Do Spanish informal caregivers come to the rescue of dependent people with formal care unmet needs? [✂]

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Abstract

This paper analyses the effect of unmet formal care needs on informal caregiving hours in Spain using the two waves of the Informal Support Survey (1994, 2004). Testing for double sample selection from formal care receipt and the emergence of unmet needs provides evidence that the omission of either one of these two variables would cause underestimation of the number of informal caregiving hours. After controlling for these two factors the number of hours of care increases with both the degree of dependency and unmet needs. In the presence of unmet needs, the number of informal caregiving hours increases when some formal care is received. This result refutes the substitution model and supports complementarity or task specificity between both types of care. For the same combination of formal care and unmet needs, informal caregiving hours increased between 1994 and 2004. Finally, in the model for 2004, the selection term associated with the unmet needs equation is larger than that of the formal care equation, suggesting that using the number of formal care recipients as an indicator of the goodness of the long-term care system may be confounding, if we do not complete this information with other quality indicators.

Keywords: double sample selection, unmet need, informal care, caregiver, formal care

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Introduction

In 2006, and still stepped in a phase of economic growth, the Spanish government enacted a new Dependency System (Act 39/2006, of 14th December, on the Promotion of Personal Autonomy and Care for Dependent persons) which purpose was to "*configure a network for public use that integrated on a coordinated basis, both public and private centres and services*". This system coped with many problems derived from the insufficient coverage of social services of dependent people and the underestimation of the potential number of beneficiaries.

However, the persistent economic crisis and the increase of public deficit (8.9% at the beginning of 2012) obliged policy makers to implement control of public expenditure. In this context of budget-slashing times, funds devoted to long-term care suffered a dramatic cut in July 2012, (Royal Decree 20/2012, 13th July). Among the measures approved, we highlight three: (1) delay in the reception of long-term care for people qualified as "moderate dependent" (until 2015), (2) reduction in the amount of economic benefits (for informal caregivers or when there is not a public provider available), and (3) decrease in the amount of Home Care hours (from 70-90 hours/month to 56-70 hours/month for "high dependent" individuals, and from 40-55 hours/month to 31-45 hours/month for "severe dependent" individuals).

Regardless of the success of the measures to reducing public deficit, our main interest is to determine the implications for informal caregivers. Spain has historically been considered as a country with strong family ties, where informal caregivers develop a substantial role in the provision of informal care. In the present context, we wonder what will be the "price", in terms of extra-caregiving hours, that informal caregivers will devote to their relatives in need of long-term care if dependent individuals do not receive the adequate amount of formal care.

The emergence of unmet personal needs with regard to daily living activities can result in a large number of negative consequences for the dependent individual, such as inability to drink or eat when thirsty or hungry, falls, neglected housekeeping and insufficient cleanliness (Allen and Mor, 1997). Unmet needs are also associated with an increase in physician visits, use of emergency departments, increase in the likelihood of home death and more frequent hospitalizations (Sands et al., 2006).

Research conducted to date has only begun to explore which factors could be related to unmet needs. The results obtained suggest that unmet needs are due to a combination of personal, social, cultural and environmental forces (Allen, 1994; Tennstedt et al., 1994). Some variables have been shown to be important predictors of unmet needs. Examples of these include dependent's age, sex, functional capacity, level of education and potential informal caregiving network (Allen, 1994; Tennstedt et al., 1994; Allen and Mor, 1997).

The literature on unmet needs in Spain is quite scarce and by no means representative of the Spanish population. Otero et al. (2003) investigated unmet needs using a sample of 1,135 elderly people living in Leganés, a large town near Madrid. Their results pointed to the existence of great social inequalities in access to home care. Unmet personal needs were particularly significant in low income households, among those with low levels of education, living alone or suffering from depression. Tomás et al. (2002) focused on the population aged over 75 living in the city of Zaragoza, and reached similar conclusions. Although the sample size was small (N=351), they found that more than one third of the population aged over 75 could be qualified as dependent. The most impaired groups were the subsample of women, very old people and those with worse self-perceived health status. Moreover, two in ten dependent people suffered unmet needs. Finally, Orfila et al. (1997) performed a study on 1,137 elderly people living in Barcelona and observed that 10% to 25% of those interviewed suffered unmet needs and that mortality and morbidity rates over a 5-year horizon were significantly higher for the unmet needs group than for the rest of the sample.

In this paper we avoid previous limitations by focusing on the representative subsample of dependent individuals who demand home care or day centre care while taking into account both the characteristics of the informal caregiving network and the socio-demographic characteristics of the primary informal caregiver. We use the two waves of the Informal Support Survey (IMSERSO, 1994 and 2004), which contain information about Spanish older people with disabilities (aged 60+) receiving informal care. Raw data show that, for the same degree of dependency, there is a great variation in informal caregiving hours depending on formal care receipt and the existence of unmet needs. In this situation there may be a selection problem that may lead to inconsistent estimates of the determinants of informal caregiving hours. The selection problem arises when individuals who receive

formal care (FC) are not a random sample of potential individuals with disabilities or when the occurrence of unmet needs (UNs) is not a random process.

To solve these limitations we specify an hours equation for informal caregivers and use a double selection framework to correct the likely non-random selection of dependent individuals in the receipt of formal care and the appearance of unmet needs regarding the provision of social services. The distinction from earlier work is that the two decisions are treated jointly, reflecting the various combinations of formal care and unmet needs. We adopt an approach outlined by Tunali (1986) to introduce the double selection criteria into the specification. To the best of our knowledge there is no study in the international (or the Spanish) context that uses nationally representative data sets to study the response of informal caregivers' hours to both formal care allocation and the emergence of unmet home care or day centre needs.

Ours results indicate that the selection term associated with the UNs equation is larger than that corresponding to the FC equation, implying that the inefficiencies in the allocation process are more important than the insufficient provision of some social resources for dependent people. Furthermore, comparing situations with UNs, the number of caregiving hours is always higher in those situations where some FC is received, which strengthens the hypothesis of complementarity or task sharing between the two types of care. Finally, the gap in caregiving hours between moderate and high dependency increased between the two waves.

The rest of the paper is structured as follows. In section 2 we describe the data, the characteristics of the sample and the determination of the degree of dependency. In section 3 we explain the double selection model. Section 4 presents the estimation results of the model. Finally, in section 5 we present some conclusions regarding long-term care policy and perspectives of the new Dependency Law.

2. Data

The data sources for the study are the two waves of the Informal Support Survey, which were carried out by IMSERSO in 1994 and 2004. The aim of the survey was to obtain information, through personal interviews at household level to informal caregivers of people with disabilities aged 60 years and older. Sample size amounts to 1,392 and 1,354 observations, respectively.

Given that the Spanish Dependency System started in 2007, the analysis of both surveys (referred to an earlier period) enable us to analyze the effect of formal care unmet needs over the provision of informal care, without fear of being "contaminated" by the 2007 reform and the budgetary cuts often observed since then[1].

Determination of the degree of dependency

Instead of proxying the degree of dependency using the traditional approach of the number of IADL and PADL, here we opt to apply the Ranking Scale mentioned in Law 39/2006, of 14th December, for the Promotion of Personal Autonomy and Care of People in a Situation of Dependency. The Ranking Scale (approved by Delegated Legislation 504/2007, of 20th April) distinguishes three degrees of dependency: *moderate dependency*, when the individual needs help for daily living activities once a day; severe dependency when he needs help for daily living activities two or three times a day, and *high dependency* when he needs help several times per day, and due to the complete loss of physical, mental, intellectual or sensory autonomy, he requires permanent support. The Ranking Scale identifies *two levels of dependency* within each of the three degrees. The first level corresponds to those individuals who can perform the activity without the direct support of a third person, whereas the second level refers to the situation in which the dependent individual requires specific support.

According to Table 1 and comparing the two waves, we observe a slight decrease in moderate dependency (level 1) and an increase in the percentage of individuals without any degree of dependency. To validate the reliability of the estimates for the various degrees of dependency, we have compared these figures with those obtained from the White Paper on Dependency (IMSERSO,

[1] Although we cannot assess the effect of the Spanish Dependency System (comparing the situation pre & post 2007), the budgetary cuts imposed in July 2012, have almost drown the potential benefits derived from it, and our long-term care system is going to draw back to pre-reform times. Consequently, the estimations for 2004 will provide an assessment of the environment faced by informal caregivers 9 years afterwards.

2004; page 89). Unfortunately, there is no information available for 1994, so we have been obliged to compare the Informal Support Survey (1994) with the estimates from the Disabilities, Deficiencies and Health Status Survey (henceforth DDHSS, conducted by the INE in 1999).

For the 2004 wave, we have performed the comparison using the forecasts for 2005 from the DDHSS. Comparison results are shown in Table 2. There is a high degree of coincidence for high and moderate dependency in the upper part of Table 2 (1999-1994) and, for severe and moderate dependency in the lower part of the table (2005-2004). The disparity for high dependency (15.39% vs. 9.45%) may be attributable to the fact that the forecasts for 2005 include the percentage of elderly people who are institutionalized, while the Informal Support Survey (2004) only considers elderly people living at home.

Concept of unmet needs

With respect to the healthcare literature on unmet needs, the concept of "need" has been defined as "*those requirements that enable individuals to reach, maintain or recover an acceptable level of social independence and quality of life*" (Department of Health Social Services Inspectorate, 1991).

In this paper, we have considered an outcome-oriented approach because it provides a solid foundation for defining the concept of unmet needs based upon norms that may change with social standards. This definition is in consonance with Davies (1977), who described "*unmet need*" as the difference between the desired and the current state of well-being.

The variable "*formal care*" takes the value 1 when the dependent individual (or his caregiver) has applied for home care and/or day centre care and actually receives it. We focus on home care and day centres because although there exist other types of social services for dependent people, demand for them was very low. Depending on the reception or not of formal care, two types of unmet needs can be distinguished.

First, for the definition of the variable "*unmet needs*" (UN) caused by an application's rejection we used the following two questions (i) "*On this card, there is a list of social services for dependent people; could you please tell me which you have ever applied for?*", and (ii) "*which of them are you receiving?*". The variable UNs takes the value 1 when the caregiver answers Home Care

and/or Day Centre to the first question, and afterwards says that he has not received the service requested.

Second, for the case of UNs caused by dissatisfaction regarding the quality or the quantity of the service, we used the following question: " *Please tell me how you would evaluate the help received from social services (excellent, good, poor, bad) with respect to the following aspects: (i) provider's training, (ii) number of hours received, (iii) provider's attitude*". We have considered that the variable UNs takes the value 1 if, for any of the previous attributes, the informal caregiver answered "*poor*" or "*bad*".

With respect to the group of individuals who do not receive formal care and do not report unmet needs, following Allen and Mor (1997), we have classified them as individuals with covered needs. However, in a strict sense, these individuals could suffer some certain type of unmet needs. For example, Wackerbath and Johnson (2002), Aoun et al. (2005) and Ornstein et al. (2009) have explored informational needs concerning community services and counselling for learning to deal with disability and illness. However, we consider that these issues are beyond the scope of this paper.

Descriptive statistics

Table 3 shows the descriptive statistics for each of the combinations of the variables FC and UNs. Between 1994 and 2004, the percentage of individuals with unmet needs decreased by 29.83 pp. (from 65.95% to 36.12%). There is a sharp difference between both types of UNs. Those needs caused by rejection of a previous application decreased by 30.34 pp., whereas UNs due to dissatisfaction with the quantity or quality of FC only decreased by 0.51 pp.

The fraction of permanent caregivers when FC=1&UN=1 rose from 70.9% to 83.3%, and the fraction of willing caregivers increased in those situations where FC=1 (from 59.8% to 68% and from 51.7% to 59%).

For the situation FC=1&UN=1, we observe an acute increase in the percentage of dependent people who live with his/her spouse (from 27.2% to 45.5%) and a decrease in the fraction living with his/her son/daughter (from 38.7% to 28.9%). For this same category, adult children became more involved in caregiving tasks (from 42.4% to 54.7%) as opposed to the son/daughter-in-law (from 12.2% to 7.8%).

Each informal caregiver indicates the number of daily caregiving hours. Therefore, the variables number of caregiving hours is always positive. We observe that the percentage of caregivers who devotes more than 8 hours/day is higher for FC=1&UN=1 as compared to FC=0&UN=1 in both years (55.66% vs. 59.42% in 1994; 59.56% vs. 63.38% in 2004). In 2004, the percentage of caregivers devoting more than 8 hours/day has increased as compared to 1994, for all the groups considered.

3. Econometric model with double sample selection

Analysing the hours problem independently of the provision of formal care and/or unmet needs may lead to inconsistent estimates, either because the appearance of unmet needs does not follow a random process or because the dependent population who receives formal care is not a random sample of the population. Lack of control of any of these two sources of potential endogenous selection may lead to inconsistent estimates of the parameters characterizing the informal hours equation.

Assuming simultaneity of all decisions, we adopt the double sample selection model proposed by Tunali (1986) to model the underlying decision process. The pair of decision rules may be presented in a standard bivariate framework (Heckman, 1979; Maddala, 1983), as shown in Figure 1:

Figure 1. Situation of dependent people

$$Dependent_i = \begin{cases} FC_i = 1 \begin{cases} UN_i = 1 \\ UN_i = 0 \end{cases} \\ FC_i = 0 \begin{cases} UN_i = 1 \\ UN_i = 0 \end{cases} \end{cases}$$

where the variables FC_i and UN_i take the value 1 when the dependent individual receives formal care and suffers an unmet need respectively, and the value 0 when the dependent individual does not receive any formal care and the informal caregiver does not inform of any unmet need. Consequently, there is an unmet need either if the dependent individual (or the caregiver) has applied for formal aid but does not receive it, or because the service received has fallen below expectations. These decisions may be expressed as follows:

$$FC_i^* = Z_{1i}^{'}\beta_1 + u_{1i} \quad (1)$$

$$UN_i^* = Z_{2i}^{'}\beta_2 + u_{2i} \quad (2)$$

where the variable FC_i^* measures the generosity level of social services for dependent people as the difference between the amount of services offered and the conditions required to be eligible for them. The variable UN_i^* measures the difference between the expected benefit from formal care and the current provision of services. The informal caregiver will report an unmet needs problem when the expected benefit is higher than the observed level of care, that is, when $UN_i^* > 0$. In equations (1) and (2), the vectors $Z_{1i}^{'}$ and $Z_{2i}^{'}$ represent the set of observable characteristics that affect the receipt of formal care and the appearance of unmet needs, where β_1 and β_2 are the corresponding coefficients, and u_{1i} and u_{2i} are the residual terms, which we suppose are bivariate normally distributed with $E[u_{1i}] = E[u_{2i}] = 0, \quad Var[u_{1i}] = Var[u_{2i}] = 1, Cov[u_{1i}, u_{2i}] = \rho$.

The dependent variables (FC_i^*, UN_i^*) are both unobservable and latent. We only observe a binary variable that takes the value 1 if the dependent individual receives formal care ($FC_i = 1(FC_i^*)$), and another binary variable that takes the value 1 if the informal caregiver perceives an unmet needs problem ($UN_i = 1(UN_i^*)$). The conditional likelihood function of the bivariate probit model is given by (Greene, 2007):

$$\ln L = \sum_{i=1}^{N} \ln \Phi_2\left(q_{1i}\left(Z_{1i}^{'}\beta\right), q_{2i}\left(Z_{2i}^{'}\gamma\right), \rho\right) \quad (3)$$

$$q_{1i} = \begin{cases} 1 \; si \; FC_i \neq 0 \\ -1 \; otherwise \end{cases} ; \; q_{2i} = \begin{cases} 1 \; si \; UN_i \neq 0 \\ -1 \; otherwise \end{cases} ; \; \rho = q_{1i} q_{2i\rho}$$

The informal care hours equation can be expressed as:

$$\ln IH_i = X_i^{'}\gamma + \varepsilon_i \quad (4)$$

where $\ln IH_i$ denotes the natural logarithm of the number of informal caregiving hours, X is a vector of exogenous variables that explain caregiving hours, and ε_i is a normally distributed error term with $Var[\varepsilon_i] = \sigma_i^2$, which is, in general, correlated with the errors in equations (1) and (2).

To illustrate the double selection problem, it might be useful to compare the number of caregiving hours of caregivers with UNs with those of caregivers without UNs. For the case in which

the dependent does not receive FC, caregivers with UNs increase their caregiving hours by 33.38%, and when the dependent does receive FC, caregivers with UNs devote 60.90% additional daily hours[2]. Is this difference indicating an extra effort by caregivers?

Two possible explanations have to be tested. Firstly, caregivers with UNs may devote more caregiving hours because they are a self-selected group with regard to observable characteristics. Should this be the case, the question of extra caregiving hours would be solved by estimating caregiving hours which control for the relevant observable variables of each group. Secondly, if caregivers with UNs are self-selected with regard to unobservable characteristics, then the OLS estimates will be inconsistent.

Figure 2 details the possible outcomes of the selection process, where S_j represents the set of individuals belonging to the j^{th} subsample (j=1, 2, 3, 4).

Figure 2. Possible outcomes for the selection process

		Unmet needs (UN_i) = 0	Unmet needs (UN_i) = 1
Formal care (FC_i)	0	S_1	S_2
	1	S_3	S_4

The expression of the corresponding probabilities S_j are shown in the Appendix. In particular, we consider a flexible specification for the logarithm of the number of informal caregiving hours for each subsample:

$$\ln IH_{1i} = X_i'\gamma_1 + \delta_{11}\lambda_{11i} + \delta_{12}\lambda_{12i} + \varepsilon_{1i} \quad (5)$$

$$\ln IH_{2i} = X_i'\gamma_2 + \delta_{21}\lambda_{21i} + \delta_{22}\lambda_{22i} + \varepsilon_{2i} \quad (6)$$

$$\ln IH_{3i} = X_i'\gamma_3 + \delta_{31}\lambda_{31i} + \delta_{32}\lambda_{32i} + \varepsilon_{3i} \quad (7)$$

$$\ln IH_{4i} = X_i'\gamma_4 + \delta_{41}\lambda_{41i} + \delta_{42}\lambda_{42i} + \varepsilon_{4i} \quad (8)$$

where δ_{kl} are the coefficients associated with the selection variables λ_{kli}; k=1,..4, and l=1,2. The expressions of the selection variables λ_{kli} are detailed in the Appendix.

[2] Average daily caregiving hours in 2004: 7.550 for FC=0&UN=0; 10.071 for FC=0&UN=1; 8.222 for FC=1&UN=0 and 13.230 for FC=1&UN=1.

The advantage of the double sample selection model is that for each one of the four group of individuals we can estimate the effect of the explanatory variables over the endogenous variable, and perform comparisons among the different effects, and we can even decompose the differential in caregiving hours in terms of differences in observable characteristics, differences in estimated coefficients and differences in selection terms [see section of Results].

It must be noted that we have applied interval regression because informal caregiving hours were coded in both surveys as an interval variable (less than one hour, 1-3, 3-5, 5-8 hours/day and more than 8 hours/day). Those who answered more than 8 caregiving hours also reported the exact number of hours.

Identification strategy

To ensure the identification of the model, Tunalli (1986) states that it is necessary to impose three restrictions. First, at least one variable of each selection equation must not be related to the unexplained hours component. Second, at least one variable included in the FC equation must not appear in the UNs equation, and vice versa. And third, these variables must not be included in the hours equations.

It is necessary to explain the awarding process of public services in Spain for a better understanding of the identification restrictions used. The provision of social services for dependent people in Spain, before the implementation of the new System of Autonomy and Attention to Dependent People in 2007, was conditioned to both the generosity and the requirements imposed by the different regional administrations. The White Paper on Dependency (2004) lists the variables considered for awarding social services for dependent people: (i) territoriality, that is, having lived for more than three years in the autonomous community where the application process is taking place, (ii) health status (functional dependency, mental and physical disabilities), (iii) age (most communities gave preference to individuals aged 60-65 or older), (iv) personal economic resources and (v) living conditions (living alone, dwelling conditions). Each autonomous community assigned a different weight to each of the aforementioned factors. Therefore, the degree of generosity of each community and the prevalence of different criteria provide an invaluable source of identification of formal care in

the model. Since the weights attributed to each of the requirements[3] envisaged in the awarding process did not change between the two waves, the comparability between them is guaranteed.

Variables referring to income (category of benefit, amount of monthly benefit) and to education (both caregiver and care-receiver) have only been included in the FC equation because they reflect the socio-economic status of the individual, and this criteria was considered by regional administrations in the awarding process. Several authors (Kemper, 1992; Portrait et al., 2000) have observed that more educated people have a higher probability of receiving FC or both types of care together. Several explanations are possible: (1) more educated patients tend to have more educated children to whom the opportunity cost of providing informal care tends to be higher; (2) more educated care-receivers usually prefer to remain independent of their children for as long as possible and do not feel uncomfortable paying for formal services; (3) more educated care-receivers or their children may find it easier to use information regarding services for dependent people.

Both FC and UN equations share some variables which are not included in the hours equation: coverage index of home care and day centres, and the co-payment for home care and day centres (all of them by autonomous communities). The coverage index is the ratio between the number of users and the population over 65 years of age. We consider that the coverage index not only affects the probability of receiving the service but also the probability of wishing to receive it. Additionally, the existence of a certain co-payment percentage may prevent some individuals from applying for the service or may influence the perception of the relationship between quantity and quality of the service. In fact, the difference in the variables "co-payment percentage" and "cost per hour" across autonomous communities means that the contribution made by two users who live in different regions and receive the same amount of service could be quite divergent.

In the specification of the UNs equation we have included the number of home care hours per month, the percentage of home care devoted to personal care (as opposed to housework) and the percentage of psycho-geriatric places in day centres, all of them at the regional level. We consider that the introduction of these variables is justified by (1) the high variability of total home care hours and percentage of time devoted to personal care as opposed to housework across autonomous

[3] See IMSERSO (2004), *Older people in Spain. 2004 Report* for detailed data of regional long-term care policies.

communities, and (2) the fact that certain mental degenerative pathologies require day centres to be adapted to specific patient needs.

Finally, the hours equation includes other caregiver characteristics: if he/she got on well with the care-receiver before the onset of the caregiving relationship, kinship between caregiver and care-receiver and kinship between primary and secondary caregivers. The importance of the kinship of the primary caregiver with respect to the care-receiver and other secondary caregivers has been widely acknowledged in the literature (Tennstedt et al., 1989; Penrod et al., 1995).

4. Empirical specification and results

The double selection process

The correlation coefficient (ρ) between formal care and unmet needs is significant for both waves (ρ=-0.2456 (p-value=0.0000) and -0.1222 (p-value=0.0288) for 1994 and 2004, respectively), implying that the joint estimation procedure is preferable to the estimation of independent probits [detailed results of the bivariate probit are not presented but are available upon request]. More importantly, an estimation procedure based on a probit model would have left the sample selection problem unsolved. The negative sign of the estimated correlation indicates that dependent people who receive FC are less prone to suffer UNs than those who have applied for it, but do not receive any. In addition, the correlation coefficient in 1994 was twice as large as in 2004, which is a direct consequence of the increase in the coverage of social services.

Table 4 reports the mean and median of the estimated marginal effect of each explanatory variable for the probabilities of FC=0&UN=1 and FC=1&UN=1 in 1994 and 2004. For example, to compute the effect of living alone on the probability of FC=0&UN=1, the average effect is given by:

$$E\left[\left(FC_i=0\&UN_i=1\right)_{Lives\ alone=1}-\left(FC_i=0\&UN_i=1\right)_{Lives\ alone=0}\right]=$$
$$=\Phi_2\left(X_i'\beta,Z_i'\gamma;\rho\right)_{Lives\ alone=1}-\Phi_2\left(X_i'\beta,Z_i'\gamma;\rho\right)_{Lives\ alone=0} \qquad (9)$$

where $\left(FC_i=0\&UN_i=1\right)_{Lives\,alone=1}$ indicates the outcome if the dependent individual lives alone and $\left(FC_i=0\&UN_i=1\right)_{Lives\,alone=0}$ indicates the outcome if the dependent does not live alone. This average

effect has been estimated by the sample mean or the sample median as the difference $\Phi_2\left(X_i'\hat{\beta}, Z_i'\hat{\gamma}; \hat{\rho}\right)_{Lives\ alone=1} - \Phi_2\left(X_i'\hat{\beta}, Z_i'\hat{\gamma}; \hat{\rho}\right)_{Lives\ alone=0}$ across the sample. In what follows we comment on some of the key results obtained from this model.

Detailed results for the selection equations

Socio-demographic variables

Younger dependent individuals (under the age of 70) showed an increase in the probability of FC=0&UN=1 of 42.48 pp. in 1994, which decreased to 22.76 pp. in 2004, because in the 1990s many regional administrations did not allocate social services to dependent people younger than 65. In turn, those older than 90 showed an increase in the probability of FC=1&UN=1 (25.96 pp.) which rose to 45.43% in 2004.

The disadvantage derived from the lack of education has decreased between both waves. The probability of FC=0&UN=1 for carereceiver "without studies" increased by 46.98 pp. in 1994, and by 33.11 pp. in 2004. Regarding the effect of caregiver's education, we observe a similar effect: the probability of FC=0&UN=1 increased by 49.50 pp. in 1994 as opposed to only 26.98 pp. in 2004.

Individuals with no income or less than €300/month are less likely to suffer FC=0&UN=1 (-50.79 pp. and -14.43 pp.) than those with more than €300 or €600/month, although the effect of income differences decreases in the second wave.

Dwelling arrangement

Dependent people living alone experienced an average decrease in the probability of FC=0&UN=1 by 44.46 pp. and an average increase in the probability of FC=1&UN=1 by 14.30 pp. (in 1994).

Degree of dependency and caregiving relationship

Being highly dependent reduced the probability of FC=0&UN=1 by 47.11 pp. on average in 1994, although this reduction decreased to 23.08 pp. in 2004. For both waves, moderately dependent people experienced a smaller decrease in the probability of FC=0&UN=1 than highly dependent ones, and in 2004 differences between degrees of dependency narrowed. On the other hand, being severely or highly dependent increased the probability of FC=1&UN=1 by 12.42 pp. and 25.24 pp. in 1994, and

this effect rose to 21.98 pp. and 35.55 pp. respectively in 2004. These results indicate that severely or highly dependent people have a higher probability of receiving formal care and considering that the amount of care (or the quality) is unsatisfactory.

With respect to specific pathologies, individuals suffering dementia in 1994 experienced an average increase in the probability of FC=0&UN=1 (46.72 pp.). In 2004, we observe that the effect of dementia remained almost constant, and also that osteoarticular problems presented an increase in the probability of FC=0&UN=1 (12.72 pp.).

Caregivers with more than 10 (12) caregiving years showed a decrease in the probability of FC=0&UN=1 (-35.18 pp. and -23.26 pp. in 1994 and 2004, respectively). Nevertheless, the probability of FC=1&UN=1 increased by an average of 14 pp. when the number of caregiving years was greater than 6 (or 5 for 2004). In this respect, a longer caregiving period increases the probabilities of receiving help from the social services but also the probability that FC=1&UN=1. This result is supported by the fact that in 2004 the percentage of dependent people who complemented home care with private formal care ranged from 37.50% (for less than 2 caregiving years) to 71.43% (for more than 12 caregiving years).

The effect of regional social services policies

With respect to regional policy variables, a higher coverage index for home care or day centre care decreases the probability of FC=0&UN=1 and FC=1&UN=1. In 2004, the probability of FC=0&UN=1 decreased more with an increase in day centre coverage, whereas the probability of FC=1&UN=1 decreased more with an increase in home care coverage. Therefore, there is a higher probability that the receipt of day centre care completely satisfies the problem of unmet needs in comparison with home care.

An additional hour of home care reduces the probability of FC=1&UN=1 by around 2 pp. for both waves, and a 1% increase in the percentage of time devoted to personal care decreases the probability of FC=1&UN=1 by 10 pp..

On the other hand, the cost per hour and the co-payment increases the probability of FC=1&UN=1 significantly, and the effect of co-payment increased from 1.83 pp. in 1994 to 7.71 pp.

in 2004. These results should be considered carefully by public authorities given the wide disparity between regions.

Results for the hours equations

First of all, to validate the double sample selection model, it has been tested against a model with one single selection. Note that the model with one single selection rule given by the unmet needs equation is, in general, unable to explain differences in the number of informal caregiving hours between individuals with unmet needs, given that some of them are receiving some formal care, and others do not receive formal care at all. From an econometric point of view, we have performed the test for non-nested models proposed by Mohanty (2001). The test of caregiving hours equation with double selection against the caregiving hours equation with single selection shows that the latter specification is not acceptable for our data.

Tables 5 and 6 provide the estimated coefficients for the number of caregiving hours. For the 1994 regressions, the terms λ_{22} and λ_{42} are significant, with positive and negative sign respectively. Their interpretation indicates that caregivers of dependent people with FC=0&UN=1 devote fewer caregiving hours than similar caregivers with FC=1&UN=1. Therefore, in the presence of unmet needs, the provision of formal care reinforces the receipt of informal care. Comparing this result with the prevailing theories which relate formal and informal care, we could infer that the substitution model, which supports a decrease in informal care as the provision of formal care increases, does not hold for the Spanish case, at least in 1994.

For the 2004 regressions, there are three significant selection terms (none of the selection terms is significant in the regression for FC=0&UN=0). The selection term λ_{21} is negative, which indicates that caregivers of dependent individuals with FC=0&UN=1 have a higher probability of devoting more caregiving hours than similar caregivers with FC=0&UN=0. The selection term λ_{31} is positive, showing that caregivers of dependent individuals with FC=1&UN=0 devote fewer caregiving hours than caregivers with FC=1&UN=1. Finally, the negative sign of the selection term λ_{42} suggests that caregivers of dependent people with FC=1&UN=1 devote more caregiving hours than similar caregivers with FC=0&UN=1. So for the second wave we have also obtained evidence against the

substitution theory (and in favour of the complementarity/task-specificity model). Moreover, the selection term λ_{42} is larger than λ_{21} and λ_{31}, in absolute terms, indicating that the selection bias associated with the UNs equation is greater than that corresponding to the FC equation. Rather than insufficient coverage of social services, the inefficiencies associated with the allocation process constitute a more serious problem[4].

Detailed results

Socio-demographic characteristics

Regression results for FC=1&UN=1 in 1994 show that male dependents receive fewer caregiving hours. In this situation we have observed that the percentage of sex coincidence between the caregiver and the care-receiver is lower than in the other situations (55.6% as opposed to 64.4%).

The number of caregiving hours decreases if the dependent individual lives alone and suffers UNs, with a greater effect if some FC is received (-0.97 and -1.65 hours/day respectively in 1994, and -1.66 and -2.03 hours/day in 2004). In fact, the data reveal that the fraction of dependent individuals living alone grew over time, from 25% in 1994 to 30.1% in 2004, and the percentage of caregivers who invest more than 20 minutes in displacement rose from 29.26% to 34.29% in this period.

Degree of dependency

The number of informal caregiving hours increases with the degree of dependency and the coefficients are always higher in the regression for FC and UNs than in the situation with UNs but no FC. For example, a highly dependent person (level 2) with FC and UNs involved an increase of 4.87 hours/day in 1994 and 5.94 hours/day (exp(1.7823)) in 2004. For this same combination, the difference in caregiving hours between moderate and high dependency increased between the two waves: from 2.95 in 1994 to 3.90 in 2004. Consequently, informal caregivers face a double problem: first, they have to devote additional caregiving hours to compensate for formal care UNs, and second, their efforts show an increasing profile over time. As regards specific pathologies, mental illnesses show an increase in hours for the situation FC=1&UN=1 (from 2.61 to 3.31) and the coefficient for FC=0&UN=1 was significant in 2004 (1.37 hours more), although it was not in 1994.

[4] We have re-estimated the model excluding the level of education, or alternatively the level of income, as an explanatory variable in the FC equation and obtained similar results for the selection terms. Therefore, the significance of the selection terms is not conditioned by the choice of these identification restrictions.

Turning our attention to the number of caregiving years, for both waves we observe a significant increase in caregiving hours (around 1.4 hours/day) when FC=0&UN=1 and the number of caregiving years is greater than 10 (or 12 for 2004). In this sense, caregivers with a long caregiving experience may be readier than others to satisfy the dependent's demands.

Caregiving relationship

Although the type of care provided by a specific caregiver appears to be related to gender-specific roles,[5] in this study we observe that caregiver's gender is not significant and male and female caregivers provide similar amounts of care, which is consistent with other previous results (Stoller and Earl, 1983).

Having a good caregiver-dependent relationship (previous to the dependency relationship) increased the amount of caregiving hours in all situations in 1994. In 2004, we only observe a significant effect for FC=0&UN=1 and FC=1&UN=1, although the amount of care devoted has increased. For example, a good relationship for the case FC=0&UN=1 implied an increase of 0.84 hours/day in 1994 and 1.28 hours/day in 2004.

If the primary caregiver receives help from another family member the number of caregiving hours decreases by 3 hours/day for both waves when FC=0&UN=1 and nearly 4 hours/day when FC=1&UN=1. However, we found that one person tends to provide all informal care (59% in 1994, 51.1% in 2004), whereas secondary caregivers are few in number. The concentration of caregiving responsibilities on a nuclear family has important implications for the emergence of family/leisure problems and could increase institutionalization risk due to caregiver's overload.

Children under 18 years old may represent an obstacle for caregiving tasks when unmet needs are present. For the situation FC=1&UN=1, having young children decreased the amount of care by 0.20 hours/day in 1994 and 1.42 hours/day in 2004.

The kinship of the caregiver with respect to the dependent reveals the existence of a gradient effect between the spouse and the son/daughter: first the spouse, and second the son or daughter. For 2004, and when FC=1, the support provided by the son/daughter-in-law is greater than for the case of

[5] The percentage of men (women) who help the dependent individual is 68.74% (81.20%) for housekeeping, 68.64% (81.68%) for cooking, 72.14% (62.91%) for financial management, and 61.59% (51.01%) for transportation.

the spouse and son/daughter, revealing the emergence of strong complementarities between formal care and informal caregivers.

The decomposition of the informal caregiving hours differential

In this section we propose the decomposition of the differential in the number of informal caregiving hours taking into account double sample selection in three different parts: (i) differences in caregiver and carerecipient characteristics; (ii) differences in the estimated parameters of the caregiving hours function; (iii) differences due to the selectivity bias[6].

Following Oaxaca (1973), we propose to analyze the difference in log IH. Given that we have estimated four equations for the number of IH we can establish four comparisons of the log IH. For example, the difference in log IH between (FC=1, UN=1) and (FC=0, UN=1) is given by:

$$\begin{aligned}\ln IH_{4i} - \ln IH_{2i} &= \left(\overline{X}'_{4i}\hat{\gamma}_4 + \hat{\delta}_{41}\overline{\lambda}_{41i} + \hat{\delta}_{42}\overline{\lambda}_{42i}\right) - \left(\overline{X}'_{2i}\hat{\gamma}_2 + \hat{\delta}_{21}\overline{\lambda}_{21i} + \hat{\delta}_{22}\overline{\lambda}_{22i}\right) = \\ &= \left(\overline{X}'_{4i}\hat{\gamma}_4 + \hat{\delta}_{41}\overline{\lambda}_{41i} + \hat{\delta}_{42}\overline{\lambda}_{42i}\right) - \left(\overline{X}'_{2i}\hat{\gamma}_2 + \hat{\delta}_{21}\overline{\lambda}_{21i} + \hat{\delta}_{22}\overline{\lambda}_{22i}\right) + \overline{X}'_{2i}\hat{\gamma}_4 - \overline{X}'_{2i}\hat{\gamma}_4 = \\ &= \left(\overline{X}'_{4i} - \overline{X}'_{2i}\right)\hat{\gamma}_4 + \overline{X}'_{2i}\left(\hat{\gamma}_4 - \hat{\gamma}_2\right) + \left(\hat{\delta}_{41}\overline{\lambda}_{41i} - \hat{\delta}_{21}\overline{\lambda}_{21i}\right) + \left(\hat{\delta}_{42}\overline{\lambda}_{42i} - \hat{\delta}_{22}\overline{\lambda}_{22i}\right) \qquad (10)\end{aligned}$$

where $\hat{\gamma}_2, \hat{\gamma}_4, \hat{\delta}_{21}, \hat{\delta}_{41}, \hat{\delta}_{22}, \hat{\delta}_{42}$ are the estimated coefficients for the explanatory variables, $\overline{X}'_{2i}$ and $\overline{X}'_{4i}$ represent the average of the observed characteristics ($\overline{X}'_{ki} = \frac{1}{N_k}\sum_i X_{ki}; k = 2,4$) and $\overline{\lambda}_{21i}, \overline{\lambda}_{41i}, \overline{\lambda}_{22i}$ and $\overline{\lambda}_{42i}$ denote the average of the selectivity terms ($\overline{\lambda}_{ki} = \frac{1}{N_k}\sum_i \lambda_{ki}; k = 21,41,22,42$). The first term is the difference in the endowments of hours-determinant characteristics between people with or without formal care. That is, the difference in hours that a dependent individual with (FC=0,UN=1) would experience if he had the same characteristics, on average, as another dependent individual with (FC=1,UN=1).

The second term represents the difference in coefficients between people with and without formal care. That is, the difference in hours that a dependent individual with (FC=0,UN=1) would experience if, given his mean characteristics, he would receive care as another dependent individual with (FC=1, UN=1). The third and the fourth term represent the hours differential due to sample selectivity in formal care and in unmet needs, respectively.

[6] We acknowledge reviewer's suggestion of applying Oaxaca decomposition to the problem of informal caregiving hours with double sample selection.

To avoid the index problem, that is the instability of the decomposition depending of the choice of the reference group (with/without formal care) we follow the approach proposed by Reimers (1983) and use a weighted average of each type:

$$\ln IH_{4i} - \ln IH_{2i} = 0.5\left(\overline{X}'_{4i} - \overline{X}'_{2i}\right)\left(\hat{\gamma}_4 + \hat{\gamma}_2\right) + 0.5\left(\overline{X}'_{4i} + \overline{X}'_{2i}\right)\left(\hat{\gamma}_4 - \hat{\gamma}_2\right)$$
$$+ \left(\hat{\delta}_{41}\overline{\lambda}_{41i} - \hat{\delta}_{21}\overline{\lambda}_{21i}\right) + \left(\hat{\delta}_{42}\overline{\lambda}_{42i} - \hat{\delta}_{22}\overline{\lambda}_{22i}\right) \quad (11)$$

The decomposition of the difference in informal caregiving hours for 2004, shown in Table 7, confirms some of the previous results. Difference in estimated coefficients indicate that a dependent with FC=1&UN=1 would receive 3.391 hours/day less if he had the same characteristics on average than a dependent with FC=0&UN=1, and 1.307 hours/day less if he had the same characteristics as a dependent with FC=1&UN=0. Therefore, the effect of FC and UNs over informal caregiving hours is captured not only by significant selection terms, but also by significant differences in the estimated coefficients in the four caregiving hours.

Two results confirm that informal care does not decrease when some formal care is received. First, comparing FC=1&UN=1 with FC=1&UN=1, caregivers devote 6.76 hours/day more due unmet needs self-selection when FC=1 as opposed to only 2.45 hours/day more due to unmet needs self-selection when FC=0. Second, comparing FC=1&UN=1 and FC=0&UN=1 caregivers devote 7.44 hours/day due to formal care self-selection when UN=1.

It is also evident that unmet needs self-selection (difference in λ_2´s) are more important than formal care self-selection (difference in λ_1´s). Unmet self-selection are responsible of 50.53% of the difference in caregiving hours when FC=0, and 48.39% of the difference when FC=1. Thus, using the number of formal care recipients as an indicator of the goodness of the long-term care system may be confounding, if we do not complete this information with other quality indicators, such as the degree of satisfaction of the carerecipients.

5. Conclusions

In this paper we have estimated the extra amount of informal caregiving hours needed when the dependent individual suffers an unmet needs problem, due to the absence, insufficiency or inadequacy of formal care. The estimation results show a negative correlation between both the

probability of receiving formal care and the probability of having unmet needs, and a significant selection bias of formal care and unmet needs on the number of caregiving hours. Given that the unmet needs selection effect is greater than the formal care one, we may infer that the increase in the number of formal care recipients constitutes just a part of the development of a long-term care system. Thus, higher expenditure in long—term care with respect to GDP has to be accompanied by quality assessment, monitoring system and improvement in outcomes.

For both waves the number of caregiving hours increases with the presence of unmet needs, and is even higher when some formal care is received, refuting the substitution model, according to which the provision of formal care produces a decrease in the number of informal caregiving hours. For the Spanish case, it seems that formal and informal caregiving are not competing forces. Instead, informal care develops a compensatory and complementary role with respect to formal care.

Our results highlight that the budgetary cuts applied to the System of Autonomy and Attention to Dependency in July 2012 may have exacerbated the problem of unmet needs. First, we have obtained that an additional hour of home care reduces the probability of unmet needs due to insufficient quantity by 2 pp. Therefore, the reduction of 20 hours/month of home care for highly dependent (10 hours/month less for severe dependent) could have dramatic consequences for dependent's and caregiver's well-being. Second, since July 2012 the implementation of the System of Autonomy and Attention to Dependency is at a standstill, and people qualified as moderate dependent will have to wait (presumably) until July 2015 to receive any type of benefit. Policy makers should be conscious that not receiving the necessary attention in due time may accelerate health decline. As we have seen, the difference in caregiving hours between moderate and high dependent has increased between both waves and it is higher in case of formal care unmet needs. In this case, long-term care negligence (due to economic reasons) will impinge on caregiver's shoulders. Third, we have ascertained that the probability of unmet needs conditioned to receiving formal care is lower for dependent who attend a day centre. However, the resource to day centres is very scarce (approximately 7% of all benefits awarded)[7].

[7] Statistical information from http://www.dependencia.imserso.es/dependencia_01/documentacion/estadisticas/est_inf/inf_gp/2014/index.htm

Will informal caregivers willing go backwards to a situation where he/she was the one and only looking after the dependent individual? We would need more data to assess the trade-off between caregiver and carereceiver's welfare. Independent of what macroeconomic figures will show, we should question any reform that casts doubts on the future of many families.

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Appendix A. Econometric Appendix

- Definition of probabilities corresponding to each subsample:

$$S_1 = \Pr[FC_i = 0, UN_i = 0] = \Pr[FC_i^* \le 0, UN_i^* \le 0] =$$
$$= \Pr[u_{1i} \le -Z_{1i}'\beta_1, u_{2i} \le -Z_{2i}'\beta_2] = \Phi_2(-\Pi_1, -\Pi_2; \rho) \quad (A.1)$$
$$S_2 = \Pr[FC_i = 0, UN_i = 1] = \Pr[FC_i^* \le 0, UN_i^* > 0] =$$
$$= \Pr[u_{1i} \le -Z_{1i}'\beta_1, u_{2i} > -Z_{2i}'\beta_2] = \Phi_2(-\Pi_1, \Pi_2; -\rho) \quad (A.2)$$
$$S_3 = \Pr[FC_i = 1, UN_i = 0] = \Pr[FC_i^* > 0, UN_i^* \le 0] =$$
$$= \Pr[u_{1i} > -Z_{1i}'\beta_1, u_{2i} \le -Z_{2i}'\beta_2] = \Phi_2(\Pi_1, -\Pi_2; -\rho) \quad (A.3)$$
$$S_4 = \Pr[FC_i = 1, UN_i = 1] = \Pr[FC_i^* > 0, UN_i^* > 0] =$$
$$= \Pr[u_{1i} > -Z_{1i}'\beta_1, u_{2i} > -Z_{2i}'\beta_2] = \Phi_2(\Pi_1, \Pi_2; \rho) \quad (A.4)$$

where $\Pi_1 = X_i'\beta_1, \Pi_2 = Z_i^i\beta_2$ and Φ_2 is the bivariate standard normal probability function.

- Definition of sample selection variables:

$$\lambda_{11} = -\frac{\phi(\Pi_1)\Phi(-\Pi_2^*)}{S_1}; \ \lambda_{12} = -\frac{\phi(\Pi_2)\Phi(-\Pi_1^*)}{S_1} \quad (A.5)$$
$$\lambda_{21} = -\frac{\phi(\Pi_1)\Phi(\Pi_2^*)}{S_2}; \quad \lambda_{22} = \frac{\phi(\Pi_2)\Phi(-\Pi_1^*)}{S_2} \quad (A.6)$$
$$\lambda_{31} = \frac{\phi(\Pi_1)\Phi(-\Pi_2^*)}{S_3}; \quad \lambda_{32} = -\frac{\phi(\Pi_2)\Phi(\Pi_1^*)}{S_3} \quad (A.7)$$
$$\lambda_{41} = \frac{\phi(\Pi_1)\Phi(\Pi_2^*)}{S_4}; \quad \lambda_{42} = \frac{\phi(\Pi_2)\Phi(\Pi_1^*)}{S_4} \quad (A.8)$$
$$\Pi_1^* = \frac{\Pi_1 - \rho\Pi_2}{\sqrt{1-\rho^2}}; \qquad \Pi_2^* = \frac{\Pi_2 - \rho\Pi_1}{\sqrt{1-\rho^2}}$$

where $\phi(\cdot)$ corresponds to the univariate standard normal density function and $\Phi(\cdot)$ is the cumulative standard normal distribution.

- Alternative estimation procedures:

More generally, the double sample selection model can also be estimated by maximum likelihood (ML). The likelihood for this problem is given by:

$$L = \prod_{\substack{FC=0 \\ UN=0}} \Phi_2(Z_{1i}'\beta_1, Z_{2i}'\beta_2, \rho) \cdot \phi(\ln IH_{1i}) \prod_{\substack{FC=0 \\ UN=1}} \Phi_2(Z_{1i}'\beta_1, -Z_{2i}'\beta_2, -\rho) \cdot \phi(\ln IH_{2i})$$
$$\prod_{\substack{FC=1 \\ UN=0}} \Phi_2(-Z_{1i}'\beta_1, Z_{2i}'\beta_2, -\rho) \cdot \phi(\ln IH_{31i}) \prod_{\substack{FC=1 \\ UN=1}} \Phi_2(-Z_{1i}'\beta_1, -Z_{2i}'\beta_2, \rho) \cdot \phi(\ln IH_{4i}) \quad (A.9)$$

However, maximum likelihood estimation is further complicated when there is a high degree of correlation between the selection and the outcome equation (Nawata, 1994) or when the selection hurdle leads to a high degree of censoring in the first equation (Manning et al., 1997). In addition,

convergence problems usually appear when it is necessary to estimate a large set of parameters (Nawata and Nagase, 1996).

Moreover, estimation via Heckman has several advantages over ML: straightforward accommodation of limited observability data to the outcome and selection equations, computational simplicity for the generation of predictions, and the possibility of avoiding multidimensional integrals. Nawata and Nagase (1996) compared the finite sample properties of the estimators obtained via ML and via Heckman's process, and concluded that a key indicator of the likely performance of Heckman's estimator with respect to ML is the collinearity in the systemic portion of the selection equation and the regressors in the outcome equation. We have estimated the model by ML and Heckman's method and observed a high degree of consistency between the two estimates (ML estimates are available upon request[8]). Therefore, we have focused on the two-step double sample selection model.

[8] We performed a test of equality of coefficients between ML estimation and the double sample selection model. For both waves we cannot reject the null hypothesis: $\chi^2(39)=27.84$ (p-value: 0.9085) in 1994 and $\chi^2(43)=30.15$ (p-value: 0.9306) in 2004.

Appendix B

Table 1. Ranking Scale for the determination of the level of dependency

		Dependency Law	Informal Support Survey	
		(score)	1994	2004
No dependency		<25	515 (30.93%)	538 (35.79%)
Moderate	Level 1	25-39	368 (22.10%)	275 (18.28%)
	Level 2	40-49	194 (11.65%)	172 (11.43%)
Severe	Level 1	50-64	275 (16.52%)	242 (16.09%)
	Level 2	65-74	160 (9.61%)	139 (9.24%)
High	Level 1	75-89	147 (8.83%)	124 (8.24%)
	Level 2	90-100	6 (0.36%)	14 (0.93%)
Total			1,665 (100%)	1,504 (100%)

Source: http://www.dependencia.imserso.es/InterPresent2/groups/imserso/documents/binario/manualusobvd.pdf

Table 2. Comparison of the estimated degrees of dependency with the White Book on Dependency

	DDHSS (1999)		Informal Support Survey (1994)	
	Aged 65+ [(a)]	%	Aged 65+	%
High	141,409	9.91%	149	9.16%
Severe	304,085	20.80%	442	27.17%
Moderate	514,396	36.06%	542	33.31%
Total	1,426,432 [(b)]		1,927	

(a): Degrees of dependency from page 87, White Book on Dependency; (b): Corresponds to the number of people with disabilities affecting physical or instrumental activities of daily living (page 85, White Book on Dependency).

	Forecasts for 2005 from DDHSS (1999)		Informal Support Survey (2004)	
	Aged 65+ [(a)]	%	Aged 65+	%
High	163,334	15.39%	137	9.45%
Severe	292,105	27.52%	365	25.19%
Moderate	371,112	34.96%	438	30.23%
Total	1,061,404 [(b)]		1,449	

(a): Degrees of dependency from page 89, White Book on Dependency; (b): Corresponds to the number of people with disabilities affecting physical or instrumental activities of daily living (page 89, White Book on Dependency).

Table 3. Descriptive statistics (using sample weights)

	1994				**2004**			
	FC=0 UN=0	**FC=0 UN=1**	**FC=1 UN=0**	**FC=1 UN=1**	**FC=0 UN=0**	**FC=0 UN=1**	**FC=1 UN=0**	**FC=1 UN=1**
Dependent's characteristics								
Male	0.315	0.302	0.228	0.296	0.284	0.309	0.281	0.450
Age								
60-69	0.112	0.123	0.133	0.146	0.081	0.125	0.116	0.091
70-79	0.360	0.303	0.330	0.358	0.322	0.301	0.338	0.319
80-89	0.415	0.453	0.434	0.398	0.450	0.399	0.464	0.484
90 and older	0.113	0.121	0.103	0.098	0.147	0.175	0.082	0.106
Level of education								
Without studies	0.960	0.967	0.954	0.965	0.571	0.697	0.498	0.582
Elementary	0.007	0.018	0.000	0.000	0.384	0.257	0.413	0.384
High school	0.016	0.009	0.013	0.019	0.034	0.027	0.064	0.014
College	0.017	0.007	0.032	0.016	0.009	0.017	0.025	0.017
Dwelling arrangement								
Lives alone	0.126	0.118	0.184	0.194	0.170	0.152	0.150	0.166
Lives with spouse	0.266	0.276	0.184	0.272	0.317	0.335	0.386	0.455
Lives with a relative of the same generation	0.074	0.081	0.099	0.048	0.042	0.035	0.043	0.047
Lives with a son/daughter	0.418	0.377	0.409	0.387	0.367	0.343	0.370	0.289
Pathologies								
Mental illness	0.473	0.577	0.538	0.669	0.314	0.403	0.349	0.446
Cancer	0.020	0.021	0.012	0.007	0.059	0.065	0.053	0.064
Respiratory problems	0.105	0.085	0.082	0.050	0.190	0.212	0.116	0.283
Osteoarticular problems	0.234	0.262	0.272	0.246	0.550	0.545	0.481	0.516
Cardiovascular problems	0.282	0.260	0.287	0.280	0.340	0.317	0.286	0.295
Degree of dependency								
Moderate. Level 1	0.249	0.233	0.216	0.218	0.209	0.149	0.148	0.194
Moderate. Level 2	0.110	0.126	0.126	0.154	0.114	0.134	0.141	0.111
Severe. Level 1	0.153	0.185	0.097	0.244	0.144	0.192	0.137	0.217
Severe. Level 2	0.086	0.106	0.094	0.134	0.068	0.129	0.130	0.101
High. Level 1	0.058	0.121	0.175	0.069	0.074	0.115	0.060	0.099
High. Level 2	0.003	0.000	0.028	0.037	0.007	0.011	0.000	0.043
Receives benefit								
Retirement benefit	0.449	0.443	0.416	0.367	0.408	0.430	0.428	0.624
Survival benefit	0.326	0.311	0.301	0.309	0.389	0.368	0.331	0.205
Disability benefit	0.062	0.062	0.140	0.082	0.064	0.075	0.067	0.051
Dependent's monthly income								
€300 or less	0.622	0.626	0.606	0.671	0.212	0.196	0.138	0.120
€301-€600	0.250	0.246	0.290	0.136	0.524	0.621	0.570	0.611
More than €600	0.028	0.025	0.010	0.028	0.079	0.076	0.095	0.134
Caregiver's characteristics								
Male	0.152	0.176	0.138	0.174	0.155	0.163	0.199	0.101
Age								
Under 40	0.210	0.178	0.235	0.205	0.166	0.156	0.202	0.128
40-49	0.256	0.235	0.292	0.283	0.246	0.248	0.267	0.209
50-64	0.357	0.376	0.282	0.361	0.387	0.368	0.329	0.412
65 and older	0.177	0.211	0.192	0.151	0.201	0.229	0.202	0.251
Level of education								
Without studies	0.646	0.704	0.471	0.642	0.125	0.145	0.114	0.145
Elementary	0.212	0.175	0.276	0.170	0.391	0.454	0.317	0.373
High school	0.088	0.081	0.172	0.075	0.409	0.343	0.376	0.336
College	0.054	0.039	0.080	0.113	0.069	0.053	0.193	0.145

Number of caregiving hours (per day)								
Less than 3	0.044	0.079	0.022	0.038	0.022	0.041	0.022	0.021
3-5	0.259	0.155	0.202	0.164	0.109	0.095	0.167	0.085
5-8	0.196	0.210	0.275	0.204	0.595	0.268	0.258	0.257
More than 8	0.501	0.557	0.502	0.594	0.574	0.596	0.554	0.637
Number of caregiving years								
Less than 2 years	0.216	0.258	0.242	0.339	0.340	0.388	0.399	0.356
2-5 years (2-4 years)	0.260	0.237	0.288	0.265	0.195	0.146	0.186	0.250
6-10 years (5-12 years)	0.198	0.221	0.189	0.177	0.354	0.359	0.294	0.328
10+ years (12+ years)	0.319	0.277	0.281	0.211	0.111	0.107	0.121	0.066
Permanent caregiver ([a])	0.780	0.749	0.798	0.709	0.749	0.781	0.761	0.833
Willing caregiver ([b])	0.618	0.558	0.598	0.517	0.641	0.538	0.680	0.590
Kinship of caregiver with respect to dependent								
Spouse	0.153	0.164	0.088	0.138	0.137	0.157	0.146	0.215
Son/Daughter	0.532	0.533	0.553	0.424	0.560	0.612	0.552	0.547
Son/Daughter-in-law	0.134	0.126	0.115	0.122	0.117	0.104	0.100	0.078
Good previous dependent-caregiver relationship	0.527	0.452	0.567	0.357	0.588	0.542	0.657	0.577
Size of municipality								
≤ 2,000	0.106	0.132	0.097	0.124	0.099	0.098	0.065	0.020
2,001-10,000	0.187	0.187	0.198	0.164	0.189	0.187	0.212	0.179
10,001-50,000	0.264	0.248	0.273	0.216	0.201	0.223	0.247	0.227
50,000-1,000,000	0.346	0.317	0.329	0.337	0.195	0.206	0.201	0.264
Provincial capitals	0.097	0.117	0.103	0.158	0.317	0.287	0.275	0.310
N	387	812	87	106	663	379	202	110
(in %)	27.80	58.33	6.25	7.61	48.97	27.99	14.92	8.12

For the number of caregiving years, figures between brackets correspond to 2004.

([a])Permanent caregiver: binary variable that takes the value 1 when the informal caregiver looks permanently after the carereceiver (in comparison with other situations where the carereceiver is looked after on a rotating basis by different caregivers).

([b])Willing caregiver: binary variable that takes the value one when the caregiver has voluntarily decided to look after the carereceiver (in comparison with other situations where the carereceiver chososes his/her caregiver, or the caregiver is obliged to accept this responsibility by circumstances)

Table 4. Marginal effects for the probabilities of FC=0&UN=1 and FC=1&UN=1

	1994				2004			
	FC=0&UN=1		FC=1&UN=1		FC=0&UN=1		FC=1&UN=1	
	Mean	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**
Age								
60-69	0.4248	*0.4523*	-0.0500	*-0.0486*	0.2276	*0.2285*	-0.0543	*-0.0514*
70-79	-0.1184	*-0.1367*	-0.0239	*-0.0331*	-0.1184	*-0.1279*	-0.0274	*-0.0379*
80-89	-0.2654	*-0.2775*	-0.0112	*-0.0184*	-0.2014	*-0.2000*	-0.0082	*-0.0244*
90+	-0.5109	*-0.5697*	0.2596	*0.2516*	-0.2837	*-0.2760*	0.4575	*0.4543*
Lives alone	-0.4446	*-0.4531*	-0.1430	*-0.1455*	-0.2128	*-0.2270*	-0.2514	*-0.2495*
Pathologies								
Mental illness	0.4672	*0.4564*	0.0508	*0.0496*	0.4626	*0.4521*	0.0588	*0.0508*
Respiratory problems	-0.4847	*-0.4785*	-0.0622	*-0.0540*	-0.1608	*-0.1457*	-0.0443	*-0.0471*
Cancer	-0.5732	*-0.5821*	-0.0692	*-0.0567*	-0.2662	*-0.2777*	-0.0640	*-0.0556*
Osteoarticular prob.	-0.3082	*-0.3231*	-0.0360	*-0.0406*	0.1272	*0.1298*	-0.0026	*0.0187*
Cardiovascular diseases	-0.3065	*-0.3102*	-0.0341	*-0.0404*	-0.1045	*-0.1239*	-0.0319	*-0.0404*
Degree of dependency								
No dependency	-0.1562	*-0.1512*	-0.0232	*-0.0459*	-0.0319	*-0.0587*	-0.0343	*-0.0412*
Moderate dependency	-0.1896	*-0.2117*	-0.0229	*-0.0279*	-0.0847	*-0.0845*	-0.0338	*-0.0401*
Severe dependency	-0.2577	*-0.2620*	0.1242	*0.1350*	-0.1175	*-0.1262*	0.2198	*0.2396*
High dependency	-0.4711	*-0.4700*	0.2524	*0.2499*	-0.2308	*-0.2645*	0.3555	*0.3525*
Level of education (dependent)								
Without studies	0.4698	*0.4808*	0.4714	*0.4825*	0.3311	*0.3366*	0.2769	*0.2808*
Elementary	0.2938	*0.2981*	0.2946	*0.2990*	0.6689	*0.6913*	0.6052	*0.6235*
High school	0.1641	*0.1654*	0.1625	*0.1638*	0.0419	*0.0420*	0.0542	*0.0543*
College	0.0723	*0.0726*	0.0715	*0.0717*	0.0428	*0.0429*	0.0637	*0.0639*
Level of education (caregiver)								
Without studies	0.4950	*0.5072*	0.3215	*0.3267*	0.2698	*0.2734*	0.2342	*0.2369*
Elementary	0.3062	*0.3108*	0.2151	*0.2174*	0.5952	*0.6129*	0.5416	*0.5562*
High school	0.1389	*0.1399*	0.3124	*0.3172*	0.0613	*0.0615*	0.0969	*0.0974*
College	0.0599	*0.0601*	0.1510	*0.1521*	0.0737	*0.0740*	0.1273	*0.1282*
Monthly income								
No income	-0.5079	*-0.5722*	-0.0499	*-0.0483*	-0.2293	*-0.2716*	-0.0516	*-0.0501*
€300 or less	-0.1433	*-0.1581*	0.0187	*0.0304*	-0.1844	*-0.2508*	-0.0541	*-0.0522*
€301-€600	0.2978	*0.3311*	-0.0436	*-0.0456*	0.1316	*0.1336*	0.0128	*0.0272*
>€600	0.5323	*0.5883*	-0.0672	*-0.0562*	0.2526	*0.2740*	-0.0524	*-0.0513*
Size of municipality								
≤2,000	0.4684	*0.4773*	-0.0555	*-0.0497*	0.2602	*0.2811*	-0.0662	*-0.0568*
2,001-10,000	0.3268	*0.3529*	-0.0423	*-0.0439*	0.2342	*0.2698*	-0.0521	*-0.0493*
10,001-50,000	0.3181	*0.3598*	-0.0420	*-0.0419*	0.1809	*0.2049*	-0.0411	*-0.0442*
50,000-1,000,000	0.1957	*0.2333*	-0.0263	*-0.0360*	0.1966	*0.2023*	-0.0438	*-0.0472*
Provincial capitals	0.2117	*0.2019*	-0.0362	*-0.0153*	0.1119	*0.0909*	-0.0289	*-0.0270*
Number of caregiving years								
Less than 2 years	-0.2607	*-0.2417*	-0.0235	*-0.0249*	-0.0849	*-0.0946*	-0.0160	*-0.0311*
2-5 years (2-4 years)	-0.2796	*-0.2647*	-0.0317	*-0.0387*	-0.1283	*-0.1286*	-0.0233	*-0.0248*
6-10 years (5-12 years)	-0.3607	*-0.3577*	0.1488	*0.1469*	-0.2180	*-0.2166*	0.1411	*0.1402*
10+ years (12+ years)	-0.3518	*-0.3472*	0.1493	*0.1494*	-0.2326	*-0.2326*	0.1573	*0.1573*

	1994				2004			
	FC=0&UN=1		FC=1&UN=1		FC=0&UN=1		FC=1&UN=1	
	Marg. eff.	**Std. error**	**Marg. eff.**	**Std. error**	**Marg. eff.**	**Std. error**	**Marg. eff.**	**Std. error**
Home care								
Coverage index	-0.0456	-2.58	-0.1829	-2.73	-0.0504	-2.53	-0.1476	-2.51
Co-payment					0.0365	2.67	0.0548	3.10
Cost/hour			0.0183	2.47			0.0771	2.77
Hours/month			-0.0229	-2.35			-0.0275	-2.86
Time devoted to personal care							-0.1070	-2.60
Day centre								
Coverage index	-0.0335	-3.08			-0.2979	-2.70	-0.0741	-2.65
Co-payment					0.0260	2.02	0.0516	2.41
% psyco-geriatric places					-0.1959	-2.33	-0.0501	-2.29

For the number of caregiving years, figures between brackets correspond to 2004. Marginal effects for dependent's marital status and receiving a benefit are not shown due to space constraints, but are available upon request.

Table 5. Interval regressions for the number of informal caregiving hours, 1994

	FC=0 UN=0		FC=0 UN=1		FC=1 UN=0		FC=1 UN=1	
Male (dependent)	-0.2481		-0.0115		0.3653		-1.4265	**
Lives alone	-0.5250		-0.9747	***	-0.4401		-1.6583	*
Pathologies								
Mental illness	0.8694	**	0.3054		0.6819		2.6104	***
Cancer	1.2890		-0.5063		4.8171		11.4809	
Respiratory problems	0.1108		-0.1445		1.6509		-1.4069	
Osteoarticular problems	-0.1594		0.0083		-1.0861	*	-0.1624	
Cardiovascular disease	-0.2621		-0.3560		0.1165		2.1007	***
Degree of dependency								
Moderate. Level 1	-0.2173		0.0054		1.0417	***	1.9536	
Moderate. Level 2	0.5819		0.6219		1.3360	***	1.9248	**
Severe. Level 1	0.4957		1.7019	***	1.9120	***	3.5190	**
Severe. Level 2	1.4405	***	2.5633	***	2.7133	***	4.4469	**
High. Level 1	1.8883	***	2.9607	***	2.8547	**	4.8091	**
High. Level 2	2.0913	**	3.2470	***	3.0384	**	4.8718	**
Male (caregiver)	-0.4563		-0.5401	**	-0.5506		-1.5559	**
Caregiver's marital status								
Married	-0.4219		-0.3877		0.0805		0.1986	
Widowed	-1.0738		-0.8851		-2.2171	*	1.7904	
Separated	-0.8822		-0.8392		0.7609		-2.7297	
Children under 18 living at home	-0.0245		-0.0516	***	-0.4895		-0.2029	***
Number of caregiving years								
2-5 years	0.4934		0.3788		0.6301		-0.7647	
6-10 years	0.8571	*	0.8413	**	-0.6869		0.8011	
More than 10 years	0.7897	*	1.4203	***	0.1249		-0.0015	
Receives help from other family member	0.0422		-2.9116	***	-2.9625	***	-3.7228	***
Good previous dependent-caregiver relationship	0.8038	*	0.8434	**	1.9631	***	1.0065	**
Kinship of caregiver with respect to dependent								
Spouse	0.8414	***	1.9288	***	0.9685	**	2.7451	***
Son/Daughter	0.5389	*	0.7612	*	0.6447	*	1.2757	**
Son/Daughter-in-law	-0.7190		1.2968	***	1.0085		1.1206	
Selection terms								
$\lambda 11$	-0.7359							
$\lambda 12$	0.2360							
$\lambda 21$			1.6126					
$\lambda 22$			5.7913	***				
$\lambda 31$					-1.0588			
$\lambda 32$					0.5590			
$\lambda 41$							-1.3254	
$\lambda 42$							-2.5723	***
Constant	3.2439	***	2.7271	***	6.7290	**	2.6949	***
N	387		812		87		106	
Pseudo- R^2	0.303		0.245		0.698		0.584	

Estimated coefficients for caregiver's age, caregiver's marital status, permanent caregiver, willing caregiver, private formal care, size of municipality and kinship of other caregivers with respect to the primary caregiver are not shown due to space constraints, but are available upon request. Omitted variables: age 60-69 (dependent), no degree of dependency, younger than 40 (caregiver), single (caregiver), less than 2 caregiving years, municipality with less than 2,000 inhabitants. Estimates using sample weights and clusters by region. (* p<0.10; ** p<0.05; *** p<0.01)

Table 6. Interval regressions for the logarithm of the number of informal caregiving hours, 2004

	FC=0 UN=0		FC=0 UN=1		FC=1 UN=0		FC=1 UN=1	
Male (dependent)	0.0828		0.1716		0.0367		-0.1930	
Lives alone	-0.4005	***	-0.5064	***	-0.2297		-0.7064	**
Pathologies								
Mental illness	0.2277	*	0.3116	**	0.0658		1.1974	***
Cancer	0.2143		0.1322		-0.5388	**	0.9609	**
Respiratory problems	0.0656		0.1718		-0.0639		-0.4780	*
Osteoarticular problems	0.1543	*	-0.0656		-0.1213		-0.1709	
Cardiovascular disease	0.0826		-0.1342		-0.1075		0.2176	
Degree of dependency								
Moderate. Level 1	0.0478		-0.0405		0.1635		0.0955	
Moderate. Level 2	0.2098	*	0.5257	**	0.4924	**	0.7127	**
Severe. Level 1	0.0735		0.7759	***	0.8381	**	1.4839	**
Severe. Level 2	0.6105	*	1.0993	**	1.1805	**	1.5630	**
High. Level 1	0.6557	**	1.3114	**	1.2958	**	1.7703	**
High. Level 2	0.7489	**	1.3535	*	1.3005	***	1.7823	**
Male (caregiver)	-0.1538		-0.5898	**	-0.0738		-0.4625	**
Children under 18 years living at home	-0.0043		-0.1442	***	0.1113		-0.3495	***
Number of caregiving years								
2-4 years	0.1244	**	0.1255		0.1701		0.2121	
5-12 years	0.0648		0.1839		0.2353		0.4568	**
>12 years	0.2832	**	0.3408	**	0.2563		0.5134	
Permanent caregiver	0.0703		-0.0437		0.0138		-0.3144	**
Good previous dependent-caregiver relationship	-0.1844		0.2464	**	0.0101		0.3444	**
Kinship of caregiver with respect to dependent								
Spouse	0.3951	**	0.4784	***	0.4065	*	1.2178	***
Son/Daughter	0.1879	**	0.3127	**	0.2535	**	0.7087	**
Son/Daughter-in-law	0.0379		0.0308	**	0.9398	***	0.7128	**
Selection terms								
$\lambda 11$	0.3195							
$\lambda 12$	-0.2334							
$\lambda 21$			-0.9185	*				
$\lambda 22$			0.2862					
$\lambda 31$					0.8837	*		
$\lambda 32$					-0.4120			
$\lambda 41$							0.4661	
$\lambda 42$							-1.1979	***
Constant	1.3313	***	2.1265	***	0.1090	***	2.8794	***
N	663		379		202		110	
Pseudo. R^2	0.2411		0.2960		0.4785		0.6490	

Estimated coefficients for caregiver's age, caregiver's marital status, permanent caregiver, willing caregiver, private formal care, size of municipality and kinship of other caregivers with respect to the primary caregiver are not shown due to space constraints, but are available upon request. Omitted variables: age 60-69 (dependent), no degree of dependency, younger than 40 (caregiver), single (caregiver), less than 2 caregiving years, municipality with less than 2,000 inhabitants. Estimates using sample weights and clusters by region. (* $p<0.10$; ** $p<0.05$; *** $p<0.01$)

Table 7. Oaxaca decomposition of the informal caregiving diferential. 2004

	(FC=1, UN=0) vs. (FC=0, UN=0)			**(FC=0, UN=1) vs. (FC=0, UN=0)**	
ln IH (FC=1, UN=0)	2.107		ln IH (FC=0, UN=1)	2.310	
	(8.222)			(10.071)	
ln IH (FC=0, UN=0)	2.022		ln IH (FC=0, UN=0)	2.022	
	(7.550)			(7.550)	
Total Difference	0.085		Total Difference	0.288	
Due to difference in X's	3.579	50.11%	Due to difference in X's	-1.823	-37.53%
Due to difference in β`s	-0.120	-1.68%	Due to difference in β`s	-0.342	-7.05%
Due to difference in λ1	-1.340	-18.76%	Due to difference in λ1	-0.238	-4.89%
Due to difference in λ2	-2.103	-29.45%	Due to difference in λ2	2.455	50.53%
	(FC=1, UN=1) vs. (FC=1, UN=0)			**(FC=1, UN=1) vs. (FC=0, UN=1)**	
ln IH (FC=1, UN=1)	2.853		ln IH (FC=1, UN=1)	2.853	
	(13.233)			(13.233)	
ln IH (FC=1, UN=0)	2.107		ln IH (FC=0, UN=1)	2.310	
	(8.222)			(10.071)	
Total Difference	0.746		Total Difference	0.543	
Due to difference in X's	-5.668	-40.57%	Due to difference in X's	-7.910	-45.81%
Due to difference in β`s	0.268	1.92%	Due to difference in β`s	1.221	7.07%
Due to difference in λ1	-1.274	-9.12%	Due to difference in λ1	7.440	43.09%
Due to difference in λ2	6.761	48.39%	Due to difference in λ2	-0.696	-4.03%

Average hours per day between brackets