CofFEE

Centre of Full Employment and Equity

Working Paper No. 08-08

The Impact of the Provision of Informal Care on Australian Labour Force Participation Behaviour

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October 2008

1. Introduction

Western countries face the challenge of providing adequate care for their citizens with disabilities and long term health problems in the context of an ageing population and other adverse economic and social trends. The ageing of the labour force has led governments to try to promote later retirement. The labour force participation of women has exhibited a long term increase, but they are typically the primary carers. Life expectancy has continued to rise and there is an increased desire on the part of the elderly to remain in their own homes, which has coincided with Australian Federal and State governments cost shifting by deinstitutionalising long term care, and reducing the quantum of formal care. With reference to England, Heitmueller (2007, p.537) notes that lower marriage and birth rates, greater geographic mobility, and declining inter-generational co-residence will reduce the availability of informal care over time. Similar trends are also evident in Australia. This tension within Australian public policy is reflected in the derisory Carer's Allowance, which is about $100 per fortnight.

There is a tendency in the literature to commodify the provision of care, rather than recognising its location within a normative framework of obligations and responsibility (Daly and Lewis, 2000, quoted in Cass, 2006). 'Caregiving and receiving is a relationship, providing worth and value to all participants' (Cass, 2006), so that public policy designed to support caring should not view it merely as a marketable service if not available informally. However the policy dilemma is usually conceptualised in terms of the costs and benefits of different combinations of formal and informal care subject to perceived funding and labour market constraints. Studies are now investigating whether informal and formal care can be viewed as substitutes or complements (see, for example, Bolin, 2008b).

While the evidence is mixed, probably reflecting the econometric techniques which were adopted, on balance the empirical literature would indicate that rates of labour force participation and hours of work are lower, ceteris paribus, for those adults of working age who engage in significant amounts of informal care (see, for example, the UK studies by Carmichael and Charles, 1998; Arber and Ginn, 1995; US studies by Ettner, 1996; Johnson and Lo Sasso, 2000; and European studies by Crespo, 2006; Casado et al, 2007 and Bolin et al, 2008a).

Unless informal carers have the capacity to negotiate the provision of respite care and flexible workplace arrangements, it would be very difficult for them to combine informal care with significant amounts of paid employment, particularly if the disabled and/or aged have significant care needs which cannot be at least partially met by formal care (Heitmueller, 2007). Thus, despite the caution associated with viewing the provision of care in purely economic terms, dignity and continued independence in old age may well be increasingly reliant on a comprehensive and affordable system of formal care to complement the diminished provision of informal care.

In 1998, 15.6% of the Australian population was acting as an informal carer, either in a primary or minor role, and this figure increased to 16.2% in 2003. Over the same period the rate of disability in Australia increased from 19.3% to 20.0% (ABS, 2003). Of over 3.5 million elderly and disabled individuals needing assistance in 2003, informal carers provided some assistance to nearly 2 million, whereas formal care was provided to between 1.3 and 1.4 million individuals. 177,000 individuals received no assistance. Estimates of the cost of providing informal care range from $4.9b under

the opportunity cost model to \$30.5b if these services were provided through formal care (Access Economics, 2005). Thus informal carers play a significant role in supporting their disabled and elderly relatives and friends.

Most early studies of the impact of informal caring on labour force participation were based on US or British data (see references listed above), but in recent years there has been a flow of European papers, including Bolin et al (2008a), Casado et al (2007) and Crespo (2006). Despite the availability of the Australian Bureau of Statistics Confidentialised Unit Record File, Survey of Disability, Ageing and Carers for 1998 and 2003, there have been no Australian econometric studies of the influence of informal caring on labour force participation behaviour. This paper is designed to fill this gap by attempting to unpack these potentially complex inter-relationships through univariate and bivariate probit analysis with the inclusion of variables representing different specifications of informal care, gender, age and a broad range of socio-economic factors. In contrast to the extant literature, which often ignores the caring behaviour of men, male behaviour is modeled both separately and jointly with that of women, the latter through the inclusion of intercept and slope dummies. Also Marginal Effects are calculated from first principles to ensure that they are correctly measured. Finally the implications of these results for the (re)design of public policy are explored.

We find that a number of different forms of specification of informal care, such as hours of care and for whom the care is provided, have significant, adverse effects on the labour force participation behaviour for both female and male carers, when univariate probit equations are estimated, but in contrast to co-residential care, extra-residential care has an insignificant effect on participation. The treatment of informal co-residential care as exogenous to the participation decision leads to an understatement of the Marginal Effect of co-residential care on the participation behaviour of both women and men. However, the estimated participation models continue to yield propositions in line with standard participation models by gender (see, for example, Kidd and Ferko, 2001), with men revealing a greater commitment to paid work, but caring responsibilities, both for dependent children and for the elderly and disabled, have a smaller impact on their participation, as compared to women.

In the next section the literature is reviewed. The dataset is described in Section 3 and the econometric techniques and results are in the following section. Concluding comments are in the final section.

2.   Informal care and labour force participation

2.1 Theoretical Models

Most theoretical models of the incidence and allocation of informal care are based on intra-household decision making about the provision of care of elderly parents by their children (see, for example, Stern, 1995 and Wolf and Soldo, 1994).

The orthodox analysis of the allocation of informal caring is underpinned by a utility maximisation framework. First the availability and cost of formal care and the extent to which it is substitutable for informal care will influence the demand for informal care. Second, the leisure work trade off is made additionally complicated by informal caring which also consumes time and has the same opportunity cost as leisure (Heitmueller and Michaud, 2006, p.5).

The impact of caring on employment and leisure can be broken down into substitution and income effects, which will be affected by whether leisure and informal care are substitutes or complements. With time being scarce, caring responsibilities will increase the reservation wage and reduce labour supply (substitution effect). Conversely, the extra expenditures associated with the caring commitment may induce extra paid work through an income effect. If leisure and care are substitutes, then hours of leisure will decline. In the presence of a respite effect, leisure and caring could be complements, and the income effect may be dominated leading to increased leisure (Heitmueller and Michaud, 2006, p.5, Carmichael and Charles, 2003, p.788).

The orthodox approach is limited, given its inability to distinguish between an informal carer reducing hours of paid work and ceasing to participate in the labour market. Unfortunately inadequate income data do not permit the inclusion of a wage variable to be estimated. Also the interpretation of empirical results within this theoretical framework can easily lapse into tautology, in that, say a greater preparedness of women to devote time to primary care and not undertake paid work, despite their educational qualifications, can be attributed to a recognition of strong mutual benefits of informal care, as expressed in their underlying preferences.

The summary statistics reveal that women are the main providers of care. The rational household division of labour taking account of the respective opportunity costs of paid care, informal care and paid work in the presence of care needs may justify women assuming the main caring roles and men being the main income earners which would accord with longstanding societal views on the respective roles of women and men in caring and paid work, with the former, in particular, recognising the reciprocal benefits of providing care. This means that there are likely to be systematic differences in the estimated participation equations for women and men.

A demand for informal care arising from a close relative or friend may be difficult to meet due to difficulty of access. A solution could be for carer(s) and the dependent to co-reside, but this may be impractical due to financial and social considerations and/or limited space in the family residence. The distinction between co- and extra-residential care is frequently made in the literature (see, for example, Heitmueller, 2007) and in the empirical work in this paper we focus mainly on the demand for co-residential informal care. However we cannot model the behaviour underpinning the decision to co-reside or the specific sharing of informal caring responsibilities within a household.

2.2 Empirical work

A key methodological issue that has to be addressed in empirical estimation of the impact of informal caring on labour force participation is the treatment of the former as exogenous. Crespo (2006, p.20) outlines the conditions necessary for the caring decision to be considered exogenous. First, the intra-family allocation of the parental help does not depend on other decision variables of the children, such as their employment status or time devoted to childcare. Second, there are no substitutes for informal care, such as market-based care services. Third, parental needs must be met. If these somewhat unrealistic conditions hold, she concludes that the children would take the parental demand for care as exogenous and the allocation of these tasks among them would only depend on the exogenous characteristics of the siblings such as sex, marital status, education, age and health status.

Casado et al (2007, p.4) identify two sources of endogeneity which result from simultaneity and unobserved individual heterogeneity. First, as noted, the time devoted to each activity is the outcome of a simultaneous choice process, subjected to an overall time constraint, which is mediated by other factors, including the availability of formal care and other sources of informal care and the previous employment status of the potential carer. Second, individuals may possess unobserved characteristics correlated with both the propensity to care for a dependent relative and the propensity to participate in the labour market. For example, Heitmueller (2007, p.538) notes that an individual may take up informal caring responsibilities to bridge spells of job search or unemployment or if inadequate skills preclude job access, due to a range of factors, including prior caring responsibilities, illness or parenthood.[1]

Authors address simultaneity by instrumenting the informal care variable, whereas unobserved individual heterogeneity can be countered by the estimation of a difference in difference model with panel data. Failure to address the endogeneity of the caring variable within a model of participation behaviour would lead to biased and inconsistent estimates. Empirical studies can be classified according to whether or not they address these potential sources of endogeneity (Casado et al, 2007).

In their UK study, Carmichael and Charles (1998), who do not address endogeneity, find that those caring for more than 20 hours a week have lower participation rates than non-carers and individuals providing less informal care are more likely to work compared to non-carers, but supply fewer hours. In a later paper (2003), they find that females are more likely to be the main carer and to report longer hours of care. Male carers experience a larger relative wage penalty than female carers, but still earn more on average than their female counterparts (Carmichael and Charles, 2003, pp.787-788). Men do not willingly forego paid employment, even when caring for highly dependent individuals. They conclude that these carers would benefit from policies which led to the provision of respite care, carer-friendly employment practices and additional non-means tested financial support.

Arber and Ginn (1995, p.452) find that most informal caring is extra-residential in Britain, which is in sharp contrast to the Australian experience. Provision of co-residential care causes significantly lower odds of employment for both men and women, but for extra-residential caring, there is a less systematic change in the odds ratios. There is no evidence that women are cushioned from the burden of informal caring by the capacity to take up part-time employment.

Amongst US studies which use instrumental variables, Wolf and Soldo (1994) and Stern (1995) find no impact of parental care on either participation or conditional hours of work, whereas caring for parents living both inside and outside the household is found to have a significant impact on both female and male labour supply by Ettner (1996) and Johnson and Lo Sasso (2000). Crespo (2006) uses data from six European countries to estimate the effects of informal care on female labour force participation, using a bivariate probit specification. Women who live in the same household as the dependent, or provide daily care elsewhere, have a lower probability of labour force participation. This is likely to reflect the intensity of care.

In a study of 11 European countries Bolin et al (2008a) find that the number of hours of informal care provided to parents outside the household significantly reduced the probability of employment for both women and men. Among women, the exogeneity of informal care could not be rejected, whereas, for men, a lack of suitable instruments meant the hypothesis could not be tested. A negative impact on hours

worked was also found, but only when men and women were analysed together. However, there were no statistically significant effects on wage-rates associated with informal caring, which is at odds with Carmichael and Charles (1998) and Heitmueller and Inglis (2007). There was some variation of outcome across the European countries which points to the importance of formal institutional arrangements, but possibly also informal factors such as preferences, norms, and traditions (Bolin et al, 2008a, p.19). Policies enabling more flexible work-hours for the care-giver to combine paid work and care-giving are an option. Another policy could be the provision of paid leave for those caring for a dependent (Bolin et al, 2008a, p.20). They note that many countries have introduced these policies but they are usually quite limited in scope (Jenson and Jacobzone, 2000).

Heitmueller (2007) initially adopts an instrumental variable approach to examine the relationship between informal care and labour force participation, drawing on the 2002 wave of the British Household Panel Study (BHPS). He differentiates between co-residential and extra-residential care. It is unclear why he does not employ bivariate probit estimation since the caring variables take the values 0 and 1. He concludes (2007, p.557-558) that co-residential caring reduces participation, so that the substitution effect between care and employment dominates the income effect from forgone income. On the other hand, he finds no link between employment and the provision of care for extra-residential carers and those caring for less than 20 hours per week. These results hold both for the cross-section and the panel estimation. The panel modeling reveals that the care variable does suffer from unobserved heterogeneity which, unless corrected, will bias the results. The different behaviours of women and men in both the cross-section and panel models are captured by the inclusion of a male intercept dummy which would appear to be inadequate since labour supply models identify significantly different slope coefficients for women and men across a broad range of socio-economic variables REF.

Heitmueller (2007, p.538) reports that qualitative studies have shown that many individuals providing care in their own home or for long hours perceive that they have little choice in becoming a carer (Mooney, Statham and Simon, 2002, Lankshear et al, 2000, Lewis, et al, 1999). Lilly et al (2007) argue however that such studies need to take account of those who chose not to take up caring responsibilities and clearly perceive some freedom of choice.

Spiess and Schneider (2003) use the first three waves (1994-96) of the European Community Household Panel (ECHP) and employ a difference-in-difference model to examine the impact on hours worked of three "stages" of informal care: starting, continuing and stopping caregiving. The results reveal that, in the southern European (Mediterranean) countries, continuing to give care, as opposed to starting, affects the hours worked, whereas in the other countries the results show the opposite.

Viitanen (2005) uses eight waves of the same dataset (1994-2001) to examine the effects of informal care on women's labour force participation, with the aid of dynamic probit models. She takes account of unobserved individual heterogeneity (random effects), state dependence, and the attrition biases that occur when panel data are used. The results obtained by Viitanen, which, unlike those of Spiess and Schneider, are country-specific, reveal that informal caregiving only has a negative influence on the probability of being employed in Germany, but when disaggregating women into specific subgroups, there are significant effects among middle-aged women (Belgium, Finland and Germany) and among single women (Greece,

Netherlands, Italy and Germany). Unobservable heterogeneity is responsible for 45-86% of the unexplained variation in labour force participation. Short-term policy interventions, such as increased labour market flexibility to facilitate the care of an elderly person may have longer term consequences, given the presence of state dependence (Viitanen, 2005, p.20).

Casado et al (2007) also use the ECHP, but confine their attention to the Spanish subsample. They estimate a dynamic ordered probit to explore the impact of informal care on the labour market behaviour of middle aged women. The impact takes the form of reduced participation, rather than reduced hours, and falls mainly on women who are co-resident with the dependent and provide care for more than one year. This result reflects in part the lack of part-time work in Spain.

Heitmueller and Michaud (2006) use 13 waves of the British Household Panel Survey (1991-2003) and estimate a dynamic bivariate probit that incorporates both state dependence and individual heterogeneity. Reduced labour force participation is found for both adult women (-6%) and men (-4.7%) when the model is estimated for the sub-sample of co-resident carers, but if the distinction between co- and extra-residential care is not made, the labour force participation of carers is not significantly lower than for non-carers. However no account is taken of the hours devoted to care which is likely to distort the results.

Heitmueller and Inglis (2007) estimate separate participation equations for carers and non-carers using panel data. Decomposing the gap of up to 8% in participation rates, most of it is attributable to unfavourable institutional arrangements, such as a lack of flexible working hours for informal carers, rather than differences in observed characteristics. Also employment re-entry probabilities for carers are significantly below those of their non-caring counterparts.

Ettner (1996) and Johnson and Lo Sasso (2000) both support Cass' claim (2006) that formal care is not an attractive substitute for informal care, but Bolin (2008b) finds that these forms of care appear to be substitutes. Also Viitanen (2007) demonstrates that increasing government expenditure on formal residential and home-help for the elderly can significantly increase the female participation rates across Europe by reducing the demands of informal care.

Bittman et al (2007) conduct an analysis of the Australian longitudinal HILDA Survey. They find that carers suffer disadvantage, through reducing hours or leaving the workforce, and earn lower levels of income. In their Australian longitudinal study based on the mid-aged cohort of the Women's Health sample, Lee and Gramotnev (2007) also note that the reduced participation in paid employment and the detrimental impact on health continues after the period of care has ceased (see also Hutton and Hirst, 2000).

3.   The dataset

ABS (2003) defines a carer as 'a person of any age who provides any informal assistance, in terms of help or supervision, to persons with disabilities or long-term conditions, or older persons (i.e. aged 60 years and over)'. This assistance is defined as likely to be ongoing at least six months. When the care recipient and carer are co-residents, the assistance is for one or more of the following activities: (i) cognition or emotion; (ii) communication; (iii) health care; (iv) housework; (v) meal preparation; (vi) mobility; (vii) paperwork; (viii) property maintenance; (ix) self care; (x) transport (ABS, 2003, p.71).

A primary carer provides most of the informal assistance, in the form of help or supervision, to a person with one or more disabilities. These carers provided assistance to 474,600 individuals in 2003, with over 90% being an immediate family member that is a partner, parent or child. 371,200 recipients of informal care were co-resident with their primary carers. Over 70% of primary carers and about 56% of all carers were women. The assistance is provided for one or more of the core activities (communication, mobility and self care) (ABS, 2003, p.77).

48.4% of primary carers provided 40 or more hours of assistance. Primary carers had a labour force participation rate of 39% in 2003 compared to all carers (56.1%) and non-carers (67.9%) (ABS, 2003). The median gross personal income per week was $237 for primary carers, $300 for all carers and $407 for non-carers. Thus, career prospects, leisure time, income, and pension entitlements may well be sacrificed by combining paid work and informal caring (Carmichael and Charles, 2003, and Heitmueller and Inglis, 2007).

The SDAC 2003 CURF is based on a survey of 49,843 respondents. The sample was reduced to 24,033 by the removal of those respondents aged under 15 and 65 years and over and those persons not resident in households. Table 1 reveals that a higher percentage of women than men in the sample were involved in caring in general, that is 17.4%, as compared to 13.4%, and also acting in a primary care capacity 4.2% (cf. 1.4%).

The capacity of a co-residential carer to participate in the labour market may well depend on the presence of other adults in the household who can share the caring responsibilities (Ettner, 1996). Consequently a variable representing the number of adults in each household minus one was constructed (nhnad). It would be expected to impact positively on the participation decision of carers, although it may also be a proxy for the number of members of the household undertaking paid work which may enable the carer to devote her/his time to care rather than paid employment. Equally the variable may be a proxy for the income needs of the household which could reinforce the need for the individual to participate in paid employment.

Table 1: Descriptive statistics: adults 15 to 64 years

Variable	Definition	Women		Men	
		Mean	**S. Deviation**	**Mean**	**S. Deviation**
lfp	Labour force participation	0.681	0.466	0.834	0.372
married	Married	0.531	0.499	0.517	0.500
divsep	Divorced and separated	0.128	0.334	0.093	0.291
age1519	Aged 15-19 years	0.097	0.296	0.107	0.309
age2024	Aged 20-24 years	0.095	0.293	0.095	0.294
age2534	Aged 25-34 years	0.205	0.404	0.204	0.403
age3544	Aged 35-44 years	0.234	0.423	0.224	0.417
age4554	Aged 45-54 years	0.213	0.409	0.215	0.411
age5564	Aged 55-64 years	0.156	0.363	0.154	0.361
inner	Inner regional	0.217	0.412	0.218	0.413
other	Other areas	0.128	0.334	0.133	0.340
cy12	Completed Year 12	0.176	0.381	0.162	0.368
cert	Certificate or Diploma	0.240	0.427	0.332	0.471
degr	Bachelor/postgraduate degree	0.195	0.397	0.171	0.377
ftstud	Current full-time study	0.115	0.319	0.109	0.312
ptstud	Current part-time study	0.071	0.257	0.068	0.252
eng	English speaking country	0.843	0.364	0.852	0.355
prim	Primary carer	0.042	0.201	0.014	0.118
c020h	Up to 20 hours primary care	0.018	0.134	0.008	0.090
c2040h	20-40 hours primary care	0.008	0.091	0.002	0.048
c40p	Over 40 hours primary care	0.015	0.123	0.004	0.060
hcare	Average hours of primary care	1.128	6.271	0.314	3.186
partner	Primary carer is partner of dependent	0.010	0.100	0.007	0.081
fmother	Primary carer is parent of dependent	0.015	0.122	0.001	0.036
sdaugh	Primary carer is child of dependent	0.013	0.112	0.005	0.072
friend	Primary carer is friend of dependent	0.004	0.066	0.001	0.033
pricores	Co-resident primary carer	0.032	0.176	0.011	0.106
prixcare	Non-resident primary carer	0.010	0.100	0.003	0.052
cores	Co-resident carer	0.118	0.323	0.106	0.308
xcare	Non-resident carer	0.056	0.229	0.028	0.164
sprof	Profound limitations core activities	0.012	0.108	0.010	0.097
ssev	Severe limitations core activities	0.032	0.176	0.025	0.157
smod	Moderate limitations core activities	0.036	0.187	0.032	0.177
smil	Mild limitations core activities	0.045	0.208	0.045	0.208
srsc	Some schooling restrictions	0.023	0.150	0.031	0.174
snsc	Disability no schooling restrictions	0.026	0.158	0.032	0.176
slth	Long term health condition, no disability	0.240	0.427	0.221	0.415

Source: ABS (2003)

Notes: 12,220 female observations & 11,813 male observations of adults residing in households.

ftstud incorporates secondary school attendance. Both *ftstud* and *ptstud* incorporate post-school study.

If hours of care for Primary Carers not stated, they are assumed to provide 0-20 hours of care per week.

friend denotes other relative, friend or neighbour.

A Matlab program was written to identify the number of children aged 0-4 years (a04), 5 -9 years (a59) and 10-14 years (a1014) and the incidence of different levels of disability, as defined in Table 1, in each household. Likewise, household level variables were constructed based on whether a dependent in need of assistance could care for herself/himself at home without difficulty for a number of days, a day or some hours. These household based variables were respecified using household and person identifiers to generate a corresponding observation for each person.

The 'demand' for care facing each adult member (15-64 years) of a household who is a potential carer, can be defined as the total incidence of disability within the household as defined by seven categories of limitations with respect to core activities (profound, severe, moderate and mild, schooling restrictions, disability without schooling restrictions and long term health condition),net of any of these limitations or restrictions experienced by the particular adult (see also Heitmueller, 2007, p.540). These net demands are identified by the prefix nh (net household) replacing s (self) yielding, for example, profound limitations with respect to core activities (nhprof). Likewise the net capacity for self-care in the household is also measured by the variables prefixed by nh, namely nhscdays, nhsc1day and nhschrs.

Finally the net household need for eleven different forms of assistance is also identified by the prefix, nh. These forms of assistance are behaviour management (nhabhavc), decision making (nhasdec), coping with feelings (nhaemotc), assistance with footcare (nhafootc), housework (nhahome), meal preparation (nhameal), paperwork (nhapaper), property maintenance (nhaprop), relationships (nharship), healthcare, other than footcare (nhaskinc) and private transport (nhatrans). The last 3 groups of variables prefixed by nh make up the 21 instruments which are used in the econometric work.

4. Econometric models and results

4.1 Probit Estimation

Our first objective is to explore the impact of informal caring by adult women and men and all adults on their labour force participation behaviour, assuming that the provision of care is exogenous. We focus on labour force participation that is a desire to engage in paid work, rather than employment per se, because the latter is more sensitive to the availability of jobs, notwithstanding the discouraged worker effect which impacts on participation.

We run robust univariate probit equations and include a range of individual socioeconomic variables, and the household based measure of the number of adults minus one, and the number of children in the three age ranges to capture potential child care demands, in addition to care of the disabled and elderly. The base case is a non-English speaking, unmarried or widowed 25-34 year old (fe)male resident of a major city who has no children, did not complete Year 12, is not currently studying or providing informal care, and enjoys good health.

The probit model can be specified as follows:

$$LFP_i^* = \alpha_1 C_i + \beta X_i + \varepsilon_i = \gamma Z_i + \varepsilon_i$$
$$LFP_i = 1(LFP_i^* > 0)$$
$$LFP_i = 0(LFP_i^* < 0) \tag{1}$$

where i indexes the observations and the explanatory variables are respectively the exogenous caring variable Ci and socioeconomic variables Xi. LFP_i^* denotes the propensity to participate in the labour market, whereas LFP_i is the corresponding observed variable.

Then the probability of labour force participation of the ith individual can be written as:

$$P(LFP_i = 1 | Z_i) = P(LFP_i^* > 0 | Z_i) = P(\varepsilon_i > -\gamma Z_i | Z_i) = G(\gamma Z_i) \tag{2}$$

where G denotes the cumulative standard normal distribution.

4.2 Marginal Effects

Of interest is not merely the significance of the explanatory variables, but their Marginal Effects (MEs). However care must be taken when using simple software generated Marginal Effects (eg. mfx in Stata), because each explanatory variable would be treated as separate and independent. All the explanatory variables in our models of participation and caring take discrete (integer) values, with some being simple (0,1) dummy variables. The explanatory variables include a number of sets of (0,1) indicator variables with each set representing different categories of a single underlying variable, such as age group, marital status and health status. Each individual can only be classified in one age group and has a particular marital and health status. Also the inclusion of gender slope dummies within a (bivariate) probit specification based on the full (male and female) sample will create further problems if automatically generated MEs are used, because the multiplicative, interaction terms will also be treated as separate independent variables rather than being linked to the constituent variables (Norton et al, 2004).

In this paper the MEs are computed from first principles using Stata code2 to capture the inter-dependencies between the explanatory variables. The MEs are calculated by averaging the effect over all observations, rather than calculating the effect using one observation based on the average values of the explanatory variables (Bartus, 2005).

For a dummy variable, say zij, the ME can be written as:

$$AME_j = (1/n)\sum_{k=1}^{n}[G(\gamma Z_k | z_{kj} = 1) - G(Z_k | z_{kj} = 0)] \tag{3}$$

where n denotes the number of observations. Most software programs, including Stata, will recognise dummy variables and will compute (3), rather than treating variables as continuous.

A consistent approach was taken with respect to the age (and similar) variables which, with the inclusion of the corresponding default variable, each separately sum to the unit vector. All MEs were calculated on the basis of a comparison between the default (age group) and the specific value (age group) averaged across all observations.

Norton et al (2004) focus on the interaction variable and note that the marginal effect of a change in the two variables making up the interaction variable is not simply equal to the marginal effect of changing just that interaction term. Thus, if the relevant terms are $\gamma_1 z_{k1} + \gamma_2 z_{k2} + \gamma_{12} z_{k1} z_{k2}$, then the cross partial ME, if both variables are continuous, is:

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$$AME_{12} = (1/n)\sum_{k=1}^{n} \delta^2 G(\gamma Z_k)/\delta z_{k1}\delta z_{k2} = \gamma_{12}g(\gamma Z_k) + (\gamma_1 + \gamma_{12}z_{k2})(\gamma_2 + \gamma_{12}z_{k1})g'(\gamma Z_k)$$

(4)

The ME corresponding to observation i, if both variables are dummies is,

$$AME_{12} = (1/n)\sum_{k=1}^{n} \Delta^2 G(\gamma Z_k)/\Delta z_{k1}\Delta z_{k2}$$

$$= (1/n)\sum_{k=1}^{n} [G(\gamma_1 + \gamma_2 + \gamma_{12} + \widetilde{\gamma}\widetilde{Z}_k) - G(\gamma_1 + \widetilde{\gamma}\widetilde{Z}_k) - G(\gamma_2 + \widetilde{\gamma}\widetilde{Z}_k) + G(\widetilde{\gamma}\widetilde{Z}_k)]$$

(5)

with $\widetilde{\gamma}, \widetilde{Z}_k$ respectively denoting the remaining estimated coefficients and associated observations for the kth individual.[3]

Norton et al (2004) have focused on combinations of two or three variables, and developed Stata code (inteff) to calculate MEs and the associated standard errors. In the presence of a gender dummy, plus say age variables, there could be up to 4 second order multiplicative (interaction) variables which include the gender dummy, so that the second order cross-partial would be more complex than (5) and not suitable for calculation using the code developed by the authors.

Consequently all Marginal Effects in the paper were manually calculated in the manner described above.[4] Standard errors need to be computed to test for significance. Consequently bootstrapping was undertaken for the calculation of all MEs, based on 50 replications of the complete dataset. The same approach was adopted to compute MEs for the bivariate probit models. The quoted MEs refer to the impact on the probability of labour force participation, as opposed to say the impact on the joint probability of both labour force participation and undertaking informal caring.

4.3 Probit Results

In Table 2 we report the results for the specification based on hours of care provided by primary carers for all adults and women and men treated separately. The specification based on all adults included male slope dummies for all variables and an intercept dummy. All the explanatory variables were retained from the female and male regressions, but a joint test of significance was undertaken of all the male dummies which were not individually significant at the 0.1 level. It was not significant ($\chi^2(15)=11.34$), so these variables were removed and the probit was re-estimated (columns 5 and 6). The MEs are computed in the manner described above, with the MEs based on the interaction terms which incorporate the male slope dummy (shown in bold in Table 2) being computed according to (5).

Table 2: Labour force participation marginal effects: univariate probit

Variables	Women		Men		Adults	
	M. Effects	S. Error	M. Effects	S. Error	M. Effects	S. Error
male					0.132	0.005
c020h	0.003#	0.025	-0.036#	0.031	-0.010#	0.018
c2040h	-0.193	0.046	-0.189**	0.078	-0.177	0.038
c40p	-0.215	0.040	-0.397	0.084	-0.306	0.047
mc40p					-0.216	0.076
married	0.008#	0.010	0.078	0.010	0.043	0.008
mmarried					0.069	0.009
divsep	0.024#	0.015	0.030**	0.013	0.029	0.009
inner	-0.004#	0.007	-0.013*	0.008	-0.006#	0.007
other	0.012#	0.011	0.016**	0.007	0.018	0.007
nhnad	0.001#	0.004	0.009	0.003	0.011	0.003
age1519	-0.005#	0.019	-0.037	0.011	-0.196	0.012
mage1519					-0.104	0.021
age2024	-0.007#	0.015	0.013#	0.010	-0.023**	0.009
age3544	-0.012#	0.011	-0.013#	0.009	-0.005#	0.007
age4554	-0.091	0.013	-0.050	0.011	-0.059	0.008
age5564	-0.356	0.012	-0.227	0.012	-0.278	0.008
a04	-0.224	0.009	-0.018**	0.008	-0.117	0.007
ma04					0.191	0.011
a59	-0.083	0.009	-0.013**	0.006	-0.048	0.005
ma59					0.059	0.012
a1014	-0.037	0.006	0.007#	0.005	-0.021	0.005
ma1014					0.036	0.009
eng	0.150	0.012	0.071	0.010	0.117	0.007
meng					-0.055	0.015
ftstud	-0.241	0.018	-0.367	0.022	-0.198	0.015
mftstud					-0.132	0.022
ptstud	0.065	0.015	0.016*	0.009	0.074	0.009
cy12	0.129	0.010	0.049	0.009	0.117	0.008
cert	0.150	0.012	0.069	0.008	0.124	0.005
degr	0.238	0.009	0.081	0.008	0.171	0.007
mdegr					-0.118	0.014
sprof	-0.579	0.027	-0.585	0.054	-0.577	0.027
ssev	-0.345	0.025	-0.458	0.028	-0.402	0.017
mssev					-0.144	0.034
smod	-0.213	0.023	-0.283	0.022	-0.247	0.017
msmod					-0.102	0.029
smil	-0.181	0.021	-0.274	0.017	-0.225	0.011
msmil					-0.124	0.031
srsc	-0.095	0.028	-0.140	0.023	-0.114	0.014
msrsc					-0.065*	0.036
snsc	0.007#	0.024	-0.056	0.017	-0.019#	0.016
msnsc					-0.062**	0.031
slth	-0.014*	0.008	-0.016**	0.007	-0.011**	0.005
Log					-9817.378	
p/likelihood	-6031.164		-3553.313			
Pseudo R^2	0.212		0.331		0.265	

Source: see Table 1.

As would be expected, increasing hours of care (above 20 per week) are associated with a falling probability of labour force participation on the part of both women and men, but less than 20 hours per week of care has an insignificant impact, which accords with the work of Carmichael and Charles (1998) and Heitmueller (2007). Of interest is that the male slope dummy for 40 or more hours of care is not only

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significant and negative but large in absolute value, indicating that long hours of informal care have a particularly strong impact on male participation. It needs to be noted that the ME calculation is based on the second order difference, so it is not comparable with the corresponding ME for adults. Conversely being male and married has a significant, positive impact on participation as compared to being female and single, ceteris paribus.

The remaining results largely conform to the standard labour force participation models for women and men. Ceteris paribus men have a 13% higher rate of participation than women. The coefficients on the adult age variables indicate a lower participation in the teenage years, when the full-time study variable is also taken into consideration, and declining participation beyond the prime age range. The presence of other adults in the household has a positive impact on male participation, but an insignificant effect on female participation, which points to the breadwinner role for men.

The number of children in successive age groups attracts a falling ME in absolute terms for both women and men, but the MEs for men are lower and less significant, and insignificant in the presence of children aged 10 to 14 years. The presence of significant male slope dummies for each of the variables representing dependent children demonstrates the potential misspecification associated with capturing the difference in male and female participation behaviour by just an intercept dummy. The marital status variables are consistent with divorced and married men assuming a breadwinner role, whereas these variables have an insignificant impact on women's participation. The positive marginal effects increase with educational attainment for both women and men, and are higher for women. Of interest is that part-time study has a positive impact on both women and men's participation and is significant at the 0.01 level which indicates a higher probability of participation than for a (wo)man not engaged in study. The impact of being English speaking is much greater for women than men. The impacts of female and male health status also accord with expectation, but the absolute values of the MEs for men for these variables are higher than those for women, which could indicate easier access to social welfare benefits for male breadwinners. The significant differences between women and men in the MEs of the health status variables is confirmed by significant negative male slope dummies for 5 of the 7 health status variables in the estimation based on the complete sample of adult women and men.

These results emphasise the importance of controlling for the standard influences on participation, so that the impact of the caring variable(s) is (are) not misrepresented (Lilly et al, 2007, p. 668). These socio-economic variables yield broadly similar MEs across the different specifications of informal care for women and men, so we just report the summary results for the care variables in Table 3.

Providing care to a partner has the greatest negative impact on the participation of women (Model 2), followed by care for a friend, son or daughter and father or mother. On the other hand, for men, caring for a friend has the greatest marginal effect, followed by father or mother, son or daughter and partner. These variables are all significant. With the exception of partner, the MEs are all greater in absolute value for men than for women.

The co-residential variable for primary carers has a negative ME and is strongly significant for women and men, whereas the extra-residential variable is insignificant (Model 3). This may seem counterintuitive because informal care which involves

travel would seem to be more disruptive to paid employment than care within the home, particularly in the presence of other resident adults (nhnad), who, subject to their work schedules, if employed, may be able to assist in informal care. However most households would have a maximum of two adults, and while nhnad is significant and positive in the male participation equation, it is insignificant for women. This suggests either a reluctance on the part of men to assist in informal care and/or the greater capacity of women to assist a (male) primary carer, due to their greater incidence of part-time employment. Also needs which are typically being met by a co-resident carer are likely to be significantly greater than those being met by a non-resident carer. The incidence of co-residential caring has a high positive correlation with some net household variables, notably profound and severe disabilities, and assistance required with housework, property maintenance and transport, and self care only being possible for a few hours. In other words, the disabled and elderly who receive co-residential informal care in most cases are in need of frequent care and unable to live independently. The only alternative to co-residential informal care could be institutionalisation.

Table 3: Marginal effects for different representations of informal care

	Women		Men		Adults	
Model 2	**M. Effects**	**S. Error**	**M. Effects**	**S. Error**	**M. Effects**	**S. Error**
partner	-0.234	0.040	-0.117	0.046	-0.181	0.028
fmother	-0.088	0.029	-0.191**	0.091	-0.084	0.026
sdaugh	-0.050*	0.030	-0.173	0.065	-0.109	0.029
msdaughter					-0.143	0.061
friend	-0.137**	0.059	-0.264	0.087	-0.149	0.048
Log p/likelihood	-6040.33		-3567.03		-9840.86	
Pseudo R^2	0.211		0.328		0.263	
Model 3						
pricores	-0.159	0.024	-0.170	0.036	-0.152	0.020
prixcare	0.001#	0.029	-0.094#	0.064	-0.049#	0.038
mprixcare					-0.111#	0.085
Log p/likelihood	-6039.38		-3567.60		-9839.65	
Pseudo R^2	0.211		0.328		0.263	
Model 4						
cores	-0.089	0.009	-0.030	0.009	-0.060	0.008
xcare	0.015#	0.015	0.000#	0.017	0.012#	0.013
Log p/likelihood	-6035.40		-3584.80		-9851.84	
Pseudo R^2	0.211		0.325		0.262	

Source: see Table 1.

Notes: # denotes insignificant at 0.1. *, ** denote significance at 0.1 and 0.05, respectively.

Remaining variables are significant at 0.01.

In Model 2 the variables represent the relationship of the primary carer to the dependent.

Heitmueller (2007) suggests that the decision to provide care outside the home can be treated as endogenous, whereas caring within the home is treated as exogenous in that the informal carer has little choice. This is clearly consistent with the results in this paper, but it is important to recognise the self-selection process which appears to be occurring.

The explanatory power of the male equations, as measured by the pseudo R2, is over 10 percentage points higher than the female equations, which can be interpreted as providing support for an instrumental perspective with respect to participation in paid employment on the part of men.

Potential impediment to labour force participation, including full-time study, poor health, and caring responsibilities, but excluding child care, tends to impact more strongly on male participation. Some men may be reluctant to undertake certain types of part-time employment which could be accommodated, despite the impediments. Such men and their prospective employers may share stereotypical views as to what constitutes appropriate forms of male employment.

On the other hand, the ability of women to participate in the labour market is likely to be contingent on a range of factors which are not captured in this dataset, including the timing and availability of paid employment and both formal care for the disabled and elderly as well as childcare. These unmeasured influences would contribute to reduced explanatory power of the probit equation for women.

The female and male data were again combined in one data set and a male intercept dummy and slope dummies for all the explanatory variables were included. The original explanatory variables were retained, but all the male slope dummies which were insignificant at the 10% level were subject to a joint test of significance. The associated chi squared test was insignificant at the 10% level, so these dummies were discarded. The informal care of an adult son or daughter attracts a negative male slope dummy indicating that that it has a greater impact on male labour force participation.

4.4 Bivariate Probit Model

As noted above, the treatment of informal care as exogenous in the participation decision is questionable because the informal care variable is likely to be endogenous, thereby yielding biased and inconsistent estimates.

One approach would be to address the possible endogeneity by a two step Instrumental Variable regression (see, for example, Heitmueller, 2007). However this approach ignores any correlation between the disturbances of the two equations, so running a bivariate probit is a more efficient estimation procedure (Greene, 1998).

The bivariate recursive probit can be specified as follows:

$$LFP_i^* = \alpha_1 C_i + \beta_1 X_{1i} + \varepsilon_i$$
$$LFP_i = I(LFP_i^* > 0)$$
$$C_i^* = \beta_2 X_{2i} + \upsilon_i$$
$$C_i = I(C_i^* > 0) \tag{6}$$

where i indexes the observations. LFP_i^*, C_i^* denote the propensities to participate in the labour market, and engage in informal caring respectively, whereas LFP_i, C_i denote the corresponding observed variables. The observed variables assume the value of unity if the corresponding propensities are greater than zero, as indicated by the indicator functions. The exogenous variables influencing the propensities to participate in the labour market and engage in informal caring are denoted as X_{1i}

and X_{2i}, respectively. The unobservable influences on these propensities are given by the error terms $\varepsilon_i, \upsilon_i$. The errors are assumed to be iid and to follow a bivariate normal distribution with zero means, and a covariance matrix, Σ where

$$\Sigma = \begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix}$$

(7)

where is the correlation of the errors and the variances are normalised to 1. If is non-zero, the participation equation will not be consistently estimated, if the two equations are separately estimated by univariate probits, whereas estimating the participation and caring equations jointly in a bivariate probit will yield consistent estimates (Knapp and Seaks, 1998; Maddala, 1983). The equations are estimated by maximum likelihood. Knapp and Seaks (1998) show that a likelihood-ratio test of the error correlation coefficient can be used as a Hausman endogeneity test.

The parameters of the model are identified due to the non-linearity of the equations and the normality assumptions (Manski et al, 1992). However the inclusion of instruments which impact on the caring decision, but do not directly impact on participation behaviour, reinforces this identification.[5] Thus it is desirable that X2 includes variables with a high explanatory power.

The extra-residential caring variables in the probit specifications (Models 3 and 4) are insignificant. The ABS survey does not provide any data which measure the 'demand' for extra-residential care from relatives or friends, so it is impossible to find plausible instruments for extra-residential caring. We employ the 21 instruments outlined in Section 3 which represent the incidence of different types of disability, needs for different forms of assistance and capacity for self-reliance within households, net of these characteristics for each adult who is part of the sample. These variables represent the net demand for care within the household.

The instruments perform relatively poorly if primary co-residential care (pricores) is the chosen care variable, particularly for men. This is unsurprising because the instruments measure the net demand for all sources of care. Consequently it was decided to model the behaviour of co-residential carers (cores), which represents a significant share of all informal care (see Table 1).

A recursive bivariate probit model was run with the exogenous variables (X2) for the caring equation consisting of the socio-economic variables used in the univariate probit model for labour force participation, plus the 21 instruments described above. The same socio-economic variables plus the endogenous caring variable appear in the participation equation. Insignificant instruments were omitted from the male and female caring equations following a chi-squared test.

4.5 Bivariate Probit Results

The coefficients on the instruments in the caring equation are not reported.6 MEs corresponding to labour force participation are reported for both the bivariate probit model and the equivalent univariate probit model (Tables 4 to 6).

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Table 4: Bivariate probit & probit: female labour force participation

| Variables | Bivariate Probit | | | | Probit | |
| | Co-residential Care | | Labour force participation | | Labour force participation | |
	Coefficient	Standard Error	M. Effects	Standard Error	M. Effects	Standard Error
cores			-0.118	0.019	-0.090	0.012
married	0.192	0.067	0.009#	0.010	0.009#	0.013
divsep	0.082#	0.085	0.024#	0.016	0.024*	0.014
inner	0.133**	0.055	-0.001#	0.010	-0.002#	0.008
other	-0.013#	0.070	0.011#	0.010	0.011#	0.010
nhnad	-0.104	0.032	0.006#	0.005	0.005#	0.004
age1519	-0.957	0.217	-0.008#	0.020	-0.007#	0.017
age2024	-0.434	0.163	-0.008#	0.016	-0.008#	0.018
age3544	0.307	0.072	-0.012#	0.010	-0.012#	0.011
age4554	0.348	0.082	-0.090	0.015	-0.091	0.015
age5564	0.332	0.085	-0.353	0.012	-0.356	0.013
a04	0.138	0.047	-0.222	0.009	-0.223	0.009
a59	0.063#	0.046	-0.078	0.008	-0.079	0.008
a1014	-0.077#	0.049	-0.034	0.007	-0.035	0.007
eng	0.014#	0.061	0.149	0.011	0.149	0.012
ftstud	0.198#	0.147	-0.239	0.018	-0.240	0.015
ptstud	-0.195**	0.094	0.064	0.016	0.065	0.013
cy12	0.188	0.072	0.128	0.012	0.129	0.009
cert	0.013#	0.058	0.149	0.011	0.150	0.009
degr	-0.011#	0.062	0.238	0.009	0.239	0.010
sprof	-1.913	0.355	-0.570	0.031	-0.574	0.036
ssev	-0.716	0.162	-0.332	0.028	-0.337	0.023
smod	-0.428	0.117	-0.198	0.021	-0.203	0.022
smil	-0.332	0.125	-0.166	0.020	-0.170	0.022
srsc	0.035#	0.121	-0.084	0.028	-0.088	0.025
snsc	0.101#	0.135	0.015#	0.020	0.012#	0.021
slth	0.113**	0.051	-0.012#	0.008	-0.013#	0.010
Const	-2.567	0.108				
+ Instruments						
Pseudo R^2					0.211	
	0.123	0.038				
Wald test of rho=0: chi2(1) = 10.127 Prob > chi2 = 0.0015						

Source: See Table 1.

A summary of the results for women are shown in Table 4. A number of observations can be made. First the instrumental variables appear to exhibit a high level of explanatory power in the cores estimation. This is confirmed by running univariate probit models for cores with and without the set of instrumental variables. Inclusion of the instrumental variables increases the Pseudo R2 from 0.081 to 0.612.

Table 5: Bivariate probit & probit: male labour force participation

| Variables | Bivariate Probit | | | | Probit | |
| | Co-residential care | | Labour force participation | | Labour force participation | |
	Coefficient	Standard Error	M. Effects	Standard Error	M. Effects	Standard Error
cores+			-0.068	0.013	-0.030	0.010
married	0.185	0.070	0.078	0.010	0.079	0.010
divsep	-0.098#	0.113	0.027**	0.012	0.029**	0.012
inner	0.007#	0.059	-0.013**	0.006	-0.013*	0.007
other	-0.067#	0.074	0.015*	0.008	0.015*	0.008
nhnad	-0.199	0.034	0.012	0.003	0.010	0.003
age1519	-0.733	0.169	-0.041	0.014	-0.038	0.013
age2024	-0.084#	0.118	0.012#	0.010	0.013#	0.011
age3544	0.169**	0.075	-0.012#	0.009	-0.012#	0.009
age4554	0.198**	0.081	-0.050	0.011	-0.038	0.012
age5564	0.207**	0.089	-0.223	0.015	-0.227	0.012
a04	0.049#	0.051	-0.017**	0.007	-0.017	0.006
a59	-0.028#	0.048	-0.011#	0.007	-0.013**	0.006
a1014	-0.033#	0.048	0.008#	0.005	0.007#	0.006
eng	-0.013#	0.069	0.072	0.009	0.072	0.009
ftstud	0.058#	0.130	-0.366	0.018	-0.367	0.022
ptstud	-0.044#	0.101	0.017#	0.012	0.017#	0.014
cy12	-0.018#	0.088	0.049	0.009	0.050	0.008
cert	-0.016#	0.056	0.069	0.007	0.070	0.008
degr	-0.084#	0.071	0.080	0.008	0.081	0.008
sprof	-1.656	0.303	-0.576	0.057	-0.584	0.042
ssev	-1.007	0.182	-0.448	0.027	-0.455	0.025
smod	-0.477	0.132	-0.271	0.022	-0.279	0.025
smil	-0.336	0.120	-0.266	0.020	-0.273	0.018
srsc	-0.062#	0.124	-0.135	0.016	-0.139	0.021
snsc	-0.003#	0.127	-0.055	0.017	-0.057	0.017
slth	0.143	0.053	-0.016**	0.007	-0.016**	0.007
Const	-2.228	0.116				
+ Instruments	0.236	0.051				
Pseudo R^2					0.325	
Wald test of rho=0: chi2(1) = 22.2046 Prob > chi2 = 0.000						

Source: Data obtained from SDAC (2003)

Second, the correlation of the errors, ρ is positive and the Wald test is significant which indicates that the hypothesis that $\rho=0$ is rejected. Thus unexplained factors that affect the incidence of co-residential informal caring are positively correlated with the unexplained factors that affect labour force participation. The results from the univariate probit are consequently biased and underestimate the negative impact of informal care on participation. The Marginal Effect from the bivariate probit model is -0.118, as compared with -0.090 for the univariate model.

Third, with the exception of the care variable, the MEs are of a similar order of magnitude and the coefficients have a similar pattern of significance in the bivariate probit estimation to those based on the univariate probit model.

Fourth, there is a strong age based impact from age 35 to 44 years onwards on the propensity to provide informal care. Also compared to women who did not complete Year 12 schooling, there is a significant positive coefficient for women who completed Year 12, which could be a consequence of their economic circumstances, and specifically their capacity to provide accommodation for the dependent. On the other hand, higher levels of educational attainment have an insignificant impact on the probability of providing care. This could reflect the competing demands of paid employment and also the financial capacity to contribute to formal care.

The results for men are shown in Table 5. Again there is evidence of endogeneity as revealed by the positive and significant value for   . The absolute value of the caring Marginal Effect is again underestimated by using a univariate probit (-0.030, as compared to -0.068). The remaining Marginal Effects are largely unchanged as compared to those derived from the univariate probit model. The age related impacts on caring are less significant and if a separate univariate probit is run, the age related coefficients are smaller than for women. The level of educational attainment has no impact on the propensity to provide care. The inclusion of the set of instruments raises the Pseudo R2 of the probit caring model from 0.065 to 0.587. The impacts of age, educational attainment and marital and health status on male participation again conform to expectations.

Table 6 shows the results based on the combined sample of women and men and the inclusion of significant male slope and intercept dummies. Again the explanatory power of the probit model of caring is enhanced by the inclusion of the instruments (0.059 to 0.614). Men have more than a 13% higher rate of participation than women, ceteris paribus. The slope dummies confirm lower impacts of co-residential caring, the presence of dependent children and having a university degree on the participation of men, as compared to women, but a stronger positive impact of being married. On the other hand, being male enhances the negative impact of poor health and full-time study on labour force participation.

Table 6: Bivariate probit & probit: adult labour force participation

| | Bivariate Probit | | | | Probit | |
| | Co-residential Care | | Labour force participation | | Labour force participation | |
Variables	Coefficient	Standard Error	M. Effects	Standard Error	M. Effects	Standard Error
cores+			-0.081	0.008	-0.061	0.009
mcores			0.055	0.017	0.054	0.016
male	0.013#	0.076	0.136	0.004	0.136	0.005
married	0.230	0.063	0.044	0.007	0.044	0.008
mmarried	0.049#	0.082	0.073	0.010	0.069	0.012
divsep	0.087#	0.072	0.028	0.008	0.029	0.010
inner	0.043#	0.042	-0.005#	0.006	-0.005#	0.005
other	-0.023#	0.051	0.017**	0.007	0.018	0.007
nhnad	-0.117	0.030	0.013	0.002	0.013	0.002
mnhnad	-0.064#	0.044	0.001#	0.005	0.000#	0.005
age1519	-0.970	0.184	-0.199	0.013	-0.197	0.015
mage1519	0.225#	0.233	-0.147	0.026	-0.117	0.020
age2024	-0.270**	0.106	-0.024	0.009	-0.024**	0.010
age3544	0.239	0.054	-0.004#	0.006	-0.004#	0.006
age4554	0.279	0.061	-0.058	0.009	-0.059	0.006
age5564	0.272	0.064	-0.275	0.012	-0.277	0.011
a04	0.179	0.042	-0.116	0.007	-0.116	0.005
ma04	-0.097#	0.063	0.188	0.012	0.192	0.012
a59	0.100**	0.042	-0.045	0.006	-0.046	0.005
ma59	-0.154**	0.062	0.055	0.009	0.057	0.009
a1014	-0.010#	0.045	-0.019	0.004	-0.020	0.005
ma1014	-0.028#	0.067	0.033	0.008	0.035	0.008
eng	0.014#	0.046	0.118	0.006	0.117	0.007
meng					-0.051	0.015
ftstud	0.258**	0.115	-0.195	0.013	-0.197	0.014
mftstud	0.077#	0.170	-0.140	0.022	-0.139	0.026
ptstud	-0.017#	0.070	0.074	0.009	0.074	0.009
cy12	0.044#	0.058	0.117	0.008	0.118	0.008
cert	-0.014#	0.040	0.123	0.006	0.124	0.007
degr	-0.085#	0.057	0.170	0.007	0.171	0.006
mdegr	0.021#	0.083	-0.093	0.012	-0.115	0.013
sprof	-0.704	0.211	-0.571	0.031	-0.574	0.023
ssev	0.196#	0.122	-0.392	0.016	-0.396	0.017
mssev	-0.405**	0.194	-0.163	0.037	-0.149	0.037
smod	0.164*	0.092	-0.237	0.015	-0.241	0.016
msmod	-0.050#	0.146	-0.119	0.029	-0.108	0.030
smil	0.105#	0.107	-0.215	0.014	-0.219	0.014
msmil	-0.059#	0.158	-0.143	0.027	-0.133	0.028
srsc	0.362	0.107	-0.108	0.013	-0.110	0.015
msrsc	-0.225#	0.159	-0.080	0.030	-0.071	0.026
snsc	0.200#	0.131	-0.015#	0.014	-0.017#	0.015
msnsc	-0.142#	0.181	-0.072	0.025	-0.067**	0.033
slth	0.154	0.038	-0.010*	0.006	-0.011*	0.006
Const	-2.503	0.089				
Instruments						
	0.105	0.031				
Pseudo R^2					0.262	

Wald test of rho=0: chi2(1) =11.135   Prob > chi2 = 0.0008

Source: Data obtained from SDAC (2003)

5.   Concluding Comments

In this paper we find that providing informal care to both the disabled and elderly and also young children, particularly impacts on the labour force participation behaviour of women. Socio-economic variables impact on the participation behaviour of women and men in a manner consistent with labour supply theory, which is underpinned by a breadwinner model, in which men generally have a greater commitment to work, as indicated by the impact of marital status and age on their labour force participation. However the interesting result is that both poor health status and full-time study have a greater adverse effect on male than female participation, which warrants further investigation. These results are remarkably robust whether bivariate or univariate techniques are employed. Men have an instrumental attitude to work which assumes priority, whereas women's capacity to participate is contingent on a range of factors, not all of which are represented in the data.

There are behavioural differences with respect to the determinants of caring by gender. In particular, there appear to be stronger age effects for women, but it should be noted that they exhibit a sharper decline in labour force participation across these age ranges than men. Also, in contrast to their male counterparts, Year 12 school leavers have a higher probability of co-residential caring.The other evidence provided in this paper would suggest that age related effects on the propensity to provide informal care are declining over time, but another dataset would be required to test this hypothesis.

As noted in the introduction, the tension between paid work and informal care is likely to intensify over the decades ahead. The ABS (2003, pp.21-22) estimates that those aged over 60 living in private accommodation accounted for 53.2% of dependents with profound limitations, 36.5% with severe limitations and 47.6% with moderate limitations. The incidence of these restrictions increased has been increasing. Also the number of citizens over 80 years old is projected to almost triple to 9.1% of the population over the next 40 years. The Productivity Commission (2005) argues that the number of low and high care residents in institutions could increase by around 215 per cent over this period. The results from this paper do not instill confidence that adequate informal care will be available in the context of this ageing population, but further empirical analysis is required.

Heitmueller (2007, pp.558) notes that if the need to provide care impacts exogenously on the participation decision, then more flexible working arrangements and/or more financial support to access formal care will assist informal carers to participate in the labour market. However, after an initial spell of care, carers' re-employment prospects are often significantly reduced because studies have shown that they often take on new caring responsibilities. On the other hand, if the caring decision is endogenous, reflecting, for example, lack of job opportunities or employability, then measures to improve the carer's access to job opportunities are necessary.

In fact the Productivity Commission (2005, pp. 179-180) suggests that there is likely to be a significant long term shortage of potential informal carers due to a range of supply side factors (see also NATSEM, 2004). First, it is anticipated that by 2021 'less than half of people over 65 will be living in couple families (AIHW 2004, p. 31)' even though many older people are currently cared for by their partners. Second, the supply of potential carers per family will fall due to the reduced birthrate. Third, women have exhibited an increasing labour force participation rate, which has been given further impetus by changes in superannuation arrangements. Also they are

having children later, which will reduce their capacity, and possibly their willingness to provide aged care. In addition, greater mobility among younger generations may reduce the access of elderly persons to informal care (Saunders, 1996). Retirees now tend to be more active and may be reluctant to commit to long term caring responsibilities. Davis, Heathcote, O'Neill and Puza (2002, p.1) claim that at least two thirds of the increased life expectancy over the decade 1988-98 was associated with coping with disability, so increased life expectancy will not necessarily increase the supply of informal care.

For the last 20 years or so Australian State and Federal Governments have promoted de-institutionalisation, ostensibly in response to the desire for independence and dignity for those with core limitations, but undoubtedly in part due to their fiscal preoccupations. McCallum and Mundy (2002), quoted in NASTSEM (2004, p.7), report that most people prefer these living arrangements, but independent living requires access to adequate resources, as well as supportive social policy (Rowland, 1991, pp.113-115). International empirical studies also find that informal care reduces the likelihood of nursing home entry and improves self-reported health status (see, Charles and Sevak, 2005, Stabile, Laporte and Coyte, 2006, and Van Houtven and Norton, 2004), but AIHW (2004, p. xvi) found that a primary carer was essential, if a dependent with high levels of assistance with core activities was to remain at home.

The Federal Government currently provides Community Aged Care Packages, a package of home based services tailored to meet the needs of older people as assessed by Aged Care Assessment Teams. A strong public sector commitment is required to meet the growing demand for complementary care which would have the additional benefit of reducing the caring demands on adult members of households who wish to participate in the labour market.

From an orthodox macroeconomic perspective, the fiscal impact of these increased outlays on formal care provides a major policy challenge (Productivity Commission, 2005). An alternative perspective is provided by advocates of a Job Guarantee (Buffer Stock Employment) model (see, for example, Mitchell, 1998), who argue that sustained full employment can be achieved by guaranteeing all unemployed workers a job at the minimum wage. A flexible system of formal care provided by Job Guarantee workers, which meets the needs of carers and their dependents, is agood example of how this macroeconomic policy could work in practice.

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[1] In addition, measurement error in the data may cause endogeneity.

[2] The author is indebted to Austin Nichols who provided the code.

[3] The simple (first order) MEs for x_1 and x_2 will also take the multiplicative term in x_1x_2 into account.

[4] MEs based on integer variables such as the net number of adults in the household and the number of children aged between 0 and 4 were calculated by simply adding 1 to the observed value and computing the change in probability as compared to the observed value of the variable, and averaging over all observations.

[5] On the basis of their Monte Carlo study, Monfardini and Radice (2008) argue that the availability of instruments or extra regressors helps to preserve the validity of a number of tests of exogeneity in the presence of misspecification.

[6] A full record of the results based on Tables 4-6 is available on request.