

Master thesis

**Informal care and labour force participation among 11 European countries;
A longitudinal analysis using SHARE**

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Introduction

As populations continue to age, the underlying demographic transformations pose a great challenge for the provision and financing of long-term care for the elderly in all societies. Over the next decades, projections in OECD countries foresee an unprecedented increase in the share of those aged 80 years and over, from 4% in 2010 to 9.4% in 2050 (OECD, 2011).

The future need for care will be defined by the number of people with severe disabilities that require assistance in basic activities of daily living. A change in disability prevalence could offset the growing demand for long-term care however evidence suggests that even though severe disability rates have declined in some countries, a growing number of people at older ages in need of care will persist (Lafortune et al., 2007). In addition, an increase in mild disability rates adds to the demand for long-term care as a result of the limited ability to treat cognitive impairment and the accumulating disease burden due to the obesity epidemic (Bernd et al., 2009).

In most countries, the family represents the most important source of care for the disabled elderly. The existing heterogeneity among European countries with respect to state policies that support and/or supplement informal caregiving generates different economic and social results. Bonsang (2008) argues that there is no clear evidence whether formal institutional care and informal care are complements or substitutes and moreover the association between the two changes along a North-South gradient. Reher (1998) characterises the central and northern European countries as areas with “weak family ties” whilst the southern European countries are characterised as areas with “strong family ties”. Family ties refer to family loyalties, commitment and authority as well as intra-generational co-residence and care for the elderly. Cultural differences in traditions and preferences are reflected in the institutional setup among countries (Bolin et al., 2008). In this paper, differences in long-term care policies, the financing and utilization of long-term care services among countries are shown to follow the same North-South gradient.

Informal care and work are both competing for time which is finite. The existing evidence about the relationship between informal care and labour is diverse.

Increasing caring responsibilities for working age carers might result in labour opportunity costs in terms of foregone employment opportunities or a reduction in working hours, especially for individuals providing high intensity of care. The underlying assumption of this

effect is that informal care is determined exogenously and that it cannot be substituted by other formal care options or left unmet.

On the other hand, an increasing labour force participation rate might have an influence on caring activities if the time costs for employed carers are high and thus, individuals choose to substitute informal care with available formal care options (Bolin et al., 2008). Vice versa, unemployed individuals might choose to provide care considering that they incur low time costs. Moreover, a problem of endogeneity arises in the presence of individual unobserved characteristics that are correlated with both informal care provision and labour market behaviour (Casado-Marin et al., 2010). This paper, accounts for this potential reverse causality by implementing an instrumental variables approach on labour force participation and fixed effects estimation on working hours.

In view of the above, the aim of this paper is to analyse the link between informal care provision and labour outcomes in eleven European countries after addressing the potential endogeneity problems resulting from unobserved heterogeneity and reverse causality. The paper addresses the question whether informal care provision generates costs beyond direct monetary payments for the caregiver in terms of foregone labour opportunities and/or hours of work.

In addition, this paper primarily focuses on the impact of the institutional framework on the relationship between informal care and labour market activity across European regions. The different institutional setup among European countries may generate different patterns. Indirect costs associated with informal care provision can arise if the process of human capital accumulation is disturbed (Bolin et al., 2008). An employee that loses a day of work due to caregiving responsibilities suffers not only a daily wage but also the loss of on-the-job training. Consequently, expectations from employers that their employees with caring responsibilities will be more absent and not devoted to their job compromises the employability of the latter and might even lead to premature retirement and permanent drop-out from the labour market. Therefore, access to part-time working can help caregivers combine paid work and caring responsibilities.

The impact of labour market characteristics and the variation in long-term care financing and utilization across countries on the relationship between informal care and employment has been a limited subject of previous studies (Moscarola, 2010). Existing literature using the Survey of Health, Ageing and Retirement in Europe (SHARE) analyses separately geographical country groups (Northern, Continental, South) focusing on the north-south gradient motivated by institutional differences and cultural differences in traditions and “family ties” (Bolin et al., 2008; Crespo, 2007). The main results suggest that a north-south

hypothesis on the impact of informal care provision on employment is not clearly justified. The results, however, may be sensitive to methodological issues and a lack of extensive comparable data and sample selection¹.

This research was motivated by an idea for a more complete analysis of the impact of institutional and cultural variation across countries on the link between informal care provision and employment. The empirical work in this paper is based on data from the first two waves of the SHARE. Following the geographical country classification proposed by Bolin et al. (2008) and Crespo (2007), this paper tests the hypothesis of a north- south gradient in the causal effect of caregiving on employment outcomes in three geographical country groups (Nordic, Central, Southern). Moreover, this research adds to existing evidence by estimating the effect of informal care on employment outcomes in four country groups defined by the actual utilization of available formal care options indicated by the share of dependent individuals using formal care across countries (Highest share, 2nd highest share, Middle, Lowest).

The theoretical background underlying this analysis is based on the basic neoclassical problem of time allocation as extended by Wold and Soldo (1994). According to this model, individuals allocate time among work, leisure and caring activities. This paper starts with a probit estimation with random effects exploiting the panel structure of the dataset assuming that informal care is determined exogenously. If the hypothesis of the exogeneity of informal care holds, evidence suggests that an increase in caring responsibilities will result in a decrease in the available time for work and leisure (Ettner, 1995).

However, considering the possible endogeneity of informal care generated by potential unobserved heterogeneity and reverse causality, an instrumental variables approach is implemented in addition to the baseline probit estimation on labour force participation. Informal care is instrumented by the age and health status of the mother. The age is used to capture health characteristics not reported by measures of health status (e.g. physical activity). The latter in combination with reported health status of the mother are assumed to increase informal care demand from the children without any direct connection with labour market decisions. At the intensive margin (working hours), exogeneity is accounted for with a linear model with fixed effects.

Overall, this research contributes to previous literature by exploiting the panel structure of the available data for the overall population. The empirical work is based on a non-linear

¹ Bolin et al. (2008) use only cross-sectional data from the early release of SHARE (2004). In addition, the paper uses data only on informal care provision outside the household. Similarly, Crespo (2007) estimates the causal effect of “intensive” care reported only for caregiving outside the household on employment.

probit estimation accounting for unobserved heterogeneity with an instrumental estimation and linear probability model estimation with fixed effects. The cross-country group comparison except from the traditional north-south geographical classification, it follows an additional classification defined by the utilization of public long-term care services. The institutional and cultural differences are used to interpret and rationalize the different findings across countries.

The main empirical findings suggest that the impact of informal care on labour market outcome differs across country groups, although the hypothesis of a north-south gradient is rejected. No significant effect was found for Nordic countries. On the other hand, in central Europe, the results revealed a significant negative effect for the overall population and higher opportunity costs for women compared to men. In the southern countries, no effect was found for the overall population however regressions by gender revealed significant labour opportunity costs for both men and women.

The country group classification based on formal care utilization yielded significant negative results for the two groups with the lowest share of dependents using some form of formal care. The assumption of exogeneity could not be rejected in all country group estimations and subsamples.

The intensive margin (working hours) is shown not to be the most crucial source of variation. A significantly negative effect of informal care on working hours was found only for the country group with the highest percentile use of formal care.

This paper starts with an overview of the existing evidence about the link between informal care and labour outcomes. Following, in section 3 the institutional background and the financing and utilization of public long-term care systems are discussed. In section 4, an overview of the data used for the present analysis is provided together with descriptive statistics. In section 5, the methodological approach is described and, finally, the empirical results are reported in section 6. The paper concludes with a discussion on the main findings.

1. Labour effects of caregiving across Europe

In response to the challenges posed by demographic ageing and the sustainability of long-term care systems as well as the targets for higher female labour force participation, several studies have been conducted to examine the relationship between informal care and labour force participation. The evidence provided is often diverse and sensitive to various factors such as methodological issues, data availability and sample selection.

In early studies for the US, Wolf and Soldo (1994) use cross-sectional data for married women and find no significant labour opportunity costs associated with informal care either at the intensive (hours of work) or at the extensive (labour participation) margin. On the other hand, Ettner (1996) finds that co-residential caregiving has a significant large negative effect on women's work hours whilst both studies test for endogeneity and use empirically strong instrumental variables.

Evidence on the impact of informal care on labour force participation using European data has been more recent. Heitmueller (2007) based on cross-sectional data from the 2002 wave of the British Household Panel Survey (BHPS) uses an instrumental variables approach accounting for possible endogeneity of informal care. He obtains a statistically significant decrease in labour force participation by up to 15% for co-residential caregivers. Following a similar approach, Bolin et al. (2008), use data from SHARE (Survey of Health, Ageing and Retirement in Europe) to examine the association between informal caregiving hours to an elderly parent and labour outcomes such as the probability of employment, hours worked and wages. They find that informal care provision is associated with significant costs in terms of foregone labour opportunities and that these effects vary between European countries. The instruments used in their analysis are indicators for parent's health status, age, distance from parent's residence and number of siblings. In general, they cannot reject the exogeneity of informal care in any of their IV-estimations.

Another study focusing on differences within European countries was conducted by Crespo (2007). Using cross sectional data from the first wave of SHARE, she estimates the causal effect of providing intensive care to an elderly parent for mid-life women in two sets of European countries that differ in terms of intensity of informal care provision; the southern countries (Spain, Italy, Greece) and the northern countries (Sweden, Denmark and the Netherlands). Using a simultaneous bivariate probit estimation technique accounting for endogeneity, she finds that caregiving decreases labour force participation by 30% on average for southern European countries and from 30-40% in northern European countries.

The aforementioned studies use cross-sectional data while a second group of studies uses longitudinal data that either test for endogeneity of informal care or use longitudinal methods to control for unobserved heterogeneity. Heitmueller et al. (2010), using a random effect specification accounting for time invariant unobserved heterogeneity and state dependence, find that current co-residential caregiving, but not non co-residential caregiving, is significantly negatively associated with future employment. Casado-Marin, Garcia-Gomez and Lopez-Nicolas (2010), examine the effects of informal care provision on labour market outcomes for middle aged women in Spain accounting for the existence of individual unobserved heterogeneity, state dependence and attrition problems. Their results suggest significant labour opportunity costs that affect mostly women who provide care for an individual within the household and/or provide care for more than 28 hours per week.

In previous literature, as far as I know, there are only few studies that examine the role of institutions in the individual decision making process. Viitanen (2007) focuses on how the availability of publicly supplied residential care and home-help services affects informal care provision rates by country. She finds that formal care substitutes for informal care when it is provided outside of the carer's household and thus, she concludes that an increase in government formal care expenditure suggests a cost-effective way of increasing labour force participation rates. Moscarola (2010), using policy simulations, estimates the influence of the institutional environment on informal caring and work patterns in Italy and the Netherlands. The institutions used consist of three policy options; the "complete" coverage of the basic care expenses, an incentive system towards care giving and an easier access to part-time jobs. Her results indicate that for the Netherlands, where coverage of non medical care is provided by specific insurance plan and part-time jobs are widespread, there is a lower negative causal effect of informal care on labour market participation with respect to Italy where public provision is minimal and access to part-time jobs is difficult.

With this paper I try to add to previous relevant literature by analysing the link between informal care and labour market outcomes on a broader European level and how is that influenced by the institutional framework. I include long-term care system characteristics as well as labour market institutions in an attempt to show how effective these policies are in reducing the trade-off between care and work.

2. Institutional background

According to previous literature on the role of institutions to the link between informal care and labour, Viitanen (2007) finds that generous long-term care financing systems that “cover” basic care expenses lead to a substitution of informal care with formal care and thus, people substitute care with work leading to a lower negative causal relation between care and work. On the other hand, Moscarola (2010) argues that the incentives to provide care, for example a benefit to the caregiver, might lead to a higher negative causal effect of caregiving on labour participation since in the presence of incentives, individuals substitute work with care easier.

As far as I know, there is no extensive literature on policies aimed to help carers combine caring responsibilities with paid work in a European context. Such policies as, for example, the legal right for a paid or unpaid leave or a flexible work schedule, may yield a lower negative causal relationship between care provision and labour. Evidence from the U.S suggests that working at firms that offer unpaid family leave has a positive influence on employment retention among caregivers (Pavalko and Henderson, 2006).

In this section, I will discuss long-term care institutions that exist in European countries and their potential effect on informal care and labour market outcomes.

The institutional data were collected from several national European reports on long-term care systems (Colombo, 2011; ENEPRI, 2010; EUROFAMCARE, 2004-2005; European Commission, 2008; OECD 2011). The set of the most relevant policies as well as data on long-term care expenditure across countries is shown in table 1 hereunder.

Carer's benefit

A carer's benefit is some income paid to carers in order to compensate for reduced working hours and/or for expenses related to caregiving. Even though, any country might reward some kind of compensation to caregivers, the amount and the eligibility conditions differ a lot between countries. In northern European countries (Denmark, Sweden) the amount of compensations is fairly generous while the entitlements are targeted towards more intensive care. In southern countries, compensation directed to the caregiver is less common. Instead, cash benefits to the dependent individuals are more prominent.

Table 1 Informal care institutions and long-term care expenditures across countries

Country	Caregiver receives benefit	Care recipient receives benefit	Paid leave	Unpaid leave	Flexible working hours	Tax benefits	Support or self-help groups for carers	Public long-term care expenditure (% GDP)*	Share of people receiving formal care
Austria	No	Yes	Yes	Yes	Yes	No	Yes	1.3	69%
Germany	No	Yes	No	Yes	Yes	Yes	Yes	0.9	82.2%
Switzerland	No	No	No	No	No	Yes	Yes	1.1	89.4%
Greece	No	Yes	Yes	Yes	No	Yes	No	1.4	70.7%
Spain	No	Yes	Yes	Yes	No	No	Yes	0.5	20.8%
Denmark	Yes	No	Yes	No	Yes	No	Yes	1.7	100%
Italy	No	Yes	-	Yes	Yes	No	Yes	1.7	20.8%
Sweden	Yes	Yes	Yes	No	Yes	No	Yes	3.5	100%
Netherlands	Yes	Yes	Yes	Yes	Yes	No	Yes	3.4	100%
France	No	Yes	Yes	Yes	Yes	Yes	Yes	1.4	66.5%
Belgium	Yes**	Yes	Yes	Yes	Yes	No	Yes	1.5	54.5%

Source: OECD, 2011; EUROFAMCARE, 2004-2005 National Background reports, European Commission, 2008

**Not national level but available in provinces

*Level of 2007

Benefit to dependants

Cash benefits directed to dependants are common in most European countries. These benefits (or part of them) can be used to compensate carers. The amount of the benefit usually depends on the care needs of the dependent individuals. In Spain and Belgium these benefits also depend on income. For France and the Netherlands, the amount of benefit depends on income above a certain level.

Cash benefits directed to dependants might constitute an easier policy in order to reach carers (no need for defining primary caregivers) and a fairer allocation of resources according to need but, there is no guarantee that the given amount will be used to pay caregivers. Restrictions in the use of the benefit and monitoring might influence the way benefits are spent. Cash benefits without monitoring might lead to incentives for caregiving and substitution of work (Moscarola, 20010). On the other hand, closer control might result in a substitution of informal care for formal care avoiding labour opportunity costs.

Tax benefits

In most European countries, tax deductions are allowed as a financial assistance to carers, usually related to certain care-related costs (e.g. drugs).

Paid or unpaid leave from work

Policies towards helping carers to combine care provision with paid work include paid or unpaid leave for carers. Specific conditions and restrictions for leave vary across countries and thus the possible effect of care leave on the employability of carers is diverse. In most countries, paid leave is fairly limited with the exception of Belgium where the longest paid leave up to 12 months is provided. In Scandinavian countries, leaves are paid the most. In Sweden, paid leave is equivalent to 80% of the wage.

Regarding unpaid leaves, one or more years are granted in Belgium, France and Spain. Even though care leaves are long in these countries, for Spain, the use of it is not a statutory right and thus it may be refused by employers. Similarly, in France, eligibility criteria are very strict. In the Netherlands, unpaid leave is only provided for up to three months while in Austria and Germany, a six month leave can be provided.

Flexible working hours

Except from care leaves, flexible working arrangements may help caregivers to remain in the labour market while they provide care to a dependent person. Significant variation in the use of part-time work across countries and sectors imposes a limitation when the effect of such a policy on the causal relationship between care and work is examined.

Support or self-help groups

Support groups aim to relieve caregivers from stress associated with caring responsibilities. Usually, this form of support is provided through local initiatives. Indirectly, improving the physical and mental state of caregivers may help care duties to be a viable option in combination with participation in the labour market.

Public long-term expenditure

This variable is used in order to “capture” the availability of formal care across countries. Public expenditure on long-term care consists of the following elements (European Commission, 2008):

- long-term nursing care services
- social services of long-term care that covers “a range of services of care assistance aimed predominantly at providing help with instrumental activities of daily living restrictions to persons with limited ability to perform these tasks on their own”.

The long-term nursing care services include services provided to persons who depend on help with basic activities of daily living (i.e. bathing, dressing, eating, moving around and using the bathroom) due to physical or cognitive limitations. Frequently, basic medical care is also provided such as pain management, medication etc. In addition, long-term care services, according to the setting in which they are provided, can include some level of home help such as help with the household, shopping, social activities and transport.

Social services of long-term care consist of home help and residential care services targeted to people with functional limitations and unable to perform daily living tasks.

Finally, the data on the utilization of formal care reflect not only whether the publicly financed formal care services suffice for the number of dependent individuals residing in each country but it also reflects preferences and cultural norms. Often, in southern countries where “family ties” as mentioned in the introduction are stronger, dependents might deny any form of non-medical formal care.

3. The data

I use data from the first two waves (2004 and 2006/2007) of the Survey of Health, Ageing and Retirement in Europe (SHARE). Eleven European countries participated in the baseline study constituting a balanced representation of the various regions in Europe, ranging from Scandinavia (Denmark and Sweden) through Central Europe (Austria, France, Germany, Switzerland, Belgium and the Netherlands) to the Mediterranean (Spain, Italy and Greece). The SHARE includes health variables (e.g. self-reported health), economic variables (e.g. current work activity, job characteristics, income, housing, education) and social support variables (e.g. assistance within families, informal care). In addition, the survey contains a rich set of other variables, for instance, age, gender, marital status, number of children, number of siblings, and age of parents. The number of observations per country varies from 700 to 2400 individuals, depending on the wave.

Since I am interested in working age individuals, the sample has been limited to the 50 to 60 age group. Even though in previous literature most analyses exclude male carers, both genders are represented in the sample. It is expected that cultural beliefs among the 11 European countries force the two genders in a different role with respect to informal caregiving. However, women are, on average, better represented in the sample and this needs to be considered carefully when interpreting the results of the analysis (Table A.1).

3.1 Informal care

Informal care is defined as unpaid care given to an individual inside or outside the household. The respondents were first asked whether in the last 12 months they have personally given any kind of help to a family member from outside the household, friend or neighbour. If the respondents answered yes, they were next questioned about the type of care they had provided; personal care, practical household help or help with paperwork. For the purpose of the analysis in this paper, informal care is defined as provision of personal care only e.g. dressing, bathing or showering, eating, getting in or out of bed, using the toilet.

Regarding informal care provision inside the household, the respondents were asked whether there is someone living in their household whom they have helped regularly during the last twelve months with personal care such as the tasks described above.

The intensity of informal care in terms of hours of care given to a dependent individual was only recorded for caregiving outside the household. How the chosen definition of informal care as well as the exclusion of a measure of intensity of care impacts results are further discussed in the discussion part.

3.2 Labour market outcomes

The labour market outcomes analysed in this thesis are two; (1) The probability of being in employment and (2) actual hours worked. The probability of being in employment is defined by whether an individual reports being employed or self-employed as her/his current job situation. To obtain the amount of actual hours worked, the respondents were asked to state how many hours a week they usually work regardless of their basic contracted hours (excluding meal breaks but including any paid or unpaid overtime).

Figure 1 and Figure 2 hereunder show the labour force participation rate and the percentage of informal caregivers for men and women by country. Labour force participation and informal care provision varies substantially across Europe; in Scandinavia and central parts of Europe higher participation rates and lower percentages of informal care provision are more common while moving to the Mediterranean countries, participation rates decline sharply and informal care provision increases. The highest participation rate and the lowest informal care provisions for women are found in Sweden (78% and 13%, respectively), with Denmark and Switzerland close behind in labour force participation and informal care provision respectively (74% and 15%). Informal care provision is roughly twice as high in

Italy and Spain as in Sweden (26%). In turn, the lowest female participation rates are found in Italy, Spain, Greece and Austria. For men, participation rates are, on average, higher than those for women while informal care provision tends to be lower. Interestingly, one can see that the southern pattern in informal care shown earlier for women slightly changes with Greece having the lowest male informal care provision rate across Europe (6%).

Figure 1 Female Informal care and Labour Force participation across Europe

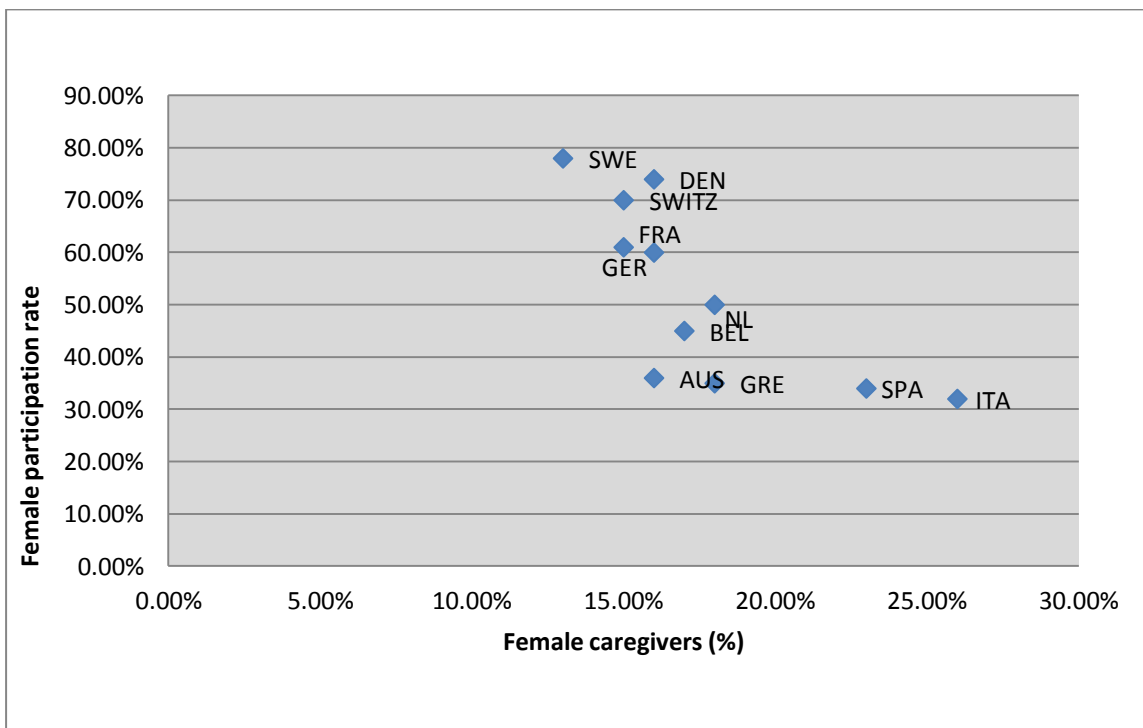
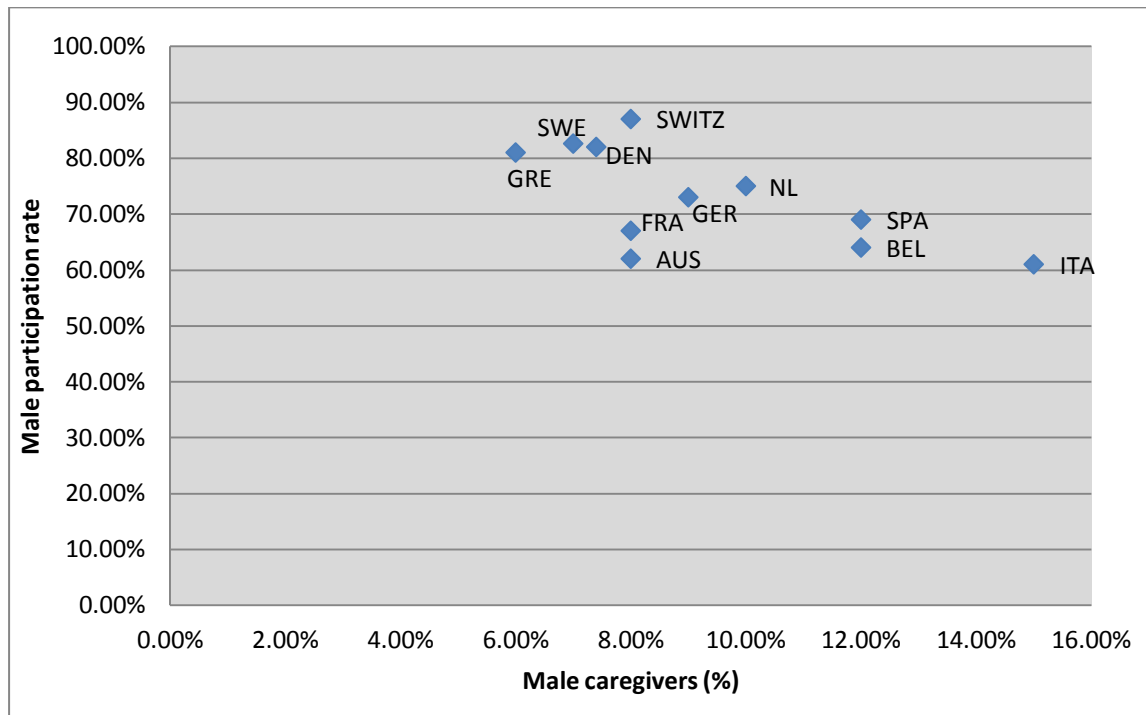


Figure 2 Male Informal care and Labour Force participation across Europe



The average number of working hours per week conditional on being in employment among the eleven European countries is shown in Table A.2. In some countries, workers appear to work considerably more than others. In Austria and Sweden, workers work on average 40.62 and 40.06 hours per week respectively, while in the Netherlands workers appear to work the lowest hours among Europe (34.3 hours per week).

Table A.3 shows the labour force participation between caregivers and non-caregivers by country and gender. We observe that in most countries the percentage of working individuals is higher among non-caregivers as compared to caregivers. If we distinguish by gender, we observe a greater difference for men compared to women. In Austria, the male labour force participation is 19 percentage points higher for non-caregivers compared to caregivers while there is no difference between female caregivers and non-caregivers.

3.3 Other variables

Other variables were included in the analysis to control for constant or time varying individual characteristics that affect labour market behaviour and caregiving. These economic and

socio-demographic variables are: gender, age, age squared, marital status, number of children, household size, education, income of other household members, health status and country of interview (Table A.4). Age is calculated based on year of birth as reported by the respondents and the year of interview.

Respondent's education is classified into 3 categories based on the 1997 International Standard Classification of Education ISCED-97 coding used by SHARE. This coding takes values from zero (=pre-primary education) to six (=second stage of tertiary education).

Health status controls include a measure of self-assessed health (sah), number of chronic diseases and depression as a measure of mental health.

Several limitations using subjective, self-reported measures of health are widely recognised, ranging from considerable response errors to uncertain level of comparability across individuals (Currie and Madrian, 1999; Baker et al., 2004). Many researchers acknowledge chronic conditions as a more objective and thus, preferable measure. However, this measure might also be associated with measurement errors (Baker et al., 2004). Therefore, use of both objective and subjective measures in the analysis is considered most appropriate.

Depression is defined based on the EURO-D scale which was developed for a valid comparison between European countries (Prince et al., 1999). The scale ranges from a minimum score 0 to a maximum score 12 denoting the number of relevant symptoms. A clinically validated cut off score of 4 was used to specify depression (Castro-Costa et al., 2007).

As an income determinant, the use of family wealth (accumulated income from other household members) is justified in the presence of possible endogeneity that leads to biased estimates when using personal income due to the obvious relationship from labour status to income (including earnings). Income quintiles based on family wealth were further constructed for a valid cross-country comparison.

Table A.5 shows descriptive statistics of the variables included in the analysis, separated for caregivers and non-caregivers. It is shown that on average across Europe, the labour force participation rate among caregivers is 8.3 percentage points lower compared to non-caregivers. At the intensive margin, it is shown that non-caregivers work per week on average 1.62 hours more than caregivers conditional on being in employment. Informal care provision seems to be dominated by women (69% of total caregivers). Other characteristics, such as education and health status, show that caregivers have lower education levels

compared to non-caregivers and lower health status. In addition, caregivers belong to bigger families even though it is shown that they have on average fewer children. Nonetheless, the latter differences are small.

Table A.6 shows the correlation matrix for the variables that explain labour market participation. Overall, the relationships do not show significantly high correlation. Moreover, the direction of the correlations is not surprising for the total of the included variables. The negative correlation between employment status and age is explained by the age range of the individuals participating in the sample. The most interesting correlations can be seen at the first column. It seems that labour behaviour is mostly correlated with age, gender, education and health status. The correlation with informal care is smaller but it has a negative direction as expected from previous published research.

3.4 Instruments

The variables for the age of mother, age of father, number of siblings, health status of mother and health status of father are assumed to influence informal care whilst they do not directly affect labour participation (table A.7). The aforementioned variables have been used as instruments in previous literature and are shown to influence informal care behaviour (Bolin et al, 2008; Crespo and Mira, 2010).

The age of the parents is assumed to be associated with informal care considering that any of their health characteristics not captured by health reported variables (physical activity, eyesight etc.) deteriorate by age posing an increasing demand for informal care provided by the children.

Regarding parental health status, respondents were asked to describe the health of their parents in a 5 point scale from very poor to very good health. Following, a dummy variable for bad health of the parent was created taking value 1 if the respondents described their parents' health as poor or very poor and value 0 otherwise. The health status of the parent is expected to influence the demand for informal care whilst not influencing directly the labour market behaviour.

Last, in the presence of other siblings, the caregiving responsibilities are expected to be equally divided between the siblings (Ettner, 1995) and thus, additional siblings are associated with less caring responsibilities and vice versa.

4. Methods

4.1 Theoretical background

According to the basic neoclassical model of labour supply, total time (T) is allocated between labour and leisure (L). Each individual chooses hours of work, rewarded at a fixed wage rate of w , so as to maximize utility derived from leisure and consumption of goods X , subject to a budget constraint that is defined by non-market income Y and wage rate w . For the purpose of the analysis, this model is expanded to include the caregiving role in the decision making process for the potential caregiver.

In line with the model explained by Wolf and Soldo (1994), individuals allocate time to labour, leisure and informal care provision. The latter can be assumed either as exogenous to the time allocation problem or as endogenous partially depending on employment and other obligations. The endogeneity of informal care occurs, for example, when individuals who work might provide less informal care because of higher opportunity costs.

Informal caregiving time is determined exogenously when for example, the individual is obligated to provide care and the burden of caring is equally divided between other family members. In that case, increasing care obligations will result in a decrease in the total amount of time available for other activities and thus work and/or leisure should decrease (Ettner, 1995).

In the present theoretical approach, it is assumed that informal care (IC) is determined exogenously. In addition, the model includes formal care (FC) as a substitute for informal care (IC). In this context formal care (FC) is also assumed to be exogenous. Thus, subject to informal care responsibilities and formal care availability, individuals choose hours of work or leisure. The time allocation problem described above can be summarized in the following maximisation problem where individuals choose the number of hours of work and consumption in order to maximize their utility function:

$$\text{Max } U = U(L, X, FC, IC) \quad (1)$$

$$\text{Subject to the budget constraint: } w(T-L-IC+FC) + Y = X \quad (2)$$

I obtain optimum conditions by maximising the following Lagrangian equation:

$$\text{Max } \mathcal{L} = \max U(L, X, FC, IC) + \lambda (w(T-L-IC) + Y - X) \quad (3)$$

With respect to L (leisure), X (consumption), FC (formal care), IC (informal care)

First order conditions (FOC) are:

$$U_L = \lambda w \quad (4)$$

$$U_X = \lambda \quad (5)$$

Where λ is the Lagrangian multiplier and U denote first derivatives with respect to the subscript.

Assuming a certain utility functional form, the labour supply function and demand function for consumption are derived from the equations (4) and (5). Thus, the labour supply function is estimated as a function of wage (w), income (Y), informal care (IC) and formal care (FC).

$$L^* = L(w, Y, IC, FC) \quad (6)$$

The above labour supply function formulates the basis of the empirical model estimated in this paper. Formal care was not included in the empirical model since SHARE data do not provide direct information about formal care use. However, expenditure in long-term care among countries is used as a proxy for formal care availability.

4.2 Econometric models

Taking into account that participation in the labour market is a binary dependent variable (1 if employed or self-employed, 0 otherwise), a probit model is used in order to estimate the probability of participating in the labour force. Linear regression models are inappropriate since they might yield negative predicted probabilities and/or above 1.

When estimating working hours, conditional on being in employment, an ordinary least square estimator (OLS) is first used. Exploiting the panel nature of the data, a random effects model and a fixed effects model were further estimated.

4.2.1 Labour force participation

A probit model estimates an unobserved latent variable L^* that stands for the individual propensity to be in employment.

The latent variable is modelled as a function of informal caregiving, observable and unobservable individual characteristics and an error term as follows:

$$L_{it}^* = \alpha_i c_{it} + \beta' X_{it} + a_i + \varepsilon_{it} \quad (8),$$

where i represents individuals and t represents years, c_{it} is the dummy variable denoting that the individual i is an informal caregiver in period t , X_{it} includes socio-demographic observed characteristics that potentially influence labour market behaviour such as age, gender, marital status, education, income etc., a_i accounts for the individual specific time-invariant unobservable characteristics that influence labour force participation and ε_{it} accounts for the residuals normally distributed.

If $L_{it}^* \geq 0$, the probability of being employed or self-employed is given by the following function:

$$\Pr(L=1|c, X) = \Phi(\alpha_i c_{it} + \beta' X_{it} + a_i), \quad (9)$$

where $\Phi(\cdot)$ is the distribution function of normal distribution.

Considering the panel structure of the data, a random effects probit estimator is first employed. At this point I make the following assumptions:

- a) The a_i and the explanatory variables (c_{it} , X_{it}) are independent
- b) The explanatory variables are strictly exogenous
- c) a_i has a normal distribution
- d) $L_{i1}^*, L_{i2}^* \dots L_{iT}^*$ are independent conditional on (c_{it} , X_{it} , a_i)

The above assumptions can be very restrictive. In case there is a correlation between the explanatory variables and the unobserved individual characteristics, the pooled and random effects probit models yield biased and inconsistent estimates (Wooldridge, 2002). For example, some people feel morally obliged to provide care to a dependent person or they might be in an anticipation of a bequest (Angelini, 2007). These individual unobserved factors included in the error term lead to estimates that are no longer unbiased.

It is often stressed in previous literature that informal care provision and labour participation might be endogenous (Heitmueller, 2007). Casado et al. (2010) identify two reasons for the presence of endogeneity of informal care. One of them relates to the simultaneity of the

individual decision making to provide informal care and to participate in the labour market both competing for the potential caregiver's time. Secondly, the problem of endogeneity might arise in the presence of unobserved individual characteristics influencing both the propensity to provide informal care and the propensity to work.

The endogeneity as described above, can be dealt with the use of panel data and a fixed effects approach that isolates individual unobserved heterogeneity that is fixed over time (Cameron and Trivedi, 2010). However, in the present non-linear setting, a fixed effects approach imposes several technical challenges since the model parameters suffer from the incidental parameters problem that biases the estimates (Neyman and Scott, 1948; Heckman, 1981 Fernandez-Val, 2009)². Thus, the baseline analysis is limited to a pooled probit and a random effects probit specification.

A pooled model is preferred over a random effects model when there are no unobserved effects at all. That is the case if we assume that the model has been so well specified that the error term consists only of the random error term ϵ_{it} and there is no a_i (Dougherty, 2007). Applying a Breusch-Pagan test³, the null hypothesis of no random effects was rejected implying that the random effects approach is more appropriate.

4.2.2 Actual working hours per week

The respondents were asked about the number of actual working hours per week, conditional on being on employment. Considering the panel structure of the data, a random effects linear estimator is first applied. The working hours' equation is given below:

$$h_{it} = \alpha_i + c_{it} + \beta'X_{it} + b_i + \epsilon_{it} \quad (10),$$

where i represents individuals and t represents years, c_{it} is the dummy variable denoting that the individual i is an informal caregiver in period t , X_{it} includes socio-demographic observed characteristics that influence labour market and informal care provision such as age, gender, marital status, education, income etc., b_i denotes unobserved time-invariant individual characteristics affecting actual working hours per week and $\epsilon_i \sim N(0, \sigma^2)$.

As described in section 4.2.1, possible endogeneity of informal care is dealt with a fixed effects approach isolating unobserved heterogeneity that is fixed over time.

² This problem occurs because unobserved individual effects are replaced by sample estimates. In non-linear models the estimation of the model parameters cannot be separated from estimation of individual effects.

³ The test is not appropriate for non-linear models thus; it was applied after a random effects linear probability model (LPM).

In linear models, a Hausman test is the most popular endogeneity test following a linear model with fixed effects and a linear model with random effects. However, the validity of the test is not completely justified. The conventional Hausman test might be subject to statistical problems if the within variation is not sufficient (Hahn et al., 2010). According to Hahn et al. (2010), if the within variation is not sufficient, the fixed effects estimates might not be asymptotically normal and thus, invalidating the basic assumption of the Hausman test. In the present data, it is expected that the within variation is indeed small since only two waves were included in the analysis and therefore it is assumed that individuals do not change status easily from one year to the other.

5. Results

In order to investigate differences in the effect of informal care provision on employment among European countries, the empirical models described in section 4 were estimated for specific country groups. The choice to look at country pools was mainly driven by the low number of observations per country as well as the presence of differential effects of informal care provision on employment by geographical country groups found in previous literature (Crespo, 2007; Bolin, 2008). In addition to geographical country groups, in an attempt to see empirically how the institutional framework existent in each country influences the link between informal care and employment, the same model specifications were estimated for country groups based on formal care use by the dependent individuals.

5.1 Labour force participation results by geographical country groups

In line with Bolin (2008), in order to test whether the differential effects of informal care provision on employment outcomes differ according to a north- south gradient, three geographical country groups were constructed as follows:

1. Nordic (Sweden, Denmark)
2. Central (Germany, Switzerland, France, Austria, Belgium, the Netherlands)
3. Southern (Spain, Italy, Greece)

Assuming informal care is exogenous, random effects probit models were estimated for each respective country group.

Considering that the scale of the probit model is arbitrary, in order to talk about the magnitude of the impact of informal care provision in the different European country groups, table A.8 (Figure A.4) shows the estimated average marginal effects for the full sample. These estimates measure the average effect of informal care provision in each country member of the respective group on the probability of being in employment for the overall population. However, as shown in the descriptive analysis (Figure 1, Table A.3) women are often assigned the main caregiving role perhaps due to such persistent social norms across countries and therefore, it is interesting to see how the results differentiate between the two genders. In tables A.9 and A.10 the average marginal effects for men and women separately are presented.

It is shown that, on average, there is no statistically significant effect of informal care provision on the probability of being in employment in the Nordic countries for the full sample as well as for both men and women separately.

On the contrary, in central Europe, the effect of informal care provision on employment was found significantly negative implying that informal carers in central Europe have, on average, a lower probability of being in employment by 4.1 percentage points than non-carers.

The regressions performed for men and women separately revealed that women in central Europe find it harder to combine informal care provision and work than men. It is shown (table A.9, A.10; Figure A.4) that female caregivers have on average a lower probability of being in employment by 8.1 percentage points compared to female non-caregivers, while for men, the negative effect of informal care provision on employment was estimated at 7.7 percentage points.

For the population residing in southern Europe, no statistically significant effect was found for the full sample. However, when analyzing the two genders separately, it was shown that both men and women face a significant negative effect of informal care provision on the probability of being in employment. This effect is on average almost double for men than women with a lower probability of employment by 12.2 and 6.6 percentage points respectively, compared to men and women non-caregivers *ceteris paribus*.

Following the aforementioned results, the persistence of differential effects between the two genders was further tested with the inclusion of a variable for intensity of care when individuals report that they provide informal care for more than 16 hours per week⁴.

When intensity of care was included in the previous model specifications, a significantly negative effect of informal care provision on employment was found, almost the same in magnitude for male and female intensive caregivers residing in central Europe compared to their corresponding peers. For the two genders, intensive caregiving outside the household was estimated to decrease the probability of employment on average by 24.3 and 24.1 percentage points for men and women respectively.

In southern Europe, the coefficient of intensity of care was found statistically insignificant for the two genders.

Comparing the results between geographical groups, the estimated average marginal effects by gender revealed that in central Europe women bear a higher burden of caregiving by incurring larger labour opportunity costs compared to women residing in southern Europe while men in southern Europe seem to find it harder to combine informal care provision and work than their corresponding peers in central Europe.

Overall, it is shown that the effect of informal care provision on labour force participation differs across geographical country groups in Europe. In Nordic countries no significant effect of informal care on employment was found while in central Europe caregivers from the overall population bear significant labour opportunity costs. Regressions by gender revealed that women in central Europe bear a greater burden compared to men residing in the same geographical group. When intensity of care is taken into account, the negative effects on both genders persist though the difference in magnitude eliminates. In southern Europe, no significant effect was found for the full sample, however, regressions performed by gender revealed significantly negative effects of informal care on employment for men and women with the effect for the first being almost double than the effect for the latter. Compared to men and women residing in central Europe, female caregivers in southern countries were found to incur a lower caregiving burden while male caregivers bear a far greater burden than their corresponding peers residing in central European countries.

⁴ The available data referred to caregiving hours outside the household. In central Europe, 11.29% of women and 10.79% of men provide intensive informal care outside the household. In southern Europe, 24.8% of women and 23.08% of men provide intensive care outside the household.

5.2 Labour force participation results by country groups based on formal care use

The mere availability of formal care options does not imply that the latter are sufficient or that these are used effectively from the dependent individuals. Thus, the actual share of the dependent individuals who receive some sort of formal care in each country is used to construct four country groups as follows:

1. Highest share (Sweden, Denmark, the Netherlands)
2. Second highest share (Switzerland, Germany)
3. Middle share (Greece, Austria, France)
4. Lowest share (Spain, Italy, Belgium)

Assuming informal care is exogenous, random effects probit models were estimated for each respective country group. The estimated average marginal effects for the full sample are shown in Table A.11-Figure A. 5.

It is shown that for individuals residing in the two country groups with the highest percentile use of formal care, there is no statistically significant effect of informal care provision on the probability of being in employment. When analyzing the two genders separately, the average marginal effect of informal care provision remains insignificant for both men and women (Table A.12, A.13; Figure A.5). Nonetheless, when intensity of care is taken into account, it was found that male caregivers residing in the country group with the 2nd highest share bear a significantly negative decrease in the probability of employment by 23.6 percentage points compared to male non-(intensive) caregivers residing in the same country group.

For the last two country groups with a lower average share of dependents using formal care, the country group regressions revealed a statistically significant negative effect of informal care provision for the full sample. Caregivers residing in the group with a middle share of dependents using formal care bear significant labour opportunity costs with an average 6.1 percentage points lower probability of being in employment than non-caregivers. The same model specifications for men and women separately revealed that the male and female caregivers bear roughly the same labour opportunity costs with a decrease in the probability of being in employment by 16.3 and 16.5 percentage points respectively.

However, when intensity of care is taken into account⁵, female intensive caregivers residing in the middle share group have on average a lower probability of employment by 29.8

⁵ In the middle share group, 14.4% of women and 11.3% of men provide intensive informal care outside the household (more than 16hours/week). In the lowest share group, 19.7% of women and 16.9% of men provide intensive informal care outside the household.

percentage points, *ceteris paribus*. For men, the effect of intensive caregiving results in a statistically significant 31.1 percentage points decrease in the probability of employment.

In the last group of countries where the share of dependents using formal care is the lowest, it was found that the probability of employment is on average 4.9 percentage points lower compared to non-caregivers residing in the same country group. The regressions performed for the two genders separately showed that male and female caregivers bear the same labour opportunity costs with an average decrease in the probability of being in employment by 8.9 percentage points, *ceteris paribus*. However, when accounting for the intensity of care, it was found that women who are intensive caregivers outside the household suffer a decrease in the employment probability by 16.9 percentage points while for men the effect of intensive caregiving is lower with a decrease in the employment probability by 12.9 percentage points.

Overall, it was shown that informal care provided by individuals residing in the two country groups with the lowest percentile use of formal care, leads to significant labour opportunity costs. Regressions performed by gender reveal a similar in magnitude statistically significant negative effect of informal care. Nevertheless, when intensity of care is taken into account, men seem to bear a greater burden of caregiving than women residing in the 2nd highest and middle share country group while for the lowest share groups, the results reveal the reverse with female intensive caregivers incurring a bigger decrease in their probability of employment compared to male intensive caregivers.

Other explanatory variables

In order to estimate the impact of informal care provision on labour force participation, other observed characteristics that might affect both the employment and caregiving decision have been controlled for. The aforementioned characteristics are demographics and socio-economic determinants such as age, gender, marital status, children, household size, education, income levels and health status variables. In tables A.8-A.13 the estimated average effects of the explanatory variables on the probability of being employed or self-employed are shown for the respective population and country groups.

Overall, where statistically significant, none of the estimated average effects is surprising in terms of magnitude and/or sign. Starting from age, in all subsamples, the negative estimate of the quadratic term indicates significant diminishing average effects of age on the probability of being employed. The correct interpretation of quadratic terms in non-linear

models requires further calculations (Norton et al., 2004) which are beyond the scope of our analysis and thus, we only make reference to the significance and sign of the coefficient.

In subsamples where they are statistically significant, the dummy variables for gender and marital status indicate that on average single women are significantly less likely to be employed. Education average effects have the expected impact on the probability of employment with statistically significant negative coefficients for low and middle education levels showing that individuals with lower levels of education are significantly less likely to be employed compared to highly educated individuals.

Regarding health status determinants, the estimated negative average effect of health status on the probability of being employed gradually increases in magnitude from “good” till “poor” self-assessed health indicating that the worse the self-assessed health status of the individuals, significantly lower the estimated probability of being in employment on average compared to individuals who report very good self-assessed health status at the respective subsamples. Mental health has also a negative influence on the probability of being in employment, *ceteris paribus*. Being depressed decreases the probability of being employed on average compared to individuals who are not depressed. Similar results are found for chronic conditions as an objective measure of health.

5.3 Instrumental variables approach accounting for endogeneity

Informal care was assumed as exogenous for the estimation of the previous specifications. However, in the present non-linear setting possible endogeneity in the labour force participation of informal caregivers is best dealt with an instrumental variables approach⁶.

5.3.1 Instrumental relevance and validity

The variables for the age of the parents, their health status and the number of siblings have been shown in previous literature as proper instruments (Bolin et al., 2008). Nevertheless, the reliability of the IV estimates depends on the appropriateness of the instrumental

⁶ In non-linear models a fixed effects approach imposes several technical challenges since the model parameters suffer from the incidental parameters problem that biases the estimates (Neyman and Scott, 1948; Heckman, 1981 Fernandez-Val, 2009).

variables in terms of validity and relevance. From the aforementioned variables, the age and the health of the mother have the highest correlation comparatively and thus, the analysis focuses on these two instruments. Following Norton et al. (1998), the instruments should be first correlated with the endogenous variable in the first stage regression. It is shown that for all the respective subsamples, the selected instruments are statistically significant at the conventional level of 5% significance at the first regression⁷ (tables A.14-A.16).

Compared to linear instrumental approaches, no rule of thumb exists in the present non-linear setting similar to the F-statistic rule of Staiger and Stock (1997) for joint significance⁸. However, based on linear first stage regression (2SLS) estimates, the F-test for joint significance revealed that the selected instruments predicted well in most of the subsamples while for others there is an indication that the instruments are weak with a relatively small F-test⁹ (tables A.14-A.16).

It is argued that the instruments are uncorrelated with unobserved characteristics influencing labour market behaviour and thus, the instruments are assumed to be valid. However, considering that two instruments were selected for the instrumental estimation, a test over-identifying restrictions was implemented for each of the subsamples (tables A.17-A.19) following a two-step probit regression. The over-identification test provides a way of testing the validity of the instruments. It is not entirely possible to test the assumption that there is no correlation between the instruments and the error term, nonetheless, acceptance of the null hypothesis of over-identifying restrictions implies there is significant evidence for the validity of the instruments (Cameron and Trivedi, 2010). In all subsamples, the test fails to reject the null hypothesis of valid exclusion restrictions implying that the assumptions about the appropriateness of the instruments are strong.

Overall, the two selected instruments are assumed relevant and valid for the majority of the subsamples with the exception of the previously mentioned subsamples of men and women residing in the Nordic countries and the subsamples of individuals residing in the highest and middle share country groups where the F-statistics indicate weak instruments. According to empirical and theoretical evidence (Stock et al., 2002) an instrumental regression with weak instruments might yield worse results than an OLS and thus, the results for the above subsamples need to be interpreted with caution.

⁷ For the subsample of men residing in the Nordic country group and the subsample of men residing in the middle share group, at least one of the two instruments was found statistically insignificant.

⁸ Staiger and Stock (1997) propose a rule of thumb for relevant instruments with an F-statistic that is bigger than 10 for one endogenous regressor.

⁹ Small F-statistics were found for the subsample of men and women residing in Nordic countries and the subsample of individuals residing in the highest and middle share group.

5.3.2 Instrumental probit regression results

Assuming that informal care might be endogenous, a two-step instrumental probit regression was estimated for each respective subsample using the age and the health status of the mother as instruments for informal care provision. The marginal effects of informal care provision on employment are shown in tables A.17-A.19. The results, compared to the random effects probit model estimates in sections 5.1-5.2 are very different. Being a caregiver does not seem to have a significant effect on employment for the majority of the subsamples. The instrumental regressions revealed significantly positive effects of informal care provision in the subsamples with the Nordic countries, the highest and the middle share group of countries for the full sample as well as for the two genders separately. However, the validity of the instruments in the aforementioned country groups is not justified (section 5.3.1).

Moreover, in all estimations the Smith-Blundell test could not reject the null hypothesis of exogeneity. Therefore, the specifications where informal care is treated as exogenous are supported.

5.4 Effects of caregiving on number of hours worked

This section reports the estimates of the impact of informal care provision on actual weekly working hours for the previously examined country pools. Considering the panel structure of the data, random effects linear models were first estimated for the respective country groups (tables A.20-A.25).

For all geographical country groups, no statistically significant effect of informal care on actual working hours per week was found for the full sample as well as for men and women separately.

Similarly, the regressions by country groups based on formal care use revealed no statistically significant effect of informal care on working hours for the full sample in all country groups. However, when analyzing men and women separately, it was found that female caregivers residing in the country group with the highest percentile formal care use incur labour opportunity costs in terms of foregone working hours. Thus, female caregivers residing in Sweden, Denmark or the Netherlands were found to work on average 2.18 hours less compared to female non-caregivers residing in the same country group. For male caregivers in the same area, a statistically significant negative effect of informal care at 10%

significance level shows a decrease in working hours by 1.33 hours per week on average compared to their corresponding peers, *ceteris paribus*¹⁰.

From the above, it is shown that the intensive margin (working hours) is not the most crucial source of variation in labour supply among the different country groups. Indeed, the Kernel density estimates of the distribution of the weekly hours of work across country groups reveal that the differences among all country groups are not very big (Figure A.1, A.2). However, the Kernel density estimates of the distribution of weekly hours of work for women residing in country groups based on formal care use reveal a greater difference between countries in the group with the highest percentile use and the remaining groups (Figure A.3)¹¹. This difference can be attributed to greater working hour flexibility and prevalence of part-time jobs in northern countries compared to southern countries where there is a high prevalence of full-time jobs with fixed working schedules (Crespo and Mira, 2010).

Overall, it is shown that the effect of informal care provision on weekly working hours is not statistically significant in most country groups with the exception of the group with the highest share of dependent individuals using some form of formal care. This result is not surprising, considering that in the presence of more flexible labour markets, caregivers residing in this country group are able to adjust their working schedules (on average decreasing them) in order to combine informal care with available formal care options.

5.5 Fixed effects approach on working hours per week

In the previous section, informal care was assumed as exogenous. However, the simultaneity of the individual decision making to provide informal care and to participate in the labour market might be a source of possible endogeneity between the dependent labour variable and the independent variable of interest denoting informal care provision. Moreover, endogeneity might arise in the presence of unobserved characteristics influencing both the caregiving behaviour and the labour market behaviour.

The possible endogeneity can be dealt with the use of a fixed effects approach that isolates unobserved individual heterogeneity that is fixed over time (Cameron and Trivedi, 2010).

¹⁰ Due to insufficient observations, the effect of intensity of informal care could not be tested.

¹¹ In order to preserve space only the Kernel density estimates for female participants are shown.

When unobserved individual heterogeneity is accounted in the previous specifications estimated by geographical country groups, no statistically significant results were obtained for the full sample as well as for the two genders separately.

When accounting for individual unobserved heterogeneity at the groups based on the percentile formal care use, large statistically significant positive effects of informal care provision on hours worked were found for female caregivers in the middle share group. However, the null hypothesis of the conventional Hausman test could not be rejected and thus, a linear specification with random effects is preferred. From the estimation of the latter, no statistically significant effect of informal care was found (section 5.4).

6. Discussion and conclusions

The findings of this research suggest that the impact of informal care provision on labour outcomes differs across European countries. Providing informal care was found to decrease the probability of being in employment in Central European countries for men and women with the effect being higher for women. In Southern countries, no effect was found for the overall population however regressions by gender revealed a negative impact for both men and women lower in magnitude than the effect incurred by their corresponding peers residing in Central Europe. Nonetheless, the average labour opportunity costs borne by male caregivers in Southern Europe were found far greater than those borne by female caregivers. These findings partly confirm the results obtained from the cross-sectional analysis conducted by Bolin et al. (2008).

The long-term care institutions and the labour market characteristics in each of the three country groups are diverse and sometimes contradictory. The cultural differences in norms and preferences seem to drive the central-south gradient on the impact of informal care provision on employment between the two European regions. In countries where “family ties” are stronger and family loyalties are important more tolerance among employers and employees seems to help carers to combine paid work with caring responsibilities (Bolin et al., 2008).

On the other hand, Nordic countries are characterized by fairly generous caregiving allowances and generously paid leaves from work for caregiving purposes. Flexible working arrangements provide additional support to working carers to maintain their employability. In addition, the financing of long-term care is the highest in Europe and in both countries

(Sweden and Denmark) the total number of dependents use some form of formal care. Compared to the institutional setting observed in central European countries, the differences mainly lie in the financing and provision of long-term care. This implies that labour market characteristics have a potentially higher impact on the relationship between informal care and employment in countries where historically both genders show high labour force participation.

The findings from country group estimations based on formal care utilization revealed significantly negative effects of informal care provision on employment for the groups with the lowest shares of dependent individuals using any form of formal care. Same in magnitude labour opportunity costs were estimated for men and women. Apart from whether the publicly financed long-term care covers adequately the care needs of the total number of dependents in each country, formal care utilization reflects preferences influenced by cultural norms and “family ties” across countries. The above findings underline the relative importance of the financing, provision and utilization of long-term care services among other institutions on the impact of informal care on employment.

The intensity of care was found not to have a significantly different impact on employment than the mere caregiving decision across country groups. However, an important limitation associated with this variable may lead to disputable results. The hours of care were only reported for caregiving activities outside the household and thus, there is a great loss of information regarding co-residential care provision that is suggested to have a higher impact on the link between informal care and employment (Ettner, 1995; Casado et al., 2010).

In the light of the above, another important drawback of this methodological approach, driven by data limitations, is that country pooling does not allow drawing conclusions on every country separately. An additional limitation lies in the fact that the relative importance of the different long-term care institutions on the impact of informal care provision on labour outcomes is associated to factors such as; eligibility requirements, restrictions in the use of monetary allowances and monitoring, that were not included in this analysis in order to avoid adding complex schemes.

The possibility of reverse causation and unobserved heterogeneity inducing potential endogeneity of informal care was taken into account with an instrumental variables approach. A limitation lies in the fact that it is assumed that there is no correlation between the error term and the instruments. This hypothesis cannot be tested leading to potentially arguable results. Time-bound opportunity costs hinder the validity of care need as an instrument (van den Berg and Hassink, 2011). Personal care seems to be unshiftable and thus time-bound opportunity costs included in the error term of the labour supply equation

are likely to be higher for employed caregivers. The latter would lead to rejection of the initial hypothesis regarding the validity of the instruments.

At the intensive margin, it was found that only caregivers residing in the country group with the highest utilization of formal care bear significant labour opportunity costs in terms of foregone working hours. This result is not confounding considering that in these countries (Denmark, Sweden, and the Netherlands) flexible working arrangements are very common and thus, caregivers might decide to adapt their working schedule to cope better even if some form of formal care is available. In addition, considering that the sample used in this paper consists of older individuals, labour force participation is likely to be lower in countries where informal care is an important source of care and thus, it is hard to find significant differential effects across country groups.

Since only two waves from SHARE were used in this paper, the within variation in the data is likely to be very small. Individuals do not change easily status within a year. This panel captures only a limited dimension of time. The effects might also depend in the duration of the caregiving spell that could not be fully exploited in the present analysis. Another limitation associated with a small panel dataset is that the validity of the Hausman test for endogeneity is hindered by statistical problems if the within variation is not sufficient (Hahn, 2010).

The results from this research provide insights for the design of future long-term care policies. Due to demographic transitions, an increasing demand of informal and formal care is likely to occur the coming years (OECD, 2010). On the other hand, increasing trends in labour force participation are expected to decrease the pool of informal carers influencing policy-makers to give incentives in order to increase informal care supply. However, as the results of this paper suggest, an increase in caring responsibilities might bring labour opportunity costs for working caregivers. A more generous long-term care financing and provision decreases or even eliminates that effect however it cannot be considered a viable option especially at the present time of economic austerity across all European countries. By reinforcing more flexibility in the labour market and by establishing or protecting already existing statutory rights for paid and unpaid leave from work, working age caregivers will be given support in order to combine paid work with caring responsibilities.

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Appendix

Table A.1 Gender representation by country

	Sample		
	Female percentage	Female frequency	Overall sample
Austria	57.52%	581	1010
Germany	55.41%	1115	2012
Sweden	55.99%	1139	2034
Netherlands	55.63%	1327	2384
Spain	58.08%	873	1503
Italy	58.64%	1109	1891
France	53.22%	1319	2478
Denmark	52.67%	915	1737
Greece	54.27%	1289	2375
Switzerland	54.75%	512	935
Belgium	52.84%	1450	2744
Total		11629	21103

Table A.2 Actual working hours per week conditional on being employed by country

	Working hours		
	Mean	s.d.	Observations
Austria	40.62	14.84	472
Germany	39.02	14.35	1321
Sweden	40.06	12.18	1611
Netherlands	34.30	14.06	1448
Spain	39.33	14.29	713
Italy	37.08	15.68	825
France	38.12	13.02	1515
Denmark	38.46	10.49	1340
Greece	39.51	19.85	1295
Switzerland	38.74	18.51	722
Belgium	37.33	15.30	1456
Total			12718

Table A.3 Comparison of labour force participation and working hours between caregivers and non caregivers

		Women						Men					
		Participation rate			Working hours per week			Participation rate			Working hours per week		
		Mean	s.d.	N	Mean	s.d.	N	Mean	s.d.	N	Mean	s.d.	N
Austria	Caregivers	0.36	0.48	80	33.1	19	28	0.46	0.5	32	43.4	16.7	15
	Non-caregivers	0.36	0.48	416	34.9	14.8	151	0.65	0.47	351	45	12.1	226
Germany	Caregivers	0.58	0.49	173	34.5	13.5	99	0.71	0.45	76	46	12.1	54
	Non-caregivers	0.61	0.48	856	32.9	14	516	0.74	0.43	758	44.9	12.6	562
Sweden	Caregivers	0.81	0.38	143	36.6	8.9	115	0.87	0.33	62	42.8	12.3	54
	Non-caregivers	0.78	0.41	917	37.7	13.7	713	0.83	0.37	770	43.3	10	638
Netherlands	Caregivers	0.54	0.49	235	27.7	13.9	126	0.73	0.44	106	40	11.4	78
	Non-caregivers	0.49	0.5	1023	26	12.7	506	0.76	0.42	881	40	11.5	675
Spain	Caregivers	0.28	0.45	201	37.4	14.3	56	0.66	0.47	71	38.4	14.4	43
	Non-caregivers	0.35	0.47	639	35.9	12.9	223	0.7	0.45	509	42.2	14.6	347
Italy	Caregivers	0.33	0.47	280	32.3	14.2	94	0.64	0.48	117	39	16.8	74
	Non-caregivers	0.31	0.46	738	33.2	14.4	246	0.6	0.48	622	40.3	16.06	371
France	Caregivers	0.58	0.49	181	35.2	13.7	101	0.68	0.46	88	40.9	1.1	59
	Non-caregivers	0.61	0.48	969	34.1	12.2	583	0.67	0.46	946	42.4	12.8	631
Denmark	Caregivers	0.73	0.44	140	35.1	6.8	102	0.74	0.44	54	41.4	9.4	40
	Non-caregivers	0.76	0.42	702	35.2	9.7	537	0.85	0.35	708	41.8	10.8	599
Greece	Caregivers	0.32	0.46	217	30.7	17.7	66	0.75	0.43	65	42.1	17.7	47
	Non-caregivers	0.34	0.47	958	35.8	18.3	319	0.82	0.38	929	41.2	20.3	745
Switzerland	Caregivers	0.66	0.47	71	34.1	19.6	47	0.9	0.3	31	47.3	14.2	28
	Non-caregivers	0.71	0.45	375	29.7	17.3	266	0.87	0.33	350	46.06	15.6	302
Belgium	Caregivers	0.4	0.49	243	32.1	15.8	96	0.64	0.48	148	45.2	13	95
	Non-caregivers	0.47	0.49	1118	31	1.4	525	0.65	0.47	1066	41.7	14	686

Table A.4 Variables included in the analysis

Labour variables	
Employed	1 if employed or self-employed, 0 otherwise
Working hours	Number of actual working hours per week
Informal care variable	
Pcarer	1 if providing unpaid personal care (e.g. dressing, bathing, eating etc) to a dependent adult, 0 otherwise
Hours	Hours of informal care provision outside household per week
Other variables	
Age	Years of age
Age square	Squared years of age
Female	1 if female, 0 if male
Married	1 if married, 0 otherwise
Children	Number of children in the household
Sahvgood	1 if self-assessed health status is very good, 0 otherwise
Sahgood	1 if self-assessed health status is good, 0 otherwise
Sahfair	1 if self-assessed health status is fair, 0 otherwise
Sahpoor	1 if self-assessed health status is poor, 0 otherwise
Depressed	1 if Euro-D scale ≥ 4 , 0 if Euro-D scale < 4
Chronic	Number of chronic conditions
Hhsize	Household size
Ed_low	Has completed low education; 1 if ISCED=0 or ISCED=1, 0 otherwise
Ed_mid	Has completed middle education; 1 if ISCED=2 or ISCED=3, 0 otherwise
Ed_high	Has completed high education; 1 if ISCED=4 or ISCED=5 or ISCED=6, 0 otherwise
Inc_low	1 if income in the 2 lowest quintiles, 0 otherwise
Inc_mid	1 if income in the 2 middle quintiles, 0 otherwise
Inc_high	1 if income in the highest quintile, 0 otherwise
AU	1 if country is Austria, 0 otherwise
GER	1 if country is Germany, 0 otherwise
SWE	1 if country is Sweden, 0 otherwise
NL	1 if country is the Netherlands, 0 otherwise
SPA	1 if country is Spain, 0 otherwise
IT	1 if country is Italy, 0 otherwise
FRA	1 if country is France, 0 otherwise
DEN	1 if country is Denmark, 0 otherwise
GRE	1 if country is Greece, 0 otherwise
SWI	1 if country is Switzerland, 0 otherwise
BEL	1 if country is Belgium, 0 otherwise

Table A.5 Descriptive statistics of the variables included in the analysis

	Non caregivers			Caregivers		
	Mean	Standard deviation	N	Mean	Standard deviation	N
Employed	0.632	0.482	16647	0.549	0.497	2814
Working hours ¹²	38.44	14.84	10367	36.82	14.60	1517
Pcarer	0	0	16669	1	0	2816
Age	55.29	3.01	16669	55.22	3.03	2816
Age squared	3066.56	333.18	16669	3059.19	334.19	2816
Female	0.526	0.49	16669	0.69	0.45	2816
Married	0.85	0.34	12131	0.81	0.391	2013
Number of children	1.39	1.43	16669	1.31	1.33	2816
Very good sah	0.41	0.49	16669	0.36	0.48	2815
Good sah	0.38	0.48	16669	0.39	0.48	2815
Fair sah	0.15	0.36	16669	0.20	0.40	2815
Poor sah	0.043	0.20	16669	0.04	0.20	2815
Depressed	0.20	0.40	16669	0.30	0.45	2816
Chronic	1.03	1.17	16669	0.60	1.06	2816
Household size	2.63	1.03	16669	2.70	1.12	2816
Low education	0.13	0.33	16669	0.83	0.37	2816
Middle education	0.37	0.48	16669	0.37	0.48	2816
High education	0.20	0.40	16669	0.18	0.39	2816
Low income class	0.90	0.29	16669	0.89	0.30	2816
Middle income class	0.06	0.24	16669	0.072	0.25	2816
High income class	0.03	0.17	16669	0.03	0.18	2816
AU	0.04	0.20	16669	0.03	0.19	2816
GER	0.09	0.29	16669	0.08	0.28	2816
SWE	0.10	0.30	16669	0.07	0.25	2816
NL	0.11	0.31	16669	0.12	0.32	2816
SPA	0.06	0.25	16669	0.09	0.29	2816
IT	0.08	0.27	16669	0.14	0.34	2816
FRA	0.11	0.31	16669	0.09	0.29	2816

¹² Respondents were asked about actual working hours per week conditional on being in employment.

DEN	0.08	0.27	16669	0.06	0.25	2816
GRE	0.11	0.31	16669	0.10	0.30	2816
SWI	0.04	0.20	16669	0.03	0.18	2816
BEL	0.13	0.32	16669	0.13	0.34	2816

Table A.6 Correlation matrix

N=9222	employe d	female	age	age2	Low_i nc	Mid_in c	High_i nc	ppcare r	marrie d	childre n	hhsiz e	Ed_lo w	Ed_mi d	Ed_hig h	sahvgoo d	sahgo od	sahfair	sahp oor	depre ssed	chron ic
employe d	1.0000																			
female	-0.212	1.000																		
age	-0.221	-0.035	1.000																	
age2	-0.223	-0.034	0.999	1.000																
Low_inc	-0.002	0.051	0.086	0.086	1.000															
Mid_inc	-0.006	-0.009	0.001	0.001	-0.092	1.000														
High_inc	-0.002	-0.009	-0.087	-0.087	-0.994	-0.016	1.000													
ppcarer	-0.055	0.115	-0.010	-0.010	-0.015	-0.004	0.016	1.000												
married	0.020	-0.050	-0.106	-0.104	-0.0009	-0.013	0.002	0.003	1.000											
children	-0.006	-0.025	-0.007	-0.007	-0.252	0.013	0.252	-0.015	0.001	1.000										
hhsiz e	0.019	-0.084	-0.192	-0.192	-0.148	-0.001	0.148	0.064	0.274	0.191	1.000									
Ed_lo w	-0.166	0.031	0.047	0.048	0.020	-0.018	-0.019	0.004	0.181	0.028	0.074	1.000								
Ed_mid	-0.015	-0.010	-0.122	-0.121	-0.012	-0.002	0.012	-0.000	0.358	-0.020	-0.012	-0.302	1.000							
Ed_hig h	0.182	-0.045	-0.088	-0.088	-0.033	-0.004	0.032	-0.014	0.212	-0.0001	-0.001	-0.197	-0.389	1.0000						
sahvgoo d	0.204	-0.044	-0.080	-0.080	0.018	0.010	-0.018	-0.029	0.046	0.007	0.004	-0.106	-0.009	0.152	1.000					
sahgood	0.016	0.010	0.022	0.022	0.006	0.0002	-0.004	0.004	-0.008	-0.025	0.019	0.007	0.019	-0.053	-0.651	1.000				
sahfair	-0.188	0.039	0.060	0.060	-0.022	-0.013	0.021	0.036	-0.025	0.011	-0.014	0.088	-0.004	-0.096	-0.366	-0.352	1.000			
sahpoor	-0.1837	0.0109	0.0295	0.0294	-0.0198	0.002	0.017	-0.006	-0.043	0.021	-0.030	0.075	-0.015	-0.063	-0.179	-0.172	-0.097	1.000		
depre ssed	-0.1553	0.1615	0.0615	-0.0343	-0.0250	-0.003	0.025	0.070	-0.045	0.020	-0.021	0.098	-0.015	-0.060	-0.225	-0.034	0.211	0.157	1.000	
chron ic	-0.1399	0.0226	-0.034	0.0617	-0.0227	0.026	0.023	0.018	0.235	0.037	-0.033	0.191	0.157	0.038	-0.217	0.004	0.192	0.233	0.155	1.000

Table A.7 Instruments included in the analysis

	Non-caregivers			Caregivers		
	Mean	s.d.	N	Mean	s.d.	N
Age of mother	80.1	5.4	5652	81.3	5.5	1016
Age of father	81.3	5.1	2573	82.7	5.4	450
Mother has bad health	0.33	0.47	7634	0.46	0.49	1434
Father has bad health	0.33	0.47	3392	0.45	0.49	600
Siblings	0.90	0.29	11995	0.90	0.29	1980

Table A.8 RE probit marginal effects for geographical country pools¹³

	Nordic		Central		Southern	
	dy/dx (s.e.)					
Pcarer	-0.010	(0.019)	-0.041**	(0.019)	-0.014	(0.024)
Age	0.218**	(0.079)	0.489**	(0.078)	0.379**	(0.129)
Age squared	-0.002**	(0.000)	-0.004**	(0.000)	-0.003**	(0.001)
Female	-0.036**	(0.013)	-0.243**	(0.014)	-0.619**	(0.029)
Married	0.024	(0.019)	-0.040**	(0.017)	-0.056	(0.032)
Household size	0.014	(0.009)	0.010	(0.007)	-0.019**	(0.009)
Number of children	0.004	(0.005)	-0.013**	(0.006)	-0.007	(0.011)
Very good sah	-	-	-	-	-	-
Good sah	-0.082**	(0.021)	-0.020	(0.014)	-0.004	(0.021)
Fair sah	-0.350**	(0.048)	-0.297**	(0.030)	-0.169**	(0.030)
Poor sah	-0.614**	(0.090)	-0.623**	(0.031)	-0.298**	(0.046)
Depressed	-0.052**	(0.020)	-0.002	(0.016)	-0.017	(0.023)
Chronic	-0.013**	(0.005)	-0.030**	(0.006)	-0.009	(0.009)
Low education	-0.113**	(0.031)	-0.320**	(0.027)	-0.325**	(0.029)
Middle education	-0.054**	(0.014)	-0.185**	(0.013)	-0.209**	(0.024)
High education	-	-	-	-	-	-
Low income class	-0.049	(0.028)	-0.018	(0.035)	-0.102	(0.072)
Middle income class	-0.043	(0.048)	-0.075	(0.041)	0.042	(0.073)
High income class	-	-	-	-	-	-
N	2601		7617		3900	

** Statistically significant at 5% significance level

¹³ Following Cohen et al. (2003), binary indicator variables for missing values were constructed for explanatory variables with a high number of missing values (marital status, number of children, household size, income classes).

Table A.9 **Female** marginal effects for geographical country pools

	Nordic	Central	Southern
	Female dy/dx (s.e.)		
Pcarer	0.002 (0.021)	-0.081** (0.023)	-0.066** (0.032)
Age	0.229** (0.093)	0.498** (0.089)	0.451** (0.177)
Age squared	-0.002** (0.000)	-0.005** (0.000)	-0.004** (0.001)
Married	0.016 (0.023)	-0.044** (0.020)	-0.029 (0.043)
Household size	0.005 (0.010)	0.024** (0.008)	0.015 (0.013)
Number of children	0.004 (0.006)	-0.028** (0.007)	-0.039** (0.015)
Very good sah	-	-	-
Good sah	-0.079** (0.024)	-0.021 (0.016)	0.036 (0.031)
Fair sah	-0.449** (0.067)	-0.296** (0.037)	-0.150** (0.044)
Poor sah	-0.557** (0.099)	-0.612** (0.037)	-0.242** (0.058)
Depressed	-0.069** (0.024)	-0.032 (0.019)	-0.117** (0.032)
Chronic	-0.016** (0.006)	-0.031** (0.007)	-0.013 (0.013)
Low education	-0.125** (0.036)	-0.356** (0.033)	-0.470** (0.046)
Middle education	-0.074** (0.018)	-0.228** (0.015)	-0.232** (0.030)
High education	-	-	-
Low income class	-0.053 (0.035)	0.027 (0.045)	-0.105 (0.098)
Middle income class	-0.047 (0.058)	-0.029 (0.045)	0.011 (0.093)
High income class	-	-	-
N	2012	6847	3197

** Statistically significant at 5% significance level

Table A.10 **Male** marginal effects for geographical country pools

	Nordic	Central	Southern
	Male dy/dx (s.e.)		
Pcarer	0.002 (0.022)	-0.077** (0.021)	-0.122** (0.031)
Age	0.190** (0.089)	0.543** (0.071)	0.493** (0.151)
Age squared	-0.001** (0.000)	-0.005** (0.000)	-0.004** (0.001)
Married	0.026 (0.023)	-0.002 (0.017)	0.017 (0.039)
Household size	0.022** (0.010)	0.019** (0.006)	-0.001 (0.011)
Number of children	0.004 (0.005)	-0.008 (0.006)	-0.031** (0.012)
Very good sah	-	-	-
Good sah	-0.090** (0.028)	-0.004 (0.013)	-0.089** (0.025)
Fair sah	-0.326** (0.054)	-0.225** (0.035)	-0.315** (0.049)
Poor sah	-0.659** (0.113)	-0.682** (0.038)	-0.452** (0.057)
Depressed	-0.060** (0.024)	-0.041** (0.016)	-0.090** (0.030)
Chronic	-0.011 (0.006)	-0.028** (0.006)	-0.011 (0.011)
Low education	-0.095** (0.032)	-0.317** (0.034)	-0.422** (0.048)
Middle education	-0.027 (0.015)	-0.171** (0.013)	-0.199** (0.026)
High education	-	-	-
Low income class	-0.043 (0.030)	-0.011 (0.033)	-0.051 (0.079)
Middle income class	-0.053 (0.052)	-0.043 (0.037)	0.037 (0.078)
High income class	-	-	-
N	1947	6674	3134

** Statistically significant at 5% significance level

Table A.11 RE probit marginal effects for country pools based on formal care use

	highest	2 nd highest	middle	lowest
	dy/dx (s.e.)			
Pcarer	-0.015 (0.017)	-0.020 (0.023)	-0.061** (0.031)	-0.049** (0.024)
Age	0.301** (0.074)	0.407** (0.101)	0.304** (0.138)	0.421** (0.128)
Age squared	-0.002** (0.000)	-0.003** (0.000)	-0.003** (0.001)	-0.004** (0.001)
Female	-0.125** (0.013)	-0.124** (0.021)	-0.426** (0.029)	-0.365** (0.026)
Married	-0.010 (0.017)	-0.013 (0.019)	-0.070** (0.026)	-0.047 (0.028)
Household size	0.004 (0.007)	-0.011 (0.008)	-0.009 (0.010)	0.005 (0.009)
Number of children	0.002 (0.005)	-0.006 (0.007)	-0.006 (0.010)	-0.006 (0.009)
Very good sah	-	-	-	-
Good sah	-0.093** (0.012)	-0.011 (0.015)	0.069** (0.023)	-0.040 (0.021)
Fair sah	-0.505** (0.042)	-0.313** (0.100)	-0.130** (0.040)	-0.243** (0.033)
Poor sah	-0.709** (0.051)	-0.0867** (0.033)	-0.381** (0.060)	-0.402** (0.038)
Depressed	-0.052** (0.018)	0.012 (0.020)	0.018 (0.024)	-0.004 (0.023)
Chronic	-0.011** (0.005)	-0.018** (0.008)	-0.041** (0.010)	-0.005 (0.008)
Low education	-0.188** (0.032)	-0.200** (0.071)	-0.299** (0.031)	-0.361** (0.030)
Middle education	-0.120** (0.013)	-0.086** (0.017)	0.101 (0.056)	-0.210** (0.022)
High education	-	-	-	-
Low income class	-0.089** (0.026)	-0.021 (0.034)	0.158** (0.073)	-0.051 (0.062)
Middle income class	-0.092 (0.052)	-0.070 (0.053)	0.101 (0.056)	-0.034 (0.062)
High income class	-	-	-	-
N	4314	2091	3608	4105

** Statistically significant at 5% significance level

Table A.12 Female marginal effects for country pools based on formal care use

	highest	2 nd highest	middle	lowest
	Female dy/dx (s.e.)			
Pcarer	-0.034 (0.020)	-0.038 (0.029)	-0.165** (0.048)	-0.089** (0.028)
Age	0.207** (0.078)	0.211 (0.125)	0.466** (0.190)	0.505** (0.150)
Age squared	-0.002** (0.000)	-0.002 (0.001)	-0.004** (0.001)	-0.005** (0.001)
Married	-0.021 (0.017)	-0.010 (0.021)	-0.008 (0.044)	-0.049 (0.033)
Household size	0.003 (0.008)	-0.017 (0.010)	0.007 (0.015)	0.005 (0.011)
Number of children	-0.001 (0.019)	-0.012 (0.009)	-0.016 (0.017)	-0.014 (0.011)
Very good sah	-	-	-	-
Good sah	-0.092** (0.015)	-0.007 (0.016)	0.036 (0.035)	-0.054** (0.025)
Fair sah	-0.604** (0.051)	-0.485** (0.195)	-0.200** (0.061)	-0.259** (0.039)
Poor sah	-0.748** (0.054)	-0.860** (0.035)	-0.311** (0.110)	-0.405** (0.040)
Depressed	-0.061** (0.021)	0.0002 (0.022)	-0.077** (0.038)	-0.041 (0.026)
Chronic	-0.009 (0.005)	-0.020 (0.010)	-0.045** (0.016)	-0.004 (0.010)
Low education	-0.172** (0.035)	-0.137** (0.063)	-0.367** (0.046)	-0.443** (0.038)
Middle education	-0.125** (0.016)	-0.088** (0.020)	-0.250** (0.032)	-0.234** (0.024)
High education	-	-	-	-
Low income class	0.071** (0.031)	-0.036 (0.038)	0.245** (0.117)	0.023 (0.070)
Middle income class	-0.062 (0.052)	-0.117 (0.083)	0.212** (0.073)	0.006 (0.069)
High income class	-	-	-	-
N	3544	1425	2874	3639

** Statistically significant at 5% significance level

Table A.13 **Male** marginal effects for country pools based on formal care use

	highest	2 nd highest	middle	lowest
	Male dy/dx (s.e.)			
Pcarer	-0.018 (0.017)	-0.036 (0.033)	-0.163** (0.047)	-0.089** (0.030)
Age	0.272** (0.068)	0.346** (0.120)	0.545** (0.166)	0.566** (0.149)
Age squared	-0.002** (0.000)	-0.003** (0.001)	-0.005** (0.001)	-0.005** (0.001)
Married	0.022 (0.017)	-0.0006 (0.026)	0.017 (0.041)	-0.001 (0.035)
Household size	0.017** (0.007)	-0.002 (0.009)	0.019 (0.013)	0.037** (0.011)
Number of children	0.005 (0.004)	-0.005 (0.008)	0.003 (0.015)	-0.025** (0.012)
Very good sah	-	-	-	-
Good sah	-0.067** (0.012)	-0.016 (0.020)	0.032 (0.030)	-0.034 (0.025)
Fair sah	-0.345** (0.044)	-0.266** (0.074)	-0.115** (0.052)	-0.247** (0.043)
Poor sah	-0.663** (0.071)	-0.895** (0.039)	-0.428** (0.092)	-0.471** (0.050)
Depressed	-0.064** (0.018)	-0.041 (0.032)	-0.070 (0.037)	-0.079** (0.029)
Chronic	-0.013** (0.004)	0.008 (0.009)	-0.057** (0.014)	-0.019 (0.010)
Low education	-0.109** (0.026)	-0.284** (0.083)	-0.362** (0.044)	-0.402** (0.037)
Middle education	-0.054** (0.011)	-0.081** (0.018)	-0.211** (0.029)	-0.218** (0.024)
High education	-	-	-	-
Low income class	-0.063** (0.022)	-0.027 (0.039)	0.152 (0.103)	-0.026 (0.070)
Middle income class	-0.058 (0.044)	-0.030 (0.056)	0.151** (0.0640)	-0.025 (0.073)
High income class	-	-	-	-
N	3371	1305	2791	3487

** Statistically significant at 5% significance level

Table A.14 First stage regression results for full sample

Instruments	Geographical country groups			Formal care use country groups			
	nordic	central	south	highest	2 nd highest	middle	lowest
Age of mother	0.003** (0.001)	0.006** (0.001)	0.004** (0.001)	0.003* (0.001)	0.008** (0.002)	0.003** (0.001)	0.008** (0.001)
Mother has bad health	0.061** (0.019)	0.048** (0.012)	0.102** (0.020)	0.049 (0.015)**	0.096** (0.023)	0.048** (0.017)	0.091** (0.020)
N	1232	3629	1752	1933	1014	1807	1859
F-test (2, N) (prob>F) ¹⁴	6.21 (0.0021)	23.32 (0.0000)	16.79 (0.0000)	6.28 (0.0001)	15.98 (0.0000)	6.35 (0.0001)	21.27 (0.0000)

* Statistically significant at 10% significance level. ** Statistically significant at 5% significance level.

Table A.15 First stage regression results for females

Instruments	Geographical country groups			Formal care use country groups			
	nordic	central	south	highest	2 nd highest	middle	lowest
Age of mother	0.003* (0.001)	0.007** (0.001)	0.005** (0.002)	0.002 (0.001)	0.007** (0.003)	0.003** (0.001)	0.009** (0.002)
Mother has bad health	0.066** (0.022)	0.054** (0.013)	0.102** (0.023)	0.060** (0.017)	0.099** (0.031)	0.047** (0.019)	0.108** (0.022)
N	971	3312	1398	1616	718	1409	1659
F-test (2, N) (prob>F)	5.08 (0.006)	26.62 (0.0000)	13.88 (0.0000)	7.01 (0.0009)	8.56 (0.0002)	5.009 (0.0068)	24.26 (0.0000)

* Statistically significant at 10% significance level. ** Statistically significant at 5% significance level.

Table A.16 First stage regression results for males

Instruments	Geographical country groups			Formal care use country groups			
	nordic	central	south	highest	2 nd highest	middle	lowest
Age of mother	0.001 (0.001)	0.006** (0.001)	0.004** (0.002)	0.003** (0.001)	0.008** (0.002)	0.003 (0.001)	0.008** (0.002)
Mother has bad health	0.031 (0.020)	0.050** (0.013)	0.106** (0.022)	0.046** (0.017)	0.074** (0.026)	0.070** (0.022)	0.091** (0.022)
N	936	3245	1399	1549	619	1344	1597
F-test (2, N) (prob>F)	1.36 (0.2532)	21.99 (0.0000)	14.02 (0.0000)	5.23 (0.0054)	9.52 (0.0001)	7.06 (0.0009)	18.06 (0.0000)

* Statistically significant at 10% significance level. ** Statistically significant at 5% significance level.

¹⁴ The F-statistics were derived from linear first stage estimation.

Table A.17 Instrumental probit regression marginal effects for full sample

	Geographical country groups			Formal care use country groups			
	nordic	central	south	highest	2 nd highest	middle	lowest
Pcarer	0.262** (0.111)	-0.122 (0.226)	-0.139 (0.245)	0.313** (0.118)	-0.193 (0.283)	-0.558 (0.206)	0.010 (0.221)
Over identification test (p-value of null of valid exclusion restrictions) ¹⁵	0.114 (0.7360)	0.0406 (0.5240)	0.522 (0.4702)	1.845 (0.1743)	1.632 (0.2015)	0.126 (0.7229)	2.522 (0.1122)
Smith-Blundell test of exogeneity- p-value of null of exogeneity	1.200 (0.2726)	0.005 (0.9426)	0.295 (0.5866)	0.023 (0.8777)	0.258 (0.6115)	0.061 (0.8047)	0.146 (0.7018)

* Statistically significant at 10% significance level. ** Statistically significant at 5% significance level.

Table A.18 Instrumental probit regression marginal effects for **females**

	Geographical country groups			Formal care use country groups			
	nordic	central	south	highest	2 nd highest	middle	lowest
Pcarer	0.305** (0.121)	-0.260 (0.197)	-0.024 (0.254)	0.370** (0.112)	-0.011 (0.325)	-0.665** (0.042)	-0.197 (0.189)
Over identification test (p-value of null of valid exclusion restrictions)	0.209 (0.6475)	0.016 (0.9002)	1.690 (0.1936)	4.847 (0.0277)	1.767 (0.1838)	0.012 (0.9125)	2.639 (0.1042)
Smith-Blundell test of exogeneity- p-value of null of exogeneity	5.928 (0.0149)	0.081 (0.7752)	1.237 (0.2659)	0.057 (0.8109)	0.051 (0.8204)	0.012 (0.9109)	0.299 (0.5839)

* Statistically significant at 10% significance level. ** Statistically significant at 5% significance level.

Table A.19 Instrumental probit regression marginal effects for **males**

	Geographical country groups			Formal care use country groups			
	nordic	central	south	highest	2 nd highest	middle	lowest
Pcarer	0.332* (0.198)	-0.178 (0.240)	-0.126 (0.270)	0.224* (0.123)	-0.353 (0.421)	-0.387 (0.359)	0.075 (0.230)
Over identification test (p-value of null of valid exclusion restrictions)	0.002 (0.9607)	2.005 (0.1568)	1.626 (0.2022)	0.100 (0.7524)	0.034 (0.8544)	2.244 (0.1341)	4.826 (0.0280)
Smith-Blundell test of exogeneity- p-value of null of exogeneity	0.374 (0.5405)	0.009 (0.9225)	0.033 (0.8552)	2.503 (0.1136)	0.006 (0.9349)	0.740 (0.3896)	0.014 (0.9053)

* Statistically significant at 10% significance level. ** Statistically significant at 5% significance level.

¹⁵ This test stands for the Amemiya-Lee-Newey over-identification test for post-estimation after two step probit regressions proposed by Baum et al. (2006).

Table A.20 Random effects model estimates by geographical country groups

	Nordic		Central		Southern	
	Random effects coefficients (s.e)					
Pcarer	-0.490	(0.826)	0.380	(0.625)	-0.774	(1.133)
Age	-1.704	(3.214)	-2.253	(2.806)	10.14	(5.512)
Age squared	0.015	(0.029)	0.019	(0.025)	-0.091	(0.050)
Female	-6.463**	(0.535)	-12.14**	(0.432)	-5.378**	(0.909)
Married	-0.241	(0.762)	-2.504**	(0.606)	2.017	(1.388)
Household size	-0.189	(0.360)	0.185	(0.236)	0.104	(0.437)
Number of children	0.360	(0.250)	0.029	(0.220)	0.098	(0.518)
Very good sah	-	-	-	-	-	-
Good sah	-1.458**	(0.598)	-0.201	(0.451)	0.074	(0.912)
Fair sah	-2.121**	(1.055)	-1.276	(0.754)	0.460	(1.459)
Poor sah	-5.180**	(2.298)	-0.630	(1.903)	-2.457	(3.235)
Depressed	0.614	(0.750)	-0.100	(0.561)	-1.274	(1.137)
Chronic	-0.466	(0.258)	0.034	(0.230)	-0.114	(0.435)
Low education	-4.820	(0.819)	-2.801**	(0.697)	4.050**	(1.168)
Middle education	-0.676	(0.541)	-1.702**	(0.447)	3.916**	(1.009)
High education	-	-	-	-	-	-
Low income class	-4.233**	(1.653)	-0.644	(1.213)	5.806**	(2.968)
Middle income class	-1.832	(1.550)	-1.898	(1.210)	2.003	(2.787)
High income class	-	-	-	-	-	-
N	2085		4688		1921	

**Statistically significant at 5% significance level

Table A.21 Random effects model estimates by geographical country groups for females

	Nordic		Central		Southern	
	Female RE coefficients (s.e)					
Pcarer	-1.163	(0.929)	-0.925	(0.728)	-0.084	(1.132)
Age	1.604	(3.841)	-0.551	(3.312)	27.04**	(5.711)
Age squared	-0.013	(0.034)	0.006	(0.030)	-0.242**	(0.052)
Married	-0.251	(0.967)	-1.358**	(0.696)	-0.418	(1.432)
Household size	-0.207	(0.453)	1.005**	(0.277)	0.402	(0.506)
Number of children	0.461	(0.298)	-0.201	(0.262)	0.601	(0.505)
Very good sah	-	-	-	-	-	-
Good sah	-1.926**	(0.706)	-0.433	(0.539)	1.555	(1.019)
Fair sah	-4.828**	(1.379)	-0.249	(0.894)	4.516**	(1.545)
Poor sah	-10.18**	(2.703)	0.202	(2.200)	1.194	(2.944)
Depressed	-0.161	(0.859)	-2.372	(0.645)	-4.855**	(1.193)
Chronic	-0.791**	(0.312)	0.154	(0.274)	-1.024**	(0.444)
Low education	0.164	(0.949)	-3.020**	(0.810)	4.934**	(1.341)
Middle education	-0.463	(0.646)	-2.538**	(0.531)	5.648**	(1.166)
High education	-	-	-	-	-	-
Low income class	-4.163**	(1.926)	-1.486	(1.461)	9.524**	(2.830)
Middle income class	0.159	(1.770)	-1.447	(1.458)	5.977**	(2.514)
High income class	-	-	-	-	-	-
N	1585		4099		1374	

**Statistically significant at 5% significance level

Table A.22 Random effects model estimates by geographical country groups for **males**

	Nordic		Central		Southern	
	Male RE coefficients (s.e)					
Pcarer	-0.419	(1.042)	-0.593	(0.715)	-0.879	(1.223)
Age	-4.593	(3.842)	0.332	(3.128)	7.866	(6.027)
Age squared	0.041	(0.034)	-0.001	(0.028)	-0.069	(0.055)
Married	0.057	(0.956)	-0.487	(0.672)	2.254	(1.536)
Household size	0.104	(0.418)	0.784**	(0.259)	0.534	(0.464)
Number of children	0.267	(0.292)	0.114	(0.245)	-0.254	(0.546)
Very good sah	-	-	-	-	-	-
Good sah	-1.923**	(0.711)	-0.021	(0.506)	-0.385	(0.965)
Fair sah	-1.355	(1.247)	-0.683	(0.838)	0.142	(1.561)
Poor sah	-7.625**	(3.094)	-0.001	(2.112)	-6.405	(3.495)
Depressed	0.387	(0.933)	-2.377**	(0.622)	-2.947**	(1.212)
Chronic	-0.357	(0.323)	0.027	(0.258)	0.155	(0.463)
Low education	-0.748	(0.936)	-3.018**	(0.773)	3.177**	(1.265)
Middle education	-0.225	(0.660)	-1.653**	(0.500)	2.220**	(1.092)
High education	-	-	-	-	-	-
Low income class	-4.190**	(1.840)	-0.865	(1.333)	6.525**	(3.130)
Middle income class	-1.902	(1.699)	-0.975	(1.329)	-0.296	(2.955)
High income class	-	-	-	-	-	-
N	1594		4148		1675	

**Statistically significant at 5% significance level

Table A.23 Random effects model estimates by country groups based on formal care use

	Highest	2 nd highest	Middle	Lowest				
	Random effects coefficients (s.e)							
Pcarer	-0.704	(0.678)	0.927	(1.245)	-0.855	(1.163)	-0.007	(0.988)
Age	-1.575	(2.781)	-7.101	(5.359)	-5.232	(4.813)	6.542	(5.236)
Age squared	0.013	(0.025)	0.064	(0.048)	0.046	(0.044)	-0.059	(0.047)
Female	-9.035**	(0.457)	-12.93**	(0.831)	-7.727**	(0.798)	-9.733**	(0.799)
Married	-1.282	(0.679)	-2.25	(1.209)	0.693	(1.085)	0.784	(1.106)
Household size	-0.333	(0.290)	-0.384	(0.481)	-0.266	(0.384)	0.475	(0.371)
Number of children	0.537**	(0.219)	0.046	(1.234)	0.672	(0.422)	-0.281	(0.403)
Very good sah	-	-	-	-	-	-	-	-
Good sah	-1.746**	(0.477)	0.385	(0.901)	0.070	(0.821)	-0.852	(0.786)
Fair sah	-4.076**	(0.853)	-0.668	(1.460)	-0.845	(1.322)	0.298	(1.310)
Poor sah	-5.541**	(2.060)	-0.108	(4.086)	0.486	(3.036)	-4.938	(3.174)
Depressed	0.057	(0.639)	-0.268	(1.253)	0.777	(0.929)	-0.991	(0.977)
Chronic	0.037	(0.224)	-0.033	(0.475)	0.508	(0.428)	-0.043	(0.375)
Low education	-1.600**	(0.718)	1.151	(1.960)	-0.359	(0.997)	-0.214	(1.089)
Middle education	-1.815**	(0.460)	-1.673**	(0.839)	1.447	(0.840)	-0.545	(0.844)
High education	-	-	-	-	-	-	-	-
Low income class	-2.270	(1.362)	-1.694	(2.198)	-0.897	(2.679)	1.453	(2.167)
Middle income class	-2.098	(1.304)	-4.058	(2.215)	1.468	(2.585)	-2.243	(2.137)
High income class	-	-	-	-	-	-	-	-
N	3127		1449		2067		1845	

**Statistically significant at 5% significance level

Table A.24 Random effects model estimates by country groups based on formal care use for females

	Highest	2 nd highest	Middle	Lowest
Female RE coefficients (s.e)				
Pcarer	-2.182** (0.784)	- ¹⁶	-1.263 (1.407)	-0.023 (0.998)
Age	-4.547 (3.260)	-	-3.903 (5.996)	13.03** (5.453)
Age squared	0.042 (0.029)	-	0.035 (0.054)	-0.115** (0.049)
Married	-0.871 (0.773)	-	3.088** (1.358)	0.539 (1.102)
Household size	-0.074 (0.358)	-	0.239 (0.482)	1.135** (0.401)
Number of children	0.546** (0.259)	-	0.209 (0.567)	-0.576 (0.410)
Very good sah	-	-	-	-
Good sah	-3.076** (0.583)	-	-0.463 (1.030)	-0.368 (0.830)
Fair sah	-3.443** (1.044)	-	-1.743 (1.662)	0.261 (1.355)
Poor sah	-5.967** (2.379)	-	2.140 (3.929)	-1.156 (3.268)
Depressed	-1.010 (0.738)	-	-0.998 (1.147)	-3.146** (0.963)
Chronic	0.106 (0.265)	-	0.579 (0.541)	0.093 (0.383)
Low education	-1.061 (0.823)	-	0.719 (1.237)	-0.565 (1.144)
Middle education	-1.665 (0.543)	-	2.465** (1.047)	-0.401 (0.881)
High education	-	-	-	-
Low income class	-3.971** (1.693)	-	-2.259 (3.372)	1.428 (2.210)
Middle income class	-2.563 (1.590)	-	1.949 (3.372)	-1.663 (2.173)
High income class	-	-	-	-
N	2538	-	1553	1732

**Statistically significant at 5% significance level

¹⁶ STATA could not perform the specific random effects estimation due to insufficient observations

Table A.25 Random effects model estimates by country groups based on formal care use for males

	Highest	2 nd highest	Middle	Lowest
Male RE coefficients (s.e)				
Pcarer	-1.331* (0.757)	2.847 (1.835)	- ¹⁷	-0.783 (1.024)
Age	0.551 (2.965)	-13.36** (6.598)	-	9.412 (5.430)
Age squared	-0.005 (0.026)	0.107 (0.059)	-	-0.083 (0.049)
Married	-0.504 (0.726)	-4.980** (1.107)	-	1.647 (1.145)
Household size	0.558 (0.306)	5.389** (0.781)	-	1.200** (0.380)
Number of children	0.338 (0.229)	-6.342** (0.659)	-	-0.576 (0.418)
Very good sah	-	-	-	-
Good sah	-0.652 (0.517)	11.17** (1.201)	-	-0.598 (0.816)
Fair sah	-2.447** (0.917)	4.802 (2.779)	-	1.095 (1.360)
Poor sah	-5.705** (2.175)	17.44 (10.77)	-	-3.619 (3.293)
Depressed	-0.531 (0.693)	7.080** (2.181)	-	-3.312** (0.995)
Chronic	-0.484** (0.237)	-6.906** (0.677)	-	-0.057 (0.390)
Low education	-0.047 (0.771)	9.756** (1.125)	-	2.686 (2.246)
Middle education	0.240 (0.488)	-1.121 (1.445)	-	-0.204 (0.877)
High education	-	-	-	-
Low income class	-1.920 (1.434)	8.525** (2.205)	-	2.686 (2.246)
Middle income class	-0.495 (1.370)	2.541 (2.176)	-	-1.031 (2.213)
High income class	-	-	-	-
N	2674	983	-	1845

* Statistically significant at 10% significance level. ** Statistically significant at 5% significance level.

¹⁷ STATA could not perform the specific random effects estimation due to insufficient observations

Figure A.1 Kernel density estimates of actual working hours per week conditional on being in employment by geographical country groups

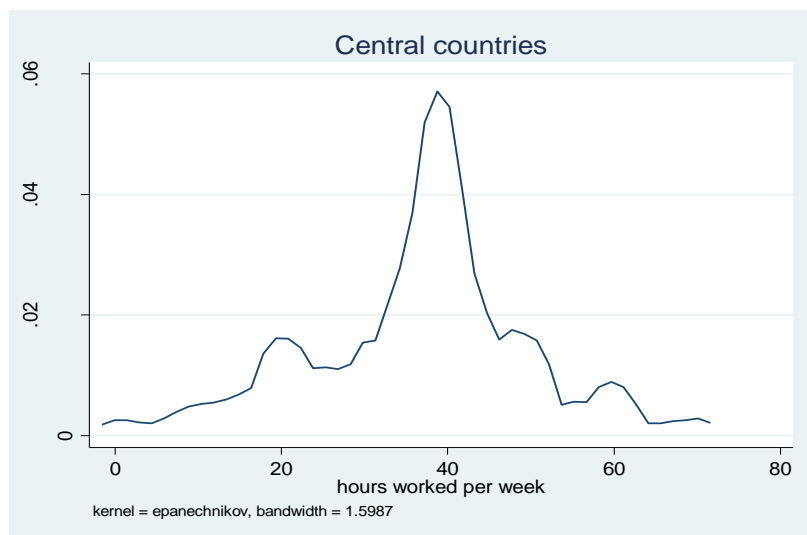
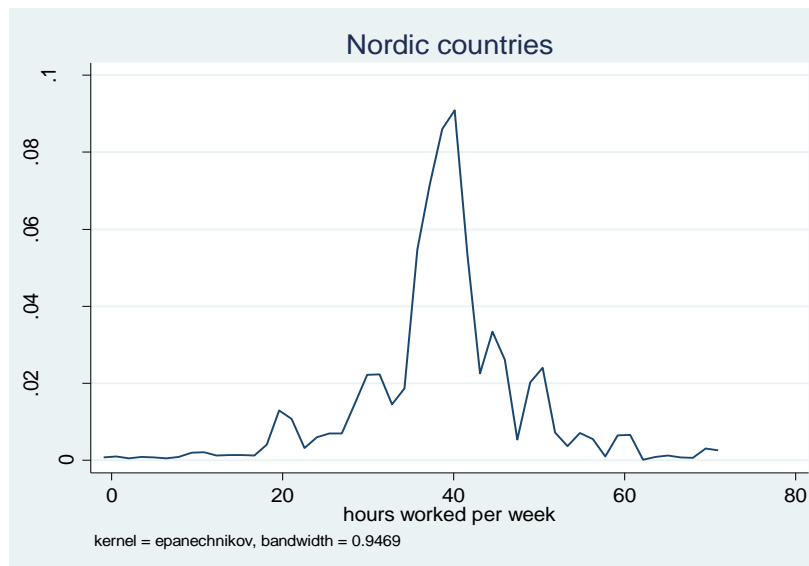
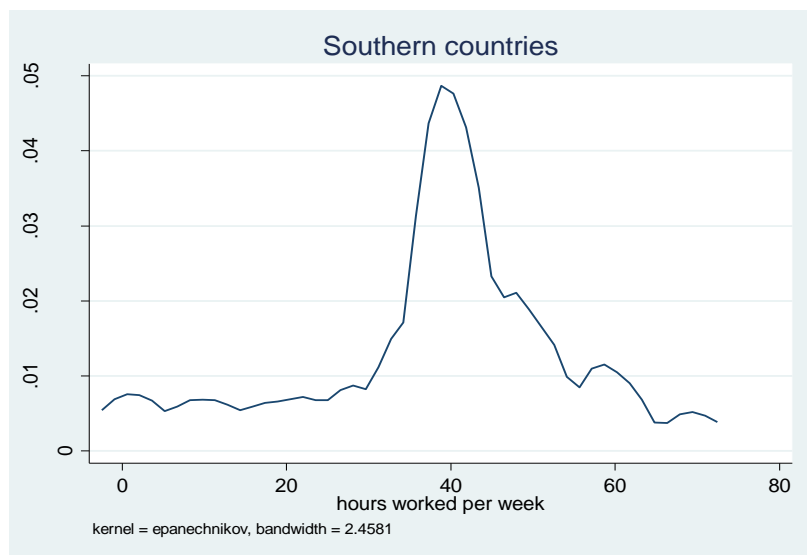


Figure A.2 Kernel density estimates of actual working hours per week conditional on being in employment by country groups based on formal care use

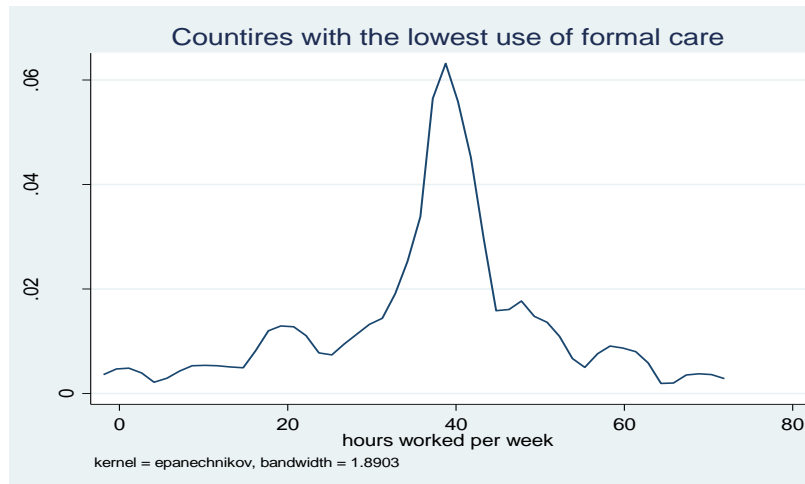
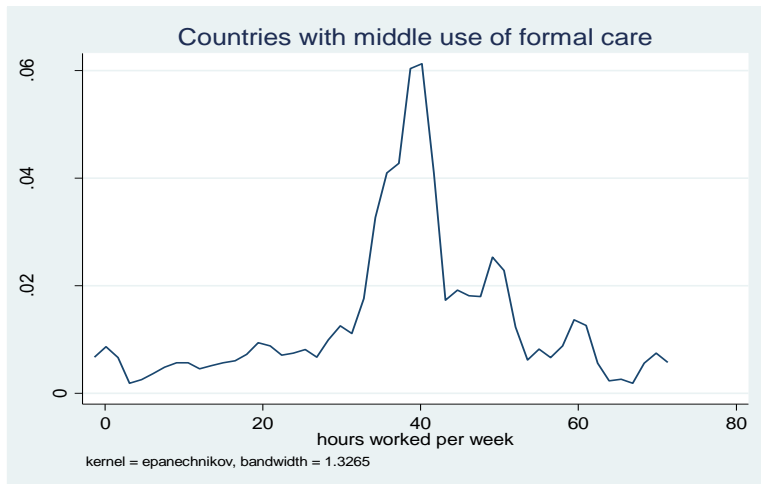
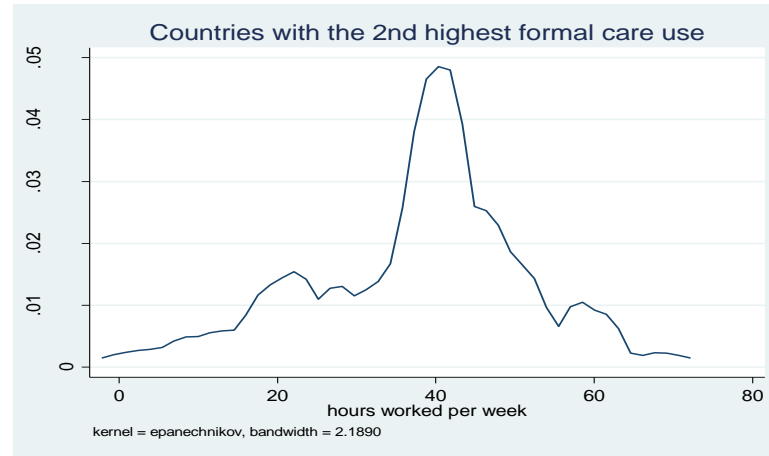
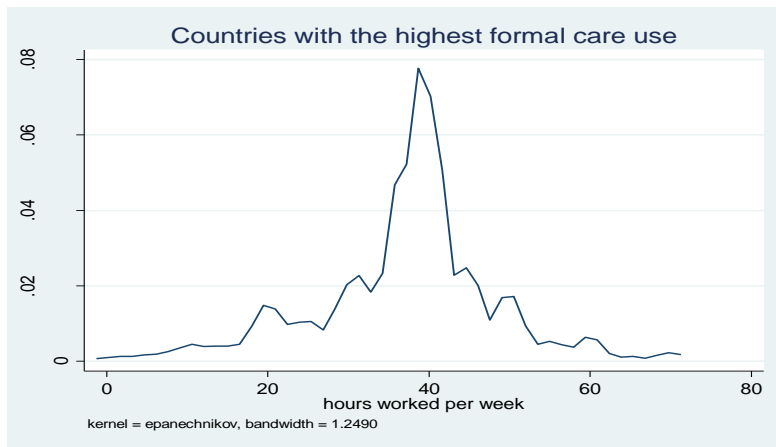


Figure A.3 Kernel density estimates of actual working hours per week conditional on being in employment by country groups based on formal care use **for females**

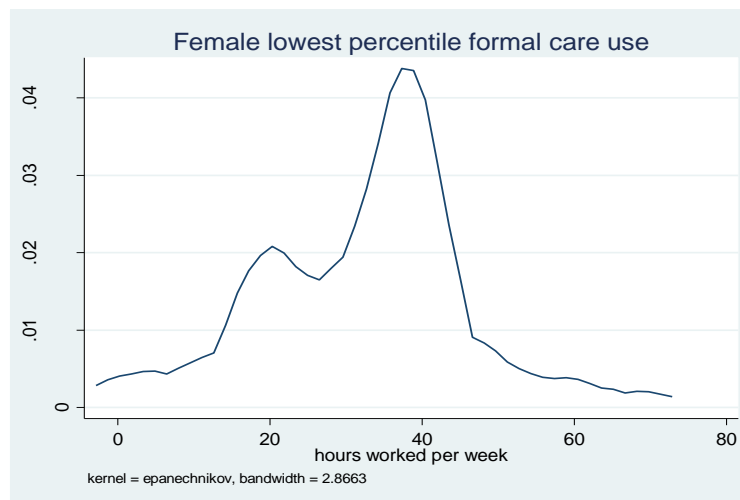
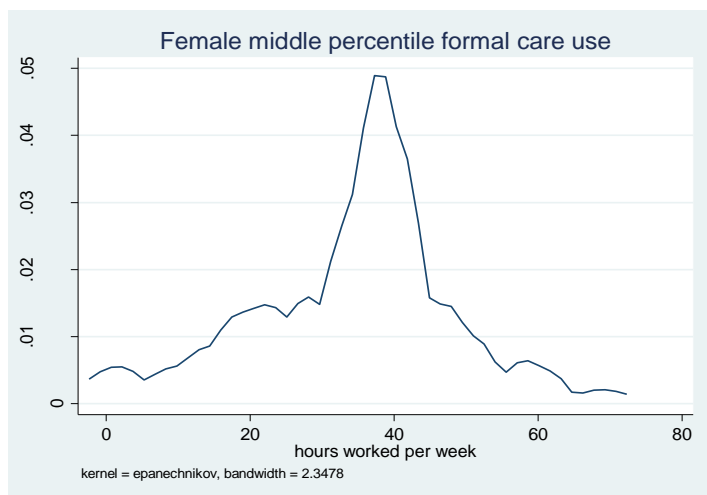
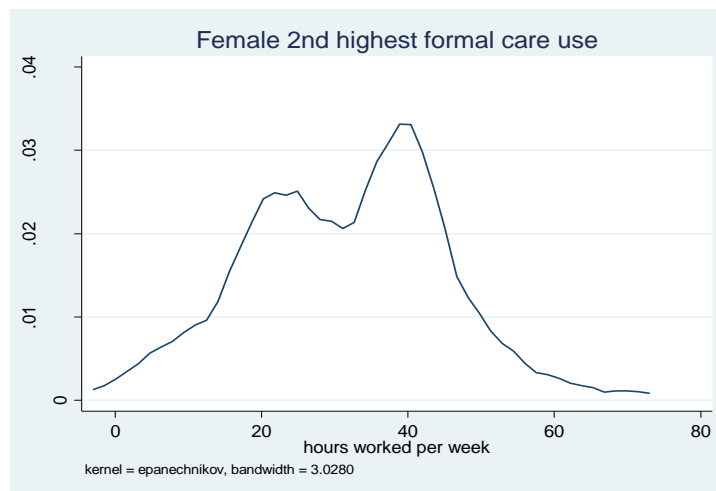
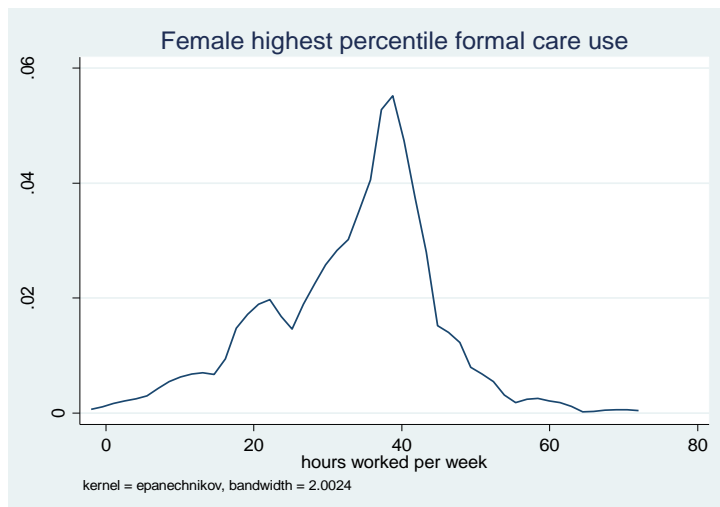


Figure A.4 Comparison of probit marginal effects by geographical country groups

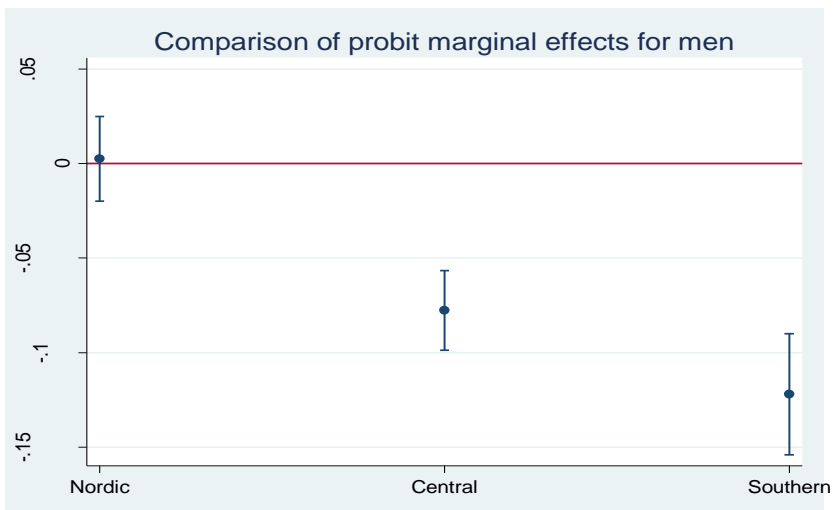
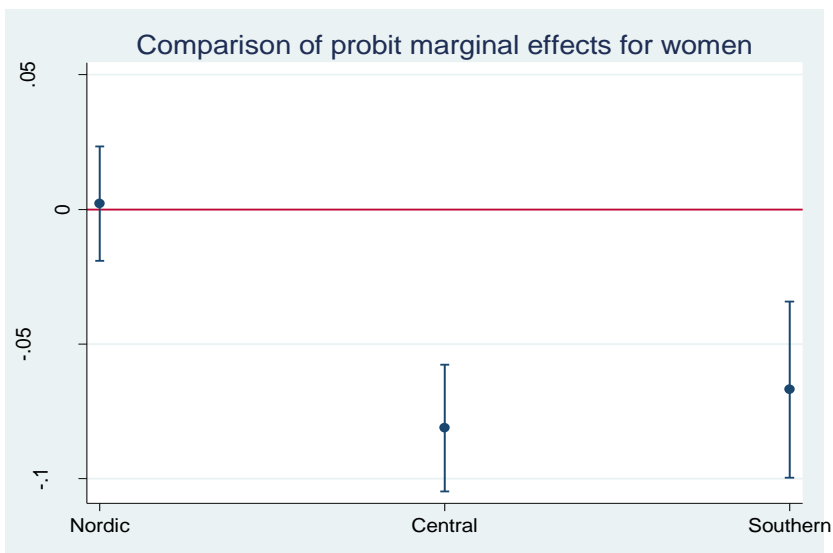
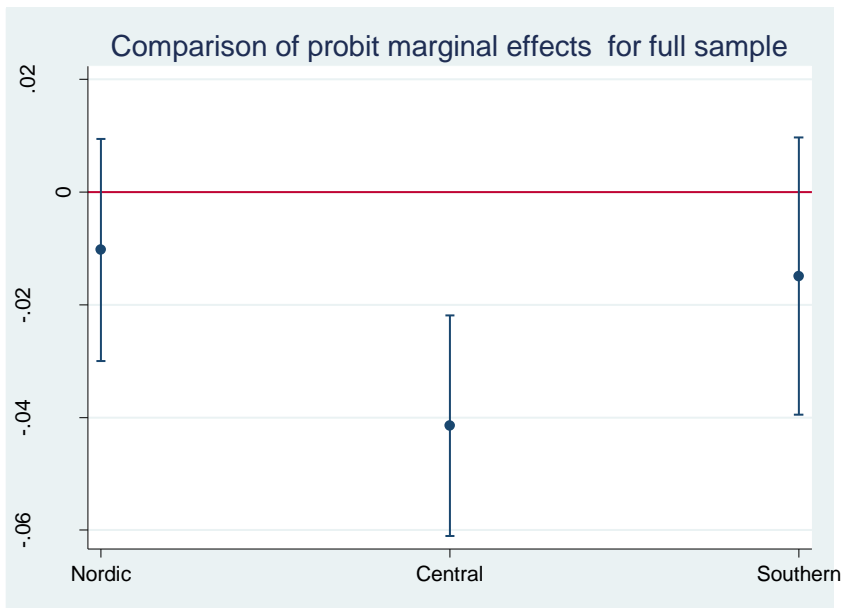


Figure A.5 Comparison of probit marginal effects by country groups based on formal care use

