61	2.64*	-1.39*
	(1.72)	(1.04)	(1.60)	(0.80)	(1.58)	(0.79)
Marital status						
Not married	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Married	-2.98**	-	-3.96***	-0.32	-2.77***	-
	(1.25)		(1.27)	(0.61)	(1.11)	
Number of children						
0	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
1	-	-1.20	-	-0.84	2.35	-1.22
		(1.37)		(1.08)	(2.21)	(1.12)
2	-	-1.98**	-	-1.50	2.02	-1.77*
		(1.20)		(0.95)	(1.95)	(0.98)
Log of the monthly non labour income	-1.68***	0.74***	-1.66***	0.17*	-1.54***	0.52***
	(0.21)	(0.13)	(0.19)	(0.09)	(0.19)	(0.10)
Siblings characteristics						
Number of sisters						
0	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
1	-	-1.20	-	-1.01*	1.20	-1.13*
		(0.75)		(0.57)	(1.19)	(0.61)
2 or more	-	-2.84***	-	-2.30***	1.98	-2.37***
		(0.82)		(0.63)	(1.27)	(0.66)

(continue...)

Table B1. Continue...

	Not constraint model (n=4234)		Model with $\alpha_{IC}=0$ (n=4234)		Model with $\alpha_{W}=0$ (n=4234)	
	(1) W*	(2) IC*	(3) W*	(4) IC*	(5) W*	(6) IC*
Number of brothers						
0	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
1	-	-0.98	-	-1.15**	0.99	-1.01*
		(0.75)		(0.57)	(1.19)	(0.61)
2 or more	-	-2.08***	-	-2.06***	-0.60	-1.56**
		(0.81)		(0.62)	(1.26)	(0.65)
Eldest child						
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	-	0.86	-	0.76	0.58	0.67
		(0.70)		(0.53)	(1.10)	(0.56)
Parent characteristics						
Gender						
Woman	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Man	-	-2.63***	-	-1.99***	-1.09	-1.80**
		(0.96)		(0.74)	(1.43)	(0.77)
Age						
Age-75	-	0.51***	-	0.38***	0.00	0.36***
		(0.07)		(0.06)	(0.11)	(0.06)
Health status						
"Poor"	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
"Fair"	-	-3.03***	-	-2.55***	1.19	-2.44***
		(0.84)		(0.64)	(2.53)	(0.68)
"Good"	-	-6.24***	-	-5.19***	4.46***	-5.43***
		(0.91)		(0.69)	(1.45)	(0.73)
"Very good"	-	-9.11***	-	-7.12***	2.96	-7.23***
		(1.34)		(1.02)	(1.99)	(1.06)
"Excellent"	-	-7.11***	-	-5.49***	1.19	-5.43***
		(1.66)		(1.27)	(2.53)	(1.33)
Geographical proximity						
Same building	-	1.91	-	1.74	-1.49	1.85
		(1.58)		(1.19)	(2.76)	(1.29)
Less than 1km away	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Between 1 and 5 km away	-	-5.23***	-	-3.74***	0.18	-3.89***
		(1.00)		(0.76)	(1.68)	(0.81)
Between 5 and 25 km away	-	-7.66***	-	-5.99***	1.73	-6.00***
		(1.01)		(0.76)	(1.65)	(0.81)
Between 25 and 100 km away	-	-11.15***	-	-8.56***	2.61	-8.49***
		(1.17)		(0.87)	(1.81)	(0.92)
Between 100 and 500 km away	-	-12.97***	-	-10.25***	2.84	-9.95***
		(1.32)		(0.99)	(1.94)	(1.03)
More than 500 km away	-	-18.55***	-	-14.81***	3.37	-14.05***
		(2.54)		(1.93)	(3.13)	(1.93)
More than 500 km away in another coutry	-	-22.43***	-	-17.09***	1.85	-16.61***
		(2.56)		(1.91)	(2.73)	(1.92)
Interactions between work and care						
Hours of care (IC)	-1.99***		-0.98***			
	(0.16)		(0.18)			
Hous of work (W)		0.64***				0.43***
		(0.04)				(0.04)
ρ	-0.52*** (0.04)		0.15*** (0.04)		-0.64*** (0.04)	

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

Appendix C :Estimation results of the Nelson-Olson model

Table C1. Estimated coefficient of the model NO (second step)

	(1) W*	(2) IC*
Constant	31.78***	-3.41*
	(2.74)	(1.80)
Country dummies	Yes	Yes
Child characterisitics		
Gender		
Man	Ref.	Ref.
Woman	-17.88***	7.63***
	(1.08)	(0.86)
Age		
Age-50	-1.05**	-0.36*
	(0.45)	(0.20)
$(\text{Age-50})^2$	-0.31***	0.09***
	(0.04)	(0.02)
Education level		
Pre-primary or primary educ.	-4.90***	-
	(1.88)	
Lower secondary educ.	Ref.	Ref.
Upper secondary educ.	4.55***	-1.02
	(1.52)	(0.67)
Post secondary educ.	13.57***	-0.35
	(1.56)	(0.90)
Healt status		
"Poor"	-30.00***	-
	(2.95)	
"Fair"	-9.35***	-
	(1.50)	
"Good"	Ref.	Ref.
"Very good"	2.28*	-
	(1.29)	
"Excellent"	3.10*	-1.13
	(1.60)	(0.77)
Marital status		
Not married	Ref.	Ref.
Married	-3.61***	-
	(1.24)	
Number of children		
0	Ref.	Ref.
1	-	-1.22
		(1.07)
2	-	-1.79*
		(0.93)
Log of the monthly non labour income	-1.65***	0.48***
	(0.19)	(0.11)
Siblings characteristics		
Number of sisters		
0	Ref.	Ref.
1	-	-1.11*
		(0.58)
2 or more	-	-2.45***
		(0.63)

(continue...)

Table C1. Continue...

		(1) W*	(2) IC*
Number of brothers			
	0	Ref.	Ref.
	1	-	-1.22**
			(0.58)
	2 or more	-	-1.93***
			(0.63)
Eldest child			
	No	Ref.	0.75
	Yes	-	(0.54)
Parent characteristics			
Gender			
	Woman	Ref.	Ref.
	Man	-	-1.85**
			(0.74)
Age			
	Age-75	-	0.38***
			(0.06)
Health status			
	"Poor"	Ref.	Ref.
	"Fair"	-	-2.76***
			(0.65)
	"Good"	-	-5.76***
			(0.72)
	"Very good"	-	-7.63***
			(1.04)
	"Excellent"	-	-5.74***
			(1.28)
Geographical proximity			
	Same building	-	1.93
			(1.20)
	Less than 1km away	Ref.	Ref.
	Between 1 and 5 km away	-	-3.86***
			(0.76)
	Between 5 and 25 km away	-	-6.34***
			(0.77)
	Between 25 and 100 km away	-	-8.98***
			(0.88)
	Between 100 and 500 km away	-	-10.71***
			(1.00)
	More than 500 km away	-	-15.31***
			(1.93)
	More than 500 km away in another coutry	-	-17.63*** (1 ?93)
Interactions between work and care			
	Hours of care latent ($\widehat{IC}$)	-0.19** (0.09)	
	Hous of work latente($\widehat{W}$)		0.18*** (0.04)
ρ		-0.04* (0.02)	

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

Appendix D : Evidence of the non significativity of the excluded instruments in the second step of the selection model

Table D1. Estimation results when the exclusion restrictions are relaxed

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
*Working aquation								
Age								
Age-50	–	-0.53	–	–	–	–	–	–
		(0.30)						
$(\text{Age-50})^2$	–	0.00	–	–	–	–	–	–
		(0.95)						
Log of the monthly non labour income	–	–	-0.16	–	–	–	–	–
			(0.48)					
*Caregiving equation								
Child characteristics								
Age								
Age-50	–	–	–	-0.21	–	–	–	–
				(0.37)				
$(\text{Age-50})^2$	–	–	–	0.01	–	–	–	–
				(0.64)				
Education level								
Pre-primary or primary educ.	–	–	–	–	1.44	–	–	–
					(0.42)			
Lower secondary educ.	–	–	–	–	Ref.	–	–	–
Upper secondary educ.	–	–	–	–	-0.42	–	–	–
					(0.58)			
Post secondary educ.	–	–	–	–	-0.87	–	–	–
					(0.43)	–	–	–
Log of the monthly non labour income	–	–	–	–	–	0.05	–	–
						(0.57)		
Marital status								
Not married	–	–	–	–	–	–	Ref.	–
Married	–	–	–	–	–	–	-0.09	–
							(0.88)	
Parent characteristics								
Gender								
Woman	–	–	–	–	–	–	–	Ref.
Man	–	–	–	–	–	–	–	1.15
								(0.37)
Hous of work (W)	-0.14	-0.11	-0.13	-0.10	-0.10	-0.14	-0.15	-0.26
	(0.52)	(0.21)	(0.52)	(0.63)	(0.70)	(0.48)	(0.53)	(0.27)

P-values are in parentheses