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formal care and informal caregiving hours of  
dependent people in Spain**

by

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**A double sample selection model for unmet needs, formal care and informal caregiving hours of dependent people in Spain<sup>§</sup>**

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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 an underestimation of the number of informal caregiving hours. After controlling for these two factors the number of caregiving hours increases with the degree of dependency and in the case of unmet needs. This growth is even greater when some formal care is received, thus refuting the substitution model. 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 the existence of inefficiencies in the formal care allocation process.

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

**JEL Codes:** H41, I10, I11

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## 1. **Introduction**

The interplay between formal and informal care has received increased attention from policymakers in response to concern about changing social patterns (increased geographical mobility, higher female labour participation, smaller family size and rising divorce rates). These factors will decrease, in the near future, the availability or willingness of family members to provide care to disabled people. Moreover, the division of formal and informal tasks is of concern from a medical perspective in terms of timely and appropriate use of formal services to ensure the well-being of both caregiver and carereceiver. The Council of Europe (2003) acknowledged that in many countries most of the healthcare budget is spent on people towards the end of their lifetime. However, this does not mean that they receive the most appropriate care for their needs. Comprehensive knowledge of patterns of healthcare services utilization for elderly dependent people is lacking.

Currently, about 32.8% of individuals aged 65 or older<sup>1</sup> are limited in their daily living activities due to a chronic health condition. Limitations in mobility (23.7%) and housekeeping (20.3%) are the most representative, although we observe an increase in self-care disabilities among those over the age of 80 (55.6%).

The emergence of unmet personal needs with regards to daily living activities can result in a large number of negative consequences for the dependent, such as inability to drink or eat when thirsty or hungry, falls, neglected housekeeping and insufficient cleanliness due to uncontrolled urination or defecation (Allen and Mor, 1997). Unmet needs are also associated with an increase in physician visits, use of emergency departments, an 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, health status and functional capacity, level of education and informal caregiving network (Allen, 1994; Tennstedt et al., 1994; Allen and Mor, 1997).

Although these studies provide evidence of the causes of unmet needs and knowledge of service barriers, they also present three important limitations. First, previous studies do not usually distinguish

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<sup>1</sup> Survey on Disabilities, Personal Autonomy and Situations of Dependency (INE, 2008).

between users and non-users of services for dependent people, and in consequence, we cannot know whether the two groups suffer the same level of unmet needs. The separation of these two subsamples is fundamental because some empirical papers suggest that willingness, need and degree of service use are different (Mui and Burnette, 1994; Andersen, 1995). Second, due to the existence of great disparities between dependents' needs and the size of their informal caregiving network, the type of unmet needs may vary among them. However, most research has not studied in depth how informal caregivers face the problem of unmet needs. Finally, many investigations are based on medical reports or non-caregivers' statements, the primary caregiver's perspective being widely ignored. Nevertheless, their point of view is very valuable because they act as a link between the patient and social services and constitute a fundamental factor for negotiation and service use (Bass et al., 1999).

The literature on unmet needs in Spain is quite scarce. Alonso et al. (2007) analysed the prevalence of unmet needs related to mental healthcare among European adults (2,121 observations for Spain). They concluded that 3.1% of the adult population suffered unmet needs. With respect to studies focusing on the elderly 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 with 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 because we focus on the subsample of dependent individuals who demand home care<sup>2</sup> or day centre care and take 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

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<sup>2</sup> Home care includes housekeeping, personal care tasks, visits, laundry and cooking.

contain information about Spanish older people with disabilities (aged 60+) receiving informal care. Raw data shows 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 selectivity problem that may lead to inconsistent estimates of the determinants of informal caregiving hours. The selectivity 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. In this regard, this research attempts to contribute to the body of literature by accounting for self-selection in both formal care and unmet needs. We specify an hours equation for informal caregivers using 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. Clearly, specifying one of these choices as exogenous, or ignoring it, leads to biased and inconsistent estimates and creates selection bias in the estimated hours equations. Therefore, we adopt an approach outlined by Tunalı (1986) to introduce the double selection criteria into the specification. To 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.

In this context the aim of this paper is to answer the following questions: (1) the extent to which personal social services for dependent people (home care and day centres) are able to satisfy dependents' needs; in this regard, we have introduced a methodological innovation by adapting the Ranking Scale of the Dependency Law to the information contained in the survey, for the purpose of applying the same procedure as the System of Autonomy and Care for Dependent People, (2) which factors are associated with the emergence of unmet personal needs, and (3) the effect of unmet formal needs on informal caregiving hours. The latter question is relevant because the informal caregiver's perception of the dependent's unmet needs may influence the number of informal caregiving hours.

## *Results*

Controlling for double sample selection reveals that the combination of the variables formal care and unmet needs points to opposite relationships between formal and informal care. Comparing situations

with UNs, dependent individuals who receive FC also receive more caregiving hours, or comparing situations with FC, dependent individuals who suffer UNs also receive more informal caregiving hours. Thereby, in these two situations there is complementarity between formal and informal care. In contrast, however, comparing situations without FC, those individuals with UNs receive more informal caregiving hours, which suggests that informal care acts as a substitute for formal care.

Additionally, 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. The number of informal caregiving hours increases with the degree of dependency. Moreover, the distance in hours between moderate and high dependency increases between the two waves, and the estimated dependency coefficients are larger in the situation with FC and UNs than in the situation with UNs but no FC.

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 double sample selection 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 was carried out by IMSERSO in 1994 and 2004. The aim of the survey was to obtain information, through personal interviews at household level, from informal caregivers of dependent people. The 2004 survey contains 1,504 observations, for dependent people aged 60 or over living in Spanish households (with the exception of Ceuta, Melilla and La Rioja). The 1994 survey contains 1,702 observations for adults aged 40 or over with disabilities living in Spanish households (excluded Ceuta and Melilla). To homogenize the two samples, we dropped individuals younger than 60 years old and those living in La Rioja (37 observations) from the 1994 survey, leading to a sample with 1,665 individuals.

As the purpose of this paper is limited to the study of unmet needs among dependent people who receive informal care, the conclusions obtained cannot be applied to the fraction of institutionalized dependent people or those who only receive formal care.

## **2.1. Determination of the degree of dependency**

To measure the degree of dependency we have used an innovative approach applying the Ranking Scale mentioned in Law 39/2006, of 14<sup>th</sup> December, for the Promotion of Personal Autonomy and Care of People in a Situation of Dependency and approved by Delegated Legislation 504/2007, of 20<sup>th</sup> April. This Ranking Scale distinguishes three dependency degrees: *moderate dependency* when the individual needs help for daily living activities at least once a day; *severe dependency* when he needs help for daily living activities two or three times a day, and is *highly 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. Moreover, the Ranking Scale identifies *two levels of dependency* within each of the three degrees (moderate, severe or high). 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.

Tables 1 and 2 in Appendix A compare the questionnaire for the Ranking Scale of the Dependency Law with the information from the survey. Finally, we compute the final scores and attribute the corresponding degree of dependency (Table A):

**Table A. 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: [www.seg-social.es/imserso/dependencia/manualusoBVD.pdf](http://www.seg-social.es/imserso/dependencia/manualusoBVD.pdf); Jiménez-Martín and Vilaplana (2008).

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<sup>3</sup>. Figures for the other degrees are approximately the same.

To validate the reliability of the estimates for the various degrees of dependency, we compare these figures with those obtained from the White Paper on Dependency (IMSERSO, 2004); see Table B below. 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

<sup>3</sup> This is an effect of the increase in the number of healthy life years at birth, from 67.7 in 1996 to 70.2 in 2003 (Eurostat, Health Indicators).

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.

**Table B. Comparison of the estimated degrees of dependency with the White Paper on Dependency**

|          | DDHSS (1999)             |        | Informal Support Survey (1994) |        |
|----------|--------------------------|--------|--------------------------------|--------|
|          | Aged 65+ <sup>(a)</sup>  | %      | 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 <sup>(b)</sup> |        | 1,927                          |        |

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

|          | Forecasts for 2005 from DDHSS (1999) |        | Informal Support Survey (2004) |        |
|----------|--------------------------------------|--------|--------------------------------|--------|
|          | Aged 65+ <sup>(a)</sup>              | %      | 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 <sup>(b)</sup>             |        | 1,449                          |        |

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

There is a high degree of coincidence in the first part of Table B (1999-1994) for high and moderate dependency and in the second part (2005-2004) for severe and moderate dependency. 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.

## **2.2. Concept of unmet needs**

With respect to the healthcare literature related to 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). A more practical definition considers that “need” is the “ability to benefit from social services” (Stevens and Gabay, 1991). However, the problem with this definition is that there is no good indicator available to measure the impact of the treatment received (Aoun et al., 2004).

One of the first definitions of “unmet need” was given by Isaacs and Neville (1976), who described an elderly person’s unmet needs as the result of one or both of the following situations: “insufficient care to fulfil his basic requirements for food, warmth, cleanliness or security at the level at which he would have provided them for himself”, and/or “when care was provided only at the cost of undue strain of relatives”.

In certain cases, an unmet need is identified with a situation in which an individual with care needs does not receive any formal aid. Alonso et al. (2007) considered that an “unmet need” appeared when mental patients had not received any formal care during the last twelve months. On the other hand,

Allen and Mor (1997) designed an algorithm in which people with some difficulties for daily living activities (who did not receive formal help and did not desire to receive it) were classified as individuals with covered needs.

Some authors view the above definition as too strict. For example, Quail et al. (2007) perceived that an unmet need could arise in two situations: (1) when the individual is currently receiving help, but would like to receive more, and (2) when he does not receive any help, but has experienced some negative consequence due to the lack of it. Williams et al. (1997) also considered those unmet needs due to insufficient or inadequate formal care.

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 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 he receives it. For the definition of the variable “unmet needs” (UN) caused by an applications’ rejection we have used the following two questions (i) *“In this card, there is a list of social services for dependent people, please, could you tell me which have you ever applied for?”*, and (ii) *“which of them are you receiving?”*. Therefore, the variable UNs takes the value one 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. In the case that the individual applied for both services, we are able to know if he has received both of them, only one or none of them. For the case of UNs caused by dissatisfaction regarding the quality or the quantity of the service, we have used the following question: *“Tell me please, which is the valuation of the help received from social services (excellent, good, regular, bad) with respect to the following aspects”: (i) provider’s training, (ii) number of hours received, (iii) provider’s kindness*”. We have considered that the variable UNs takes the value one if for any of the previous attributes, the informal caregiver answered “regular” or “bad”.

With respect to the question of the group of individuals who do not receive formal care and do not report unmet needs, we have followed Allen and Moor’s (1997) approach and we have classified them as individuals with covered needs. In a strict sense these individuals could suffer some certain type of unmet needs. For example, Wackerbath and Johnson (2002), Mangan et al. (2003), Aoun et al. (2005), Orstein et al. (2009) have explored the informational needs about community services and counselling

needs regarding how to deal with disability and illness. However, the survey does not provide any question referred to the desire to any type of help to improve carerecivers' situation. To circumvent this potential problem, in the estimations we have introduced the variables "coverage index of Home Care" and "coverage index of Day Centre" in the formal care equation to gather the effect that higher coverage might increase the possibilities that the caregiver become aware of these services.

Regarding the comparability of unmet needs between 1994 and 2004, the weight attributed to each of requirements<sup>4</sup> envisaged in the awarding process (age, economic resources, family situation functional and mental disability, dwelling conditions), which are different across Autonomous Communities, have not changed between both waves. However, comparisons between 1994 and 2004 should be tempered by the fact that informal caregivers' preferences have experienced slight changes<sup>5</sup>.

### **2.3. Descriptive statistics**

Table 3 in Appendix B shows the descriptive statistics for each of the combinations of the variables FC and UNs. The level of education changes substantially: the fraction that has not even finished elementary education decreases from 95.94% in 1994 to 61.60% in 2004. Attending to specific pathologies, there is an increase in respiratory (from 8.54% to 18.05%) and osteoarticular problems (from 24.24% to 52.65%).

The group of dependents with an income of €301-€600/month increases from 23.81% to 57.19%. In aggregate terms there is no variation in the type of benefit received (around 40% corresponds to retirement benefit, 30% to survival benefit and 6% to disability benefit), but we find an increase in the percentage of retired individuals with FC=1&UN=1 (from 36.7% to 62.4%).

Most caregivers are women (85%) and over 50 years old<sup>6</sup>. There is a considerable growth in the percentage of caregivers with elementary (18.26% to 42.97%) and high school education (9.08% to 32.61%). As a consequence, there is an increase in the percentage of working caregivers (21.74% to 26.03%) and a decrease in those devoted to housekeeping (49.87% to 44.15%).

The fraction of permanent caregivers rises when FC=1&UN=1 (from 70.9% to 83.3%) and the fraction of willing caregivers increases in those situations where FC=1 (from 59.8% to 68% and from

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<sup>4</sup> See Older people in Spain. 2004 Report. IMSERSO for detailed data of regional long-term care policies..

<sup>5</sup> Between 1994 and 2004, we have observed an increase in the percentage of respondents who consider that women should always be the primary caregiver and a decrease in the percentage who consider that care devoted by present generations is worse than in the past.

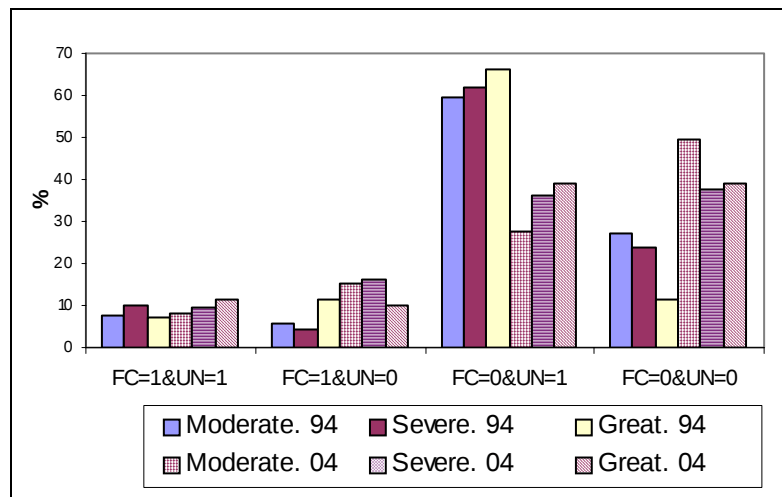
<sup>6</sup> There is a slight increase in caregiver's age from 51.86 in 1994 to 53.19 in 2004. We observe a higher fraction of caregivers in the intervals 50-64 and 65+ for the situation FC=1&UN=1 (from 36.1% to 41.2% and from 15.1% to 25.1% respectively).

51.7% to 59%). Both facts point to a lack of perfect substitutability between formal and informal care and may indicate a caregiver's attempt to alleviate the insufficient allocation of formal care.

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%). Adult children become 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%).

Finally, we observe an increase in the percentage of dependent people who live in provincial capitals and suffer unmet needs (from 11.86% to 27.83% when  $FC=0$  and from 15.8% to 31% when  $FC=1$ ).

**Figure 1. Distribution of FC and UNs according to degree of dependency. 1994 and 2004 (%)**



**Figure 2. Average hours and years of informal caregivers who devote at least 21 hours/week, 2004**

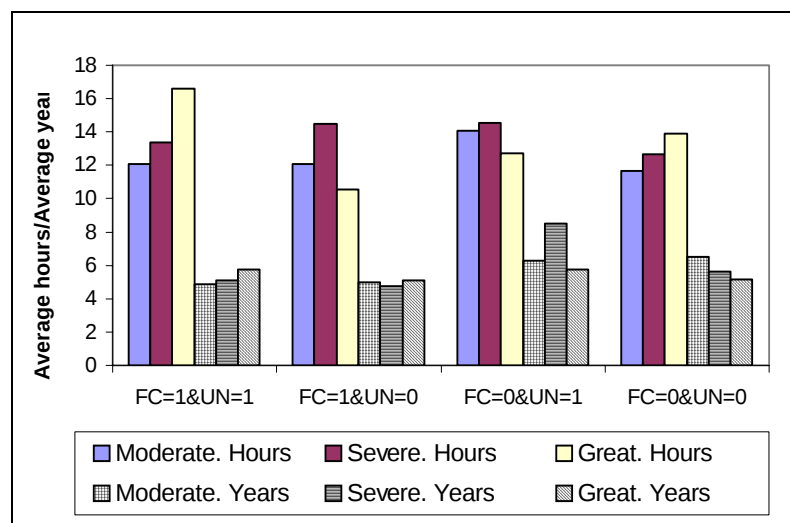


Figure 1 shows the relationship between formal care and unmet needs according to the degree of dependency. The percentage with  $FC=1&UN=1$  increased between 1994 and 2004 for all three types of

dependency, the largest increase corresponding to high dependency (from 7.12% to 11.66%). The fraction with  $FC=0&UN=1$  shows an increasing profile with degree of dependency, and in 2004 nearly 40% of highly dependent people did not receive any formal service although they had applied for home care or day centre care.

Figure 2 shows the average caregiving hours and years for those informal caregivers who provide care at least 3 hours per day<sup>7</sup>. In the case of high dependency, caregivers devote more hours when  $FC=1&UN=1$  (16.59 hours/day), whereas informal caregivers of moderate or severely dependent people devote more hours when  $FC=0&UN=1$  (14.54 hours/day and 12.72 hours/day respectively). In turn, informal caregivers of severely dependent people with  $FC=0&UN=1$  report more caregiving years (8.52) in comparison with the average of 5.64 years for the other situations.

### **3. Econometric model with double sample selection**

The main aim of this study is to assess whether informal caregivers of dependent people with unmet needs and/or receiving formal care devote more caregiving hours than caregivers whose dependent relatives do not suffer any unmet need and/or do not receive any formal care. As we mentioned above, unmet needs may arise because the dependent does not receive any of the formal aid that he or she has applied for (home care and/or day centre care), or because he or she is not satisfied with either the quality or the quantity of the formal aid received.

Although we observe hours for the whole sample of informal caregivers, analyzing 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 selection may lead to inconsistent estimates (Heckman, 1979) of the parameters characterizing the informal hours equation. To the best of our knowledge, there is no previous evidence considering the potential problem of selection in formal care or the emergence of unmet needs and their effect on informal caregiving hours. Assuming simultaneity of all decisions, we adopt the

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<sup>7</sup> We focus on caregivers providing at least 3 hours of care per day because this level of intensity is more likely to be provided to *disabled* older people than care provided at lower levels of intensity (Kemper, 1992). For 2004, we have information about the number of daily caregiving hours. By fixing a threshold at 3 hours per day, we obtain the sample of caregivers with at least 21 hours per week (1,286 informal caregivers from the initial sample of 1,504 devote at least 21 hours/week).

double sample selection model proposed by Tunali (1986) to model the underlying decision process involved in receiving formal care and having unmet formal care needs and their implications for the number of informal caregiving hours. 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 the 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:

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

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

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 (functional and mental disabilities, financial resources, dwelling conditions, family situation). The dependent individual receives formal care when the latent dependency level is higher than the threshold required ( $FC_i^* > 0$ ). 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  $X_i$  and  $Z_i$  represent the set of observable characteristics that affect the receipt of formal care and the appearance of unmet needs, where  $\beta_1$  and  $\beta_2$  are the corresponding coefficients, and  $u_{1i}$  and  $u_{2i}$  are the residual terms, which we suppose are bivariate normally distributed with  $E[u_{1i}] = E[u_{2i}] = 0$ ,  $Var[u_{1i}] = Var[u_{2i}] = 1$ ,  $Cov[u_{1i}, u_{2i}] = \rho$ .

The dependent variables  $(FC_i^*, UN_i^*)$  are 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):

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

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

Let us now turn to the hours equation:

$$\ln IH_i = W_i'\gamma + \varepsilon_i \quad (4)$$

where  $\ln IH_i$  denotes the natural logarithm of the number of informal caregiving hours,  $W$  is a vector of exogenous variables that explain caregiving hours, and  $\varepsilon_i$  is an error term normally distributed with  $Var[\varepsilon_i] = \sigma_i^2$ . 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<sup>8</sup>. Is this difference indicating an extra effort by caregivers to compensate for formal care deficiencies?

Two other possible explanations have to be tested before answering this question. 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 simply 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 (i.e., inadequacy of formal care for the disabilities suffered by the dependent individual), 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 ( $j=1, 2, 3, 4$ ).  $S_1$  corresponds to the state in which the dependent does not receive any formal care and does not suffer any unmet need;  $S_2$  denotes the state in which the dependent does not receive any formal care but would like to, and therefore an unmet need appears;  $S_3$  is the situation in which the dependent receives formal care and is satisfied with it; and  $S_4$  denotes the

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<sup>8</sup> See Table 8 for mean caregiving hours in 2004.

situation in which the dependent individual receives formal care but considers that the amount or quality of the aid received is not what he or she expected, and consequently there is an unmet need.

Figure 2. Possible outcomes for the selection process

|                                | Unmet needs (UN <sub>i</sub> ) |                |
|--------------------------------|--------------------------------|----------------|
|                                | 0                              | 1              |
| Formal care (FC <sub>i</sub> ) | 0                              | S <sub>1</sub> |
|                                | 1                              | S <sub>3</sub> |
|                                |                                | S <sub>2</sub> |
|                                |                                | S <sub>4</sub> |

The probabilities corresponding to each subsample are expressed as follows:

$$S_1 = \Pr[FC_i = 0, UN_i = 0] = \Pr[FC_i^* \leq 0, UN_i^* \leq 0] = \Pr[u_{1i} \leq -X_i'\beta_1, u_{2i} \leq -Z_i'\beta_2] = \Phi_2(-\Pi_1, -\Pi_2; \rho) \quad (6)$$

$$S_2 = \Pr[FC_i = 0, UN_i = 1] = \Pr[FC_i^* \leq 0, UN_i^* > 0] = \Pr[u_{1i} \leq -X_i'\beta_1, u_{2i} > -Z_i'\beta_2] = \Phi_2(-\Pi_1, \Pi_2; -\rho) \quad (7)$$

$$S_3 = \Pr[FC_i = 1, UN_i = 0] = \Pr[FC_i^* > 0, UN_i^* \leq 0] = \Pr[u_{1i} > -X_i'\beta_1, u_{2i} \leq -Z_i'\beta_2] = \Phi_2(\Pi_1, -\Pi_2; -\rho) \quad (8)$$

$$S_4 = \Pr[FC_i = 1, UN_i = 1] = \Pr[FC_i^* > 0, UN_i^* > 0] = \Pr[u_{1i} > -X_i'\beta_1, u_{2i} > -Z_i'\beta_2] = \Phi_2(\Pi_1, \Pi_2; \rho) \quad (9)$$

where  $\Pi_1 = X_i'\beta_1$ ,  $\Pi_2 = Z_i'\beta_2$  and  $\Phi_2$  is the bivariate standard normal probability function. These probabilities will determine the structure of the informal caregiving hours equations. In particular, we consider a flexible specification for the logarithm of the number of informal caregiving hours for each subsample, allowing for variation in the coefficients of the regressors and the selection correction terms:

$$\ln IH_{1i} = W_i'\gamma_1 + \delta_{11}\lambda_{11i} + \delta_{12}\lambda_{12i} + \varepsilon_{1i} \quad (10)$$

$$\ln IH_{2i} = W_i'\gamma_2 + \delta_{21}\lambda_{21i} + \delta_{22}\lambda_{22i} + \varepsilon_{2i} \quad (11)$$

$$\ln IH_{3i} = W_i'\gamma_3 + \delta_{31}\lambda_{31i} + \delta_{32}\lambda_{32i} + \varepsilon_{3i} \quad (12)$$

$$\ln IH_{4i} = W_i'\gamma_4 + \delta_{41}\lambda_{41i} + \delta_{42}\lambda_{42i} + \varepsilon_{4i} \quad (13)$$

where  $\delta_{11}$  to  $\delta_{42}$  are the coefficients associated with selection variables  $\lambda_{11i}$  to  $\lambda_{42i}$ , which are defined as follows:

$$\begin{aligned} \lambda_{11} &= -\frac{\phi(\Pi_1)\Phi(-\Pi_2^*)}{S_1}; \quad \lambda_{12} = -\frac{\phi(\Pi_2)\Phi(-\Pi_1^*)}{S_1} \\ \lambda_{21} &= -\frac{\phi(\Pi_1)\Phi(\Pi_2^*)}{S_2}; \quad \lambda_{22} = \frac{\phi(\Pi_2)\Phi(-\Pi_1^*)}{S_2} \\ \lambda_{31} &= \frac{\phi(\Pi_1)\Phi(-\Pi_2^*)}{S_3}; \quad \lambda_{32} = -\frac{\phi(\Pi_2)\Phi(\Pi_1^*)}{S_3} \\ \lambda_{41} &= \frac{\phi(\Pi_1)\Phi(\Pi_2^*)}{S_4}; \quad \lambda_{42} = \frac{\phi(\Pi_2)\Phi(\Pi_1^*)}{S_4} \\ \Pi_1^* &= \frac{\Pi_1 - \rho\Pi_2}{\sqrt{1-\rho^2}}; \quad \Pi_2^* = \frac{\Pi_2 - \rho\Pi_1}{\sqrt{1-\rho^2}} \end{aligned}$$

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

The sequential nature of our approach does not preclude any implication about the joint relation between unmet needs, formal care and informal caregiving hours. More generally, the double sample

selection model can also be estimated by maximum likelihood (ML). Full-information estimation of the double sample model via maximum likelihood is very appealing given the limited nature of the dependent variables, the need to numerically approximate multidimensional integrals to capture error correlations and the high-dimensional parameter space of the selection models (Nawata and Nagase, 1996). The likelihood for this problem is given by:

$$L = \prod_{\substack{FC=0 \\ UN=0}} \Phi_2(X_i'\beta_1, Z_i'\beta_2, \rho) \cdot \phi(\ln IH_{1i}) \prod_{\substack{FC=0 \\ UN=1}} \Phi_2(X_i'\beta_1, -Z_i'\beta_2, -\rho) \cdot \phi(\ln IH_{2i}) \\ \prod_{\substack{FC=1 \\ UN=0}} \Phi_2(-X_i'\beta_1, Z_i'\beta_2, -\rho) \cdot \phi(\ln IH_{3i}) \prod_{\substack{FC=1 \\ UN=1}} \Phi_2(-X_i'\beta_1, -Z_i'\beta_2, \rho) \cdot \phi(\ln IH_{4i}) \quad (14)$$

However, maximum likelihood estimation is further complicated when there is a high degree of correlation between the selection and the outcome equation (Nawata, 1994), when the selection hurdle leads to a high degree of censoring in the first equation (Manning et al., 1997), and 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 estimated the model by ML and Heckman's method and observe a high degree of consistency between the two estimates (ML estimates are available upon request<sup>9</sup>). Therefore, in the following we will focus on the double sample selection model.

### **3.1. Empirical specification and identification strategy**

The variable "informal caregiving hours" (IC hours) records the number of daily caregiving hours devoted by the respondent caregiver. Thus, although we know whether there are other informal caregivers, we do not know the total amount of care received by the dependent. In the 1994 survey, the number of caregiving hours is recorded in 4 intervals: less than 1, 1-2, 2-5 and more than 5 hours/day. In the 2004 survey, the number of informal caregiving hours was recorded in the following way: less than one hour, 1-3, 3-5, 5-8 and more than 8 hours. Those who answered more than 8 caregiving hours (607

<sup>9</sup> 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:  $\chi^2(43)=29.15$  (p-value: 0.9473) in 1994 and  $\chi^2(43)=22.01$  (p-value: 0.9967) in 2004.

observations), were asked to indicate the exact number of hours. Only 593 individuals indicated the number of caregiving hours (from 9 to 24). We have 107 missing observations of more than 8 hours of care, but we do not know the exact number. For these cases we create a bracket variable, which consists of making assumptions about the intensity of caregiving (Byrne et al., 2006). Using a conservative approach, we compute the average caregiving hours assuming that the amount of care was less than or equal to 8 hours (4.06 hours per day). Nevertheless, we tested the sensitivity of this bracketing approach<sup>10</sup>.

With respect to the explanatory variables, we can bring them together in four groups. *The selection of independent variables is based on previous evidence (Tennstedt et al., 1994; Allen and Moor, 1997; Lima and Allen, 2001).* The first group of variables is related to the carereceiver's characteristics: age, sex, marital status, dwelling arrangements, pathologies, degree of dependency (obtained from the application of the Ranking Scale of the Dependency Law), type of benefit received and dependent's monthly income. Second, caregiver's characteristics are represented by age and sex<sup>11</sup>, marital status, number of caregiving years, permanent and/or willing caregiver, kinship between the dependent and the caregiver<sup>12</sup> and whether they got on with each other before the onset of the caregiving tasks.

In third place, we consider the characteristics of the informal network, that is, whether the caregiver receives help from another family member, the kinship between the primary and secondary caregivers and whether there are children living with them. Finally, we have considered the possibilities offered by formal care: the receipt of private formal help (nurse or household employee) and characteristics of social services (home care and day centres)<sup>13</sup>. We consider these services, and exclude residential homes because we are considering the situation of non-institutionalized dependent people. For home care services, we have information, at the regional level, about the following instruments: the coverage index<sup>14</sup>, the number of monthly hours, the percentage of time devoted to personal care, the public cost per hour and the percentage of the cost paid by the user (i.e., co-payment). For day centres, we have information, also at the regional level, about the coverage index, the percentage of psycho-geriatric

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<sup>10</sup> We re-estimated the bivariate probit model and the OLS regressions with the selection terms excluding the 121 observations with imputed hours, and the results did not change significantly.

<sup>11</sup> Caregiver's age and sex may affect the demand for social services because older caregivers may also suffer disabilities that prevent them from providing an adequate level of care to the carereceiver. With regards to gender, there is evidence that women caregivers report more unmet needs than male ones (Lima and Allen, 2001).

<sup>12</sup> Being the partner of the care recipient may induce a higher burden *ceteris paribus*, but this burden may be more tolerable (with less need for support) because of greater satisfaction for an informal caregiver looking after his/her partner than for another person. The percentage of caregivers of a highly dependent person who feel themselves to be in a "dead end street" is 4.24% for spouses and 13.06% for brothers/sisters-in-law.

<sup>13</sup> Older people in Spain. 2004 Report. IMSERSO.

<sup>14</sup> Ratio between the number of users and the population aged 65 or over.

places and the co-payment. Unfortunately, for some regions there is no information available and we define the corresponding observability variables<sup>15</sup>. To reinforce the regional nature of these services, we also include the size of the municipality as an explanatory variable.

Estimating the two-step model requires some identification assumptions on the coefficients (Tunali, 1986). If  $\rho=0$  the matrices  $X_i'$  and  $Z_i'$  are required to contain at least one element that is not part of  $W_{ji}'$ ,  $j = 1..4$ , but if  $\rho \neq 0$ , it is necessary to impose an additional restriction to estimate the covariance between  $u_{1i}$  and  $u_{2i}$ . Therefore, at least one element in  $X_i'$  must not be contained in  $Z_i'$ , and vice versa. Additionally, these variables must not be part of  $W_{ji}'$ ,  $j = 1, \dots, 4$ .

In our model the identification of the equations is achieved because FC equation does not include certain characteristics of home care (hours per month, percentage of time devoted to personal care, percentage of co-payment, binary variable for the observability of percentage of time devoted to personal care and binary variable for the observability of co-payment) and day centres (coverage index of psycho-geriatric places, percentage of co-payment and binary variable for the observability of psycho-geriatric coverage index). We have not included co-payment variables in the FC equation because in accordance with other authors (Koopmanschap et al., 2004; Jakobsson et al., 2006; Bolin et al., 2008) who have not used any price variable in their specification for FC equations. The UNs equation does not include dependent's marital status, type of benefit, dependent's monthly income and number of caregiving years. Neither the UNs nor the FC equations include the variables willing caregiver, kinship between the dependent and the caregiver, kinship between the primary and the secondary caregiver, private formal help, good previous relationship between dependent and caregiver and children under 18 living at home (these variables are only included in the hours equation).

The variable "receives help from other family member" is included in the FC and hours equation because several studies (Bass and Noelker, 1987; Chappel, 1989; Penning, 1990; Soldo et al., 1990, White-Means, 2004) have stated that the receipt of formal care is linked to the unavailability of spouse or adult children (co-resident or not). We ignore the living arrangement of the secondary caregiver, but we introduce controls for marital status in the FC equation and for kinship relationships in the hours equation. Finally, the hours equation does not include regional policy variables, dependent's marital

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<sup>15</sup> We define four dummy variables (percentage co-payment for home care and day centres, and percentage of home care time devoted to personal care) which take the value 1 if there is information for that particular characteristic and the value 0 otherwise.

status, type of benefit and dependent's monthly income. Estimated coefficients of the bivariate probit for both samples are available upon request.

#### **4. Empirical specification and results**

##### **4.1. The double selection process**

The correlation coefficient ( $\rho$ ) between formal care and unmet needs is significant for both waves ( $\rho=-0.2456$  (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<sup>16</sup>.

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 has been defined as:

$$E[(FC_i = 0 \& UN_i = 1)_{Lives\ alone=1} - (FC_i = 0 \& UN_i = 1)_{Lives\ alone=0}] = \Phi_2(X_i' \beta, Z_i' \gamma; \rho)_{Lives\ alone=1} - \Phi_2(X_i' \beta, Z_i' \gamma; \rho)_{Lives\ alone=0} \quad (14)$$

where  $(FC_i = 0 \& UN_i = 1)_{Lives\ alone=1}$  indicates the outcome if the dependent individual lives alone and

$(FC_i = 0 \& UN_i = 1)_{Lives\ alone=0}$  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

$\Phi_2(X_i' \hat{\beta}, Z_i' \hat{\gamma}; \hat{\rho})_{Lives\ alone=1} - \Phi_2(X_i' \hat{\beta}, Z_i' \hat{\gamma}; \hat{\rho})_{Lives\ alone=0}$  across the sample. In what follows we

comment on some of the key results obtained from this model.

##### **4.1.1. Detailed results for the selection equations**

###### *Socio-demographic variables*

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<sup>16</sup> In 1994, 12.98% and 2.23% of the elderly people interviewed received home care and day centre care respectively. In 2004, these percentages were 23.38% and 6.31%.

Younger dependent individuals (under the age of 70) show an increase in the probability of  $FC=0&UN=1$  of 43.25% in 1994, which decreases to 22.77% in 2004, because in the 1990s many regional administrations did not allocate social services to dependent people younger than 65. On the other hand, those older than 90 show an average increase in the probability of  $FC=1&UN=1$  (25.78%) which rises to 45.59% in 2004. In this respect, the early onset of some pathologies<sup>17</sup> in conjunction with the progressive ageing of the population<sup>18</sup> may exacerbate the problem of  $FC=0&UN=1$  in the first case, and of  $FC=1&UN=1$  in the second.

Individuals with no income or less than €300/month have less probability of suffering  $FC=0&UN=1$  (-42.21% and -14.08%) than those with more than €300 or €600/month, although the effect of income differences decreases in the second wave. With regards to the allocation system applied in 1994 and 2004 (before the Dependency Law), the dependent's economic situation, the number of functional or cognitive disabilities and the availability of the family were taken into account for the allocation of home care and day centre care.

#### *Dwelling arrangement*

Living in a municipality with fewer than 2,000 inhabitants increased the probability of  $FC=0&UN=1$  by 47.05% in 1994, but this effect decreases to 26.44% in 2004. The marginal effect diminishes as the size of the municipality increases (10.98% in 2004 for the case of provincial capitals).

Dependent people living alone experience an average decrease in the probability of  $FC=0&UN=1$  of 43.64% and an average increase in the probability of  $FC=1&UN=1$  of 14.26% (in 1994). Between the two waves the effect on the first probability diminishes, although the effect on the second one becomes stronger (-20.89% and 25.18% in 2004 respectively). In this case, rather than a problem of hours there may be a problem of accounting of the aid received. When formal caregivers go to the dependent's home they pursue a set of objectives in a limited amount of time and this situation is totally different from the environment of the dependent individual who lives with co-resident caregivers who provide the required help throughout the day.

#### *Degree of dependency and caregiving relationship*

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<sup>17</sup> According to data from Fundación Alzheimer España and Asociación Parkinson Madrid, around 2.5% of Alzheimer patients are under 55 and approximately 20% of Parkinsonism cases are diagnosed before the age of 50.

<sup>18</sup> Long-term population projections (INE) for 2060 estimate that around 13.12%-14.44% of the population will be older than 80.

Being highly dependent reduced on average the probability of  $FC=0 \& UN=1$  by 47.01% in 1994, although this reduction decreased to 22.10% in 2004. For both waves, moderately dependent people experience a smaller decrease in the probability of  $FC=0 \& UN=1$  than highly dependent ones, and in 2004 differences between degrees of dependency narrow. On the other hand, being severely or highly dependent increases the probability of  $FC=1 \& UN=1$  by 12.54% and 25.18% in 1994, and this effect rises to 22.33% and 35.44% 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 experience an average increase in the probability of  $FC=0 \& UN=1$  (46.31%). In 2004, we observe that the effect of dementia remains almost constant, and also that osteoarticular problems present an increase in the probability of  $FC=0 \& UN=1$  (12.75%).

Caregivers with more than 10 (12) caregiving years show a decrease in the probability of  $FC=0 \& UN=1$  (35.36% and -23.25% in 1994 and 2004 respectively). Nevertheless, the probability of  $FC=1 \& UN=1$  increases by an average of 14% when the number of caregiving years is 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 complement home care with private formal care ranges 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  $FC=0 \& UN=1$  decreases more with an increase in day centre coverage, whereas the probability of  $FC=1 \& UN=1$  decreases 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% 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%. 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 has increased from 1.81% in 1994 to 7.70% in 2004. These results should be considered carefully by public

authorities given the wide disparity between regions. For example, in 2004, 80% of home care time in Navarra was devoted to personal care, as opposed to only 20% in Extremadura; the average number of monthly hours was 25.14 in Navarra as opposed to 8 hours in Andalucía, and the cost per hour was highest in Navarra (€22.32) and lowest in Extremadura (€6.18).

#### **4.2. Results for the hours equations**

Tables 5 and 6 provide the estimated coefficients of the interval regressions for the number of caregiving hours<sup>19</sup>. For the 1994 survey we perform an interval regression and standard errors are based on a resampling bootstrap method<sup>20</sup>. For 2004, the hours variable is interval coded up to 8 caregiving hours/day (less than one hour, 1-3, 3-5, 5-8) and continuous from 8 hours upwards. We estimate an interval regression using the logs of the intervals or the log of the exact number of caregiving hours.

In 1994, the terms  $\lambda_{22}$  and  $\lambda_{42}$  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. So the substitution theory, 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  $\lambda_{21}$  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  $\lambda_{31}$  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  $\lambda_{42}$  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. Moreover, the selection term  $\lambda_{42}$  is larger than  $\lambda_{21}$  and  $\lambda_{31}$ , in absolute terms, indicating that the selection

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<sup>19</sup>We have performed various specification tests. First of all, we have tested the equality of coefficients between caregiving hours equations for each year. In all cases, the calculated chi-square statistic rejects the null hypothesis, indicating that the impact of the explanatory variables for the hours equation corresponding to each combination of the variables UNs and FC is different from that of the others. Second, we have tested the equality of coefficients between 1994 and 2004 for the same combination of UNs and FC. Once again, we reject the null hypothesis. Thereby, the adverse effects of unmet needs on informal caregiving hours do not remain constant over time and it becomes necessary to compare the estimates from the two waves and determine the magnitude of this change. Finally, we have tested the equality of coefficients between regressions with and without controls for sample selection test.

<sup>20</sup> Thus, 1,000 samples of size N are drawn from the original sample with replacement. For each sample, all coefficients are re-estimated and used to derive standard errors.

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.

#### 4.2.1. Detailed Results

##### *Socio-demographic characteristics*

The regression results (see tables 5 and 6) for FC=1&UN=1 in 1994 shows that male dependents receive fewer caregiving hours. In this situation we have observed that the percentage of sex coincidence between the caregiver and the carereceiver is lower than in the other situations (55.62% as opposed to 64.37%). Sometimes, the sex of the carer may be problematic for the recipient, because the dependent may feel uncomfortable discussing needs or receiving care from a different-sex caregiver (Cordingley and Webb, 1997).

Those living alone are more than twice as likely to use private formal help (11.20% as opposed to 5.82% for elderly people who do not live alone). In fact, the data reveal that the fraction of dependent individuals living alone is growing over time, from 24.95% in 1994 to 30.05% in 2004, and the percentage of caregivers who invest more than 20 minutes in displacement time rose from 29.26% to 34.29% in this period. The number of caregiving hours decreases if the dependent individual lives alone and suffers UNs, with a greater effect if some FC is received (-0.98 and -1.68 hours/week respectively in 1994, and -1.66 and -2.04 hours/week in 2004).

##### *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 4.65 hours/week in 1994 and 5.76 hours/week ( $\exp(1.7516)$ ) in 2004. The distance in caregiving hours between moderate (level 2) and high dependency (level 2) increases between the two waves: 2.76 in 1994 and 3.73 in 2004<sup>21</sup>. 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. Attending to specific pathologies, mental illnesses show an increase in hours

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<sup>21</sup>  $\exp(1.7516) - \exp(0.7077)$ .

for the situation  $FC=1 \& UN=1$  (from 2.54 to 3.27) and the coefficient for  $FC=0 \& UN=1$  is significant in 2004 (1.36 hours more), although it was not in 1994.

Attending to the number of caregiving years, for both waves we observe a significant increase in caregiving hours (around 1.4 hours/week) when  $FC=0 \& UN=1$  and the number of caregiving years is greater than 10 (or 12 for 2004). The “career in caregiving” theory (Aneshensel et al., 1995) provides a good explanation for this result, although not all caregivers follow the same “career sequence”. The literature usually distinguishes three major stages: the acquisition role (diagnosis and transition into the role of caregiving), the enactment role (combination of in-home care and institutional care) and the disengagement role (cessation of caregiving, bereavement and social readjustment). For example, the percentage of caregivers that have been obliged to reduce leisure time or social activities is almost the same (35.19-34.36%) for the groups with less than 2 or more than 12 caregiving years (in 2004). However, the percentage of caregivers who consider caregiving as a moral obligation increases from 41.70% (less than 2 years) to 54.56% (more than 12 years). Therefore, 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<sup>22</sup>, 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; McKinlay and Tennstedt, 1986). 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/week in 1994 and 1.28 hours/week in 2004.

If the primary caregiver receives help from another family member the number of caregiving hours decreases by 3 hours/week for both waves when  $FC=0 \& UN=1$  and nearly 4 hours/week when  $FC=1 \& UN=1$ . However, we found that one person tends to provide all informal care (58.99% in 1994, 51.13% in 2004), whereas secondary caregivers are few in number<sup>23</sup>. This concentration of caregiving responsibilities on a nuclear family has important implications for the emergence of family/leisure

<sup>22</sup> 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.

<sup>23</sup> For 2004, 20.15% of respondent caregivers receive help from one other family member, 14.63% from two people and 7.71% from three.

problems and the possible increase in the risk of institutionalization when the primary caregiver is overloaded.

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

### *Regional effects*

Table 7 reports the confidence intervals for the predicted number of informal caregiving hours for two different prototypes of caregiver: (1) wife aged 50 or older and (2) daughter aged 30-49. For all combinations of FC and UNs, wives provide more caregiving hours than daughters. There are sharp regional differences in the provision of informal care. Andalucía, Aragón, Baleares, Canarias, C. Valenciana, Extremadura and Navarra show higher than average values for the first case, and Andalucía, Baleares, Canarias, Cantabria, Castilla La Mancha, C. Valenciana, Galicia, Madrid and Navarra do so for the second case. In fact, Navarra constitutes a special case, with different characteristics from other regions: only 31.82% of caregivers living in Navarra do not receive additional help from other family members (50.93% in Spain); the informal caregiving network is larger (5.73 as opposed to 2.25 for Spain); 77.27% had a very good relationship with the dependent individual (previous to the caregiving relationship) and none of the care receivers have private formal care (9.44% for the rest of Spain).

To corroborate the importance of controlling for self-selection, in Table 8 we compare the average predicted caregiving hours with the sample mean for each subsample. If these selection variables were not incorporated, we would obtain biased estimates of the risk of not receiving formal care and the risk of having unmet needs. When comparing situations with UNs, the omission of formal care selection would cause an overestimation of the number of caregiving hours in those cases where there is no FC (11.06 vs. 10.07 for  $FC=0&UN=1$  and 12.73 vs. 13.23 for  $FC=1&UN=1$ ). Additionally, when comparing situations without FC, not including the unmet needs selection would cause an overestimation of caregiving hours in those cases where there are no UNs (9.87 vs. 7.55 for  $FC=0&UN=0$  and 11.06 vs.

10.07 for  $FC=0 \& UN=1$ ). Finally, the comparison of situations with FC reveals that the omission of the unmet needs selection would underestimate the number of caregiving hours when there are UNs (10.22 vs. 8.22 for  $FC=1 \& UN=0$  and 8.22 vs. 12.62 for  $FC=1 \& UN=1$ ).

## **5. Conclusions**

The main aim of this study has been to address a double selection problem in order to estimate an unbiased informal caregiving hours differential for the situation in which the respective dependent individual who is being looked after suffers unmet needs, due to the absence, insufficiency or inadequacy of formal care. As already discussed, two selection processes have to be considered when estimating models related to the provision of social services and the availability of informal caregivers. The first one is due to the self-selective nature of formal care: with regard to both observable and unobservable characteristics, formal care receivers are not a random sample of the dependent population. The second selection issue concerns the expected well-being of the individual after his or her application for home care or day centre care or its allocation: those who are not satisfied with the quality or quantity of the care received are not randomly selected from the whole population of potential receivers. The results indicate a negative correlation between receiving formal care and 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 rather than a problem of insufficient provision of social services for dependent people there is a problem of inefficiency in the allocation process, because the conditions required in the admission process or the quantity of the services received are not suited to the dependent's specific needs.

Moreover, the number of caregiving hours increases with the presence of unmet needs, and is even greater 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 care are not competing forces. Instead, informal care develops a compensatory and complementary role with respect to formal care.

The results indicate that caregiving hours and demand for formal care depend on characteristics of the caregiver, the care receiver and the caregiving situation. From a health policy point of view, it could be fruitful to segregate the population in a structured manner. As we have seen, the number of caregiving years is a significant variable, emphasizing the idea that caregivers move through different stages, face

different demands and consequently ask for different types of support. Another recommendation to improve home care services could be to ask dependent people (or informal caregivers) whether there are specific tasks they need help with, because asking if they would like to receive more help, in general terms, may not produce an accurate assessment of needs. Thus, therapists could focus on those aspects that enable people to maintain independence and re-integrate into their social environment. Given that many older people are anxious to protect their relationships with friends and relatives and try to avoid making demands even when they acknowledge their need for help, health professionals should assume that although some support is available from family members, the older person may be reluctant to overburden those relatives with requests for help.

In the future we would like to tackle two questions related to unmet needs. First, we would like to evaluate the impact of the new Dependency Law on the presence of unmet needs. The present regulation establishes that each dependent individual will receive an Individual Care Programme that details the benefits in kind that he should receive (article 29). These services will be provided by the Public Social Services Network, but in the case of insufficient provision, the dependent individual will receive a financial benefit to pay the cost of a private provider. Second, as we have ascertained, caregivers with unmet needs devote more informal caregiving hours. Therefore, a reasonable next step is to study whether there is a significant relationship between unmet needs, caregiver's quality of life and the emergence of labour problems (reduction in the number of working hours or early exit from the labour market). In terms of the econometric implementation, this extension would imply a notable challenge, because we should have regard for the effect of the selection terms on the new variables, and the correlations between informal caregiving hours, quality of life and labour problems. But from an economic point of view it would be very insightful to determine the extent to which unmet needs account for part of the caregiver's burden and the observed lower employment rate for caregivers.

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## **Appendix A**

### **Determination of the degree of dependency**

The Ranking Scale considers 47 tasks grouped in 10 activities (eating and drinking, control of physical needs, washing oneself, other physical care, dressing and undressing, keeping one's health, mobility, moving inside home, moving outside home and housekeeping). The questionnaire for people who suffer mental illness or have some kind of cognitive impairment includes six additional tasks referring to the ability to make decisions<sup>24</sup>. The final score is the sum of the weights of the tasks for which the individual has difficulty, multiplied by the degree of supervision required and the weight assigned to that activity:

$$\text{Score} = \sum \left( \text{Weight of the task performed with difficulty} * \text{Degree of supervision} * \text{Weight of the corresponding activity} \right)$$

The table of weights for tasks and activities distinguishes four age intervals: 3-6, 7-10, 11-17, and 18 and over. Given that our sample contains only individuals older than 60 years, we will use the

<sup>24</sup> With the information contained in the Informal Support Survey, we consider that an individual has cognitive impairment or intellectual disability when the informal caregiver has answered in the affirmative to the questions about memory problems, dementia, mental illness or Alzheimer.

weights attributed to the fourth interval. The weights assigned to each activity and task are shown in Table 1, the score in brackets corresponding to dependent people with mental illness or cognitive impairment.

We have been obliged to adapt some questions. For example, for the activity “eating and drinking”, the Ranking Scale distinguishes six different tasks, but in the survey we only have information about the ability to eat (which we assume includes the ability to drink). With respect to “control of physical needs” we have no information about the specific tasks of “dressing and undressing” and “adopting the right posture”. For this reason, we have incorporated their respective scores into the task “using the toilet”. In the activity “other personal tasks”, the survey does not include information about the abilities to comb one’s hair or cut one’s nails, so we have synthesized all these variables into one called “smartening oneself up”. The same has happened with the activity “mobility”, where we have summarized five different tasks in the ability to go to bed/stand up. With all these simplifications, we are not attempting to replace the work of the assessment professionals. The purpose of this exercise is to apply the legal benchmark and introduce a new way of classifying dependent people.

**Table 1. Comparison between the Task Table of the Ranking Scale contained in the Dependency Law and the information from the Informal Support Survey**

| Ranking Scale (Dependency Law)           |                    | Informal Support Survey                   |                    |
|------------------------------------------|--------------------|-------------------------------------------|--------------------|
| <b>1. Eating and drinking</b>            | <b>17.8 (10)</b>   | <b>1. Eating and drinking</b>             | <b>17.8 (10)</b>   |
| Using artificial nutrition or hydration  |                    | Eating                                    | 1                  |
| Opening bottles and cans                 | 0.10               |                                           |                    |
| Cutting up meat                          | 0.25               |                                           |                    |
| Using cutlery                            | 0.25               |                                           |                    |
| Holding a glass                          | 0.15               |                                           |                    |
| Putting a glass to one’s mouth           | 0.15               |                                           |                    |
| Drinking                                 | 0.10               |                                           |                    |
| <b>2. Control of physical needs</b>      | <b>14.8 (7)</b>    | <b>2. Control of physical needs</b>       | <b>14.8 (7)</b>    |
| Go to the appropriate place              | 0.20               | Using the toilet                          | 0.55               |
| Dressing and undressing                  | 0.15               | No information                            | -                  |
| Adopting the right posture               | 0.20               | No information                            | -                  |
| Cleaning oneself                         | 0.20               | Refuses to clean oneself                  | 0.20               |
| Urination control                        | 0.10               | Needs nappies for uncontrolled urination  | 0.10               |
| Defecation control                       | 0.15               | Needs nappies for uncontrolled defecation | 0.15               |
| <b>3. Washing oneself</b>                | <b>8.8 (8)</b>     | <b>3. Washing oneself</b>                 | <b>8.8 (8)</b>     |
| Washing hands                            | 0.15               | No information                            | -                  |
| Washing face                             | 0.15               | No information                            | -                  |
| Washing lower part of the body           | 0.35               | Refuses to have a bath                    | 0.65               |
| Washing upper part of the body           | 0.35               | Having a bath/shower                      | 0.35               |
| <b>4. Other personal tasks</b>           | <b>2.9 (2)</b>     | <b>4. Other personal tasks</b>            | <b>2.9 (2)</b>     |
| Combing hair                             | 0.30               | No information                            | -                  |
| Cutting nails                            | 0.15               | No information                            | -                  |
| Washing hair                             | 0.25               | No information                            | -                  |
| Brushing teeth                           | 0.30               | Smartening oneself up                     | 1                  |
| <b>5. Dressing</b>                       | <b>11.9 (11.6)</b> | <b>5. Dressing</b>                        | <b>11.9 (11.6)</b> |
| Putting on shoes                         | 0.15               | No information                            | -                  |
| Buttoning oneself up                     | 0.15               | Buttoning oneself up                      | 0.3                |
| Dressing upper part of the body          | 0.35               | Dressing                                  | 0.7                |
| Dressing lower part of the body          | 0.35               | No information                            | -                  |
| <b>6. Keeping one’s health</b>           | <b>2.9 (11)</b>    | <b>6. Keeping one’s health</b>            | <b>2.9 (11)</b>    |
| Applying therapeutic measures            | 0.25               | Going to the doctor                       | 0.25               |
| Avoiding indoor risks                    | 0.25               | Having accidents                          | 0.5                |
| Avoiding outdoor risks                   | 0.25               | No information                            | -                  |
| Distress call                            | 0.25               | Distress call                             | 0.25               |
| <b>7. Mobility</b>                       | <b>7.4 (2)</b>     | <b>7. Mobility</b>                        | <b>7.4 (2)</b>     |
| Sitting down                             | 0.15               | No information                            | -                  |
| Lying down                               | 0.10               | No information                            | -                  |
| Standing up                              | 0.20               | No information                            | -                  |
| Changing posture from a sitting position | 0.25               | No information                            | -                  |
| Changing posture from bed                | 0.30               | Going to bed/Standing up                  | 1                  |
| <b>8. Moving inside home</b>             | <b>12.3 (12.1)</b> | <b>8. Moving inside home</b>              | <b>12.3 (12.1)</b> |
| Movements related to self-care           | 0.50               | No information                            | -                  |
| Movements not related to self-care       | 0.25               | Being disorientated indoors               | 0.50               |
| Access to all settings of the rooms      | 0.10               | No information                            | -                  |
| Access to all rooms                      | 0.15               | Walking inside home                       | 0.50               |
| <b>9. Moving outside home</b>            | <b>13.2 (12.9)</b> | <b>9. Moving outside home</b>             | <b>13.2 (12.9)</b> |
| Leaving the house/building               | 0.25               | Refuses to leave the house                | 0.25               |
| Walking around the house/building        | 0.25               | No information                            | -                  |
| Walking short distances                  | 0.10               | No information                            | -                  |
| Walking long distances                   | 0.15               | Being disorientated outdoors              | 0.5                |
| Using transport                          | 0.25               | Using public transport                    | 0.25               |
| <b>10. Housekeeping</b>                  | <b>8 (8)</b>       | <b>10. Housekeeping</b>                   | <b>8.0 (8)</b>     |
| Cooking                                  | 0.45               | Cooking                                   | 0.45               |
| Shopping (for food)                      | 0.25               | Shopping (for food)                       | 0.25               |
| Cleaning the house                       | 0.20               | Piles up useless objects                  | 0.20               |
| Washing clothes                          | 0.10               | Other housekeeping tasks                  | 0.10               |
| <b>11. Making decisions</b>              | <b>(15.4)</b>      | <b>11. Making decisions</b>               | <b>(15.4)</b>      |
| Self-care activities                     | 0.30               | Forgets medication/Eats forbidden foods   | (0.30)             |
| Mobility activities                      | 0.20               | Moving                                    | (0.20)             |
| Housekeeping                             | 0.10               | Unable to find belongings                 | (0.10)             |

|                        |      |                                |        |
|------------------------|------|--------------------------------|--------|
| Personal relationships | 0.20 | Verbally/Physically aggressive | (0.20) |
| Use of money           | 0.10 | Managing funds                 | (0.10) |
| Use of public services | 0.10 | Doing business                 | (0.10) |

Source: [www.seg-social.es/imsero/dependencia/manualusoBVD.pdf](http://www.seg-social.es/imsero/dependencia/manualusoBVD.pdf); Jiménez-Martín and Vilaplana (2008).

Variables in brackets are only applied to mental patients.

With respect to the degree of support, the Ranking Scale considers four possibilities: *supervision* (if the dependent only needs a third person to prepare the necessary elements to perform the activity), *partial physical care* (when the third person has to participate actively), *maximum physical care* (if the third person has to substitute the dependent individual in the execution of the activity) and *special care* (the dependent individual suffers behavioural disorders that hinder the provision of the task by the third person).

**Table 2. Comparison between information about the degree of support of the Ranking Scale contained in the Dependency Law and the Informal Support Survey**

| Support coefficient     | 0.9                                                                   | 0.9                                                                                         | 0.95                                                                                             | 1                  |
|-------------------------|-----------------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|--------------------|
| Dependency Law          | Supervision                                                           | Partial Physical Assistance                                                                 | Maximum Physical Assistance                                                                      | Special Assistance |
| Informal Support Survey | Can sometimes do the activity by himself. A third person keeps watch. | Cannot do the task by himself. Needs help from a third person. (Frequency: Always or Often) | Cannot do the task by himself. A third person has to do it for him. (Frequency: Always or Often) | Mental illness     |

Source: [www.seg-social.es/imsero/dependencia/manualusoBVD.pdf](http://www.seg-social.es/imsero/dependencia/manualusoBVD.pdf); Jiménez-Martín and Vilaplana (2008).

## Appendix B

**Table 3. Descriptive statistics (using sample weights)**

|                                              | 1994         |              |              |              | 2004         |              |              |              |
|----------------------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
|                                              | FC=0<br>UN=0 | FC=0<br>UN=1 | FC=1<br>UN=0 | FC=1<br>UN=1 | FC=0<br>UN=0 | FC=0<br>UN=1 | FC=1<br>UN=0 | FC=1<br>UN=1 |
| <b>Dependent's characteristics</b>           |              |              |              |              |              |              |              |              |
| 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        |
| <b>Caregiver's characteristics</b>           |              |              |              |              |              |              |              |              |
| 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        |
| 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                            | 0.780 | 0.749 | 0.798 | 0.709 | 0.749 | 0.781 | 0.761 | 0.833 |
| Willing caregiver                              | 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                           |       |       |       |       |       |       |       |       |
| Under 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   |

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

**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                         | 0.4325     | 0.4503     | -0.0501    | -0.0486    | 0.2277     | 0.2280     | -0.0545    | -0.0514    |
| 70-79                         | -0.1160    | -0.1369    | -0.0237    | -0.0331    | -0.1171    | -0.1281    | -0.0271    | -0.0379    |
| 80-89                         | -0.2608    | -0.2783    | -0.0111    | -0.0184    | -0.2016    | -0.2004    | -0.0081    | -0.0244    |
| 90+                           | -0.4584    | -0.5730    | 0.2578     | 0.2510     | -0.2865    | -0.2768    | 0.4559     | 0.4523     |
| Lives alone                   | -0.4364    | -0.4552    | -0.1426    | -0.1457    | -0.2089    | -0.2275    | -0.2518    | -0.2501    |
| Pathologies                   |            |            |            |            |            |            |            |            |
| Mental illness                | 0.4631     | 0.4543     | 0.0507     | 0.0496     | 0.4587     | 0.4501     | 0.0584     | 0.0508     |
| Respiratory problems          | -0.4885    | -0.4808    | -0.0627    | -0.0540    | -0.1637    | -0.1459    | -0.0442    | -0.0471    |
| Cancer                        | -0.5576    | -0.5855    | -0.0701    | -0.0567    | -0.2618    | -0.2785    | -0.0646    | -0.0556    |
| Osteoarticular problems       | -0.3013    | -0.3242    | -0.0358    | -0.0406    | 0.1275     | 0.1296     | -0.0027    | 0.0187     |
| Cardiovascular diseases       | -0.3045    | -0.3112    | -0.0339    | -0.0404    | -0.1023    | -0.1241    | -0.0316    | -0.0404    |
| Degree of dependency          |            |            |            |            |            |            |            |            |
| No dependency                 | -0.1571    | -0.1514    | -0.0227    | -0.0459    | -0.0310    | -0.0587    | -0.0341    | -0.0412    |
| Moderate dependency           | -0.1845    | -0.2122    | -0.0228    | -0.0279    | -0.0847    | -0.0846    | -0.0336    | -0.0401    |
| Severe dependency             | -0.2560    | -0.26269   | 0.1254     | 0.1348     | -0.1163    | -0.1264    | 0.2233     | 0.2390     |
| High dependency               | -0.4701    | -0.4722    | 0.2518     | 0.2493     | -0.2210    | -0.2652    | 0.3544     | 0.3513     |
| Monthly income                |            |            |            |            |            |            |            |            |
| No income                     | -0.4521    | -0.5755    | -0.0500    | -0.0483    | -0.2173    | -0.2723    | -0.0517    | -0.0501    |
| €300 or less                  | -0.1408    | -0.1584    | 0.0189     | 0.0304     | -0.1706    | -0.2514    | -0.0542    | -0.0522    |
| €301-€600                     | 0.3053     | 0.3300     | -0.0435    | -0.0456    | 0.1318     | 0.1334     | 0.0130     | 0.0272     |
| >€600                         | 0.5510     | 0.5849     | -0.0680    | -0.0562    | 0.2568     | 0.2733     | -0.0525    | -0.0513    |
| Size of municipality          |            |            |            |            |            |            |            |            |
| ≤2,000                        | 0.4705     | 0.4750     | -0.0558    | -0.0497    | 0.2644     | 0.2803     | -0.0669    | -0.0568    |
| 2,001-10,000                  | 0.3330     | 0.3517     | -0.0422    | -0.0439    | 0.2410     | 0.2691     | -0.0523    | -0.0493    |
| 10,001-50,000                 | 0.3281     | 0.3585     | -0.0420    | -0.0419    | 0.1846     | 0.2045     | -0.0410    | -0.0442    |
| 50,000-1,000,000              | 0.2019     | 0.2328     | -0.0260    | -0.0360    | 0.1975     | 0.2019     | -0.0436    | -0.0472    |
| Provincial capitals           | 0.2099     | 0.2015     | -0.0370    | -0.0153    | 0.1098     | 0.0908     | -0.0290    | -0.0270    |
| Number of caregiving years    |            |            |            |            |            |            |            |            |
| Less than 2 years             | -0.2674    | -0.2423    | -0.0235    | -0.0249    | -0.0840    | -0.0947    | -0.0158    | -0.0311    |
| 2-5 years (2-4 years)         | -0.2852    | -0.2654    | -0.0315    | -0.0387    | -0.1282    | -0.1288    | -0.0233    | -0.0248    |
| 6-10 years (5-12 years)       | -0.3616    | -0.3590    | 0.1485     | 0.1467     | -0.2183    | -0.2171    | 0.1410     | 0.1400     |
| 10+ years (12+ years)         | -0.3536    | -0.3484    | 0.1493     | 0.1492     | -0.2325    | -0.2331    | 0.1573     | 0.1571     |
|                               | 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                | -0.0458    | 2.65       | -0.1832    | 2.81       | -0.0514    | 2.60       | -0.1478    | 2.58       |
| Co-payment                    |            |            |            |            |            |            | 0.0535     | 3.01       |
| Cost/hour                     |            |            | 0.0181     | 2.41       |            |            | 0.0770     | 2.70       |
| Hours/month                   |            |            | -0.0232    | 2.41       |            |            | -0.0273    | 2.95       |
| Time devoted to personal care |            |            |            |            |            |            | -0.1071    | 2.67       |
| Day centre                    |            |            |            |            |            |            |            |            |
| Coverage index                | -0.0346    | 3.18       |            |            | -0.2988    | 2.78       | -0.0742    | 2.72       |
| Co-payment                    |            |            |            |            |            |            | 0.0505     | 2.35       |
| % psycho-geriatric places     |            |            |            |            | -0.1963    | 2.39       | -0.0501    | 2.35       |

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)        | -0.2489   | -0.0115     | 0.3630     | -1.4475 ** |
| Lives alone             | -0.5280   | -0.9844 *** | -0.4431    | -1.6867 *  |
| Pathologies             |           |             |            |            |
| Mental illness          | 0.8618 ** | 0.3045      | 0.6763     | 2.5456 *** |
| Cancer                  | 1.2726    | -0.5089     | 4.6041     | 10.3994    |
| Respiratory problems    | 0.1105    | -0.1447     | 1.6235     | -1.4273    |
| Osteoarticular problems | -0.1599   | 0.0083      | -1.0992 *  | -0.1627    |
| Cardiovascular disease  | -0.2630   | -0.3573     | 0.1154     | 2.0583 *** |
| Degree of dependency    |           |             |            |            |
| Moderate. Level 1       | -0.2180   | 0.0054      | 1.0301 *** | 1.9169     |
| Moderate. Level 2       | 0.5784    | 0.6181      | 1.3176 *** | 1.8891 **  |

|                                                |            |             |             |             |
|------------------------------------------------|------------|-------------|-------------|-------------|
| Severe. Level 1                                | 0.4931     | 1.6739 ***  | 1.8758 ***  | 3.4032 **   |
| Severe. Level 2                                | 1.4201 *** | 2.5008 ***  | 2.6425 ***  | 4.2650 **   |
| High. Level 1                                  | 1.8537 *** | 2.8779 ***  | 2.7766 **   | 4.5977 **   |
| High. Level 2                                  | 2.0491 **  | 3.1479 ***  | 2.9504 **   | 4.6551 **   |
| Male (caregiver)                               | -0.4586    | -0.5430 **  | -0.5547     | -1.5809 **  |
| Caregiver's marital status                     |            |             |             |             |
| Married                                        | -0.4239    | -0.3892     | 0.0794      | 0.1982      |
| Widowed                                        | -1.0858    | -0.8931     | -2.2696 *   | 1.7594      |
| Separated                                      | -0.8903    | -0.8464     | 0.7542      | -2.8086     |
| Children under 18 living at home               | -0.0247    | -0.0516 *** | -0.4929     | -0.2033 *** |
| Number of caregiving years                     |            |             |             |             |
| 2-5 years                                      | 0.4908     | 0.3774      | 0.6252      | -0.7706     |
| 6-10 years                                     | 0.8497 *   | 0.8343 **   | -0.6927     | 0.7948      |
| More than 10 years                             | 0.7834 *   | 1.4007 ***  | 0.1237      | -0.0015     |
| Receives help from other family member         | 0.0420     | -3.0017 *** | -3.0569 *** | -3.8728 *** |
| Good previous dependent-caregiver relationship | 0.7972 *   | 0.8364 **   | 1.9250 ***  | 0.9966 **   |
| Kinship of caregiver with respect to dependent |            |             |             |             |
| Spouse                                         | 0.8342 *** | 1.8930 ***  | 0.9583 **   | 2.6736 ***  |
| Son/Daughter                                   | 0.5358 *   | 0.7555 *    | 0.6396 *    | 1.2598 **   |
| Son/Daughter-in-law                            | -0.7244    | 1.2804 ***  | 0.9975      | 1.1083      |
| Selection terms                                |            |             |             |             |
| λ11                                            | -0.7416    |             |             |             |
| λ12                                            | 0.2352     |             |             |             |
| λ21                                            |            | 1.5874      |             |             |
| λ22                                            |            | 5.4899 ***  |             |             |
| λ31                                            |            |             | -1.0713     |             |
| λ32                                            |            |             | 0.5549      |             |
| λ41                                            |            |             |             | -1.3434     |
| λ42                                            |            |             |             | -2.6421 *** |
| Constant                                       | 3.1448 *** | 2.6565 ***  | 6.3276 **   | 2.6259 ***  |
| N                                              | 387        | 812         | 87          | 106         |
| (Maximum likelihood) R <sup>2</sup>            | 0.298      | 0.211       | 0.687       | 0.576       |

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 fewer than 2,000 inhabitants. Estimates using sample weights and clusters by region. (\* p<0.10; \*\* p<0.05; \*\*\* p<0.01)

$R^2_{Max. likelihood} = 1 - \left[ \frac{L(M_C)}{L(M_F)} \right]^{2/N}$  where  $L(M_C)$  is the likelihood of the restricted model (only constant) and  $L(M_F)$  is the likelihood of the full model.

**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)                               | 0.0825      | 0.1713      | 0.0357     | -0.1934     |
| Lives alone                                    | -0.4023 *** | -0.5090 *** | -0.2312    | -0.7115 **  |
| Pathologies                                    |             |             |            |             |
| Mental illness                                 | 0.2270 *    | 0.3106 **   | 0.0648     | 1.1834 ***  |
| Cancer                                         | 0.2136      | 0.1320      | -0.5427 ** | 0.9518 **   |
| Respiratory problems                           | 0.0654      | 0.1715      | -0.0649    | -0.4803 *   |
| Osteoarticular problems                        | 0.1539 *    | -0.0656     | -0.1224    | -0.1712     |
| Cardiovascular disease                         | 0.0823      | -0.1344     | -0.1086    | 0.2171      |
| Degree of dependency                           |             |             |            |             |
| Moderate. Level 1                              | 0.0476      | -0.0405     | 0.1622     | 0.0954      |
| Moderate. Level 2                              | 0.2092 *    | 0.5230 **   | 0.4890 **  | 0.7077 **   |
| Severe. Level 1                                | 0.0732      | 0.7700 ***  | 0.8302 **  | 1.4625 **   |
| Severe. Level 2                                | 0.6066 *    | 1.0875 **   | 1.1659 **  | 1.5393 **   |
| High. Level 1                                  | 0.6513 **   | 1.2946 **   | 1.2785 **  | 1.7400 **   |
| High. Level 2                                  | 0.7432 **   | 1.3357 *    | 1.2830 *** | 1.7516 **   |
| Male (caregiver)                               | -0.1542     | -0.5933 **  | -0.0749    | -0.4647 **  |
| Children under 18 years living at home         | -0.0045     | -0.1444 *** | 0.1102     | -0.3507 *** |
| Number of caregiving years                     |             |             |            |             |
| 2-4 years                                      | 0.1240 **   | 0.1253      | 0.1688     | 0.2117      |
| 5-12 years                                     | 0.0646      | 0.1836      | 0.2338     | 0.4547 **   |
| >12 years                                      | 0.2822 **   | 0.3396 **   | 0.2547     | 0.5108      |
| Permanent caregiver                            | 0.0701      | -0.0437     | 0.0128     | -0.3154 **  |
| Good previous dependent-caregiver relationship | -0.1849     | 0.2458 **   | 0.0091     | 0.3432 **   |
| Kinship of caregiver with respect to dependent |             |             |            |             |
| Spouse                                         | 0.3934 **   | 0.4761 ***  | 0.4039 *   | 1.2033 ***  |
| Son/Daughter                                   | 0.1873 **   | 0.3117 **   | 0.2519 **  | 0.7037 **   |
| Son/Daughter-in-law                            | 0.0377      | 0.0308 **   | 0.9301 *** | 0.7078 **   |
| Selection terms                                |             |             |            |             |
| λ11                                            | 0.3183      |             |            |             |
| λ12                                            | -0.2341     |             |            |             |
| λ21                                            |             | -0.9271 *   |            |             |
| λ22                                            |             | 0.2854      |            |             |
| λ31                                            |             |             | 0.8750 *   |             |
| λ32                                            |             |             | -0.4147    |             |
| λ41                                            |             |             |            | 0.4639      |
| λ42                                            |             |             |            | -1.2126 *** |
| Constant                                       | 1.3138 ***  | 2.0831 ***  | 0.1079 *** | 2.8009 ***  |
| N                                              | 663         | 379         | 202        | 110         |

|                                     |        |        |        |        |
|-------------------------------------|--------|--------|--------|--------|
| (Maximum likelihood) R <sup>2</sup> | 0.2385 | 0.2816 | 0.4580 | 0.6311 |
|-------------------------------------|--------|--------|--------|--------|

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 fewer than 2,000 inhabitants. Estimates using sample weights and clusters by region. (\* p<0.10; \*\* p<0.05; \*\*\* p<0.01)

**Table 7. Confidence intervals (95%) for the predicted number of caregiving hours in 2004**

| <b>(a) Caregiver: dependent's wife, aged 50 or older (11.17% of the sample)</b> |           |        |           |        |           |        |           |        |
|---------------------------------------------------------------------------------|-----------|--------|-----------|--------|-----------|--------|-----------|--------|
|                                                                                 | FC=0 UN=0 |        | FC=0 UN=1 |        | FC=1 UN=0 |        | FC=1 UN=1 |        |
|                                                                                 | Min.      | Max.   | Min.      | Max.   | Min.      | Max.   | Min.      | Max.   |
| Andalucía                                                                       | 9.701     | 10.140 | 10.960    | 11.408 | 10.131    | 10.806 | 10.951    | 11.541 |
| Aragón                                                                          | 9.024     | 9.396  | 11.148    | 11.622 | 8.230     | 8.851  | 11.116    | 11.758 |
| Asturias                                                                        | 6.760     | 7.068  | 8.762     | 9.248  | 6.466     | 6.865  | 8.742     | 9.333  |
| Baleares                                                                        | 12.683    | 13.123 | 13.903    | 14.364 | 11.557    | 12.177 | 13.871    | 14.572 |
| Canarias                                                                        | 8.759     | 9.098  | 8.647     | 9.084  | 11.442    | 12.032 | 8.671     | 9.169  |
| Cantabria                                                                       | 6.894     | 7.063  | 8.629     | 9.001  | 3.992     | 4.338  | 8.590     | 9.081  |
| C. Mancha                                                                       | 8.390     | 8.679  | 9.012     | 9.321  | 9.492     | 10.125 | 9.016     | 9.411  |
| C. León                                                                         | 8.693     | 9.048  | 8.907     | 9.288  | 7.510     | 7.999  | 8.895     | 9.376  |
| Cataluña                                                                        | 7.562     | 7.971  | 8.929     | 9.322  | 6.313     | 6.760  | 8.906     | 9.409  |
| C. Valenciana                                                                   | 8.891     | 9.240  | 9.583     | 10.039 | 10.332    | 11.061 | 9.590     | 10.143 |
| Extremadura                                                                     | 8.545     | 8.888  | 11.905    | 12.180 | 7.844     | 8.371  | 11.858    | 12.330 |
| Galicia                                                                         | 8.499     | 8.832  | 9.342     | 9.818  | 8.665     | 9.281  | 9.336     | 9.916  |
| Madrid                                                                          | 8.205     | 8.610  | 7.678     | 8.062  | 6.834     | 7.325  | 7.672     | 8.128  |
| Murcia                                                                          | 8.097     | 8.464  | 9.397     | 9.799  | 7.190     | 7.751  | 9.377     | 9.896  |
| Navarra                                                                         | 8.566     | 8.912  | 16.554    | 17.211 | 9.637     | 10.135 | 16.443    | 17.502 |
| País Vasco                                                                      | 7.024     | 7.286  | 7.236     | 7.570  | 6.469     | 6.887  | 7.230     | 7.628  |
| SPAIN                                                                           | 8.694     | 9.079  | 9.646     | 10.091 | 8.791     | 9.423  | 10.441    | 11.622 |

| <b>(b) Caregiver: dependent's daughter, aged 30-49 (22.47% of the sample)</b> |           |       |           |        |           |       |           |       |
|-------------------------------------------------------------------------------|-----------|-------|-----------|--------|-----------|-------|-----------|-------|
|                                                                               | FC=0 UN=0 |       | FC=0 UN=1 |        | FC=1 UN=0 |       | FC=1 UN=1 |       |
|                                                                               | Min.      | Max.  | Min.      | Max.   | Min.      | Max.  | Min.      | Max.  |
| Andalucía                                                                     | 6.722     | 6.984 | 7.320     | 7.657  | 8.638     | 9.131 | 6.866     | 7.607 |
| Aragón                                                                        | 5.600     | 5.795 | 6.001     | 6.222  | 4.676     | 4.984 | 3.011     | 3.409 |
| Asturias                                                                      | 4.289     | 4.402 | 4.219     | 4.428  | 5.914     | 6.376 | 3.064     | 3.329 |
| Baleares                                                                      | 4.457     | 4.704 | 4.912     | 5.138  | 8.888     | 9.806 | 6.694     | 7.232 |
| Canarias                                                                      | 6.310     | 6.534 | 6.890     | 7.401  | 8.179     | 8.590 | 5.259     | 5.811 |
| Cantabria                                                                     | 5.996     | 6.264 | 7.722     | 8.005  | 4.089     | 4.410 | 8.231     | 8.861 |
| C. Mancha                                                                     | 6.375     | 6.577 | 7.234     | 7.505  | 7.120     | 7.791 | 8.409     | 9.210 |
| C. León                                                                       | 5.746     | 5.910 | 5.788     | 6.025  | 4.745     | 5.016 | 4.699     | 5.523 |
| Cataluña                                                                      | 5.172     | 5.467 | 5.947     | 6.331  | 4.785     | 5.095 | 4.171     | 4.631 |
| C. Valenciana                                                                 | 6.188     | 6.427 | 6.502     | 6.809  | 8.633     | 9.194 | 7.350     | 8.044 |
| Extremadura                                                                   | 5.320     | 5.565 | 7.413     | 7.640  | 6.545     | 6.962 | 3.140     | 3.466 |
| Galicia                                                                       | 6.052     | 6.442 | 6.223     | 6.589  | 7.966     | 8.551 | 6.232     | 6.868 |
| Madrid                                                                        | 6.737     | 7.093 | 5.036     | 5.316  | 5.935     | 6.236 | 6.736     | 7.364 |
| Murcia                                                                        | 5.329     | 5.618 | 6.319     | 6.710  | 6.322     | 6.801 | 7.054     | 7.984 |
| Navarra                                                                       | 4.313     | 4.512 | 23.003    | 23.747 | 6.723     | 7.113 | 3.138     | 3.656 |
| País Vasco                                                                    | 5.678     | 5.974 | 5.293     | 5.652  | 5.472     | 5.774 | 6.007     | 6.819 |
| SPAIN                                                                         | 6.019     | 6.298 | 6.657     | 7.063  | 7.114     | 7.609 | 6.074     | 6.774 |

**Table 8. Comparison of the average predicted number of informal caregiving hours with the sample mean, 2004**

|           | Average predicted value | Sample mean |
|-----------|-------------------------|-------------|
| FC=0&UN=0 | 9.8670                  | 7.5501      |
| FC=0&UN=1 | 11.0645                 | 10.0705     |
| FC=1&UN=0 | 10.2254                 | 8.2222      |
| FC=1&UN=1 | 12.7273                 | 13.2303     |

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