Self-Assessed Health, Caring and Labour Market Outcomes in Taiwan

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Abstract

This thesis explores the relationship between self-assessed health (SAH), caring and labour market outcomes based on three empirical studies, for which the existing studies for Taiwan were limited. Our results may help in identifying priorities in terms of the most important individual characteristics for determining health, well-being and the impact of caring on the labour force. In the first empirical study, we use panel data from the Panel Study of Family Dynamics (PSFD) to explore the determinants of self-assessed health. In contrast to the existing studies for Taiwan, we use the generalized ordered probit (GOP) model. We find that, although both family background and a shared living environment play important roles in explaining health status, the effect of a common living environment is stronger than the effect of family characteristics on health. There is also evidence that suggests that reporting bias in the SAH measure is prevalent in the PSFD. In the second empirical study, we explore the determinants of well-being, with a particular focus on job characteristics, which has attracted little attention in the literature on Taiwan. We use data from the 2005 PSFD and explore potential sample selection issues when analysing employees only. Our results suggest that, while socio-economic characteristics are a significant determinant of well-being, there is no evidence to suggest that long working hours are associated with a lower level of well-being. The final empirical study investigates the relationship between caring and labour market outcomes. We use panel data from the Health and Living Status of the Middle Aged and Elderly. Our results suggest that informal care has an adverse effect on the labour force participation of women, but not of men. However, for males, a positive association between the provision of financial support and employment is found.

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Chapter 1. Introduction

Over the past two decades, the growing empirical evidence on the determinants of health has fostered a debate on the decline in the health of the Taiwanese. Chronic illness has been the major health problem for the Taiwanese, which may be attributable to public health issues, with poor diet, growing obesity, smoking and less exercise all playing their part (e.g., Chen et al., 2012; Yen and Lin, 2010). In addition, existing studies for Taiwan (Cheng et al., 2011) show that stress is an important psychological concept that can affect health and well-being negatively. Hence, the improvement of people's health has become a major concern of the Taiwan government. This thesis seeks to understand the effect of early childhood conditions on later health, as well as the impact of job characteristics on mental health, so that the government can suggest ways in which health policy can be used to help people maintain and improve their personal physical health and mental health. Recent empirical analysis provides supporting evidence that health status can be explained by, for example, childhood living conditions in France (Trannoy et al., 2010), caring responsibilities in the US (Schulz et al., 2003) and job stress in the UK (Robone et al., 2011). Using French data, Trannoy et al. (2010) found a long-lasting impact of childhood conditions such as parents' socio-economic status (SES) and health characteristics on their offspring's health in adulthood. Wilson et al. (2007) provided evidence that informal care has a negative effect on the caregiver's emotional health and often gives rise to caregiver depression. One study of American caregivers for dementia patients indicated that higher levels of depression are common among family caregivers (Schulz et al., 2003). In addition, growing levels of job stress, work involving physical strain or job insecurity and their links to depressive illness have also been found within the American (Cheng et al., 2000), British (Robone et al., 2011) and Taiwanese workforces (Cheng et al., 2005).

The existence of a negative correlation between poor health and labour market outcomes has been found in a number of existing studies (e.g. Contoyannis and Rice, 2001; Disney et al., 2006; Jones et al., 2010, for the UK). Poor health may lead to absence due to sickness from work or an increase in the number of family members who give up work in order to look after those needing to be looked after, i.e., caring. Furthermore, the size of the workforce may be reduced since Taiwan is facing rapid demographic aging. Recent studies in the UK (Heitmueller and Michaud, 2006) and

South Korea (Do, 2008) found that one of the significant effects of population aging is the increase in the demand for caring, meaning that working-age individuals will face an increased likelihood of providing care for their elderly parents. Such phenomena mean that a significant proportion of the working-age population may be unable to work because of poor health or caring responsibilities which may reduce the aggregate level of labour productivity in the economy and damage competitiveness in Taiwan. Hence, understanding the relationship between health and labour market outcomes is important for shaping health and labour market policy. The main analysis of this thesis is split into three chapters using two different datasets for Taiwan: the Panel Study of Family Dynamics (PSFD) and the Health and Living Status of the Middle Aged and Elderly.

Overall, this thesis consists of three main empirical studies and is structured as follows. The first empirical study, Chapter Two, explores the determinants of self-assessed health (SAH) in Taiwan using panel data from the PSFD; the second empirical study, Chapter Three, explores the determinants of psychological well-being in Taiwan focusing on job characteristics using the 2005 PSFD. The final empirical study, Chapter Four, explores the relationship between informal care and employment in Taiwan using the Health and Living Status of the Middle Aged and Elderly. Finally, the key results, policy implications, limitations and avenues for future work of the thesis are summarised in Chapter Five.

Chapter 2 The Determinants of Self-Assessed Health in Taiwan

The Department of Health in Taiwan has launched a ten-year framework for health improvement in Taiwan, which involves increasing the current 25% of adults doing exercise to 52% and decreasing the smoking population from 20% to 10% by 2020. For this reason, understanding the determinants of health is important for shaping health policy that is directed toward the Taiwan people. The determinants of SAH that may be attributable to individual characteristics such as diet, physical activity, obesity, smoking, genetically inherited characteristics and socioeconomic characteristics (SES) have all been revealed in existing studies to play their part (e.g., Lin et al., 2006, for Taiwan; Wen, 2004, for Taiwan; Trannoy et al., 2010, for France; Tubeuf and Jusot, 2011, for the EU; van Doorslaer et al., 1997, for the US and the UK; Bath, 1999, for the UK; Aue and Roosen, 2010, for Germany; Robone et al., 2011, for the UK). Recent analysis (e.g., Trannoy et al., 2010, for France) provides evidence that SAH can be explained by the

long-lasting impact of childhood living conditions such as the effect of parents' SES and longevity on their offspring's SAH in adulthood. However, it has been argued by Trannoy et al., (2010) that parents' SAH is a better health measure compared to parents' longevity in attempting to estimate the long-term effects of parents' health on the SAH of their adult children.

Our analysis has estimated the determinants of SAH by employing the generalized ordered probit (GOP) model which has not been used in the existing literature on Taiwan and also includes the respondent's parents' SAH status which other existing studies have neglected. We find that parents' characteristics influence the health of their adult children. In addition, there is a strong effect of spouse's SAH on the respondent's SAH, suggesting the importance of a shared living environment effect. There is also evidence found that reporting bias exists in the measure of SAH in the PSFD.

Chapter 3 The Determinants of Psychological Well-Being in Taiwan

With the globalization of the world economy, Taiwanese workers in recent decades have exposed themselves to a high-tech industrial structure where the level of job stress is higher than before (Lu et al., 2006). Work-related illness has been found to have an adverse impact on psychological well-being in Western society (e.g., Schulz et al., 2003, for the US; Wilson et al., 2007, for the US; Clark, 2003, for the UK; Clark and Oswald, 1994, for the UK, Robone et al., 2011, for the UK). Few attempts, however, have been made to examine the issue of well-being in Asian countries where poor job characteristics, for example, long working hours, are much more prevalent than in Western countries (Cheng and Luh, 2003, for Taiwan; Cheng et al., 2011 for Japan, South Korea and Taiwan). Through the analysis of large scale surveys, economists have gained important insights into the determinants of psychological well-being, such as a U-shaped association with age, and the effects of income and relative income on well-being (e.g., Clark, 1996, for the UK; Clark and Lelkes, 2005, for Europe).

In contrast, the relationship between job characteristics other than income and psychological well-being is less clear. For example, in terms of occupation, UK studies (e.g., Llena-Nozal et al., 2004) find that high-level occupational positions are positively associated with psychological well-being, but the opposite correlation is found for Taiwanese workers in the psychology literature (e.g., Cheng et al., 2001). Our empirical analysis differs from the existing studies for Taiwan in that it not only focuses on the

effects of job characteristics, i.e., work hours, on psychological well-being, but also employs the State-Trait Anxiety Inventory (STAI) measure of well-being. We find higher levels of reported well-being for those individuals working 36-45 hours per week relative to those working less than 15 hours per week.

Chapter 4 Informal Care and Employment in Taiwan

Most of the existing literature on the impact of informal care on labour market outcomes is based on the US, UK or European data (e.g., Ettern, 1995, 1996; Heitmueller, 2007; Bolin et al., 2008). This issue is also important for Taiwan since rapid population aging has greatly increased the number of elderly individuals in the Taiwanese population and the total number of elderly in need of personal care assistance has continued to rise over the last two decades in Taiwan (Hsu and Shyu, 2003). Since the caring responsibilities are mainly placed on family members, particularly women in Taiwan, policy-makers are facing a trade-off between the need for carers, on the one hand, and also the need to keep people in the labour market, on the other. Therefore, it is important to understand the relationship between caring responsibility and employment. Informal care has been found to have a negative effect on labour market outcomes since the care hours provided by the caregivers may reduce the time devoted to paid work and prevent the caregivers from participating in the labour market (e.g., Do, 2008, for South Korea). For example, Carmichael and Charles (2003) found that, in the UK, providing over 20 care hours adversely affects the probability of employment for women. A similar UK result is found by Heitmueller (2007) in that informal care reduces the probability of employment for an individual caring for someone living in the same household. Our results show that, while caring responsibility affects the probability of employment for women but not for men, the negative effects are moderate for those women who are highly educated. Moreover, it is shown that a positive impact on men's employment occurs only when we take the provision of financial support as a measure of informal care.

Chapter 2. The Determinants of Self-Assessed Health in Taiwan

2.1 Introduction

Self-assessed health (SAH) has been one of the most commonly used subjective indicators of health in survey research (Manderbacka et al., 1999), coinciding with the growing interest in the fields of public health and health economics over the last half century. SAH has been identified as an important indicator of a person's general health status (Idler and Benyamini, 1997) and has also been recommended for health monitoring by the World Health Organization (WHO) (de Bruin et al., 1996). Although the SAH measure may not be a perfect measure of the underlying latent health variable, it has been found to be a useful and valuable overall subjective measure of health status and is increasingly being used as an 'outcome' variable in health services research (Vang, 1997). It has been found to be a useful and valuable overall subjective measure of health status and is increasingly being used as an 'outcome' variable in health services research (Vang, 1997). Understanding the key determinants of SAH is crucial as this is likely to shed light on a number of policy issues such as improving people's health by, for example, counteracting possible poor effects of childhood conditions or targeting household behaviour such as encouraging the purchase of healthy food. There is limited knowledge, however, of the determinants of SAH in Taiwan and why Taiwanese individuals differ in their health perceptions. Hence, this topic warrants further investigation. Thus, the aim of this chapter is to analyse panel data to explore the determinants of SAH in the Taiwanese population.

SAH is commonly measured via a survey question which asks respondents how they rate their health out of five response categories. For example, the question is frequently '*How is your health in general?*', with the responses being '*excellent*', '*good*', '*fair*', '*poor*' or '*very poor*'. There have only been a few previous studies of the determinants of SAH in Taiwan, and these have focused mainly on the elderly, such as the study by Zimmer et al. (2000). The main drawback of the existing studies on Taiwan is that they are limited by cross-sectional data, which might raise the question of whether causal relationships can be identified. For example, unobserved individual-invariant characteristics, such as genetic factors, affect health outcomes in every period and, therefore, failure to properly control for the unobserved factors may lead to bias in the estimation of the determinants of SAH. However, such omitted variables could potentially be controlled for by using

panel data. Panel data for Taiwan has recently become widely available with detailed information on health and personal characteristics. Although the study by Beckett et al. (2002) used panel data to analyse the association between health, the social environment and life challenges, it concentrated on the Taiwanese elderly, which may reflect a lack of data. It appears, therefore, that no previous studies have explored the determinants of SAH using a nationally representative panel data set for Taiwan.

In general, the previous results of Taiwanese studies show that socio-economic and demographic characteristics, such as ethnicity, marital status, income (Hu et al., 2005) and spousal health status (Beckett et al., 2002), are important determinants of SAH. However, the effects of intergenerational transmission of health on SAH, coming from, for example, the same exposure to a risky geographical environment, poor living conditions during childhood or genetic inheritance within families, and the method of transmission across generations of Taiwanese, are less well understood. Evidence related to other countries, for example, Finland and France, suggests that the variation in SAH can be explained by genetic factors and a shared living environment (Silventoinen et al., 2007; Trannoy et al., 2010). Genetic inheritance has been found to affect SAH the most at age 16 and the influence declines steadily to age 25, due to living independently after the age of 16 in Finland (Silventoinen et al., 2007). Trannoy et al. (2010) used French data and showed that long-lasting effects of childhood characteristics on health exist in adulthood through the direct or indirect influence of parents' socio-economic status and longevity. Jusot et al. (2010), who also used French data, suggested that the role of historical characteristics (e.g., childhood circumstances and parents' health during childhood) plays a more important role than the individual's health behaviours (e.g., smoking and lifestyle) in influencing health outcomes after controlling for demographic characteristics. In addition, the persistent effect of genetic inheritance on an individual's health over their life-span, especially at older ages, still remains poorly understood because of the lack of data on parents' health status (Trannoy et al., 2010). In the empirical study presented in this chapter, parents' health is reported by the respondents, who were asked to rate the SAH of their parents. This is based on a similar question to the one used in the study by Jusot et al. (2010), in which children were asked to indicate their parents' SAH. Hence, the primary contribution of this chapter is that we not only explore the effect of childhood characteristics on the respondents' SAH, but also the effect of parents' SAH, as perceived by the respondents, on the respondents' SAH.

The final contribution of this chapter is that we use a generalised ordered probit (GOP) model to explore the determinants of SAH using Taiwanese panel data. Several studies have argued that SAH measures are subject to measurement error (Lindeboom and Doorslaer, 2004). In other words, the SAH indicator may not correspond with 'true' health. This bias may be influenced by personal characteristics, such as gender and age, i.e., personal characteristics may affect the decision to choose one of the SAH response categories over another. In the existing literature on Taiwan, SAH is modelled by conventional methods, such as ordered probit or logit models (e.g., Zimmer et al., 2000; Chen et al., 2008), which assume that the estimated coefficients of the independent variables are constant across the categories (Lindeboom and Doorslaer, 2004). Hence, due to the possibility of measurement bias, using SAH in empirical studies may be misleading. However, the GOP model is a flexible approach, which allows heterogeneity between independent variables. In other words, for example, the individual assessments of the '*good*' or '*poor*' categories of SAH can be found to depend on the age of individuals. The GOP model has been used in a variety of applications. For example, Brown et al. (2010) used the GOP model to analyse SAH in the UK with a large number of objective health measures and controls for socio-economic status, to allow for the endogeneity of health in influencing labour market outcomes. The same model is also used by Jürges (2007) to correct for the potential bias in SAH with a view to exploring health inequalities across European countries.

To summarise, in order to explore the determinants of SAH, we employ a GOP model using data from the Panel Study of Family Dynamics (PSFD) for Taiwan. As shown in the empirical findings presented in Section 2.4, father's socio-economic status is found to have a long-term effect on married children's SAH but this is not the case for mother's socio-economic status. In addition, the results accord with intergenerational transmission of health on to the offspring's SAH, especially from the mother's SAH. As a consequence, adult SAH is significantly determined by factors for which the individual is not responsible, such as parents' socio-economic characteristics and parents' SAH. However, after controlling for spouse's SAH, the influence of parents' SAH is less pronounced and this may imply that a shared living environment has a greater influence on adult SAH than parental characteristics. There is also evidence that reporting bias exists in the measure of SAH in the PSFD.

The structure of this chapter is as follows: Section 2.2 reviews the definition of SAH and then reviews previous studies on the determinants of SAH, including the methodologies employed. Section 2.3 describes the data and econometric approach used. Section 2.4 presents the results, Section 2.5 discusses the possible reporting bias in the measure of SAH used in the PSFD and Section 2.6 concludes, discusses policy implications and highlights avenues for future research.

2.2 Literature Review

This section presents a review of the literature on the determinants of SAH. There have been a growing number of empirical studies exploring SAH. Given the aims of this chapter, this literature review focuses mainly on the determinants of SAH and the methodology used. This section is organised as follows: Sections 2.2.1 and 2.2.2 review the key empirical studies and methodology used in this area, respectively, whilst Section 2.2.3 provides an overview of the previous empirical studies on SAH in Taiwan.

2.2.1 Self-Assessed Health

SAH is a commonly used measure of health status (Manderbacka et al., 1999). It is evaluated by asking questions with ordinal categorical responses in population surveys. For example, one of the most frequently used questions is, '*How would you rate your health in general?*', with response categories such as '*excellent*', '*very good*', '*good*', '*fair*' or '*poor*' (Schulz et al., 1994). The concept of SAH reflects a general self-rating of the respondent's own health, which covers different aspects of health, including actual medical status as well as mental health, that are combined within the individual's perceptual framework (Svedberg et al., 2001). This means that SAH captures a person's perception of his or her own health at a given point in time. Even though SAH is not equivalent to objective health measures, it has been found to be highly correlated with physicians' ratings of patient health in the Netherlands (Groot et al., 2004). Moreover, it may provide an insight into how people perceive their own health in the context of factors such as obesity, unhealthy lifestyles or being high risk smokers. SAH has been found to be a predictor of future health and social service use in the UK (Bath, 1999), mortality in the UK (Idler and Benyamini, 1997), and hospitalisation in the US (Mutran and Ferraro, 1988).

Not only has this subjective health measure been found to be an efficient way of measuring the overall health of individuals, but SAH is also increasingly an important

indicator when used as an outcome variable in health services research (Vang, 1997). In the Taiwanese survey used for the empirical study in this chapter, respondents were asked '*How is your current health*?' with the standard five response categories. A similar question on SAH appears in many other well-known household surveys, such as the British Household Panel Survey (BHPS) and the Canadian National Population Health Survey (NPHS).

2.2.2 Modelling Self-Assessed Health

SAH has been used widely in the existing literature to investigate the relationship between socio-economic status (Park, 2005; Humphries et al., 2000; van Dooslar et al., 1997; Benzeval and Judge, 2001), demographic characteristics (Ferraro, 1980; Gerdtham and Johannesson, 1999; Schulz et al., 1994), childhood living conditions (Lundberg, 1993; Trannoy et al., 2010), parents' health status (Jusot et al., 2010), and SAH. This section reviews the literature which has explored these important determinants of SAH and then goes on to describe the methodology used to model SAH.

The relationship between socio-economic status (SES) and SAH has been of increasing concern in recent years. Park (2005) analysed the effects of SES on SAH in Korea using the Korean Labour and Income Panel Study (KLIPS) in 2001 by adopting the ordinary least squares (OLS) method. The study included three alternative indicators of SES (liquid financial assets, home ownership and real estate ownership) as well as two traditional measures (education and household income). Although the liquid financial asset variable had an impact on SAH, the findings suggest that the alternative indicators (home ownership and real estate ownership) do not have as strong effects as the traditional indicators of SES. The findings also suggest that the SES indicators are statistically significantly associated with SAH and that individuals with higher education or household income report better health than individuals with lower levels of these variables. A similar result was also reported by Humphries et al. (2000), who used data from the Canadian National Population Health Survey (1994) to analyse the effects of income inequality on SAH in Canada, using the health concentration curve, a method used to deal with the ordinal scale of SAH. Their health concentration curve plotted the cumulative percentage of income (on the horizontal axis) against the cumulative percentage of health (on the vertical axis) and allowed for the scoring of the SAH categories using the midpoint of the interval between categories, corresponding to the

lognormal distribution. This method enables a comparison of results across surveys with differing numbers of response categories to the SAH questions (van Doorslaer et al., 1997). Their study explored health inequalities related to SES in Canada and concluded that the higher the level of income, the higher the level of SAH. Furthermore, a loss in income was found to have a very large negative impact on SAH.

Benzeval and Judge (2001) moved beyond cross-sectional data, using British panel data between 1991 and 1996/97 to explore whether the effect of long-term income on SAH is more important than an income measure at any one point in time. The SAH outcome was measured as a binary variable with '*fair*', '*poor*' and '*very poor*' health combined into one category while the other category included '*excellent*' and '*good*' health. The household income variables were measured at four different points in time and included current income (i.e., income in the survey year), previous income (i.e., income in the previous survey year), initial income (i.e., income in the first survey year) and the five-year average income. These income variables were divided into quartiles of the income distribution and were included in the logistic regression model. The findings show that the five-year average family income has a statistically significant association with SAH but that current income does not, when controlling for age, gender and initial health. This finding suggests that the five-year average income is a much better indicator of SAH than current income, and that the relationship between income and the SAH measure may be under-estimated by using cross-sectional data sets. Furthermore, the study provides evidence that poorer individuals are more likely to report poor health than wealthy individuals.

Contoyannis et al. (2004) used eight years of the British Household Panel Survey (BHPS) data and dynamic ordered probit models to explore the dynamics of SAH, with a particular focus on the relative contributions of state dependence and heterogeneity. The reason for focusing on the relative importance of these two factors for SAH is that individuals have repeatedly reported SAH status during the survey years, which means that persistence in reporting SAH status is potentially an important aspect of the SAH measure. Persistence in reporting SAH may be due to state dependence and unobserved heterogeneity, which could increase bias in estimation results. After controlling for these two factors, Contoyannis et al. (2004) found that a strong correlation exists between educational attainment and SAH for women but not for men. The 'permanent' income

(the logarithm of average household income over eight waves) effect is significant for SAH but this is not the case for 'current' income (the logarithm of household current income in each wave). Therefore, they concluded that the 'permanent' income variable may be a better measure of long-term income whilst 'current' income may capture transitory income shocks.

Demographic characteristics frequently included as possible predictors of SAH are gender, age, marital status, race and ethnicity. Ferraro (1980) analysed the effects of demographic characteristics and health-related problems on SAH using a 1973 survey of the elderly poor in the US. It appears that when the sample was split into those aged 65 to 74 and those aged over 75, the group aged over 75 tended to report better health than the younger group, when controlling for objective health problems. For the sample aged over 75, gender differences in SAH appeared in the findings, with females tending to report better health than males, even though the females reported more physical problems than the males. Therefore, the findings suggest that elderly females aged over 75 tend to be more optimistic in reporting their SAH than other elderly individuals.

A number of studies show mixed results regarding the effect of gender on SAH. For example, Schulz et al. (1994) used stepwise regression analyses, based on data from the Cardiovascular Health Study of the Elderly (CHS) in the US, to explore gender differences in SAH. They concluded that women tend to have poorer 'objective' health status than men, but that there are no significant gender differences in reporting SAH. Similar results have been found for Swedish twins (Svedberg et al., 2001). Such findings tend to indicate that no difference exists between males and females in rating their SAH when considering objective health measures (such as medical conditions) in the analysis. Svedberg et al. (2001) also explored gender differences in SAH in the context of longitudinal data sets. An interesting finding of Svedberg et al.'s study was that genetic influences on SAH were highest in the 45-74 age group and the greatest environmental influences could be seen in the oldest age group (over 74). Silventoinen et al. (2007) analysed genetic and environmental determinants of SAH. The data were drawn from the FinnTwin16 study, carried out between 1991 and 2002, in which the respondents were aged between 16 and 25. They found evidence of gender differences in reporting SAH, and that the heritability of SAH was greatest at age 16. However, the effect of genetic factors on SAH decreased steadily to age 25, due to living independently after the age of

16. In conclusion, Silventoinen et al. (2007) and Svedberg et al. (2001) both provide evidence that individual specific genetic factors and the shared living environment are important determinants of individual differences in SAH. However, Silventoinen et al. (2007) argued that it is necessary to identify whether such shared environment effects contribute to SAH independently or through interaction with the genetic factors.

There are two potential pathways for the transmission of health from one generation to the next (Benzeval et al., 2000). The first pathway assumes that the parents' SES has an indirect influence on their children's health. As an example of an influence, educational attainment may be strongly influenced by parents' SES during childhood; this is an important determinant of the individual's ability to earn income and their income level will affect their future health (Benzeval et al., 2000). Trannoy et al. (2010) found that there is a positive and significant impact on the health status of individuals born to a mother who was an office clerk, and a negative and significant impact for individuals born to mothers in elementary occupations. This provides evidence that the effect of the mother's SES on the offspring's health is direct. Lundberg (1993) provided an example of the pathway model which showed evidence of the lasting effects of childhood characteristics on adult health. The study used logit regression analysis to analyse the relationship between an adult's health and his or her parents' SES during his or her childhood, using data from the Swedish Level of Living Surveys of 1968, 1974 and 1981. Illness indicators, which included physical health problems and mental health problems, were used as dependent variables. The findings suggest that economic hardship during childhood results in a significantly increased risk of ill health in adulthood. One possible explanation is that adverse childhood conditions may lead to poor school performance, which may have a negative impact on employability in adulthood. As a result, education and childhood living conditions are important determinants of adult health. Therefore, according to the concept of the pathway model, parents' SES has an indirect influence on adult health.

The second pathway of transmission of health across generations has also been demonstrated in the existing literature. Parents' health is assumed to be correlated with the health of the next generation. Possible rationales for this assumption include the impact of parents' health on their offspring's health through genetic inheritance, a similar lifestyle within families or having parents who tend to be more conscious of good

nutrition and a healthy lifestyle (Jusot et al., 2010; Case et al., 2005). In order to understand how childhood characteristics and parents' health affect adult health, Trannoy et al. (2010) analysed French data from the Survey of Health, Ageing and Retirement in Europe (SHARE), thereby investigating both potential pathways. The five categories of SAH formed a categorical dependent variable, which was modelled via an ordered logit approach, to explore whether adult health is strongly linked to childhood living standards. They found that parents' characteristics, such as their occupation during the respondent's childhood, result in long-lasting effects on health in adulthood: mother's education was found to have a direct effect on the descendant's SAH, whilst father's education was found to have an indirect effect which operates through the individual's education level. In addition, parents' health variables, measured by their longevity, were found to have an effect on SAH in adulthood, meaning that an individual whose parents had higher longevity were statistically significantly more likely to report better SAH.

Recently, some studies have argued that health can be attributed to family background, which is beyond the individual's control, and therefore called 'circumstance'. In contrast, other factors, called 'effort', are those for which the individual is responsible (Roemer, 2002), such as lifestyle. Jusot et al. (2010) attempted to measure the relative contributions of 'circumstance' and 'effort' to health inequalities. They used French data drawn from the French Health, Health Care and Insurance Survey (ESPS survey), 2006. The outcome of interest (SAH) was measured by responses to the question '*In general would you say that your health is...very good, good, fair, poor, or very poor?*' They used probit regressions to explore the role of 'circumstance' and 'effort' in adult SAH. Parents' health was reported by the respondents, who were asked retrospectively about the SAH of their parents when they were 12 years old. There are some important features of this study which are worth highlighting. Firstly, adult health was statistically significantly influenced by the parents' SES, including the parents' education and their financial situation during the respondent's childhood. The education of the mother was found to have a more important impact than the education of the father. Secondly, the effect on SAH of having a living mother was positive, whilst the effect of having deceased parents was a statistically significant determinant of poor health. Moreover, the results indicated that individuals who perceived their fathers as having '*fair*' SAH were less likely to report that they themselves had '*good*' health. Again, this relationship is also true for the mother's SAH, as perceived by the respondent. Where the respondents perceived their

mothers as having less than '*very good*' SAH, they were less likely to report that they themselves had '*good*' or '*very good*' health. Overall, it seems that the proportion of the SAH measure captured by 'circumstance' factors is higher than that captured by 'effort' factors. One suggestion of this study is that 'circumstance' not only has effects on health in adulthood directly, but also has indirect influences through 'effort' factors, such as educational attainment (Dias, 2009).

There is additional evidence relating to the lasting effects of family background, such as parents' health and parents' occupation, on the health of those who are middle-aged and older (i.e. aged over 50) (Tubeuf and Jusot, 2011). Tubeuf and Jusot (2011) used data for ten European countries from the 2004 SHARE. The dependent variable was SAH, and the analysis employed interval regression models. The authors found that those individuals whose fathers were still alive or whose fathers had died at a later age had higher SAH than respondents whose fathers had died during their childhood (the respondents were from Sweden, the Netherlands and Greece). Similarly, having a mother still alive was a statistically significant indicator of better health in comparison to having a mother who died during their childhood for respondents in Germany, the Netherlands, Spain and Italy. In addition, there were positive effects on adult SAH from having a parent who lived longer. Having a father with a higher educational level was found to have a positive effect on reported SAH for respondents in every European country, but the effect was insignificant in Austria and Denmark. Fathers with higher level occupations (e.g., senior managers, technicians and associate professionals) had statistically significant positive effects on an individual's SAH in Austria, Germany, Spain and France in comparison to those individuals whose fathers were unskilled workers. However, the effect of mothers' occupations on their children's SAH in adulthood was smaller than that of the fathers' occupations.

From a methodological point of view, it has been argued that SAH does not reflect the 'true' health status (Hernandez-Quevedo et al., 2005). Mathers and Douglas (1998) found that Aboriginals are more likely to report better health than the general Australian population, in spite of recording poorer objective health measures, such as mortality for the Aboriginals. Therefore, health disparities derived from objective health measures are arguably more reliable than subjective health measures in developing countries (Sen, 2002). As a subjective health measure, SAH may be prone to measurement error.

Individuals who have the same 'true' health status may have different reference levels when they rate their own health on a categorical scale. For example, respondents may be more likely to report '*very poor*' health if they feel that they are much less healthy than others of their own age or gender. Thus, the differences in SAH may be influenced by age and gender. Hence, the assumption of equal thresholds for all individuals in the traditional models, e.g., ordered probit or logit models, is open to question. The effects of measurement error can be divided into an 'index shift' and a 'cut-point shift'. This means that the cumulative distribution shifts to the right or left but that the shape of the distribution remains the same in terms of an increase in an independent variable. The 'index shift' appears if the shape of the SAH distribution remains the same but its location shifts in parallel with all reporting thresholds for sub-groups, so that the relative position remains unaltered. A 'cut-point shift' implies that the reporting thresholds have different positions which are affected by the response behaviour, leading to a change in the relative positions of the reporting thresholds. Those measurement error problems associated with SAH measures have been an area of concern in the recent literature (see, e.g., Brown et al., 2010; Jones et al., 2010; Jürges, 2007).

SAH heterogeneity may be influenced by reporting behaviour (reporting bias) and may reflect 'true' health differences. In order to ascertain whether, for example, SES causes SAH variations, it is important to separate reporting bias from health heterogeneity. The problem of reporting bias can be corrected by modelling SAH based on more objective health measures or using the 'vignettes' approach. Lindeboom and van Doorslaer (2004) used the Canadian National Population Health Surveys from 1994 and 1995 and employed the McMaster Health Utility Index (HUI) as their objective health indicators and adopted a hierarchical ordered probit model to adjust for reporting bias. Their results provide evidence of reporting bias varying by age and gender, but not by education and income. These findings suggest that the measurement of socio-economic inequalities in health in developed countries is reliable, but that the effects of demographic characteristics on SAH may be relatively greater than the effects of socio-economic characteristics in developing countries. However, the disadvantage of using objective health indicators is that these indicators are much more rarely available than data based on the general SAH question in surveys.

Another approach is the 'vignettes' approach, which can be used to adjust reporting bias

in SAH. The 'vignettes' are included in the World Health Organisation Multi-Country Survey (WHO-MCS) and are designed to calibrate the six domains of the WHO's generic health measure. For example, respondents are asked to report not only their health in each of six health domains (mobility, cognitive functioning, affective behaviour, pain or discomfort, self-care and usual activities) but are also asked to rate the scales for the same questions based on an imaginary person. The general idea is to use the responses to these health domain questions to identify reporting bias. Bago d'Uva et al. (2008) used data on Indonesia, India and China from the WHO-MCS on Health and Responsiveness, 2000-2001. They used 'vignettes' to identify reporting bias in SAH and analysed the effects of demographic and socio-economic characteristics on SAH using a hierarchical ordered probit model. They found that the hypothesis of homogeneous reporting by the SES group on SAH was rejected, and they concluded that reporting bias may be influenced by SES in those three developing countries. Nevertheless, one drawback of the 'vignettes' approach is that the views of older adults on specific health questions such as mobility health problems may differ from the views of younger respondents and this means that the reference thresholds of a specific health question may also be dependent on the respondent's age (Lindeboom and van Doorslaer, 2004). Moreover, the 'vignettes' question is not common in existing surveys.

An alternative method for dealing with measurement error is to use a generalised ordered probit (GOP) model which allows for differences between SAH thresholds, based on respondents' characteristics. The GOP model is a flexible approach which allows all coefficients to vary across categories. This means that threshold parameters vary with independent variables. Brown et al. (2010) estimated the determinants of reservation wages for men, using fourteen waves of the BHPS. They focused on the influence of SAH and used the GOP framework to model SAH, with objective health measures and socio-economic characteristics included in the set of explanatory variables in order to deal with the potential endogeneity of health on labour market outcomes. Their results indicated that poor health is the most important factor determining the probability of being out of the labour market. The GOP approach was also used by Jürges (2007) to correct for the potential bias in SAH in order to explore health inequalities across ten European countries, using the Survey of Health, Aging and Retirement in Europe (SHARE). In order to better understand cross-country differences in SAH, comparable measures are needed. Jürges' study employed several objective health variables to

estimate a GOP model of SAH, and constructed a 0-to-1 health index as a proxy for true health, where 0 represents the worst observed health state ('near death') and 1 represents perfect health. Health status between near death and perfect health are given an index value of between 0 and 1. Furthermore, the health index incorporated country-cultural effects related to cultural perceptions of SAH response categories. The author argued that modelling SAH with a GOP model can reduce the bias in SAH that can arise due to inter-country differences.

2.2.3 Self-Assessed Health Studies in Taiwan

SAH in Taiwan has attracted attention among a wide range of disciplines, including economics, sociology and health. The ordinal measures of SAH have been shown to be good predictors of mortality and chronic illnesses (Goldman et al., 2003; Zimmer et al., 2005). Also, some studies have concentrated on examining the factors determining SAH (Zimmer et al., 2000; Chen et al., 2008).

Although the Taiwanese studies are to some extent outdated, due to the lack of data, there are still some interesting patterns to be observed in the SAH of older adults which is the focus of the existing studies. For example, Zimmer et al. (2000) analysed cross-sectional data for older adults (aged above 50) from the Philippines, Taiwan and Thailand. The data came from the Study of Rapid Demographic Change and the Welfare of the Elderly, which was conducted by the Population Studies Center at the University of Michigan, using individual population centres in the three countries. They aimed to analyse the cross-national differences in SAH in these three Asian countries by applying ordered probit models. Their motivation for comparing these three countries was that they are all located in eastern Asia and are also characterised by high rates of co-residence (that is, older parents living with their adult offspring). In this study, demographic characteristics, SES, the existence of network supports (such as marital status, the number of living offspring and household size), health behaviours and objective health measures were included as controls. Zimmer et al. (2000) found that Taiwan had the highest SAH and that the Philippines had the lowest. This may be due to Taiwan being by far the smallest of the three countries in terms of population size and geographical area, both of which can influence health care access. In addition, the study found that being older, having a higher level of education, being employed and being married increased the probability of reporting better SAH. Household size, number of children and co-residence with adult

children were all statistically insignificant determinants of the SAH of the elderly Taiwanese.

Zimmer et al.'s study showed how older individuals across countries tend to have different perceptions of their SAH and that the determinants of SAH did differ across the three nations. However, different reporting behaviour related to cross-cultural differences may be a concern in their analysis. For example, Filipino respondents tended to under-rate their SAH, relative to the other two nations, and reporting bias may also exist due to each country's linguistic variations resulting in slightly different wording for the SAH question. Hence, it is important to consider the potential reporting bias in SAH, particularly in cross-national comparisons. In addition, their findings were based on cross-sectional data and issues of causality are arguably better explored with panel data. Finally, the focus on elderly respondents is a limitation; attempting to generalise their results to the overall population would be potentially misleading.

Chen et al. (2008) employed a data set of a representative sample of the Taiwanese population, taken from the Social Development Survey on Health and Safety, 2001, to investigate gender differences in SAH using an ordinal logistic model. They explored the association between household caring (which included the number of children aged under 15, the number of elderly individuals aged over 65, the number of household members who were disabled and the number of household members injured), personal characteristics and SAH. Respondents reported their SAH over the previous three months via four scales ranging from '*good*' to '*very poor*', which were coded on a three-point scale. The results show the existence of gender differences in reporting SAH; females are more likely to report poor SAH than males. In addition, they found that the effect of the number of children on SAH was statistically insignificant for both men and women. The number of household members who were disabled or injured both appeared to have negative effects on SAH but had a stronger impact on men's SAH than women's. This finding is contrary to that of Walters et al. (2002), who found that household care had more of an effect on Canadian women than on men. This result can be explained by the strong social pressure to look after their family that is placed on Taiwanese men rather than women. However, no difference was found between the genders in terms of how their SAH responses related to their personal income, education, whether they smoked, and physical inactivity. An interesting finding was that men tended to report better SAH if

they were business owners, self-employed or had a full-time job, while women tended to report better SAH than men if they were housewives.

Chen et al.'s study demonstrates the gender gap in reporting SAH in the case of Taiwan; females report poorer SAH than males after taking personal characteristics and household caring factors into consideration. However, some of the findings, such as the fact that being a housewife is correlated with better SAH, are based on cross-sectional data, which may raise the question of whether the study ignores unobserved factors that may be important, such as attitudes towards work and ability to work; such information was unfortunately not available in the study's data. Furthermore, we would argue that the variation in SAH between genders could be attributed to reporting behaviour, that is, men and women may respond to questions about SAH using different reference thresholds and, therefore, it may be difficult to directly compare SAH differences between genders. A reliable SAH measure could be implemented conditional on objective indicators and a generalised ordered probit model (GOP) could be estimated to relax and vary the thresholds across individual characteristics.

Socio-economic characteristics have commonly been included in empirical studies based on educational attainment, income and occupation. For example, the subjective ladder ranking (Singh-Manoux et al., 2003) asks individuals where they think they stand on a ladder. For example, the question (with ten rungs or answers) might be '*Think of this ladder as representing where people stand in our society. At the top of the ladder are the people who are the best off, those who have the most money, most education, and best jobs. At the bottom are the people who are the worst off, those who have the least money, least education, and worst job or no job*.' The subjective ladder rating has been put forward as an important determinant of morbidity in British civil service employees (Singh-Manoux et al., 2003). Hu et al. (2005) analysed data on elderly Taiwanese to compare the relationship between the subjective ladder ranking and SAH. The data was drawn from the Survey of the Health and Living Status of the Elderly, 2000. Health outcomes were measured using ordinal responses to the question '*Regarding your current state of health, do you feel it is excellent, good, fair, poor or very poor?*' and the scales were collapsed into two categories: '*excellent*' and '*good*' were classified as '*good health*' and '*fair*', '*poor*' and '*very poor*' were classified as '*poor health*'. Health outcomes were modelled using a multivariate ordinal logistic regression model, controlling for age, sex, income,

employment status, ethnicity, marital status, alcohol and smoking consumption (measured by dummy variables where 1 indicates current users and 0 indicates non-users) and a depression score (measured using a 10-item short form of the Centre for Epidemiologic Studies Depression Scale, CED-D). They found that a lower subjective ladder rating related to poorer SAH and the relationship was even stronger amongst those who were less well educated. The findings showed that the strength of the association appeared to be similar in different ethnic groups in Taiwan, suggesting that the relationship between subjective social status measured using a ladder ranking and health may be robust across various ethnic populations. Their findings also showed that SES inequalities in health existed among elderly Taiwanese people.

Hu et al.'s study showed that a lower level of SES was related to poorer SAH. However, there are two potential biases in their study. Firstly, the authors did not control for potential endogeneity, meaning that health and labour market status may be jointly determined. In other words, it is possible that individuals with poor SAH have a decreased probability of participating in the labour market, which may lead to lower wages, which in turn may lead to poor health. Secondly, SAH indicators are subject to reporting bias and, therefore, the variation in the SAH measure may be due to reporting bias varying by individuals' SES.

The influence of a spouse's health on the SAH of older adults has also been explored. For example, Beckett et al. (2002) used three waves of data on the Taiwanese elderly to explore the effects of the social environment and life challenges on SAH, employing multinomial and binomial logistic models. The health outcome was captured by a question with five ordinal responses, ranging from '*excellent*' to '*poor*'. Strong evidence suggested that the negative impact of the poor health of a spouse was greater on a female respondent's health than on a male respondent's health. The study also found that father's education and the respondent's occupation were both statistically insignificant in relation to health outcomes for older adults. They also found that not living with children is statistically significantly associated with poor health for older men but not for older women.

The last finding is a surprising result because sons have an important role in the extended family in Taiwanese culture. Extended families are more prevalent in Taiwan as compared to the West (Chen et al., 2008) and the household structure for elders with

adult children has typically been the co-residence of parents and their adult sons. This result arguably reflects not only that the Taiwanese are changing with respect to the traditional social values, but also that the family has been transformed from the traditional extended structure into a more nuclear family structure (Leung et al., 1997). However, another study provides evidence to suggest that, when controlling for the elderly who live with their children, a positive effect on older adult health can be seen (Chi and Hsin, 1999).

This subsection has reviewed studies on SAH based on data from Taiwan. The existing studies are limited by their use of cross-sectional data and by the fact that most of them have focused on older people. In the next section, panel data for a representative sample, based on survey data from the national population, is analysed with a view to addressing these limitations. Panel data which has been neglected for SAH measures in Taiwan, are more appropriate is because factors other than underlying health may influence how individuals answer questions regarding SAH. The advantage of using panel data is that it introduces heterogeneity into the model (e.g., the impact of genetic factors on SAH), which the cross-sectional dataset does not allow in terms of exploring the intergenerational transmission of health, and this allows us to improve the efficiency of estimates. In addition, measurement error is not considered in any of the existing studies on Taiwan, which may lead to estimation problems when using traditional models (such as the ordered probit model). Hence, our approach will allow for measurement error in the SAH measure.

2.3 Data and Methodology

In the empirical analysis which follows, we use panel data from Taiwan and a flexible GOP model, to deal with the problem of measurement error when exploring the determinants of SAH. First, we estimate a range of models for all individuals as our baseline model. Next, we re-estimate the baseline model focusing on a sample of married individuals. We then repeat those models by focusing on samples where: the individual's mother is alive; the individual's father is alive; and both parents are alive. Definitions for all the variables used in the empirical analysis are presented in Section 2.3.1. In Sections 2.3.2, 2.3.3 and 2.3.4, the econometric methodology is described.

2.3.1 Data

The empirical analysis presented in this chapter is based on the Panel Study of Family Dynamics (PSFD) in Taiwan, which is a longitudinal survey that began in 1999. The survey aims to provide information on the structure and evolution of the family in Taiwan, and was extended in 2003 to include Shanghai, Zhejiang and Fujian in mainland China. The sample is followed up annually. A three-stage, stratified random sampling procedure is used. In the first stage, all cities or towns are assigned to a stratum according to population size and urbanisation level. A number of geographical areas are then randomly selected based on the proportion of the area's population size. In the second stage, smaller villages (boroughs called 'li' in Taiwan) are randomly drawn from the geographical areas selected during the first stage. Finally, in the last stage, a nationally representative sample of individuals is randomly drawn from each borough.[1]

The PSFD sample is comprised of three cohorts: individuals born in 1934-1953, in 1954-1963 and in 1964-1978. The 1954-1963 cohort of 999 respondents was initially interviewed and completed in 1999 and then followed up each year after that. The interviewing of the 1934-1953 cohort began in 2000 with 1,959 respondents. In 2000, in addition to interviewing the 1954-1963 cohort, individuals born in 1934-1953 were interviewed in the spring. Those born in the 1964-1978 cohort joined the survey in 2003, with 1,230 interviews taking place. All respondents were selected following the three-stage random selection procedure as described above.

This is a multi-purpose survey and, hence, it covers a wide range of topics, such as socio-economic status, the spouse's personal information, family values and attitudes, family decisions and expenditure, health status, information on relatives, family relationships and child care and education. Only one respondent[2] is taken from any single household. From the year 2000 onwards, the contact information for the children of the respondents of the 1935-1954 and 1953-1964 cohorts were collected (consisting of young adults aged between 16 and 22). This sample of young adults has been traced and interviewed every two years.

[1] Taiwan's population is 23 million and the PSFD sample has around 3,000 respondents. The US Panel Study of Income Dynamics (PSID) in 2001 used 7,406 families, which was considered to be representative of the US population of 284.8 million. Thus, the size of the PSFD is more than comparable with that of the PSID (Kan, 2007).

[2] A sample of respondents who are selected in terms of their age, i.e., the individuals are born in one of the three cohorts 1934-1953, 1954-1963, and 1964-1978, are interviewed.

Individuals are included in this analysis if they were interviewed in the first wave (1954-1963 cohort only), and the analysis also includes respondents who joined the survey at a later date (e.g., in the 1934-1953 and 1964-1978 cohorts). The smallest sample size was 999 interviews in the first wave, and the largest sample size was 3,469 interviews in the fifth wave. If we include individuals who were interviewed in each subsequent wave, the smaller sample consists of 1,724 respondents. Therefore, an unbalanced panel of data is analysed in this chapter. That is, individuals may not appear for the full survey period, as some individuals may leave the sample, while new individuals may join. The raw attrition rate for the full sample of the panel was 22.01 percent of the original sample for all eight waves. Attrition can lead to biased parameter estimates when the reason for leaving the survey is related, for example, to the health that is being modelled. However, some studies have found that although a health-related non-response exists, it does not appear to distort the magnitudes of the estimated effects of SES (Jones et al., 2006). Similar findings have been reported concerning the limited influence of attrition bias in models of various labour market outcomes in the first 4 waves of the PSFD (Yu, 2005).

Our study focuses on respondents aged between 25 and 74 over eight waves (1999-2006); the average age being 49; and the overall sample size is 20,607 observations. Descriptive statistics are presented in Table 2.1 in Appendix One. The dependent variable, SAH, is measured on a five-point scale: '*excellent*', '*good*', '*fair*', '*poor*' and '*very poor*' health[3], in response to the question '*How is your current health condition?*' We exclude individuals who have missing information on SAH. Because of the relatively small number of respondents reporting either '*poor*' or '*very poor*' SAH, these responses are collapsed into a single category, '*poor*' and, hence, there are four categories in our dependent variable, with 16.51% of individuals reporting '*excellent*' health, 32.37% '*good*', 36.56% '*fair*', and 14.56% '*poor*'. Table 2.2 presents the percentage of individuals' SAH in each category by year. It shows that the percentage of individuals reporting their own SAH as *'poor'* and *'fair'* increased over time while, on the other hand, the percentage reporting it as *'excellent'* decreased. However, there is an increase in the percentage of individuals who reported their health as *'excellent'* in 2003 which is likely to be because of the youngest group joining the survey. Overall, the majority of

[3] Between the years 1999 and 2004 (waves 1-6), SAH is, however, measured on a six-point scale with an '*other*' category. This category is regarded as a missing value in our study and 0.06% of the observations have missing values in total. The distribution of SAH for Taiwanese is similar to that for other countries in that more people report their SAH as fair and good as opposed to 'poor' or 'excellent'.

individuals report their SAH as either *'fair'* or *'good'* in each year.

2.3.2 Methodology

In the panel data set used for our study, the dependent variable SAH includes four categories which are ordered discrete variables where higher numeric scores denote better health. The regression analysis for SAH can be performed by specifying an ordered probit model (Hernàndez-Quevedo et al., 2005) and the latent health specification is given by:

$$H_{it}^{*} = \beta' X_{it} + \varepsilon_{it} \qquad i = 1,2,...,N\ ;\ \ t = 1,2,...,8 \tag{1}$$

Here, H_{it}^{*} is the unobserved latent health status, the measure of SAH, of respondent i at time t. X_{it} is a vector of explanatory variables comprising age, gender, marital status, the number of children, education, household size, employment, ethnicity, household income and region of residence. In our model, some of the explanatory variables are qualitative. The most usual approach to their inclusion is based on dummy variables. For example, a categorical variable with k categories is described by $(k-1)$ dummy variables which are introduced as regressors. β is a vector of coefficients and ε_{it} is a normally distributed random error.

In this case, the observed variable H_{it} (SAH) will fall in category 0 if $H_{it}^{*} \le \mu_0$, H_{it}=1 if $\mu_0 < H_{it}^{*} \le \mu_1$ and so on, where the $\mu's$ are a set of unknown thresholds (also referred to as cut points) to be estimated jointly with β. The probability that an individual i will choose the j^{th} category given the probability that the latent variable H_{it}^{*} lies between μ_{j-1} and μ_j is:

$$\Pr(H_{it} = j \mid X_{it}) = \Phi(\mu_j - \beta' X_{it}) - \Phi(\mu_{j-1} - \beta' X_{it}) \tag{2}$$

It can be seen that the $\beta's$ are coefficients that are common to all waves; given the latent variable specification, these parameters should be unaffected by changes in the individuals' characteristics.

Our GOP model extends the latent variable specification and follows Boes and Winkelmann (2006), who allow for the possible heterogeneity in reporting SAH. Therefore, the unknown thresholds μ_j depend on the explanatory variables, X_{it}. In this specification, $\mu_j = \tilde{\mu}_{ij} + \gamma_j' X_{it}$ where γ_j represents the influence of the explanatory

variables on the thresholds. Also, our model allows for two kinds of heterogeneity. Firstly, we allow for clustering at the individual level. Secondly, time fixed effects, which control for omitted variables that change over time but have the same values for all individuals, are captured using year dummy variables. Hence, our GOP model can be reformulated as equation (3), which allows thresholds to vary across explanatory variables and where potential heterogeneities are captured by the cluster specification and the time fixed effects (Robone et al., 2011), T_t, which are individual-invariant. So the latent variable specification of the model can be written as:

$$H_{it}^{*} = \beta' X_{it} + \varepsilon_{it} \qquad \varepsilon_{it} = T_t + \nu_{it} \tag{3}$$

$$H_{it} = j \quad \text{if and only if} \qquad \tilde{\mu}_{ij-1} + \gamma'_{j-1} X_{it} < H_{it}^{*} \leq \tilde{\mu}_{ij} + \gamma'_{j} X_{it}$$

$$= \mu_{ij-1} < H_{it}^{*} \leq \mu_{ij} \tag{4}$$

where $j = 0,1,2,3$ denotes the number of ordered categories of SAH, being '*poor'/'very poor', 'fair', 'good'* and *'excellent'* health, respectively.

$$H_{it} = 0 \quad \text{(poor/very poor)} \quad \text{if} \quad H_{it}^{*} \leq \mu_{i0}$$

$$H_{it} = 1 \quad \text{(fair)} \quad \text{if} \quad \mu_{i0} < H_{it}^{*} \leq \mu_{i1}$$

$$H_{it} = 2 \quad \text{(good)} \quad \text{if} \quad \mu_{i1} < H_{it}^{*} \leq \mu_{i2}$$

$$H_{it} = 3 \quad \text{(excellent)} \quad \text{if} \quad \mu_{i2} < H_{it}^{*} \tag{5}$$

The cumulative probability, Φ (the cumulative standard normal distribution), of the health outcome is then related to a set of explanatory variables, X_{it}, as follows:

$$\Pr(H_{it} = j \mid X_{it}) = \Phi(\mu_{ij} - (\beta - \gamma_j)' X_{it}) - \Phi(\mu_{ij-1} - (\beta - \gamma_{j-1})' X_{it}) \tag{6}$$

Thus, the set of ($\beta - \gamma_j$) allows a different parameter vector for each health outcome.[4]

[4] The random effects ordered probit model (REOP) was also estimated and made little difference to the results (see Appendix Two). For example, if a statistically significant effect is found in income in the GOP model but not in the REOP model, this might refer to the presence of reporting heterogeneity related to the income variable. The GOP model is appropriate for our data since it relaxes the assumption of a constant threshold regarding the nature of responses given.

2.3.3 Variable Definitions

The explanatory variables[5], X_{it}, in equation (6) include age, marital status, the number of children, education, the number of adult members in a household, ethnicity, household labour income, household unearned income, labour market status, region of residence, parents' education and health and, if married or co-habiting, the spouse's health status.

Age (see Table 2.1) is represented by five categories and is described by four dummy variables: 25 to 34, 35 to 44, 45 to 54, 55 to 64 and over 65 (the omitted category): 65% of the sample are over 45 years old. A male dummy variable is included; 47.9% of the overall sample are male. For marital status, the dummy variable equals '1' for married and cohabiting individuals and '0' for single, separated, divorced and widowed individuals. Around 80% of the overall sample are married.

We also include the number of children in our empirical analysis. Three categories for the number of children in the household, based on age, are included: the number of children aged 0 to 7, the number of children aged 8 to 12 and the number of children aged 13 to 18. Education levels are measured by the highest level of attainment and are grouped into three categories: no education (the omitted category); secondary education[6], which includes: elementary school, junior high school, junior vocational school, senior vocational high school, senior high school, vocational high school and junior college; and, finally university and higher education, which includes certification at a senior college (two years), senior college (three years), technical college, university or college, masters degree or doctoral degree.

The number of adult members in a household is also included, with the maximum value of '10' being used when there are ten or more people in a household. For labour market status, controls are included for being employed, self-employed, unemployed and out of the labour market (the omitted category), which is defined as those individuals who are unable or reluctant to work (i.e. those of working age who are without work and are

[5] The variables for smoking, drinking and other objective health variables are not included because these variables are only available for one year– the wave 2005.

[6] Here, the secondary education includes: elementary school which is equivalent to primary school in the UK, junior high school which is equivalent to secondary school in the UK, junior vocational school which is equivalent to the General National Vocational Qualification, GNVQ, in the UK, senior vocational high school which is also equivalent to the General National Vocational Qualification, GNVQ, in the UK, senior high school which is equivalent to A-levels in the UK, vocational high school which is equivalent to Advanced Subsidiary, AS level, in the UK and junior college which is equivalent to Advanced Subsidiary, AS level, in the UK.

unavailable for work, such as students, and those in retirement). For ethnicity, four categories are controlled for: the Hokkien group, the Hakka group, the Mainlander group and aboriginal or other origin (the omitted category). The vast majority of early settlers in Taiwan were Hokkien and Hakka. In 1949, approximately one million nationalist military and civilian supporters migrated from mainland China. This group of migrants and their offspring became known as Mainlanders. Being a Mainlander may mean that an individual is physically healthier than others because the Mainlanders are more highly educated and have better access to health care than the other two ethnic groups (Zimmer et al., 2005), which would thus lead to better SAH than for the other groups. The Mainlanders, with more education, have lower mortality and hence survive longer. The differences in the capacity to work between the Mainlanders and the other two ethnic groups as well as the differences in educational attainment may account for observed differences in health status between different types of ethnicity. However, this is beyond the scope of our analysis, but would be an interesting avenue for future research.

Household labour income (that is, income from work as opposed to that from benefits or financial assets) is defined as average monthly income from full-time and part-time work and is deflated by the retail price index to adjust for inflation (year 2006=100). The specific questions asked were '*What is the average monthly income of your/your spouse's current job?*' and '*What is the average monthly income of your/your spouse's part-time job?*'. The natural logarithm of total household labour income is converted into sterling using an exchange rate of 47NT/£1[7], which is also used for the variable 'unearned income', described below. Since we cannot take the log of zero (0.76% of the sample reported missing values, 20.43% reported zero labour income and 0.34% a labour income value of between 0 and 1), a value of zero and a value between 0 and 1 are simply kept at zero. Income from all types of benefits and income from financial assets are aggregated to obtain 'total household unearned income'. This includes asset and investment income, benefits, rental income, unemployment insurance benefit and government subsidies.[8] Unearned income is again deflated by the retail price index to adjust for inflation (year 2006=100), the natural logarithm is taken and it is converted into sterling using the above exchange rate. Once again, a zero value is kept at zero (77.18% of the sample reported a

[7] The exchange rate of 47 (NT dollars/ Pounds) at the Bank of Taiwan on 29/03/10.

[8] This includes: low- and middle-income benefits; household living allowance; social assistance for medical care; social insurance benefits; education subsidies; allowances for child care; allowances for the elderly; allowances for veterans; and subsidiary living costs for the disabled.

zero value and 1.25% a value of between 0 and 1 for unearned income).

Region of residence is controlled for following the definition of 'Regional Divisions' of the Taiwan Bureau of National Health Insurance, which divides the country into northern, central, southern and eastern areas. The north of Taiwan is the most developed area and the eastern region is the least developed. The eastern region is the omitted category. Year dummy variables are also included. Turning to the characteristics of the respondent's parents, amongst the parents of the respondents, a large proportion have lived in a traditional agricultural society for most of their lives. Hence, most of them have primary education or no education. So, the mother's education level and the father's education level are split into three categories: no education (the omitted category), primary education and 'secondary or above' education. There are large differences in education levels between the mothers and the fathers. For example, 53.36% of fathers have a primary or higher education, while only 35.86% of the mothers fall into one of these two categories.

The survey also includes information on the health status of the parents and, if married, the health status of the spouse as perceived, i.e. reported, by the respondent. There are five categories: '*excellent*', '*good*', '*fair*', '*poor*' and '*very poor*' health in response to the question '*How is your spouse's/ father's/mother's current health condition?*'. As before, health status is defined as a missing value if the respondent selected the 'other' category; these observations are omitted from the analysis (0.81% of spousal health is missing; 1.6% of the father's health is missing; and 1.1% of the mother's health is missing). Perceived health status is included as a set of four perceived health status dummy variables for each category: '*excellent*', '*good*', '*fair*', '*poor*/*very poor*' (the omitted category). Interestingly, some studies have provided evidence supporting the validity of proxy reporting of health. For example, van der Linden et al. (2008) designed separate questions for patients and proxy respondents, where proxy respondents were asked '*How do you think the patient experiences the impact of multiple sclerosis on his/her life*?' They used t-tests to examine whether the mean difference was statistically different between patients' reports and proxy respondents' reports. The results suggested that proxy respondents may report a more reliable measure of health status as compared to the patients themselves in cross-sectional data. Although health status is reported by proxy in this context, one of the advantages of the data is that we can use these measures to move a

step further in exploring the effect of parents' health on their offspring's SAH in Taiwan.

Table 2.3 presents the percentage of mothers' and fathers' SAH in each category by year. It shows that the percentage of individuals reporting their mothers' SAH as *'fair'* increased over time. The percentage reporting it as *'excellent'* decreased from 11.20% in 2001 to 8.40% in 2002 for mothers' SAH but it rose to 11.50% in 2004 and then once again decreased by 2006. A similar pattern appears in fathers' SAH as well. The reason for the higher percentage in 2004 than in the previous wave is probably related to the unbalanced panel data. The youngest cohort joined the survey in 2003.

Table 2.4 shows the parents' SAH cross-tabulated against the respondents' SAH.[9] There is a high degree of correlation between the individuals' SAH and their mothers' SAH. For example, the highest percentage of individuals who reported themselves as having *'poor'* SAH also rated their mother's SAH as *'poor'*. Turning to the category of *'fair'* SAH of individuals, the frequency of reporting their mothers' SAH as *'fair'* is higher than that of any other category, and a similar correlation exists between the individuals who report themselves as having *'good'* and *'excellent'* SAH. This is also the case for fathers' SAH as well.

Interestingly, reporting behaviour varies by gender (see Table 2.5). For example, if the highest frequency of reporting the SAH of the individuals themselves is that of being in the *'poor'* category, it is observed that reporting their mothers' SAH as *'poor'* has the highest frequency. The same is true for those individuals who reported themselves as being in the *'fair'* category, since among those individuals those reporting their mothers' SAH as *'fair'* make up the highest percentage. However, when turning to the male individuals who reported their own SAH as being *'good'*, reporting their mothers' SAH as being *'fair'* instead of *'good'* has the highest frequency. Nevertheless, this is not the case for females: females reported their mothers' SAH as being in the same *'good'* category as themselves. As for males who reported their own SAH as being *'excellent'*, the highest percentage of these individuals reported their mothers' SAH as being *'fair'*. In the case of the female respondents, their mothers were reported as being in either the *'fair'* or *'good'* categories. However, a high correlation exists between one's own SAH and

[9] The distributions for the respondents' own and the parents' SAH are presented in Figure 2.1 in Appendix Two.

reporting one's father's SAH.

2.3.4 The Empirical Models

The empirical analysis presented in this chapter explores the relationship between socio-economic and demographic characteristics and the SAH of individuals. Initially, equation (7) below is estimated for all individuals, including demographic and socio-economic characteristics as explanatory variables. This model is regarded as the baseline model. We then focus on the sample of married individuals only and re-estimate equation (7), omitting the controls for marital status, both with and without the inclusion of the individual's spouse's SAH (S_{it}) in the set of explanatory variables, as depicted by equations (8) and (9). This investigation enables us to explore the effects of the SAH of the spouse on a married individual's SAH.

Turning back to the baseline model, and once again including both married and unmarried individuals, we then extend the baseline model, equation (7), by adding F_{it}^{Moth} (which includes the mother's SAH and mother's education). Equation (10) is estimated over a sample of individuals whose mothers are alive. We then repeat the analysis, replacing the mother's SAH and education with F_{it}^{Fath} (the father's SAH and education) and focus on the sample of individuals whose fathers are alive, which is depicted by equation (11). We then focus on individuals whose parents are both alive and, therefore, include both parental characteristics ($F_{it}^{Moth}, F_{it}^{Fath}$) in the set of explanatory variables, as depicted by equation (12).

$$H_{it} = \beta_0 + \beta_1 Age_{it} + \beta_2 Gender_{it} + \beta_3 Married_{it} + \beta_4 SES_{it} + T_t + \nu_{it} \quad (7)$$

$$H_{it} = \beta_0 + \beta_1 Age_{it} + \beta_2 Gender_{it} + \beta_4 SES_{it} + T_t + \nu_{it} \quad (8)$$

$$H_{it} = \beta_0 + \beta_1 Age_{it} + \beta_2 Gender_{it} + \beta_4 SES_{it} + T_t + \beta_5 S_{it} + \nu_{it} \quad (9)$$

$$H_{it} = \beta_0 + \beta_1 Age_{it} + \beta_2 Gender_{it} + \beta_3 Married_{it} + \beta_4 SES_{it} + T_t + \beta_6 F^{Moth} + \nu_{it} \quad (10)$$

$$H_{it} = \beta_0 + \beta_1 Age_{it} + \beta_2 Gender_{it} + \beta_3 Married + \beta_4 SES_{it} + T_t + \beta_7 F_{it}^{Fath} + \nu_{it} \quad (11)$$

$$H_{it} = \beta_0 + \beta_1 Age_{it} + \beta_2 Gender_{it} + \beta_3 Married + \beta_4 SES_{it} + T_t + \beta_6 F_{it}^{Moth} + \beta_7 F_{it}^{Fath} + \nu_{it} \quad (12)$$

We then re-estimate equations (10), (11) and (12) for the sample of married individuals only, omitting the controls for marital status. We then re-estimate these three equations

including controls for the spouse's SAH.

2.4 Results

This section presents the results of analysing the determinants of SAH using a generalised ordered probit model (GOP). In all models, we include personal socio-economic and demographic characteristics. Firstly, the baseline model is estimated over the overall sample representing the Taiwanese population. Secondly, we focus on married respondents with and without additional controls for the spouse's SAH. Then, we re-estimate the baseline model using samples where: the respondent's mother is alive, the respondent's father is alive and both of the respondents' parents are alive. All results tables are presented in Appendix One.

Since the GOP model allows the parameters associated with a given explanatory variable to differ for each outcome category, we use likelihood ratio tests[10] to determine whether the differences in each set of parameters associated with a given explanatory variable of the baseline model are the same for all outcome choices, before discussing the estimated results in more detail. For model parsimony, if a test statistic for the null hypothesis of no difference among parameters is not rejected in a generalised ordered probit model, then the parameters are constrained to be equal for that explanatory variable. Likewise, if we fail to reject the hypothesis of equality of parameters for each explanatory variable, the standard ordered probit model is a preferable approach. In our likelihood ratio tests $\chi^2_{60} = 589.50$ is obtained and the p-value is 0.00 for the baseline model. Therefore, the coefficients do vary across categories in our empirical model and, hence, the GOP model is a preferable method here to the conventional ordered probit model. In the GOP model, the estimated coefficients cannot be taken to directly indicate changes in the probabilities of given health outcomes (see Greene and Hensher, 2010). Hence, the marginal effects are presented and discussed here for each model.

2.4.1 Demographic and Socio-economic Characteristics (Full Sample)

Table 2.6 shows the results of the baseline model, equation (7), for the full sample. The sample size is 20,607 observations. Focusing firstly on age, all age categories are inversely correlated with reporting '*poor*' SAH. The probability of reporting '*poor*' SAH is 7.1 percentage points lower if individuals are aged 25 to 34 compared to those in the

[10] In our case, the likelihood ratio test is used to test the hypothesis that the GOP model is an appropriate model against the standard ordered probit model.

over 65 group (the omitted category); 6.2 percentage points lower for the 35 to 44 age group; and 2.3 percentage points lower in the 45 to 54 age group. The results show that younger and older respondents respond differently to the SAH question. Turning to gender, male respondents are 3.1 percentage points less likely to report being in '*fair*' SAH than females, and around two percentage points more likely to report '*good*' and '*excellent*' SAH. These findings are consistent with the previous literature where, in general, women are found to report poorer SAH than men (Chen et al., 2008). In accordance with our expectations, married individuals are nearly three percentage points more likely to report being in '*good*' SAH than non-married individuals. This is in line with Zimmer et al. (2000).

In accordance with several studies (such as Park, 2005), the level of education has a strong positive association with SAH. Individuals with higher levels of education tend to report better SAH than those without education (the omitted category). There is a small negative effect of household size on reporting '*poor*' SAH. As compared to those respondents who are unable to work (the omitted category), respondents who are employed or self-employed are less likely to report being in '*poor*' SAH, seven and five percentage points less, respectively; meanwhile, unemployed respondents are four percentage points more likely to report being in '*fair*' SAH than respondents who are unable to work. On the other hand, the probability of reporting *'good'* and '*excellent*' SAH are approximately five percentage points higher and two percentage points higher, respectively, if individuals are in employment or self-employment, but about four percentage points lower for those who are unemployed. Individuals with a job tend to report better SAH than those who are unable to work, but unemployed individuals are more likely to report *'poor'* SAH than those who are unable to work.

The three ethnic groups are all statistically significantly less likely to report being in '*poor*' SAH than individuals of aboriginal or other ethnicities (the omitted category). The population of aboriginals is the smallest and this category is slightly poorer, on average, than the rest of the Taiwanese population (Chang, 2009). Moreover, being a Mainlander has a stronger association with reporting '*excellent*' SAH than being in the Hakka group. Similar evidence was reported in Beckett et al. (2002). Labour income has a statistically significant negative effect on reporting '*poor*' SAH and the probability of reporting '*excellent*' SAH increases by around 0.4 percentage points if income increases by 1%.

Therefore, an increase in income is found to lead to an individual reporting better SAH.

There appear to be regional differences in reporting SAH. Individuals who live in the Northern and Central regions of Taiwan are less likely to report being in '*poor*' SAH than those living in the East—four percentage points less and two percentage points less, respectively. This may be due to the North being the most developed area (and the East, the omitted category, being the least developed) (Knöbel et al., 1994). On the other hand, the respondents who live in the South of Taiwan are found to be three percentage points less likely to report '*excellent*' SAH than those living in the East. When we take this extensive set of regressors (e.g., SES and demographic characteristics) into consideration, we still observe statistically significant differences across waves, this being evident from the marginal effects on the year dummy variables. Year fixed effects capture the influence of common shocks that affect individuals' SAH at the same time.

2.4.2 Demographic and Socio-economic Characteristics (Married Individuals)

Table 2.7 shows the results of estimating equation (8) for a sample of 16,542 observations of married individuals.[11] In the *'excellent'* SAH category, there are small increases in the marginal effects across all regressors for married individuals relative to the results for the same category in the baseline model. This suggests that married individuals are more inclined to report '*excellent'* SAH than the overall population (Chi and Hsin, 1999; Jürges, 2007). Being male has a statistically significant positive effect on the probability of reporting either *'good'* or *'excellent'* SAH of nearly three percentage points and males are 4.3 percentage points less likely to report *'fair'* SAH. Hence, the differences between genders increased slightly for married individuals compared to the full sample. Higher labour income is associated with reporting better SAH for married individuals. Compared to the baseline model, the marginal effect of education is larger for *'poor'* and *'excellent'* SAH. Therefore, the positive effect of education on SAH appears to be stronger for married individuals than it is for the general population (in the baseline model). For labour force participation, employment and self-employment are not statistically significant in the case of reporting *'excellent'* SAH. Interestingly, there is an increase of 6.8 percentage points in unemployed individuals reporting being in *'fair'* SAH and a decrease of 3.9 percentage points in those reporting *'excellent'* SAH compared to those who are unable to work. Therefore, for married respondents, there is a greater negative

[11] The question about the spouse's SAH was not asked in 2003 for the 1934-1953 and 1954-1963 cohorts.

association between SAH and unemployment than for the general population. This may indicate that married individuals may have to take on more responsibilities, as compared to unmarried individuals, for example, to hold a job for a family, and therefore unemployment may be associated with feeling in worse health.

Table 2.8 shows the results of estimating equation (9) for the same sample of married individuals, but with the SAH of the spouse as perceived by the respondent included as an additional explanatory variable. Compared to those who report their spouse's SAH as *'poor'* (the omitted category), married individuals who report their spouse's SAH as *'fair'*, *'good'* and *'excellent'*, have 8.8 percentage point, 12.4 percentage point and 10.8 percentage point, respectively, lower probabilities of reporting their own SAH as *'poor'*. On the other hand, individuals who report that their spouse is in the *'good'* or *'excellent'* SAH categories are more likely to report *'good'* or *'excellent'* SAH themselves. These findings suggest that a positive association exists between the spouse's SAH and the respondent's SAH (Beckett et al., 2002). This can be explained by the shared living environment, such as exposure to a risky geographical environment (Trannoy et al., 2010), eating the same food or individuals may choose to marry someone with similar personal characteristics.

Turning to the other explanatory variables, the marginal effects of most of the explanatory variables on SAH are smaller than the results without controlling for the spouse's SAH, except for those relating to labour force participation. Respondents who are employed are almost two percentage points more likely to report *'good'* SAH than in the results without controlling for the spouse's SAH. Those who are unemployed are four percentage points less likely to report being in *'excellent'* SAH than the rest of the sample, which is slightly higher than in the previous models (without controlling for the spouse's SAH). The finding indicates that the effects of labour force participation on SAH are stronger after controlling for the spouse's SAH than the marginal effects without controlling for the spouse's SAH.

2.4.3 Mother's Characteristics

In order to explore how mother's education and mother's SAH affect the reported SAH of their offspring, we estimate equation (10) over a sample of respondents whose mothers

are alive, including mothers' characteristics.[12] We then repeat the analysis, omitting the controls for marital status, and re-estimate equation (10) with and without controlling for the spouse's SAH. Tables 2.9, 2.10 and 2.11 report these results. The SAH of parents is only observed in the years 2001, 2002, 2004, 2005 and 2006. Thus the sample is smaller.

It is apparent from Table 2.9 that a mother's characteristics influence the respondent's SAH. There is a negative association between the individuals' SAH and their mothers' education. An individual whose mother has a secondary or higher degree is more likely to report *'fair'* health, that is 8.8 percentage points higher than an individual whose mother has no education. Meanwhile, compared to individuals whose mothers have no education, individuals whose mothers have a secondary or higher degree are less likely to report *'excellent'* health themselves. Turning to the mother's SAH variable, respondents who report that their mother is in *'fair'*, *'good'* or *'excellent'* health are less likely to report *'poor'* health themselves. Moreover, a strong marginal effect is apparent for individuals who report that their mother is in the *'good'* or *'excellent'* health categories, with an increase of around 21.9 and 36.7 percentage points in the probability of reporting *'good'* and *'excellent'* health themselves, respectively. Our findings provide evidence that a positive correlation between mother's SAH and their offspring's SAH exists. One of the possible explanations is that individuals may inherit genetic factors from their mother as well as longevity, and react to a lasting effect of the mother's health on the individuals' SAH over their entire life cycle (Trannoy et al., 2010). It may also be the case that the mother's SAH has an impact on her offspring's SAH through a transmission of preferences or the same lifestyle. Mothers normally spend more time on housework than fathers do (Chen et al., 2008), such as cooking meals or purchasing food in a family. Therefore, this correlation in SAH between mothers and their offspring may be because the individuals concerned have similar preferences to their mother. Alternatively, the existence of the intergenerational transmission of SAH may be related to the reporting behaviour. For example, the individuals interviewed try to evaluate their SAH and their mother's SAH in an optimistic way.

Table 2.10 shows the influence of the mother's characteristics on the married respondents' SAH. Married respondents who report that their mother is in the *'fair'*,

[12] It should be noted that restricting the sample in this way may lead to sample selection bias since the sample excludes individuals whose mothers died due to poor health. Similarly, potential selection bias may also exist in estimating equation (11) (over the sample of respondents whose fathers are alive) and equation (12) (over the sample of respondents where both parents are alive).

'good' or *'excellent'* SAH categories are less likely to report *'poor'* SAH themselves compared to those who report their mother's SAH as *'poor'* with a probability of 4.8, 5.7 and 5.8 percentage points less, respectively. Moreover, a strong marginal effect is apparent for individuals who report their mothers' SAH as *'good'* or *'excellent'*: they have more than a twenty percentage point higher probability of reporting *'good'* or *'excellent'* SAH themselves. The results imply that the higher is the mother's SAH, the higher is the likelihood of the individual reporting better SAH for themselves. The mother's SAH still influences the adult individual's SAH, which as stated above may come from the transmission of similar lifestyle preferences or a common genetic factor within a family (Trannoy et al., 2010).

It is apparent from Table 2.11 that the marginal effects of the respondents reporting the mother's SAH as '*fair*', '*good*' and '*excellent*' on their reporting *'poor'* SAH themselves are smaller after controlling for the spouse's SAH. In addition, the marginal effects of the respondents reporting their mother's SAH as *'good'* or *'excellent'* on their reporting *'good'* or *'excellent'* SAH themselves are also smaller when controlling for the spouse's SAH where the probabilities of reporting *'good'* and *'excellent'* SAH are approximately 17.1 and 19.4 percentage points higher, respectively, compared to those reporting their mother's SAH as *'poor'*. On the other hand, individuals who report their spouse's SAH as *'good'* or *'excellent'* are statistically significantly more likely to report *'good'* or *'excellent'* SAH themselves with a probability of around 33 percentage points higher when we consider the mother's SAH. These results suggest that a stronger correlation exists between the spouse's SAH and the respondent's SAH than the correlation between the mother's SAH and the respondent's SAH. The evidence accords with the existence of an influence of a shared common living arrangement on SAH.

2.4.4 Father's Characteristics

Table 2.12 presents the marginal effects for equation (11) for the sample of respondents whose fathers are alive. We then omit the controls for marital status and re-estimate equation (11) for a sample of married individuals whose fathers are alive while controlling for spouse's SAH. Tables 2.13 and 2.14 show these results.

Respondents who report their father's SAH as *'good'* or *'excellent'* are more likely to report *'good'* or *'excellent'* health themselves, with probabilities of 19.9 and 28.9 percentage points higher, respectively, compared to those who report their father's SAH

as being *'poor'*. These findings indicate that there is a positive correlation between the SAH of a father and his offspring. However, the contribution of a father's SAH on his offspring's SAH is smaller than the contribution of a mother's SAH (as shown in Table 9).

It is apparent from Table 2.13 that, by focusing on married respondents whose fathers are alive, a respondent who reports his or her father's SAH as being *'good'* or *'excellent'* is more likely to report *'good'* or *'excellent'* SAH, compared to an individual who reports his or her father's SAH as *'poor'*, with increases of 19.4 percentage points and 30.6 percentage points in the respective probabilities. Our results provide evidence of the effect of the father's SAH on his offspring's SAH. In Table 2.14 we observe that the effect of the father's SAH declines after controlling for the spouse's SAH. For example, fathers having *'good'* SAH are associated with a 19.4 percentage point higher likelihood of reporting '*good*' SAH without controlling for the spouse's SAH, as compared to a 15.6 percentage point higher likelihood when controlling for the spouse's SAH. On the other hand, the corresponding marginal effect of reporting the spouse's SAH as being '*good*' is associated with a 31 percentage point higher probability of reporting a *'good'* SAH for themselves. This means that there is a stronger positive effect of the spouse's SAH on the respondent's SAH than on the father's SAH. It is again possible that common living conditions are an important determinant in explaining the respondent's SAH.

2.4.5 Both Parents' Characteristics

In order to assess the relative importance of the mother's and the father's characteristics, Table 2.15 presents the results from estimating equation (12), where both the mother's and father's characteristics are included, for the sample of individuals whose parents are both alive. We then estimate equation (12) over the sample of married individuals, with and without controlling for the spouse's SAH. Tables 2.16 and 2.17 report these results.

It is apparent from Table 2.15 that respondents whose fathers have primary or higher education are associated with an approximately 9 percentage point lower probability of reporting *'fair'* SAH themselves than those whose fathers have no education. On the contrary, respondents whose mothers have primary education are more likely to report *'fair'* SAH themselves, compared to those whose mothers have no education, with a 6.9 percentage point higher probability. Meanwhile, individuals whose mothers have secondary or higher education are less likely to report *'excellent'* SAH than those whose mothers have no education. Overall, our findings are consistent with those of Tubeuf and

Jusot (2011), which indicate that having a father with higher education is found to have a positive effect on reporting SAH. However, the effect of the mother's education on an individual's SAH has the opposite sign. This may be because a father's educational attainment reflects his income ability and, therefore, having a father with higher education may lead to a wealthy family during childhood and this may have a positive effect on an individual's SAH (Tubeuf and Jusot, 2011). It is interesting to note that an individual's education does not have a statistically significant association with the individual's SAH after controlling for both parents' education.

Individuals who report their father's SAH as being *'fair'* or *'good'* are statistically significantly less likely to report *'poor'* SAH themselves, with 3.6 and 4 percentage point lower probabilities, respectively, compared to those individuals who report their father as having *'poor'* SAH; meanwhile, the marginal effects of reporting the father's SAH as being *'good'* or *'excellent'* on reporting *'good'* or *'excellent'* SAH themselves are increased by 11.1 and 7.7 percentage points, respectively, compared to an individual reporting his or her father's SAH as being *'poor'*. A similar pattern appears for the effect of the mother's SAH. Individuals who report their mother's SAH as *'fair'*, *'good'* or *'excellent'* are statistically significantly less likely to report *'poor'* SAH themselves, with probabilities of 3.9, 5.3 and 5.2 percentage points less, respectively, relative to those individuals who report their mother as having *'poor'* SAH. Furthermore, a respondent who reports his or her mother's SAH as being *'good'* or *'excellent'* is more likely to report *'good'* or *'excellent'* SAH himself or herself, compared to a respondent who reports his or her mother's SAH as *'poor'*, with increases of 16.7 percentage points and 27.4 percentage points in the respective probabilities. These findings provide evidence that a positive correlation in SAH between parents and their offspring exists. The findings also imply that the proportion of SAH captured by the mother's SAH is higher than that captured by the father's SAH. This may be because in general a mother spends more time on housework, such as caring for the respondents during their childhood, purchasing food and cooking meals in a family, compared to a father. Alternatively, it may be related to reporting bias.

Table 2.16 shows that the marginal effects of the parents' education differ between mothers and the fathers. Individuals whose mothers have primary or higher education are more likely to report '*fair*' SAH but are less likely to report '*excellent*' SAH compared to

individuals whose mothers have no education. On the contrary, individuals whose fathers have primary education are less likely to report '*fair*' SAH than those whose fathers have no education. It is interesting to note that after controlling for the individual's socio-economic and demographic characteristics, both the mother's and father's education have long-term effects on their offspring's SAH in adulthood. However, their impacts on the offspring's SAH have opposite signs to each other. Our results indicate that family background (i.e., parents' education) influences SAH in adulthood.

Our findings are consistent with previous studies (Jusot et al., 2010; Trannoy et al., 2010) in that they show a positive effect of parents' SAH and relative longevity on their offspring's SAH. Compared to individuals who report their mother's SAH as '*poor*', those who report their mother's SAH as '*good*' or '*excellent*' are more likely to report their own SAH as '*good*' or '*excellent*' by 15.4 and 29.4 percentage points, respectively. Turning to fathers' SAH, the results are also statistically significant; individuals who report their father's SAH as '*good*' are 11.3 percentage points more likely to report their own SAH as '*good*', than those who report their father's SAH as '*poor*'. It is interesting to note that the marginal effects of the mother's SAH on an individual's SAH are considerably larger than the marginal effects of the father's SAH. Mothers' SAH explains more of the differences in respondents' SAH than fathers' SAH. It seems that reporting the mother's SAH as being higher is a better signal for an individual's own SAH than reporting the father's SAH as higher. These findings are consistent with those of Jusot et al. (2010).

It is apparent from Table 2.17 that, after controlling for the spouse's SAH, individuals who report their mother's SAH as *'good'* or *'excellent'* are more likely to report their own SAH as *'good'* or *'excellent'* with percentage points increases of 10.1 and 22.1, respectively. However, the marginal effects are considerably smaller than the estimated results without controlling for the spouse's SAH, where there are increases of 15.5 and 29.4 percentage points, respectively. In terms of the father's SAH, the results are statistically significant for *'good'* SAH but not for *'excellent'* SAH: individuals who report their father's SAH as *'good'* have a 11.1 percentage point higher likelihood of reporting their own SAH as *'good'*, the same result as was obtained without controlling for the spouse's SAH, when an increase of 11.3 percentage points was estimated. Both parents' SAH is positively correlated with their adult children's SAH (as in Trannoy et al.,

2010; Jusot et al., 2010).

The spouse's SAH is the main determinant of the individual's SAH. Individuals who report that their spouse's SAH is '*good*' or '*excellent*' are around 27.2 and 40.4 percentage points more likely to report their own SAH as '*good*' or '*excellent*', respectively. Although it seems that there is a correlation between both parents' SAH and their offspring's SAH, with the mother's SAH being stronger, the marginal effects are smaller after controlling for the spouse's SAH. This suggests that the spouse's SAH explains more SAH heterogeneity than the parents' SAH and this may imply that the contribution of a shared common living environment in adulthood to SAH is much higher than the contribution of the parents' characteristics (e.g., the parents' SAH and parents' education).

2.5 Reporting Bias

The purpose of this section is to analyse whether there is any evidence of reporting bias in the measure for SAH used in the Panel Study of Family Dynamics (PSFD). As it has been argued by Lindeboom and Doorslaer (2004) that the SAH measure does not correspond with 'true' health, SAH may be prone to reporting bias due to differences in reporting SAH across individuals with the same 'true' health status. This means that how individuals report their SAH may be influenced by their age and gender. In other words, individuals may report their SAH using different reference thresholds when they respond to the same SAH question. Although the GOP model allows for the rescaling of SAH to vary across individual characteristics (Hernàndez-Quevedo et al., 2005), the influence of individual characteristics on 'true' health still cannot be distinguished from 'true' SAH heterogeneity. In an attempt to analyse the possibility of reporting bias, we explore the relationship between parents-in-law's SAH as reported by the respondents and the individual's SAH using the GOP model with robust standard errors corrected for clustering within individuals. It is reasonable to assume that there is no association between parents-in-law's SAH and the individual's SAH because there are no common genetic factors or shared environmental factors between them.[13] However, one may argue that parents-in-law's SAH could act as a proxy variable for a spouse's SAH which is correlated with a respondent's SAH. In order to explore the potential for reporting bias

[13]Around 87% of the married individuals do not live with their mothers-in-law if mothers-in-law are alive; 88% do not live with their fathers-in-law if their fathers-in-law are alive and 90% do not live either one of their parents-in-law if they are both alive.

in the measure of SAH, our empirical analysis explores the relationship between parents-in-law's SAH and the respondent's SAH with and without controlling for spouse's SAH. If the marginal effects related to the parents-in-law's SAH are statistically significant, this suggests that the correlation between the parents-in-law's SAH and the individual's SAH may be the result of reporting bias rather than reflecting 'true' SAH heterogeneity. In addition, we would expect that a smaller marginal effect related to parents-in-law's SAH would be observed in the model after controlling for the spouse's SAH than the corresponding marginal effects in the model without controlling for the spouse's SAH.

Parents-in-law's SAH is reported by the married respondents, who were asked to rate it as *'excellent'*, *'good'*, *'fair*', *'poor'*, *'very poor'* or *'other'*, in response to the question '*How is your parents-in-law's current health condition?*'. As before, *'very poor'* and *'poor'* were collapsed into a single *'poor'* category and SAH was coded as a missing value for married individuals who replied in the *'other'* category (1.35% of the mother-in-law's SAH and 1.78% of the father-in-law's SAH was reported as *'other'*). 10% of the married individuals reported their mother-in-law's SAH as *'excellent'*, 27% as *'good'*, 38% as *'fair'*, and 24% as *'poor'*. Meanwhile, 11% of individuals reported their father-in-law's SAH as *'excellent'*, 30% as *'good'*, 38% as *'fair'*, and 19% as *'poor'*. The SAH of parents-in-law is only observed in the years 2001, 2002, 2004, 2005 and 2006.

2.5.1 Descriptive Statistics

Table 2.18 presents the percentages of the mother-in-law's and the father-in-law's SAH in each category by year. It shows that the percentage of individuals reporting their mother-in-law's SAH as '*fair*' increased over time but the percentage reporting it as '*excellent*' has decreased. The majority of respondents reported their mother-in-law's SAH as either *'poor'* or *'fair'* in each year and a similar pattern appeared for the father-in-law's SAH in the years 2005 and 2006. The percentage of individuals reporting their father-in-law's SAH as either '*poor*' or '*fair*' increased year by year, but the percentage reporting their father-in-law's SAH as either '*good*' or '*excellent*' decreased year by year. For example, 21% of individuals reported their father-in-law's SAH as '*excellent*' in 2001 compared to 9% in 2006. There is a trend for both parents-in-law's reported SAH to worsen over time. This may be due to the 'true' health status deteriorating as the parents-in-law age.

Table 2.19 shows the parents-in-law's SAH cross-tabulation against the respondents' SAH. For those individuals who reported their own SAH as either '*poor*' or '*fair*', reporting their mother-in-law's SAH as either '*poor*' or '*fair*' has the highest frequency. This is also true for the father-in-law's SAH. This demonstrates that a high correlation exists between reporting one's own SAH as '*poor*' or '*fair*' and reporting one's parents-in-law's SAH as '*poor*' or '*fair*'. Meanwhile, for those individuals who rated their own SAH as '*excellent*', reporting their father-in-law's SAH as '*excellent*' has the highest frequency. However, the same pattern does not appear to exist for mothers-in-law, since reporting their mother-in-law's SAH as *'fair'* has the highest frequency.

If we look at the distribution of the parents-in-law's SAH based on the respondent's gender, as shown in Table 2.20, '*poor*' and '*fair*' SAH for mothers-in-law are reported with the highest frequencies when the individuals report themselves as being in either the '*poor*' or '*fair*' category. For those married females who rate their own SAH as '*excellent*', reporting their father-in-law's SAH as '*excellent*' has the highest frequency. However, this is not the case for their mothers-in-law. Overall, the results show that the highest frequency exists among individuals who rate their own SAH as *'poor'* or *'fair'* and who report both their parents-in-law as having the same SAH as themselves. In addition, it can be seen that a higher percentage of married females reported their fathers-in-law as having *'excellent'* SAH just like themselves.

2.5.2 Empirical Model

We focus on the sample of married individuals and re-estimate equation (7), omitting the controls for marital status, and including the mother-in-law's SAH ($F^{Moth-in-law}$), father-in-law's SAH ($F^{Fath-in-law}$) and both parents-in-law's SAH ($F^{Moth-in-law}$ and $F^{Fath-in-law}$) as depicted in equations (13), (14) and (15):

$$H_{it} = \beta_0 + \beta_1 Age_{it} + \beta_2 Gender_{it} + \beta_4 SES_{it} + T_t + \beta_6 F^{Moth-in-law} + \nu_{it} \quad (13)$$

$$H_{it} = \beta_0 + \beta_1 Age_{it} + \beta_2 Gender_{it} + \beta_4 SES_{it} + T_t + \beta_7 F_{it}^{Fath-in-law} + \nu_{it} \quad (14)$$

$$H_{it} = \beta_0 + \beta_1 Age_{it} + \beta_2 Gender_{it} + \beta_4 SES_{it} + T_t + \beta_6 F_{it}^{Moth-in-law} + \beta_7 F_{it}^{Fath-in-law} + \nu_{it} \quad (15)$$

We then re-estimate these three equations including controls for the spouse's SAH.

2.5.3 Results for Parents-in-law's Self-Assessed Health

This section presents the results of investigating reporting bias using the GOP model. In Tables 2.21, 2.22 and 2.23, the marginal effects of the individuals' parents' SAH from Section 2.4 are included in order to compare them with the effects of the parents-in-law's SAH on the individual's SAH. All selected results tables are presented in Appendix One. However, the results of SES and demographic characteristics are not shown in the tables but they have all been controlled for in the analysis.

Tables 2.21, 2.22 and 2.23 present the results from estimating equations (13), (14) and (15), respectively, both with and without controlling for the spouse's SAH. The results show that a statistically significant correlation exists between the parents-in-law's SAH and the individual's SAH and these may come from three main factors: for example, being a proxy variable for the spouse's SAH; reporting bias; and/or a shared living environment (e.g., co-residence with mothers-in-law). We expect that the effect of the parents-in-law's SAH on a respondent's SAH will be smaller in the regression with controls for the spouse's SAH than in a regression without controls for the spouse's SAH. In addition, since around 10% of the respondents in our sample co-reside with their parents-in-law, we drop from the sample those married individuals who live with their parents-in-law to particularly focus on the effect of the non-co-residing group on SAH. Therefore, if a statistically significant effect of the parents-in-law's SAH on the respondent's SAH is observed, it can arguably be explained by reporting behaviour.

In Table 2.21, when comparing the marginal effects between the mother-in-law's SAH and the SAH of the respondents' own mothers, the results show that there exists a similar negative effect of the mother's SAH on the individual reporting *'poor'* SAH and in the case of the mother-in-law's SAH on the individual reporting *'poor'* SAH, which may reflect reporting bias. Although it should be acknowledged that the sample used to model the effect of the mothers-in-law's SAH is different to that used to model the effect of the mothers' SAH due to differences in the number of deceased parents and parents-in-law, it is interesting that those individuals who report their mothers-in-law as having *'good'* or *'excellent'* SAH are more likely to report *'excellent'* SAH themselves in the estimation without the spouse's SAH. However, after controlling for the spouse's SAH, such a likelihood is only statistically significant for those individuals whose mothers-in-law are reported as having *'excellent'* SAH as compared to the respondents reporting their own

mother's SAH as *'good'* or *'excellent'*.

The effects of the SAH of the fathers-in-law (equation 14) and fathers are shown in Table 2.22. A statistically significant effect of fathers-in-law's SAH on respondents' SAH is observed in our dataset. For example, compared to individuals who report their fathers-in-law as being in '*poor*' SAH, individuals who report their fathers-in-law as being in '*fair*', '*good*' or '*excellent*' SAH are statistically significantly less likely to report '*poor*' SAH themselves. However, the effect of the father's SAH on an individual's SAH appears to be slightly stronger than the effect of the father-in-law's SAH, which may be due to genetic factors inherited from their father or a shared living environment during childhood. For the category of the individual reporting '*fair*' SAH, the effects are statistically significant regardless of whether the fathers-in-law's SAH is reported as being in any of the categories. Nevertheless, after controlling for the spouse's SAH, this effect is expected to be smaller, but the positive marginal effect is larger for fathers-in-law (being 16.6 percentage points more likely to report '*excellent*' SAH themselves with spouse's SAH included) than the respondents reporting their own father's SAH as *'excellent'* with the spouse's SAH (being 14.8 percentage points more likely to report '*excellent*' SAH themselves). This may be due to reporting behaviour whereby individuals tend to rate the same SAH for their fathers-in-law and for themselves. Focusing on the marginal effect of reporting '*good*' SAH, an inverse association appears for those individuals who report their fathers-in-law as being in '*excellent*' SAH, 8.6 percentage points less, compared to those individuals who report their father-in-law's SAH as being '*poor*'. Once again, by comparing the results between the regressions with and without the spouse's SAH, the sizes of the marginal effects are smaller after adding the spouse's SAH, which is also the case for the analysis of the effect of the mothers-in-law's SAH as discussed above. While there is a statistically significant effect between reporting a father-in-law's SAH as either being '*good*' or *'excellent'* and an individual reporting his or her own SAH as *'good'*, such an effect is only statistically significant for those individuals who report their fathers-in-law's SAH as being *'good'* and report themselves as being in the same category when the spouse's SAH is included. A similar pattern appears in the case of reporting *'excellent'* SAH for themselves as well. The effects of reporting their father-in-law's SAH as either *'good'* or *'excellent'* are statistically significant in the regression without controlling for the spouse's SAH. However, these effects are only statistically significant for those individuals who report

both themselves and their fathers-in-law as being in the *'excellent'* category when controlling for spouse's SAH and this appears to follow the same pattern for respondents reporting their own father's SAH. These findings suggest that married individuals tend to report their fathers-in-law as having the same SAH as themselves, and this may imply that reporting bias exists in terms of there being no common living environment or genetic link between fathers-in-law and the respondents.

It is apparent from Table 2.23 that there are some statistically significant effects of parents-in-law's SAH on the respondent's SAH in the case where both parents-in-law are alive (equation 15). When comparing the marginal effects between the father-in-law's SAH and the SAH of the respondents' own father, for individuals reporting their own SAH as '*poor*', there is only a negative effect from individuals who report their fathers-in-law as being in '*fair*' SAH. The probability of reporting '*excellent*' SAH for themselves increases if the individuals report their fathers-in-law as being in '*excellent*' SAH, however, such an effect is statistically insignificant as compared to the respondents reporting their own father's SAH as *'excellent'*. On the other hand, a statistically significant effect is found when individuals report themselves as being in the *'good'* or *'excellent'* category and their mother-in-law's SAH is reported in the same category. When the spouse's SAH is added, once again, the marginal effects are statistically significant for those respondents who report themselves and their fathers-in-law as being in the *'good'* or *'excellent'* category. In the case where both parents-in-law are alive, the findings suggest a positive correlation between the mothers-in-law's SAH and the individual's own SAH; however, the correlation is moderated with the spouse's SAH included. For the fathers-in-law's SAH, the statistically significant effects are smaller with the spouse's SAH included than without the spouse's SAH, suggesting that the correlations may reflect reporting behaviour.

To summarise, this section aims to shed light on whether there exists reporting bias in the measure for SAH used in the PSFD. In particular, we investigate reporting bias by using an additional piece of information, namely, the parents-in-law's SAH as perceived by respondents. A statistically significant effect of the parents-in-law's SAH on the respondent's SAH has been found in our study after taking the spouse's SAH into account. As expected, the sizes of the marginal effects of the parents-in-law's SAH are smaller than the size of the effects of the respondent's own parents' SAH and the magnitude is

even smaller after controlling for the spouse's SAH. We also found that married individuals tend to report their parents-in-law's SAH as having the same SAH as themselves. For example, the effects of reporting the father-in-law's SAH as either *'good'* or *'excellent'* are statistically significant in the model without the spouse's SAH. However, the effects are only statistically significant when they report themselves and their fathers-in-law as being in the *'excellent'* category after including the spouse's SAH. Based on these results, our investigations of reporting bias suggest that some degree of reporting bias may exist in the PSFD.

2.6 Conclusion

The aim of this chapter has been to explore the determinants of SAH in Taiwan using eight waves (1999-2006) of the Panel Study of Family Dynamics (PSFD). We explore the hypothesis of an intergenerational transmission of health and our chapter makes a potentially important methodological contribution to the Taiwan literature on SAH by relaxing the assumption of constant threshold parameters that is a restriction of the standard ordered probit model. This chapter contributes to the existing studies of Taiwan in three important ways. Firstly, the extant literature on Taiwan is based on cross-sectional data which may lead to bias in the estimation of the determinants of SAH due to the inability to control for unobserved individual-invariant characteristics, e.g., genetic factors. In addition, most existing studies mainly focus on elderly people. In contrast, our findings are based on panel data and are based on a sample that is representative of the national population. Secondly, a generalised ordered probit model (GOP) is employed with robust standard errors and cluster specifications instead of the conventional methods used in the existing studies of Taiwan such as the ordered probit model. This means that GOP model can allow for the SAH thresholds to depend on some or all of the individual characteristics such as age. Thirdly, we provide additional insights into the effects of parents' socio-economic status (SES) and parents' SAH, as perceived by the respondents, on their offspring's SAH. Finally, we analyse the effect of the parents-in-law's SAH on the married individuals' SAH to explore reporting behaviour and we find evidence to suggest that reporting bias may exist in the PSFD.

Our results indicate that married individuals tend to report better SAH than non-married individuals. This finding is consistent with existing studies such as Chi and Hsin (1999) and Jürges (2007). Moreover, a greater negative association between SAH and being

unemployed is observed for married individuals than for the general population. Spouse's SAH is found to have a strong correlation with an individual's SAH. This positive correlation may reflect the fact that both the spouse and the individual share the same environment. For example, they may have the same preferences for eating healthy food and similar lifestyle preferences, which develop in marriage, and may lead to correlations in spousal SAH. Alternatively, these correlations in SAH may be because individuals choose to marry someone with similar characteristics and preferences.

The father's SES appears to have an effect on the offspring's SAH which is also consistent with existing studies such as Trannoy et al. (2010) and Tubeuf and Jusot (2011). This implies that the father's SES has a long-term effect on the offspring's SAH in adulthood. Another possible explanation is that having a father with a higher level of education may lead to a wealthy family during childhood, which may have a positive effect on an individual's SAH (Tubeuf and Jusot, 2011). There is no statistically significant effect of the mother's SES on the married children's SAH, but a negative correlation is found for the sample of both married and non-married individuals.

When we explore the relationship between the parents' SAH and their offspring's SAH, we find a statistically significant influence of parents' current SAH on their adult children's SAH. In accordance with Trannoy et al. (2010), this may emanate from the transmission of the same lifestyle preferences or a common genetic factor within a family. The effect of a mother's SAH is found to be much stronger than that of the father's SAH. However, the effect of a mother's SAH on her offspring's SAH is moderated after controlling for a spouse's SAH. In other words, the mother's SAH has a smaller impact on an individual's SAH than that of a spouse's SAH. These results suggest that, for married individuals, the role of a shared environment may explain the majority of the differences in individuals' SAH.

It should be acknowledged that this study has some limitations. Although we used the GOP model to explore the determinants of SAH, the variations in the influence of these independent variables on 'true' health and on reporting bias cannot be identified. In addition, this chapter uses parents' SAH to explore whether the intergenerational transmission of health exists. Nevertheless, the measurement of the parents' SAH can be criticised, as it is not reported by the respondents' parents but by the respondents themselves. Hence, it would be preferable to have the parents' SAH as reported by the

parents instead. However, the health measure from proxy respondents is known to be reliable in some existing studies (e.g., van der Linden et al., 2008).

To summarise, our study provides evidence that, for married individuals, a spouse's SAH has a stronger influence on an individual's SAH than the SAH of parents. Therefore, our empirical findings suggest that, for married individuals, future studies on the correlation between parents' characteristics and their children's SAH could also consider the role of the spouse's SAH. In addition, the influence of a shared living environment appears to be an important determinant of SAH. These findings suggest that policies focusing on improving people's health could focus on encouraging healthy lifestyles within a family, for example, encouraging family members to do regular exercise together or eating healthy food as a family. This may be an effective way of improving the health of people.

Appendix One

Table 2.1 Descriptive Statistics

Variable	Mean	STD	Min	Max
Sample=All individuals, number of observations:20,607				
Continuous and categorical				
Log household labour income	4.73	3.35	0	12.09
Log household unearned income	0.92	2.17	0	12.53
Household size	3.15	2.19	1	10
Number of children aged 0-7	0.14	0.44	0	4
Number of children aged 8-12	0.20	0.52	0	4
Number of children aged 13-18	0.31	0.66	0	4
Binary (%)				
Health Status (dependent variable)				
Excellent	16.51			
Good	32.37			
Fair	36.56			
Poor/very poor (omitted category)	14.56			
Age groups				
Aged 25-34	10.06			
Aged 35-44	24.72			
Aged 45-54	31.69			
Aged 55-64	24.42			
Aged 65+ (omitted category)	9.11			
Gender				
Male	47.90			
Marital status				
Married	80.24			
Education levels				
No education (omitted category)	8.27			
Secondary or below education	74.06			
University or above education	17.67			
Labour force participation				
Employee	42.48			
Self-employed	22.24			
Unemployed	3.08			
Out of labour market (omitted category)	32.20			
Ethnicity				
Aborigine/other (omitted category)	2.21			
Hokkien	76.81			
Hakka	11.54			
Mainlander	7.80			
Others	2.09			
Resident regions				
Northern	42.09			
Central	14.90			
Southern	33.89			
Missing	0.24			
Eastern (omitted category)	8.88			
Father's education levels				
No education (omitted category)	46.31			
Primary education	34.47			
Secondary education or above	18.89			
Mother's education levels				
No education (omitted category)	63.76			
Primary education	27.86			
Secondary education or above	8.00			
Missing	0.33			
Father's perceived health status				
Excellent	4.74			
Good	10.52			
Fair	13.91			
Poor/very poor (omitted category)	6.88			
Deceased	63.80			
Missing	0.16			
Mother's perceived health status				
Excellent	4.88			
Good	12.75			
Fair	21.09			
Poor/very poor (omitted category)	12.21			
Deceased	48.95			
Missing	0.11			
Sample=Married individuals, number of observations:16,542				
Spouse's perceived health status				
Excellent	15.04			
Good	27.21			
Fair	27.86			
Poor/very poor (omitted category)	10.19			

Table 2.2 Individual's SAH (Sample=All individuals)

	poor	fair	good	excellent
1999	3.70	31.60	41.30	23.40
2000	13.20	30.90	35.50	20.30
2001	13.50	35.10	30.90	20.60
2002	19.00	39.00	29.80	12.10
2003	13.20	30.70	34.40	21.60
2004	15.90	35.60	32.70	15.80
2005	15.60	42.60	29.50	12.30
2006	16.10	45.10	29.60	9.20

Note: Figures denote percentages.

Table 2.3 Parents' SAH (Sample=All individuals)

	Mother's SAH				Father's SAH			
Year	poor	fair	good	excellent	poor	fair	good	excellent
2001	27.50	38.20	23.20	11.20	20.60	35.00	27.50	16.90
2002	29.80	38.40	23.40	8.40	23.30	33.80	32.10	10.90
2004	20.90	39.60	28.10	11.50	16.80	37.20	30.70	15.30
2005	21.60	43.20	25.60	9.60	17.90	41.20	28.10	12.80
2006	22.80	46.40	23.80	7.00	19.10	43.10	27.90	9.90

Note: Figures denote percentages.

Table 2.4 Parents' and Individual's SAH: Cross-Tabulation (Sample=All individuals)

	Mother's SAH				Father's SAH			
Individual's SAH	poor	fair	good	excellent	poor	fair	good	excellent
poor	51.10	31.80	12.70	4.30	44.60	31.50	14.60	9.30
fair	26.80	51.70	16.60	4.90	20.20	49.90	22.60	7.40
good	17.50	37.70	36.80	8.10	14.60	33.60	40.50	11.20
excellent	15.10	30.70	27.70	26.60	12.90	26.10	27.70	33.30

Note: Figures denote percentages.

Table 2.5 Parents' SAH and Individual's SAH by Gender: Cross-Tabulation (Sample=All individuals)

		Mother's SAH				Father's SAH			
Individual's SAH		poor	fair	good	excellent	poor	fair	good	excellent
poor	Male	55.80	29.40	10.40	4.30	48.90	29.00	13.60	8.50
	Female	44.40	35.30	16.00	4.40	36.70	36.10	16.30	10.90
fair	Male	29.50	49.50	15.50	5.50	20.80	50.00	20.90	8.40
	Female	23.90	54.10	17.70	4.30	19.50	49.80	24.50	6.20
good	Male	19.40	36.80	34.90	8.90	16.10	33.80	38.00	12.20
	Female	15.90	38.30	38.40	7.40	13.50	33.50	42.60	10.50
excellent	Male	15.50	31.50	24.70	28.40	12.40	24.20	27.20	36.20
	Female	14.70	30.10	30.10	25.10	13.30	27.70	28.10	30.90

Note: Figures denote percentages.

Table 2.6 Baseline Model, Marginal Effects of the GOP Model (Sample=All individuals)

Dependent variable: SAH	poor	fair	good	excellent
Aged 25-34	-0.071***	-0.026	0.019	0.078***
	(0.01)	(0.024)	(0.023)	(0.024)
Aged 35-44	-0.062***	-0.014	0.039	0.036
	(0.011)	(0.021)	(0.021)	(0.019)
Aged 45-54	-0.023*	0.012	-0.003	0.013
	(0.011)	(0.017)	(0.018)	(0.016)
Aged 55-64	0.011	0.000	-0.018	0.007
	(0.01)	(0.015)	(0.016)	(0.015)
Male	-0.011	-0.031**	0.020*	0.022**
	(0.007)	(0.01)	(0.009)	(0.008)
Married	-0.012	-0.015	0.029*	-0.003
	(0.009)	(0.012)	(0.012)	(0.01)
Number of children aged 0-7	0.003	0.003	0.004	-0.009
	(0.01)	(0.012)	(0.011)	(0.008)
Number of children aged 8-12	-0.013	0.016	-0.007	0.005
	(0.008)	(0.01)	(0.009)	(0.007)
Number of children aged 13-18	0.006	-0.012	-0.002	0.009
	(0.005)	(0.008)	(0.007)	(0.005)
Education: secondary	-0.088***	-0.060***	0.079***	0.069***
	(0.013)	(0.015)	(0.015)	(0.014)
Education: university+	-0.101***	-0.128***	0.107***	0.122***
	(0.009)	(0.021)	(0.021)	(0.025)
Household size	-0.005***	0.001	0.003	0.002
	(0.001)	(0.002)	(0.002)	(0.002)
Employed	-0.071***	0.005	0.050***	0.015
	(0.008)	(0.012)	(0.012)	(0.009)
Self-employed	-0.049***	-0.013	0.039**	0.023*
	(0.007)	(0.013)	(0.013)	(0.011)
Unemployed	0.025	0.044*	-0.031	-0.037*
	(0.014)	(0.022)	(0.022)	(0.015)
Ethnic origin: Hokkien	-0.054**	-0.011	0.036	0.029
	(0.017)	(0.021)	(0.02)	(0.019)
Ethnic origin: Hakka	-0.064***	-0.043	0.049*	0.058*
	(0.011)	(0.025)	(0.024)	(0.026)
Ethnic origin: Mainlander	-0.067***	-0.053	0.053*	0.067*
	(0.012)	(0.028)	(0.026)	(0.029)
Log labour income	-0.005***	-0.002	0.004**	0.004**
	(0.001)	(0.002)	(0.001)	(0.001)
Log unearned income	0.000	0.002	-0.002	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Region: North	-0.042***	0.004	0.021	0.017
	(0.012)	(0.017)	(0.015)	(0.013)
Region: South	0.000	0.034*	-0.004	-0.030*
	(0.012)	(0.017)	(0.015)	(0.013)
Region: Middle	-0.026*	-0.021	0.053**	-0.006
	(0.013)	(0.019)	(0.018)	(0.015)
Year 2000	0.025	-0.048*	0.003	0.02
	(0.018)	(0.022)	(0.019)	(0.013)
Year 2001	0.042*	-0.011	-0.051**	0.02
	(0.019)	(0.023)	(0.018)	(0.013)
Year 2002	0.098***	0.023	-0.064***	-0.057***
	(0.023)	(0.025)	(0.018)	(0.01)
Year 2003	0.058**	-0.045*	-0.025	0.012
	(0.019)	(0.023)	(0.018)	(0.013)
Year 2004	0.096***	-0.008	-0.052**	-0.036**
	(0.022)	(0.025)	(0.018)	(0.011)
Year 2005	0.087***	0.069**	-0.087***	-0.069***
	(0.022)	(0.025)	(0.017)	(0.01)
Year 2006	0.087***	0.090***	-0.083***	-0.094***
	(0.022)	(0.025)	(0.017)	(0.009)

Number of Observations: 20,607 Wald Chi2(90)=1862.45 p=0.000

Notes: (1)***p<0.001, **p<0.01, *p<0.05 (2) Standard errors in parentheses. (3) Omitted categories: Aged over 65; Female; Single; No education; Unemployed; Aborigine and other group; Eastern area; Poor health status.

Table 2.7 Marginal Effects of the GOP Model (Sample=Married individuals)

Dependent variable: SAH	poor	fair	good	excellent
Aged 25-34	-0.067***	-0.030	0.018	0.078**
	(0.012)	(0.029)	(0.030)	(0.029)
Aged 35-44	-0.060***	-0.014	0.045	0.029
	(0.013)	(0.025)	(0.025)	(0.022)
Aged 45-54	-0.024*	0.015	0.005	0.003
	(0.012)	(0.020)	(0.021)	(0.018)
Aged 55-64	0.015	0.007	-0.018	-0.004
	(0.011)	(0.018)	(0.018)	(0.017)
Male	-0.012	-0.043***	0.025*	0.030***
	(0.008)	(0.011)	(0.010)	(0.009)
Number of children aged 0-7	0.004	0.003	0.006	-0.013
	(0.010)	(0.013)	(0.012)	(0.008)
Number of children aged 8-12	-0.018*	0.019	-0.005	0.005
	(0.008)	(0.011)	(0.009)	(0.007)
Number of children aged 13-18	0.006	-0.014	-0.001	0.009
	(0.006)	(0.008)	(0.007)	(0.006)
Education: secondary	-0.101***	-0.073***	0.084***	0.090***
	(0.015)	(0.017)	(0.018)	(0.016)
Education: university+	-0.104***	-0.138***	0.094***	0.148***
	(0.008)	(0.023)	(0.025)	(0.031)
Household size	-0.000**	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Employed	-0.070***	0.010	0.047***	0.013
	(0.008)	(0.013)	(0.013)	(0.010)
Self-employed	-0.048***	-0.002	0.032*	0.018
	(0.008)	(0.014)	(0.014)	(0.011)
Unemployed	0.010	0.068**	-0.040	-0.039*
	(0.015)	(0.025)	(0.026)	(0.018)
Ethnic origin: Hokkien	-0.062**	-0.008	0.044	0.026
	(0.019)	(0.025)	(0.023)	(0.023)
Ethnic origin: Hakka	-0.061***	-0.031	0.046	0.046
	(0.012)	(0.029)	(0.027)	(0.030)
Ethnic origin: Mainlander	-0.065***	-0.062	0.068*	0.059
	(0.013)	(0.033)	(0.031)	(0.035)
Log labour income	-0.004***	-0.003	0.003	0.004***
	(0.001)	(0.002)	(0.002)	(0.001)
Log unearned income	0.000	0.001	-0.002	0.002
	(0.001)	(0.002)	(0.002)	(0.002)
Region: North	-0.037**	-0.007	0.030	0.014
	(0.013)	(0.020)	(0.018)	(0.016)
Region: South	0.006	0.030	-0.004	-0.033*
	(0.014)	(0.020)	(0.018)	(0.015)
Region: Middle	-0.020	-0.023	0.057**	-0.013
	(0.014)	(0.022)	(0.020)	(0.017)
Year 2000	0.019	-0.048*	0.012	0.017
	(0.018)	(0.024)	(0.020)	(0.014)
Year 2001	0.035	-0.019	-0.040*	0.025
	(0.019)	(0.025)	(0.020)	(0.014)
Year 2002	0.085***	0.033	-0.060**	-0.058***
	(0.023)	(0.027)	(0.019)	(0.011)
Year 2003	0.047*	-0.047	-0.013	0.012
	(0.020)	(0.025)	(0.020)	(0.014)
Year 2004	0.087***	-0.008	-0.043*	-0.036**
	(0.023)	(0.026)	(0.019)	(0.012)
Year 2005	0.082***	0.082**	-0.092***	-0.072***
	(0.023)	(0.026)	(0.019)	(0.011)
Year 2006	0.072**	0.100***	-0.076***	-0.096***
	(0.023)	(0.027)	(0.019)	(0.011)

Number of Observations: 16,542 Wald Chi2 (87)=1468.63 p=0.000

Notes: (1)***p<0.001, **p<0.005, *p<0.05 (2) Standard errors in parentheses. (3) Omitted categories: Aged over 65; Female; Single; No education; Unemployed; Aborigine and other group; Eastern area; Poor health status.

Table 2.8 Marginal Effects of the GOP Model (Sample=Married individuals with spouse's SAH)

Dependent variable: SAH	poor	fair	good	excellent
Aged 25-34	-0.035*	0.032	-0.033	0.037
	(0.016)	(0.031)	(0.029)	(0.024)
Aged 35-44	-0.038**	0.011	0.018	0.009
	(0.014)	(0.025)	(0.025)	(0.018)
Aged 45-54	-0.013	0.004	-0.001	0.009
	(0.011)	(0.020)	(0.021)	(0.016)
Aged 55-64	0.016	0.000	-0.026	0.010
	(0.011)	(0.018)	(0.019)	(0.015)
Male	-0.007	-0.038***	0.017	0.029***
	(0.007)	(0.011)	(0.011)	(0.008)
Number of children aged 0-7	0.011	0.011	-0.006	-0.016*
	(0.010)	(0.013)	(0.012)	(0.007)
Number of children aged 8-12	-0.014	0.018	-0.005	0.002
	(0.008)	(0.011)	(0.010)	(0.007)
Number of children aged 13-18	0.004	-0.012	-0.001	0.008
	(0.005)	(0.008)	(0.007)	(0.005)
Education: secondary	-0.084***	-0.071***	0.087***	0.068***
	(0.014)	(0.018)	(0.018)	(0.015)
Education: university+	-0.089***	-0.116***	0.101***	0.104***
	(0.009)	(0.024)	(0.025)	(0.027)
Household size	-0.000*	0.000	0.000	0.000
	0.000	0.000	0.000	0.000
Employed	-0.072***	-0.008	0.063***	0.016
	(0.008)	(0.013)	(0.013)	(0.009)
Self-employed	-0.050***	-0.010	0.042**	0.017
	(0.007)	(0.014)	(0.014)	(0.010)
Unemployed	0.009	0.069**	-0.038	-0.040**
	(0.014)	(0.026)	(0.026)	(0.015)
Ethnic origin:Hokkien	-0.048**	0.016	0.019	0.012
	(0.018)	(0.025)	(0.024)	(0.022)
Ethnic origin:Hakka	-0.044***	0.017	0.010	0.017
	(0.013)	(0.030)	(0.028)	(0.027)
Ethnic origin:Mainlander	-0.055***	-0.024	0.048	0.030
	(0.014)	(0.033)	(0.031)	(0.030)
Log labour income	-0.001	0.001	-0.001	0.001
	(0.001)	(0.002)	(0.002)	(0.001)
Log unearned income	-0.001	-0.001	0.000	0.001
	(0.001)	(0.002)	(0.002)	(0.002)
Region: North	-0.030*	-0.021	0.032	0.019
	(0.012)	(0.019)	(0.018)	(0.014)
Region: South	0.005	0.004	0.005	-0.014
	(0.013)	(0.019)	(0.018)	(0.013)
Region: Middle	-0.012	-0.041	0.058**	-0.005
	(0.014)	(0.022)	(0.021)	(0.015)
Year 2000	0.034	-0.021	-0.007	-0.006
	(0.020)	(0.025)	(0.021)	(0.013)
Year 2001	0.039	0.010	-0.043*	-0.006
	(0.020)	(0.026)	(0.021)	(0.012)
Year 2002	0.076***	0.048	-0.065**	-0.059***
	(0.023)	(0.027)	(0.020)	(0.010)
Year 2003	-0.034*	-0.083***	0.055*	0.061***
	(0.014)	(0.023)	(0.023)	(0.017)
Year 2004	0.079***	0.008	-0.045*	-0.043***
	(0.022)	(0.027)	(0.020)	(0.011)
Year 2005	0.067**	0.090***	-0.091***	-0.066***
	(0.022)	(0.027)	(0.020)	(0.010)
Year 2006	0.061**	0.082**	-0.072***	-0.072***
	(0.022)	(0.028)	(0.021)	(0.011)
Spouse health:fair	-0.088***	0.122***	-0.016	-0.018
	(0.006)	(0.014)	(0.014)	(0.010)
Spouse health:good	-0.124***	-0.214***	0.317***	0.021
	(0.006)	(0.013)	(0.014)	(0.012)
Spouse health:excellent	-0.108***	-0.311***	0.007	0.413***
	(0.005)	(0.011)	(0.017)	(0.019)

Number of Observations: 16,542 Wald Chi2(96)=4029.95 p=0.000

Notes:(1)***p<0.001, **p<0.005, *p<0.05 (2) Standard errors in parentheses. (3) Omitted categories: Aged over 65; Female; Single; No education; Unemployed; Aborigine and other group; Eastern area; Poor health status.

Table 2.9 Marginal Effects of the GOP Model (Sample=All individuals whose mothers are alive)

Dependent variable: SAH	poor	fair	good	excellent
Aged 25-34	-0.051***	0.057	-0.043	0.037
	(0.014)	(0.056)	(0.056)	(0.055)
Aged 35-44	-0.051**	0.062	-0.014	0.003
	(0.018)	(0.051)	(0.052)	(0.049)
Aged 45-54	-0.036*	0.082	-0.057	0.011
	(0.018)	(0.048)	(0.050)	(0.048)
Aged 55-64	-0.018	0.026	-0.005	-0.003
	(0.017)	(0.048)	(0.051)	(0.048)
Male	-0.007	-0.059***	0.036*	0.030**
	(0.008)	(0.016)	(0.015)	(0.011)
Married	-0.028*	-0.028	0.025	0.031*
	(0.012)	(0.021)	(0.020)	(0.014)
Number of children aged 0-7	0.012	0.013	-0.006	-0.018
	(0.009)	(0.016)	(0.016)	(0.012)
Number of children aged 8-12	-0.011	0.015	-0.011	0.007
	(0.007)	(0.014)	(0.013)	(0.009)
Number of children aged 13-18	0.007	-0.009	-0.008	0.010
	(0.005)	(0.011)	(0.010)	(0.008)
Education: Secondary	-0.055**	-0.090*	0.092*	0.053
	(0.021)	(0.042)	(0.042)	(0.032)
Education: University+	-0.066***	-0.146**	0.123**	0.089
	(0.014)	(0.046)	(0.046)	(0.046)
Household size	-0.005**	0.005	0.000	0.000
	(0.002)	(0.004)	(0.004)	(0.003)
Employed	-0.043***	-0.013	0.055*	0.002
	(0.011)	(0.022)	(0.023)	(0.017)
Self-employed	-0.020*	0.033	0.003	-0.016
	(0.010)	(0.024)	(0.023)	(0.018)
Unemployed	0.043*	0.043	-0.031	-0.054**
	(0.020)	(0.034)	(0.034)	(0.021)
Ethnic origin:Hokkien	-0.024	-0.039	0.091*	-0.028
	(0.023)	(0.041)	(0.037)	(0.035)
Ethnic origin:Hakka	-0.039**	-0.083	0.134***	-0.012
	(0.015)	(0.046)	(0.040)	(0.034)
Ethnic origin:Mainlander	-0.040*	-0.098*	0.115**	0.023
	(0.016)	(0.048)	(0.043)	(0.041)
Log labour income	-0.004**	-0.004	0.005	0.003
	(0.001)	(0.003)	(0.003)	(0.002)
Log unearned income	-0.001	0.003	-0.003	0.001
	(0.001)	(0.003)	(0.003)	(0.002)
Region: North	-0.036**	0.046	-0.010	0.001
	(0.014)	(0.027)	(0.026)	(0.020)
Region: South	-0.015	0.091**	-0.026	-0.051**
	(0.013)	(0.028)	(0.027)	(0.019)
Region: Middle	-0.033**	-0.001	0.032	0.002
	(0.012)	(0.030)	(0.029)	(0.023)
Year 2002	0.026*	0.068***	-0.012	-0.082***
	(0.010)	(0.019)	(0.018)	(0.010)
Year 2004	0.033**	0.025	0.006	-0.064***
	(0.011)	(0.019)	(0.018)	(0.011)
Year 2005	0.009	0.111***	-0.028	-0.092***
	(0.011)	(0.019)	(0.018)	(0.010)
Year 2006	0.024*	0.109***	-0.020	-0.113***
	(0.012)	(0.022)	(0.020)	(0.011)
Mother education:primary	-0.004	0.031	-0.013	-0.014
	(0.009)	(0.018)	(0.017)	(0.013)
Mother education:secondary+	-0.004	0.088**	-0.047	-0.037*
	(0.016)	(0.028)	(0.025)	(0.017)
Mother health:fair	-0.054***	0.003	0.035*	0.016
	(0.007)	(0.017)	(0.017)	(0.014)
Mother health:good	-0.066***	-0.230***	0.219***	0.078***
	(0.007)	(0.017)	(0.019)	(0.017)
Mother health:excellent	-0.065***	-0.278***	-0.023	0.367***
	(0.006)	(0.019)	(0.025)	(0.029)

Number of Observations: 6,866 Wald Chi2 (96)=1237.54 p=0.000

Notes:(1)***p<0.001, **p<0.005, *p<0.05 (2) Standard errors in parentheses. (3) Omitted categories: Aged over 65; Female; Single; No education; Unemployed; Aborigine and other group; Eastern area; Poor health status.

Table 2.10 Marginal Effects of the GOP Model (Sample=Married individuals whose mothers are alive)

Dependent variable: SAH	poor	fair	good	excellent
Aged 25-34	-0.042**	0.086	-0.058	0.015
	(0.016)	(0.065)	(0.068)	(0.063)
Aged 35-44	-0.047*	0.092	-0.029	-0.016
	(0.022)	(0.059)	(0.064)	(0.057)
Aged 45-54	-0.037	0.116*	-0.067	-0.011
	(0.022)	(0.055)	(0.061)	(0.056)
Aged 55-64	-0.016	0.046	-0.015	-0.014
	(0.020)	(0.055)	(0.061)	(0.054)
Male	-0.004	-0.074***	0.044**	0.034*
	(0.009)	(0.018)	(0.017)	(0.013)
Number of children aged 0-7	0.006	0.016	-0.005	-0.017
	(0.009)	(0.017)	(0.018)	(0.013)
Number of children aged 8-12	-0.011	0.010	-0.008	0.009
	(0.008)	(0.015)	(0.014)	(0.010)
Number of children aged 13-18	0.006	-0.009	-0.009	0.012
	(0.006)	(0.012)	(0.011)	(0.009)
Education: Secondary	-0.078**	-0.092*	0.095*	0.075*
	(0.025)	(0.043)	(0.048)	(0.037)
Education: University+	-0.073***	-0.150**	0.113*	0.110
	(0.013)	(0.048)	(0.057)	(0.058)
Household size	-0.006**	0.009*	-0.001	-0.001
	(0.002)	(0.004)	(0.004)	(0.003)
Employed	-0.043***	-0.017	0.059*	0.000
	(0.011)	(0.024)	(0.024)	(0.018)
Self-employed	-0.023*	0.037	0.006	-0.020
	(0.010)	(0.026)	(0.025)	(0.019)
Unemployed	0.033	0.059	-0.044	-0.047
	(0.021)	(0.038)	(0.039)	(0.025)
Ethnic origin:Hokkien	-0.036	-0.036	0.088*	-0.015
	(0.026)	(0.045)	(0.041)	(0.039)
Ethnic origin:Hakka	-0.042**	-0.057	0.107*	-0.008
	(0.014)	(0.052)	(0.045)	(0.039)
Ethnic origin:Mainlander	-0.044**	-0.098	0.102*	0.040
	(0.015)	(0.054)	(0.049)	(0.048)
Log labour income	-0.003	-0.006	0.004	0.004
	(0.002)	(0.004)	(0.004)	(0.003)
Log unearned income	-0.001	0.001	-0.002	0.003
	(0.001)	(0.003)	(0.003)	(0.002)
Region: North	-0.034*	0.032	0.003	-0.002
	(0.015)	(0.031)	(0.028)	(0.024)
Region: South	-0.005	0.090**	-0.029	-0.056*
	(0.015)	(0.032)	(0.029)	(0.022)
Region: Middle	-0.033*	-0.008	0.041	-0.001
	(0.013)	(0.035)	(0.032)	(0.027)
Year 2002	0.025*	0.077***	-0.013	-0.089***
	(0.011)	(0.021)	(0.020)	(0.011)
Year 2004	0.030*	0.024	0.015	-0.069***
	(0.012)	(0.021)	(0.020)	(0.012)
Year 2005	0.009	0.129***	-0.039*	-0.099***
	(0.012)	(0.022)	(0.020)	(0.011)
Year 2006	0.016	0.121***	-0.021	-0.115***
	(0.013)	(0.025)	(0.023)	(0.012)
Mother education:primary	-0.003	0.036	-0.010	-0.022
	(0.010)	(0.020)	(0.019)	(0.014)
Mother education:secondary+	0.009	0.084**	-0.046	-0.047*
	(0.020)	(0.032)	(0.029)	(0.019)
Mother health:fair	-0.048***	0.007	0.026	0.016
	(0.008)	(0.019)	(0.019)	(0.015)
Mother health:good	-0.057***	-0.235***	0.213***	0.078***
	(0.007)	(0.019)	(0.021)	(0.019)
Mother health:excellent	-0.058***	-0.284***	-0.050	0.391***
	(0.007)	(0.020)	(0.028)	(0.033)

Number of Observations: 5,504 Wald Chi2 (93)=1061.67 p=0.000

Notes:(1)***p<0.001, **p<0.005, *p<0.05 (2) Standard errors in parentheses. (3) Omitted categories: Aged over 65; Female; Single; No education; Unemployed; Aborigine and other group; Eastern area; Poor health status.

Table 2.11 Marginal Effects of the GOP Model (Sample=Married individuals whose mothers are alive with spouse's SAH)

Dependent variable: SAH	poor	fair	good	excellent
Aged 25-34	-0.041**	0.140*	-0.117	0.018
	(0.015)	(0.067)	(0.070)	(0.055)
Aged 35-44	-0.044*	0.163**	-0.097	-0.023
	(0.021)	(0.062)	(0.066)	(0.048)
Aged 45-54	-0.039	0.157**	-0.122	0.003
	(0.021)	(0.058)	(0.063)	(0.048)
Aged 55-64	-0.026	0.078	-0.068	0.016
	(0.017)	(0.058)	(0.066)	(0.052)
Male	-0.003	-0.061***	0.037*	0.028*
	(0.009)	(0.018)	(0.017)	(0.012)
Number of children aged 0-7	0.006	0.013	-0.009	-0.011
	(0.009)	(0.017)	(0.017)	(0.011)
Number of children aged 8-12	-0.010	0.004	-0.007	0.013
	(0.007)	(0.015)	(0.014)	(0.009)
Number of children aged 13-18	0.004	-0.005	-0.012	0.013
	(0.005)	(0.012)	(0.011)	(0.008)
Education: Secondary	-0.069**	-0.105*	0.122*	0.053
	(0.023)	(0.046)	(0.049)	(0.035)
Education: University+	-0.067***	-0.151**	0.147**	0.070
	(0.012)	(0.050)	(0.056)	(0.052)
Household size	-0.005**	0.008	-0.002	-0.001
	(0.002)	(0.004)	(0.004)	(0.003)
Employed	-0.039***	-0.030	0.070**	-0.001
	(0.011)	(0.025)	(0.025)	(0.017)
Self-employed	-0.025**	0.026	0.013	-0.014
	(0.010)	(0.027)	(0.026)	(0.018)
Unemployed	0.043*	0.054	-0.052	-0.045
	(0.022)	(0.040)	(0.040)	(0.023)
Ethnic origin:Hokkien	-0.014	-0.016	0.070	-0.040
	(0.023)	(0.051)	(0.044)	(0.040)
Ethnic origin:Hakka	-0.028	-0.021	0.082	-0.033
	(0.017)	(0.058)	(0.049)	(0.033)
Ethnic origin:Mainlander	-0.031	-0.053	0.086	-0.002
	(0.018)	(0.059)	(0.051)	(0.040)
Log labour income	-0.001	-0.001	0.000	0.002
	(0.002)	(0.004)	(0.004)	(0.003)
Log unearned income	-0.002	-0.001	0.001	0.001
	(0.001)	(0.003)	(0.003)	(0.002)
Region: North	-0.029*	0.015	0.001	0.013
	(0.014)	(0.031)	(0.029)	(0.022)
Region: South	-0.005	0.060	-0.026	-0.029
	(0.014)	(0.032)	(0.030)	(0.021)
Region: Middle	-0.027*	-0.025	0.036	0.017
	(0.013)	(0.035)	(0.034)	(0.026)
Year 2002	0.025*	0.060**	-0.023	-0.062***
	(0.012)	(0.022)	(0.021)	(0.011)
Year 2004	0.035**	0.008	0.009	-0.051***
	(0.013)	(0.022)	(0.021)	(0.011)
Year 2005	0.008	0.107***	-0.042*	-0.073***
	(0.012)	(0.023)	(0.021)	(0.011)
Year 2006	0.017	0.071**	-0.022	-0.067***
	(0.013)	(0.026)	(0.025)	(0.013)
Spouse health:fair	-0.071***	0.049	0.023	-0.001
	(0.009)	(0.029)	(0.027)	(0.022)
Spouse health:good	-0.095***	-0.260***	0.330***	0.025
	(0.010)	(0.025)	(0.026)	(0.024)
Spouse health:excellent	-0.071***	-0.341***	0.025	0.387***
	(0.007)	(0.023)	(0.033)	(0.038)
Mother education:primary	-0.001	0.051*	-0.024	-0.025*
	(0.009)	(0.020)	(0.019)	(0.012)
Mother education:secondary+	0.013	0.085**	-0.061*	-0.037*
	(0.019)	(0.032)	(0.028)	(0.018)
Mother health:fair	-0.039***	0.014	0.014	0.010
	(0.008)	(0.019)	(0.019)	(0.013)
Mother health:good	-0.043***	-0.171***	0.171***	0.043**
	(0.007)	(0.021)	(0.022)	(0.016)
Mother health:excellent	-0.048***	-0.184***	0.038	0.194***
	(0.007)	(0.026)	(0.029)	(0.031)

Number of Observations: 5,504 Wald Chi2 (102)=1974.16 p=0.000

Notes:(1)***p<0.001, **p<0.005, *p<0.05 (2) Standard errors in parentheses. (3) Omitted categories: Aged over 65; Female; Single; No education; Unemployed; Aborigine and other group; Eastern area; Poor health status.

Table 2.12 Marginal Effects of the GOP Model (Sample=All individuals whose fathers are alive)

Dependent variable: SAH	poor	fair	good	excellent
Aged 25-34	-0.055**	-0.045	-0.028	0.128
	(0.019)	(0.072)	(0.099)	(0.092)
Aged 35-44	-0.072**	-0.037	0.031	0.077
	(0.027)	(0.069)	(0.090)	(0.075)
Aged 45-54	-0.052*	-0.034	-0.008	0.093
	(0.025)	(0.067)	(0.090)	(0.078)
Aged 55-64	-0.034	-0.056	-0.010	0.101
	(0.019)	(0.069)	(0.098)	(0.092)
Male	-0.028**	-0.071***	0.063***	0.035**
	(0.009)	(0.019)	(0.018)	(0.013)
Married	-0.020	-0.019	0.035	0.005
	(0.014)	(0.025)	(0.023)	(0.017)
Number of children aged 0-7	0.010	0.011	0.004	-0.026*
	(0.010)	(0.018)	(0.018)	(0.013)
Number of children aged 8-12	0.000	0.000	-0.008	0.008
	(0.008)	(0.016)	(0.016)	(0.011)
Number of children aged 13-18	0.005	-0.017	-0.004	0.016
	(0.006)	(0.014)	(0.012)	(0.009)
Education: Secondary	-0.026	-0.022	0.063	-0.015
	(0.022)	(0.049)	(0.047)	(0.040)
Education: University+	-0.043*	-0.055	0.096	0.002
	(0.018)	(0.054)	(0.050)	(0.042)
Household size	-0.007**	-0.003	0.005	0.005
	(0.003)	(0.005)	(0.004)	(0.003)
Employed	-0.032**	0.023	0.011	-0.001
	(0.011)	(0.027)	(0.028)	(0.019)
Self-employed	-0.016	0.051	-0.016	-0.020
	(0.010)	(0.028)	(0.028)	(0.020)
Unemployed	0.030	0.066	-0.043	-0.054*
	(0.021)	(0.043)	(0.044)	(0.024)
Ethnic origin:Hokkien	-0.012	0.016	0.023	-0.028
	(0.035)	(0.062)	(0.058)	(0.049)
Ethnic origin:Hakka	-0.033	-0.060	0.096	-0.003
	(0.024)	(0.068)	(0.061)	(0.048)
Ethnic origin:Mainlander	-0.034	-0.086	0.099	0.021
	(0.024)	(0.069)	(0.062)	(0.054)
Log labour income	-0.003	-0.003	0.003	0.003
	(0.002)	(0.004)	(0.004)	(0.003)
Log unearned income	-0.002	0.007*	-0.006	0.001
	(0.002)	(0.003)	(0.003)	(0.002)
Region: North	-0.030	0.034	-0.011	0.007
	(0.016)	(0.036)	(0.032)	(0.023)
Region: South	-0.012	0.059	0.002	-0.048*
	(0.016)	(0.036)	(0.033)	(0.022)
Region: Middle	-0.033*	-0.004	0.040	-0.003
	(0.014)	(0.039)	(0.036)	(0.025)
Year 2002	0.009	0.058*	0.003	-0.070***
	(0.011)	(0.023)	(0.022)	(0.012)
Year 2004	0.012	0.004	0.034	-0.050***
	(0.011)	(0.022)	(0.022)	(0.014)
Year 2005	-0.008	0.079***	0.009	-0.081***
	(0.010)	(0.023)	(0.022)	(0.013)
Year 2006	-0.001	0.083**	0.014	-0.095***
	(0.012)	(0.026)	(0.025)	(0.014)
Father education:primary	-0.007	-0.040	0.041	0.005
	(0.010)	(0.023)	(0.022)	(0.017)
Father education:secondary+	-0.009	-0.005	0.014	0.000
	(0.012)	(0.027)	(0.025)	(0.020)
Father health:fair	-0.055***	0.047*	0.018	-0.011
	(0.009)	(0.022)	(0.021)	(0.016)
Father health:good	-0.072***	-0.158***	0.199***	0.031
	(0.008)	(0.022)	(0.023)	(0.019)
Father health:excellent	-0.053***	-0.245***	0.010	0.289***
	(0.007)	(0.022)	(0.028)	(0.031)

Number of Observations: 4,876 Wald Chi2(96)=840.93 p=0.000

Notes: (1)***p<0.001, **p<0.005, *p<0.05 (2) Standard errors in parentheses. (3) Omitted categories: Aged over 65; Female; Single; No education; Unemployed; Aborigine and other group; Eastern area; Poor health status.

Table 2.13 Marginal Effects of the GOP Model (Sample=Married individuals whose fathers are alive)

Dependent variable: SAH	poor	fair	good	excellent
Aged 25-34	-0.032	-0.029	-0.073	0.134
	(0.021)	(0.082)	(0.122)	(0.111)
Aged 35-44	-0.053*	-0.022	-0.002	0.078
	(0.026)	(0.078)	(0.105)	(0.085)
Aged 45-54	-0.036	-0.013	-0.031	0.080
	(0.024)	(0.075)	(0.105)	(0.087)
Aged 55-64	-0.012	-0.029	-0.063	0.104
	(0.022)	(0.073)	(0.113)	(0.105)
Male	-0.021*	-0.105***	0.077***	0.049**
	(0.010)	(0.021)	(0.020)	(0.015)
Number of children aged 0-7	0.006	0.013	0.011	-0.030*
	(0.010)	(0.020)	(0.019)	(0.014)
Number of children aged 8-12	-0.001	-0.002	-0.001	0.003
	(0.008)	(0.017)	(0.017)	(0.011)
Number of children aged 13-18	0.002	-0.014	-0.004	0.015
	(0.007)	(0.015)	(0.013)	(0.010)
Education: Secondary	-0.031	-0.017	0.069	-0.022
	(0.025)	(0.048)	(0.048)	(0.045)
Education: University+	-0.042*	-0.039	0.089	-0.009
	(0.019)	(0.055)	(0.053)	(0.046)
Household size	-0.008**	0.002	0.002	0.004
	(0.003)	(0.005)	(0.005)	(0.004)
Employed	-0.032**	0.028	0.017	-0.012
	(0.012)	(0.029)	(0.030)	(0.021)
Self-employed	-0.021	0.068*	-0.021	-0.027
	(0.011)	(0.031)	(0.031)	(0.022)
Unemployed	0.025	0.075	-0.050	-0.051
	(0.023)	(0.048)	(0.049)	(0.028)
Ethnic origin:Hokkien	-0.010	0.017	0.030	-0.036
	(0.043)	(0.071)	(0.058)	(0.057)
Ethnic origin:Hakka	-0.029	-0.037	0.085	-0.019
	(0.030)	(0.076)	(0.062)	(0.052)
Ethnic origin:Mainlander	-0.031	-0.084	0.103	0.012
	(0.029)	(0.077)	(0.065)	(0.060)
Log labour income	-0.001	-0.004	-0.001	0.006
	(0.002)	(0.004)	(0.005)	(0.004)
Log unearned income	-0.002	0.006	-0.005	0.001
	(0.002)	(0.004)	(0.004)	(0.003)
Region: North	-0.026	0.010	0.016	0.000
	(0.019)	(0.044)	(0.036)	(0.027)
Region: South	-0.008	0.041	0.024	-0.058*
	(0.018)	(0.044)	(0.037)	(0.025)
Region: Middle	-0.032*	-0.018	0.061	-0.010
	(0.016)	(0.046)	(0.040)	(0.029)
Year 2002	0.005	0.071**	-0.004	-0.072***
	(0.012)	(0.025)	(0.024)	(0.013)
Year 2004	0.001	0.006	0.049*	-0.055***
	(0.011)	(0.024)	(0.024)	(0.015)
Year 2005	-0.020	0.101***	0.003	-0.084***
	(0.010)	(0.025)	(0.024)	(0.014)
Year 2006	-0.012	0.089**	0.013	-0.090***
	(0.012)	(0.028)	(0.028)	(0.016)
Father education:primary	-0.013	-0.028	0.031	0.009
	(0.011)	(0.026)	(0.025)	(0.019)
Father education:secondary+	-0.009	0.015	0.005	-0.010
	(0.013)	(0.030)	(0.028)	(0.021)
Father health:fair	-0.047***	0.054*	0.003	-0.010
	(0.009)	(0.024)	(0.023)	(0.018)
Father health:good	-0.067***	-0.153***	0.194***	0.026
	(0.008)	(0.024)	(0.026)	(0.021)
Father health:excellent	-0.045***	-0.248***	-0.014	0.306***
	(0.008)	(0.025)	(0.032)	(0.035)
Number of Observations: 3,848 Wald Chi2(93)=692.79 p=0.000				

Notes: (1)***p<0.001, **p<0.005, *p<0.05 (2) Standard errors in parentheses. (3) Omitted categories: Aged over 65; Female; Single; No education; Unemployed; Aborigine and other group; Eastern area; Poor health status.

Table 2.14 Marginal Effects of the GOP model (Sample=Married individuals whose fathers are alive with spouse's SAH)

Dependent variable: SAH	poor	fair	good	excellent
Aged 25-34	-0.024	0.084	-0.131	0.070
	(0.023)	(0.086)	(0.114)	(0.102)
Aged 35-44	-0.042	0.105	-0.081	0.018
	(0.027)	(0.082)	(0.101)	(0.081)
Aged 45-54	-0.034	0.072	-0.083	0.045
	(0.025)	(0.079)	(0.101)	(0.084)
Aged 55-64	-0.011	0.065	-0.139	0.085
	(0.023)	(0.078)	(0.109)	(0.104)
Male	-0.018	-0.087***	0.064**	0.041**
	(0.009)	(0.021)	(0.020)	(0.014)
Number of children aged 0-7	0.005	0.004	0.008	-0.017
	(0.010)	(0.019)	(0.019)	(0.012)
Number of children aged 8-12	-0.002	-0.009	0.003	0.008
	(0.008)	(0.018)	(0.017)	(0.010)
Number of children aged 13-18	0.000	-0.007	-0.008	0.015
	(0.007)	(0.015)	(0.014)	(0.010)
Education: Secondary	-0.027	-0.011	0.075	-0.037
	(0.023)	(0.047)	(0.049)	(0.040)
Education: University+	-0.036*	-0.025	0.090	-0.029
	(0.018)	(0.055)	(0.054)	(0.037)
Household size	-0.006**	0.001	0.001	0.004
	(0.002)	(0.006)	(0.005)	(0.003)
Employed	-0.030**	0.006	0.031	-0.007
	(0.011)	(0.030)	(0.030)	(0.020)
Self-employed	-0.019	0.044	-0.007	-0.018
	(0.010)	(0.032)	(0.031)	(0.021)
Unemployed	0.037	0.067	-0.059	-0.045
	(0.025)	(0.050)	(0.051)	(0.026)
Ethnic origin:Hokkien	-0.006	-0.001	0.029	-0.022
	(0.037)	(0.071)	(0.055)	(0.046)
Ethnic origin:Hakka	-0.023	-0.030	0.060	-0.007
	(0.028)	(0.075)	(0.060)	(0.045)
Ethnic origin:Mainlander	-0.021	-0.091	0.103	0.009
	(0.030)	(0.075)	(0.063)	(0.051)
Log labour income	0.000	0.005	-0.008	0.002
	(0.002)	(0.004)	(0.005)	(0.003)
Log unearned income	-0.002	0.003	-0.001	0.000
	(0.002)	(0.004)	(0.004)	(0.003)
Region: North	-0.026	0.010	0.008	0.008
	(0.019)	(0.042)	(0.038)	(0.026)
Region: South	-0.011	0.043	0.008	-0.040
	(0.018)	(0.043)	(0.039)	(0.024)
Region: Middle	-0.029	-0.007	0.039	-0.003
	(0.016)	(0.046)	(0.043)	(0.028)
Year 2002	0.005	0.060*	-0.015	-0.050***
	(0.012)	(0.026)	(0.025)	(0.013)
Year 2004	0.005	-0.003	0.035	-0.038**
	(0.011)	(0.026)	(0.026)	(0.014)
Year 2005	-0.020*	0.084**	-0.005	-0.059***
	(0.010)	(0.026)	(0.026)	(0.014)
Year 2006	-0.013	0.054	0.005	-0.046**
	(0.012)	(0.030)	(0.030)	(0.017)
Spouse health:fair	-0.047***	0.099**	-0.022	-0.031
	(0.009)	(0.034)	(0.034)	(0.022)
Spouse health:good	-0.086***	-0.219***	0.310***	-0.005
	(0.011)	(0.030)	(0.032)	(0.024)
Spouse health:excellent	-0.056***	-0.326***	0.048	0.335***
	(0.008)	(0.028)	(0.038)	(0.042)
Father education:primary	-0.005	-0.010	0.022	-0.007
	(0.010)	(0.026)	(0.026)	(0.016)
Father education:secondary+	-0.006	0.028	-0.009	-0.013
	(0.012)	(0.030)	(0.029)	(0.019)
Father health:fair	-0.044***	0.034	0.013	-0.002
	(0.009)	(0.024)	(0.024)	(0.017)
Father health:good	-0.055***	-0.120***	0.156***	0.019
	(0.008)	(0.026)	(0.026)	(0.018)
Father health:excellent	-0.039***	-0.156***	0.046	0.148***
	(0.008)	(0.030)	(0.031)	(0.030)

Number of Observations: 3,848 Wald Chi2(102)=1445.55 p=0.000

Notes: (1)***p<0.001, **p<0.005, *p<0.05 (2) Standard errors in parentheses. (3) Omitted categories: Aged over 65; Female; Single; No education; Unemployed; Aborigine and other group; Eastern area; Poor health status.

Table 2.15 Marginal Effects of the GOP Model (Sample=All individuals whose parents are both alive)

Dependent variable: SAH	poor	fair	good	excellent
Aged 25-34	-0.054**	0.152	-0.125	0.027
	(0.017)	(0.110)	(0.120)	(0.100)
Aged 35-44	-0.066*	0.162	-0.077	-0.019
	(0.027)	(0.106)	(0.116)	(0.092)
Aged 45-54	-0.053**	0.177	-0.133	0.008
	(0.020)	(0.105)	(0.115)	(0.094)
Aged 55-64	-0.039***	0.094	-0.051	-0.004
	(0.011)	(0.117)	(0.123)	(0.094)
Male	-0.023**	-0.072***	0.058**	0.038*
	(0.009)	(0.021)	(0.020)	(0.015)
Married	-0.015	-0.036	0.037	0.013
	(0.013)	(0.028)	(0.026)	(0.019)
Number of children aged 0-7	0.007	0.023	-0.002	-0.028*
	(0.009)	(0.020)	(0.020)	(0.013)
Number of children aged 8-12	-0.006	0.011	-0.013	0.008
	(0.007)	(0.017)	(0.017)	(0.011)
Number of children aged 13-18	0.004	-0.003	-0.014	0.014
	(0.006)	(0.016)	(0.014)	(0.011)
Education: Secondary	0.018	-0.043	0.038	-0.013
	(0.021)	(0.092)	(0.083)	(0.062)
Education: University+	-0.001	-0.073	0.06	0.015
	(0.025)	(0.093)	(0.084)	(0.064)
Household size	-0.005*	0.000	0.001	0.005
	(0.002)	(0.005)	(0.005)	(0.004)
Employed	-0.027*	0.004	0.03	-0.007
	(0.012)	(0.032)	(0.033)	(0.023)
Self-employed	-0.015	0.043	-0.003	-0.025
	(0.011)	(0.035)	(0.034)	(0.024)
Unemployed	0.016	0.019	-0.002	-0.033
	(0.020)	(0.052)	(0.054)	(0.033)
Ethnic origin:Hokkien	-0.054	-0.015	0.084	-0.015
	(0.039)	(0.077)	(0.074)	(0.063)
Ethnic origin:Hakka	-0.044***	-0.125	0.158*	0.011
	(0.012)	(0.080)	(0.072)	(0.066)
Ethnic origin:Mainlander	-0.043***	-0.124	0.142	0.025
	(0.012)	(0.082)	(0.075)	(0.071)
Log labour income	-0.002	-0.004	0.002	0.004
	(0.002)	(0.005)	(0.005)	(0.004)
Log unearned income	-0.002	0.005	-0.003	0.000
	(0.001)	(0.003)	(0.002)	(0.002)
Region: North	-0.023	0.038	-0.032	0.017
	(0.015)	(0.041)	(0.038)	(0.027)
Region: South	-0.006	0.061	-0.018	-0.036
	(0.015)	(0.042)	(0.039)	(0.025)
Region: Middle	-0.028*	-0.015	0.031	0.012
	(0.012)	(0.044)	(0.042)	(0.030)
Year 2002	0.015	0.057*	0.005	-0.077***
	(0.013)	(0.028)	(0.027)	(0.014)
Year 2004	0.021	0.005	0.028	-0.054***
	(0.013)	(0.026)	(0.026)	(0.016)
Year 2005	-0.006	0.081**	0.005	-0.079***
	(0.011)	(0.027)	(0.026)	(0.016)
Year 2006	0.000	0.098***	0.004	-0.102***
	(0.012)	(0.028)	(0.027)	(0.015)
Father education:primary	0.001	-0.093**	0.056	0.036
	(0.012)	(0.030)	(0.029)	(0.022)
Father education:secondary+	0.003	-0.090*	0.042	0.045
	(0.014)	(0.036)	(0.035)	(0.027)
Mother education:primary	-0.002	0.069*	-0.016	-0.051**
	(0.010)	(0.028)	(0.027)	(0.018)
Mother education:secondary+	0.008	0.122**	-0.058	-0.072***
	(0.018)	(0.038)	(0.036)	(0.020)
Father health:fair	-0.036***	0.031	0.023	-0.019
	(0.009)	(0.028)	(0.027)	(0.022)
Father health:good	-0.040***	-0.086**	0.111***	0.016
	(0.010)	(0.032)	(0.033)	(0.027)
Father health:excellent	-0.016	-0.121**	0.06	0.077*
	(0.015)	(0.043)	(0.045)	(0.038)
Mother health:fair	-0.039***	0.011	0.021	0.007
	(0.009)	(0.028)	(0.027)	(0.022)
Mother health:good	-0.053***	-0.143***	0.167***	0.028
	(0.009)	(0.031)	(0.034)	(0.029)
Mother health:excellent	-0.052***	-0.211***	-0.01	0.274***
	(0.007)	(0.039)	(0.048)	(0.050)

Number of Observations: 3,899 Wald Chi2(111) =824.44 p=0.000

Notes:(1)***p<0.01, **p<0.05, *p<0.1 (2) Standard errors in parentheses. (3) Omitted categories: Aged over 65; Female; Single; No education; Unemployed; Aborigine and other group; Eastern area; Poor health status.

Table 2.16 Marginal Effects of the GOP Model (Sample=Married individuals whose parents are both alive)

Dependent variable: SAH	poor	fair	good	excellent
Aged 25-34	-0.049***	0.196	-0.18	0.037
	0.014)	(0.10)	(0.154)	(0.138)
Aged 35-44	0.072*	0.216	-0.134	-0.01
	(0.032)	(0.130)	(0.145)	(0.123)
Aged 45-54	-0.059**	0.234	-0.183	0.008
	(0.021)	(0.125)	(0.143)	(0.124)
Aged 55-64	-0.037**	0.124	-0.098	0.01
	(0.012)	(0.129)	(0.148)	(0.127)
Male	-0.021*	-0.099***	0.072**	0.048**
	-0.01	-0.024	-0.023	-0.017
Number of children aged 0-7	0.001	0.022	0.004	-0.028
	(0.009)	(0.021)	(0.021)	(0.014)
Number of children aged 8-12	-0.005	0.004	-0.004	0.005
	(0.007)	(0.019)	(0.018)	(0.012)
Number of children aged 13-18	0.001	-0.006	-0.009	0.014
	(0.006)	(0.017)	(0.015)	(0.012)
Education: Secondary	0.003	-0.054	0.039	0.012
	(0.028)	(0.080)	(0.088)	(0.070)
Education: University+	-0.012	-0.072	0.05	0.034
	(0.028)	(0.083)	(0.093)	(0.079)
Household size	-0.005*	0.005	-0.002	0.002
	(0.002)	(0.006)	(0.006)	(0.004)
Employed	-0.025*	0.01	0.025	-0.01
	(0.012)	(0.035)	(0.036)	(0.025)
Self-employed	-0.012	0.061	-0.02	-0.029
	(0.012)	(0.039)	(0.038)	(0.026)
Unemployed	0.042	0.041	-0.039	-0.045
	(0.027)	(0.059)	(0.062)	(0.036)
Ethnic origin:Hokkien	-0.041	0.002	0.088	-0.05
	(0.047)	(0.088)	(0.074)	(0.072)
Ethnic origin:Hakka	-0.038*	-0.075	0.143*	-0.031
	(0.017)	(0.088)	(0.073)	(0.060)
Ethnic origin:Mainlander	-0.038*	-0.099	0.143	-0.006
	(0.017)	(0.089)	(0.077)	(0.069)
Log labour income	0.000	-0.007	0.001	0.006
	(0.002)	(0.005)	(0.006)	(0.004)
Log unearned income	-0.002	0.002	-0.003	0.002
	(0.001)	(0.003)	(0.003)	(0.002)
Region: North	-0.025	0.027	-0.009	0.007
	(0.017)	(0.050)	(0.042)	(0.031)
Region: South	-0.005	0.05	0.000	-0.045
	(0.016)	(0.050)	(0.044)	(0.029)
Region: Middle	-0.032*	-0.025	0.051	0.006
	(0.013)	(0.052)	(0.046)	(0.035)
Year 2002	0.012	0.059*	0.007	-0.078***
	(0.013)	(0.030)	(0.030)	(0.016)
Year 2004	0.01	0.005	0.05	-0.065***
	(0.013)	(0.029)	(0.029)	(0.017)
Year 2005	-0.011	0.101***	-0.004	-0.086***
	(0.012)	(0.030)	(0.029)	(0.017)
Year 2006	-0.011	0.102**	0.005	-0.096***
	(0.011)	(0.031)	(0.031)	(0.017)
Father education:primary	-0.001	-0.083*	0.04	0.043
	(0.012)	(0.034)	(0.033)	(0.024)
Father education:secondary+	0.000	-0.078	0.032	0.046
	(0.015)	(0.041)	(0.040)	(0.030)
Mother education:primary	0.003	0.069*	-0.003	-0.069***
	(0.011)	(0.032)	(0.030)	(0.020)
Mother education:secondary+	0.026	0.133**	-0.066	-0.093***
	(0.024)	(0.046)	(0.043)	(0.021)
Father health:fair	-0.028**	0.038	0.012	-0.023
	(0.010)	(0.031)	(0.030)	(0.024)
Father health:good	-0.042***	-0.066	0.113**	-0.005
	(0.010)	(0.036)	(0.037)	(0.030)
Father health:excellent	-0.016	-0.123*	0.055	0.083
	(0.015)	(0.048)	(0.052)	(0.045)
Mother health:fair	-0.040***	0.017	0.019	0.004
	(0.010)	(0.032)	(0.031)	(0.025)
Mother health:good	-0.041***	-0.152***	0.154***	0.039
	(0.010)	(0.036)	(0.039)	(0.032)
Mother health:excellent	-0.044***	-0.229***	-0.021	0.294 **
	(0.008)	(0.043)	(0.057)	(0.059)

Number of Observations: 3,033 Wald Chi2(108) =686.2 p=0.000

Notes:(1)***p<0.001, **p<0.01, *p<0.05 (2) Standard errors in parentheses. (3) Omitted categories: Aged over 65; Female; Single; No education; Unemployed; Aborigine and other group; Eastern area; Poor health status.

Table 2.17 Marginal Effects of the GOP Model (Sample=Married individuals whose parents are both alive with spouse's SAH)

Dependent variable: SAH	poor	fair	good	excellent
Aged 25-34	-0.048**	0.336**	-0.341*	0.053
	(0.015)	(0.126)	(0.155)	(0.111)
Aged 35-44	-0.072*	0.384**	-0.307*	-0.005
	(0.034)	(0.131)	(0.146)	(0.092)
Aged 45-54	-0.062**	0.355**	-0.333*	0.040
	(0.023)	(0.127)	(0.148)	(0.098)
Aged 55-64	-0.039***	0.243	-0.273	0.069
	(0.011)	(0.130)	(0.164)	(0.119)
Male	-0.017	-0.083***	0.061**	0.038*
	(0.010)	(0.024)	(0.023)	(0.016)
Number of children aged 0-7	0.003	0.009	0.002	-0.014
	(0.008)	(0.020)	(0.021)	(0.013)
Number of children aged 8-12	-0.006	-0.006	0.001	0.011
	(0.007)	(0.019)	(0.019)	(0.011)
Number of children aged 13-18	-0.001	-0.005	-0.009	0.015
	(0.006)	(0.017)	(0.015)	(0.011)
Education: Secondary	0.002	-0.062	0.081	-0.021
	(0.024)	(0.072)	(0.090)	(0.066)
Education: University+	-0.012	-0.072	0.097	-0.013
	(0.025)	(0.075)	(0.090)	(0.064)
Household size	-0.005	0.006	-0.002	0.001
	(0.002)	(0.006)	(0.006)	(0.004)
Employed	-0.023	0.005	0.029	-0.011
	(0.012)	(0.036)	(0.036)	(0.024)
Self-employed	-0.012	0.053	-0.018	-0.022
	(0.012)	(0.040)	(0.038)	(0.025)
Unemployed	0.051	0.046	-0.064	-0.033
	(0.030)	(0.059)	(0.061)	(0.034)
Ethnic origin:Hokkien	-0.035	0.028	0.071	-0.064
	(0.041)	(0.088)	(0.070)	(0.055)
Ethnic origin:Hakka	-0.036*	-0.039	0.114	-0.039
	(0.016)	(0.087)	(0.073)	(0.041)
Ethnic origin:Mainlander	-0.033*	-0.045	0.117	-0.039
	(0.017)	(0.090)	(0.078)	(0.043)
Log labour income	0.001	0.003	-0.005	0.002
	(0.002)	(0.006)	(0.006)	(0.004)
Log unearned income	-0.002	0.004	-0.001	0.000
	(0.002)	(0.004)	(0.004)	(0.003)
Region: North	-0.024	0.016	-0.008	0.015
	(0.017)	(0.049)	(0.044)	(0.030)
Region: South	-0.007	0.039	-0.009	-0.023
	(0.016)	(0.050)	(0.046)	(0.030)
Region: Middle	-0.030*	-0.018	0.031	0.017
	(0.013)	(0.053)	(0.049)	(0.035)
Year 2002	0.013	0.056	-0.013	-0.055***
	(0.013)	(0.030)	(0.030)	(0.015)
Year 2003	0.009	0.004	0.032	-0.046**
	(0.012)	(0.029)	(0.029)	(0.016)
Year 2004	-0.014	0.097**	-0.019	-0.064***
	(0.011)	(0.031)	(0.030)	(0.016)
Year 2006	-0.010	0.064	-0.001	-0.053**
	(0.012)	(0.034)	(0.035)	(0.020)
Spouse health:fair	-0.045***	0.070	-0.044	0.019
	(0.010)	(0.042)	(0.042)	(0.031)
Spouse health:good	-0.072***	-0.242***	0.272***	0.043
	(0.012)	(0.037)	(0.040)	(0.032)
Spouse health:excellent	-0.044***	-0.334***	-0.026	0.404***
	(0.009)	(0.033)	(0.049)	(0.053)
Father education:primary	0.007	-0.076*	0.041	0.029
	(0.012)	(0.033)	(0.033)	(0.022)
Father education:secondary+	0.003	-0.078	0.031	0.044
	(0.015)	(0.041)	(0.042)	(0.028)
Mother education:primary	0.002	0.074*	-0.021	-0.056**
	(0.011)	(0.032)	(0.030)	(0.018)
Mother education:secondary+	0.030	0.126**	-0.081	-0.075***
	(0.025)	(0.046)	(0.044)	(0.020)
Father health:fair	-0.027**	0.012	0.037	-0.021
	(0.010)	(0.033)	(0.031)	(0.022)
Father health:good	-0.032**	-0.066	0.111**	-0.013
	(0.010)	(0.037)	(0.038)	(0.025)
Father health:excellent	-0.013	-0.063	0.078	-0.002
	(0.014)	(0.054)	(0.053)	(0.032)
Mother health:fair	-0.030**	0.018	-0.001	0.013
	(0.010)	(0.033)	(0.032)	(0.022)
Mother health:good	-0.036***	-0.101**	0.101*	0.036
	(0.010)	(0.038)	(0.041)	(0.029)
Mother health:excellent	-0.042***	-0.159**	-0.020	0.221***
	(0.008)	(0.052)	(0.061)	(0.057)

Number of Observations: 3,033 Wald Chi2(117)=1237.24 p=0.000

Notes:(1)***p<0.001, **p<0.01, *p<0.05 (2) Standard errors in parentheses. (3) Omitted categories: Aged over 65; Female; Single; No education; Unemployed; Aborigine and other group; Eastern area; Poor health status.

Table 2.18 Parents-in-law's SAH (Sample=Married individuals)

	Mother-in-law's SAH				Father-in-law's SAH			
Year	poor	fair	good	excellent	poor	fair	good	excellent
2001	32.80	33.40	23.86	9.94	16.90	38.73	23.24	21.13
2002	32.70	37.55	21.08	8.63	27.08	34.72	25.69	12.50
2004	29.10	40.33	22.28	8.29	23.13	36.25	30.63	10.00
2005	28.85	41.15	20.58	9.42	33.33	41.67	18.06	6.94
2006	30.39	44.35	21.15	4.11	32.35	41.18	17.65	8.82

Note: Figures denote percentages

Table 2.19 Parents-in-law's and Individual's SAH: Cross-Tabulation (Sample=Married individuals)

	Mother-in-law's SAH				Father-in-law's SAH			
Individual's SAH	poor	fair	good	excellent	poor	fair	good	excellent
poor	49.85	28.83	15.02	6.31	55.84	25.97	11.69	6.49
fair	33.50	45.99	14.87	5.65	25.18	48.58	16.31	9.93
good	23.27	38.19	31.98	6.56	25.71	35.51	31.84	6.94
excellent	22.70	33.51	23.78	20.00	12.30	28.69	29.51	29.51

Note: Figures denote percentages

Table 2.20 Parents-in-law's SAH by Gender: Cross-Tabulation (Sample=Married individuals)

Individual's SAH		Mothers-in-law's SAH				Fathers-in-law's SAH			
		poor	fair	good	excellent	poor	fair	good	excellent
poor	Male	48.92	29.03	17.74	4.30	56.10	29.27	12.20	2.44
	Female	51.02	28.57	11.56	8.84	55.56	22.22	11.11	11.11
fair	Male	34.13	47.70	14.57	3.59	28.68	55.15	11.76	4.41
	Female	32.87	44.29	15.16	7.68	21.92	42.47	20.55	15.07
good	Male	23.19	40.43	30.21	6.17	29.33	38.00	26.00	6.67
	Female	23.37	35.33	34.24	7.07	20.00	31.58	41.05	7.37
excellent	Male	25.33	33.78	23.56	17.33	16.18	30.88	29.41	23.53
	Female	18.62	33.10	24.14	24.14	7.41	25.93	29.63	37.04

Note: Figures denote percentages

Table 2.21 Marginal Effects of the GOP Model (Mother/Mother-in-law is alive)

Dependent variable: SAH				
Married individual's SAH				
	poor	fair	good	excellent
Mother's SAH (Sample=Married individuals whose mothers are alive)				
fair	-0.048***	0.007	0.026	0.016
	(0.008)	(0.019)	(0.019)	(0.015)
good	-0.057***	-0.235***	0.213***	0.078***
	(0.007)	(0.019)	(0.021)	(0.019)
excellent	-0.058***	-0.284***	-0.050	0.391***
	(0.007)	(0.020)	(0.028)	(0.033)
Number of Observations: 5,504 Wald chi2(93)=1061.67 p=0.00				
Mother's SAH (Sample=Married individuals whose mothers are alive with spouse's SAH)				
fair	-0.039***	0.014	0.014	0.010
	(0.008)	(0.019)	(0.019)	(0.013)
good	-0.043***	-0.171***	0.171***	0.043***
	(0.007)	(0.021)	(0.022)	(0.016)
excellent	-0.048***	-0.184***	0.038	0.194***
	(0.007)	(0.026)	(0.029)	(0.031)
Number of Observations: 5,504 Wald chi2(102)=1974.16 p=0.00				
Mother-in-law's SAH (Sample=Married individuals whose mothers-in-law are alive)				
fair	-0.047***	-0.002	0.029	0.020
	(0.009)	(0.020)	(0.019)	(0.016)
good	-0.057***	-0.193***	0.200***	0.051**
	(0.009)	(0.019)	(0.021)	(0.018)
excellent	-0.043***	-0.228***	-0.037	0.308***
	(0.010)	(0.024)	(0.028)	(0.034)
Number of Observations: 4,864 Wald chi2(87)=743.43 p=0.00				
Mother-in-law's SAH (Sample=Married individuals whose mothers-in-law are alive with spouse's SAH)				
fair	-0.030***	0.006	0.017	0.007
	(0.009)	(0.021)	(0.020)	(0.015)
good	-0.036***	-0.119***	0.142***	0.013
	(0.009)	(0.022)	(0.022)	(0.016)
excellent	-0.025*	-0.109***	0.019	0.114***
	(0.012)	(0.030)	(0.028)	(0.029)
Number of Observations: 4,864 Wald chi2(96)=1588.36 p=0.00				

Notes: (1)***p<0.001, **p<0.005, *p<0.05 (2) Standard errors in parentheses. (3) Controls for: Aged groups; Gender; Marital status; Education; Labour market status; Ethnic groups; Regional dummy; Spouse's SAH. (4) Omitted categories: Aged over 65; Female; Single; No education; Unemployed; Aborigine and other group; Eastern area; Poor health status.

Table 2.22 Marginal Effects of the GOP Model (Father/Father-in-law is alive)

Dependent variable: SAH				
Married individual's SAH				
	poor	fair	good	excellent
Father's SAH (Sample=Married individuals whose fathers are alive)				
fair	-0.047***	0.054*	0.003	-0.010
	(0.009)	(0.024)	(0.023)	(0.018)
good	-0.067***	-0.153***	0.194***	0.026
	(0.008)	(0.024)	(0.026)	(0.021)
excellent	-0.045***	-0.248***	-0.014	0.306***
	(0.007)	(0.025)	(0.032)	(0.035)
Number of Observations: 3,848 Wald chi2(93)=692.79 p=0.00				
Father's SAH (Sample=Married individuals whose fathers are alive with spouse's SAH)				
fair	-0.044***	0.034	0.013	-0.002
	(0.009)	(0.024)	(0.024)	(0.017)
good	-0.055***	-0.120***	0.156***	0.019
	(0.008)	(0.026)	(0.026)	(0.018)
excellent	-0.039***	-0.156***	0.046	0.148***
	(0.008)	(0.030)	(0.031)	(0.030)
Number of Observations: 3,848 Wald chi2(102)=1445.55 p=0.00				
Father-in-law's SAH (Sample=Married individuals whose fathers-in-law are alive)				
fair	-0.047***	0.054*	-0.037	0.030
	(0.010)	(0.026)	(0.025)	(0.021)
good	-0.053***	-0.188***	0.180***	0.061*
	(0.009)	(0.025)	(0.028)	(0.024)
excellent	-0.043***	-0.229***	-0.086*	0.358***
	(0.008)	(0.028)	(0.035)	(0.041)
Number of Observations: 3,352 Wald chi2(87)=554.68 p=0.00				
Father-in-law's SAH (Sample=Married individuals whose fathers-in-law are alive with spouse's SAH)				
fair	-0.038***	0.065*	-0.049	0.022
	(0.010)	(0.027)	(0.028)	(0.021)
good	-0.036***	-0.099***	0.103***	0.032
	(0.009)	(0.028)	(0.030)	(0.022)
excellent	-0.028**	-0.080*	-0.059	0.166***
	(0.010)	(0.037)	(0.038)	(0.037)
Number of Observations: 3,352 Wald chi2(96)=1152.76 p=0.00				

Notes: (1)***p<0.001, **p<0.005, *p<0.05 (2) Standard errors in parentheses. (3) Controls for: Aged groups; Gender; Marital status; Education; Labour market status; Ethnic groups; Regional dummy; Spouse's SAH. (4) Omitted categories: Aged over 65; Female; Single; No education; Unemployed; Aborigine and other group; Eastern area; Poor health status.

Table 2.23 Marginal Effects of the GOP Model (Parents/Parents-in-law are both alive)

Dependent variable: SAH				
Married individual's SAH	poor	fair	good	excellent
Father's SAH (Sample=Married individuals whose parents are both alive)				
fair	-0.028**	0.038	0.012	-0.023
	(0.010)	(0.031)	(0.030)	(0.024)
good	-0.042***	-0.066	0.113**	-0.005
	(0.010)	(0.036)	(0.037)	(0.030)
excellent	-0.016	-0.123*	0.055	0.083
	(0.015)	(0.048)	(0.052)	(0.045)
Mother's SAH				
fair	-0.040***	0.017	0.019	0.004
	(0.010)	(0.032)	(0.031)	(0.025)
good	-0.041***	-0.152***	0.154***	0.039
	(0.010)	(0.036)	(0.039)	(0.032)
excellent	-0.044***	-0.229***	-0.021	0.294**
	(0.008)	(0.043)	(0.057)	(0.059)
Number of Observations: 3,033	Wald chi2(108)=686.2	p=0.00		
Father's SAH(Sample=Married individuals whose parents are both alive with spouse's SAH)				
fair	-0.027**	0.012	0.037	-0.021
	(0.010)	(0.033)	(0.031)	(0.022)
good	-0.032**	-0.066	0.111**	-0.013
	(0.010)	(0.037)	(0.038)	(0.025)
excellent	-0.013	-0.063	0.078	-0.002
	(0.014)	(0.054)	(0.053)	(0.032)
Mother's SAH				
fair	-0.030**	0.018	-0.001	0.013
	(0.010)	(0.033)	(0.032)	(0.022)
good	-0.036***	-0.101**	0.101*	0.036
	(0.010)	(0.038)	(0.041)	(0.029)
excellent	-0.042***	-0.159**	-0.020	0.221***
	(0.008)	(0.052)	(0.061)	(0.057)
Number of Observations: 3,033	Wald chi2(117)=1237.24	p=0.00		
Father-in-law's SAH (Sample=Married individuals whose parents-in-law are both alive)				
fair	-0.033**	0.049	-0.032	0.015
	(0.012)	(0.033)	(0.032)	(0.026)
good	-0.020	-0.132***	0.141***	0.011
	(0.013)	(0.036)	(0.038)	(0.031)
excellent	-0.024	-0.196***	-0.001	0.222***
	(0.018)	(0.047)	(0.059)	(0.063)
Mother-in-law's SAH				
fair	-0.023*	-0.037	0.033	0.028
	(0.011)	(0.031)	(0.031)	(0.027)
good	-0.045***	-0.117***	0.102**	0.060
	(0.012)	(0.034)	(0.037)	(0.034)
excellent	-0.025	-0.111*	-0.011	0.148*
	(0.019)	(0.053)	(0.059)	(0.062)
Number of Observations: 2,726	Wald chi2(96)=491.84	p=0.00		
Father-in-law's SAH (Sample=Married individuals whose parents-in-law are both alive with spouse's SAH)				
fair	-0.029*	0.045	-0.028	0.012
	(0.011)	(0.035)	(0.034)	(0.025)
good	-0.011	-0.081*	0.088*	0.004
	(0.013)	(0.038)	(0.040)	(0.029)
excellent	-0.014	-0.101	-0.008	0.123*
	(0.021)	(0.054)	(0.058)	(0.055)
Mother-in-law's SAH				
fair	-0.013	-0.015	0.022	0.006
	(0.011)	(0.034)	(0.033)	(0.026)
good	-0.032**	-0.060	0.071	0.020
	(0.012)	(0.038)	(0.039)	(0.031)
excellent	-0.017	-0.036	0.022	0.031
	(0.021)	(0.058)	(0.055)	(0.046)
Number of Observations: 2,726	Wald chi2(105)=1013.01	p=0.00		

Notes: (1)***p<0.001, **p<0.005, *p<0.05 (2) Standard errors in parentheses. (3) Controls for: Aged groups; Gender; Marital status; Education; Labour market status; Ethnic groups; Regional dummy; Spouse's SAH. (4) Omitted categories: Aged over 65; Female; Single; No education; Unemployed; Aborigine and other group; Eastern area; Poor health status.

Appendix Two

Robustness: Random Effects Ordered Probit Model

The random effects ordered probit model (REOP) is an alternative approach for the analysis of panel data for ordered responses, such as SAH. In order to explore the robustness of the findings presented in this chapter, all equations in Section 2.3.4 are re-estimated using the REOP model and the empirical findings are presented in Table 2.24.

We explore the panel structure of the data and include individual random effects for the latent health variable H_{it}^{*} (Greene and Hensher, 2010), which is defined as follows:

$$H_{it}^{*} = \alpha' X_{it} + \varepsilon_{it} \qquad i = 1,2,...N; \quad t = 1,2,...8 \tag{16}$$

The error term ε_{it} is decomposed into two independent terms $\varepsilon_{it} = \nu_i + \eta_{it}$, where ν_i represents the individual random effects that do not vary over time, i.e., the unobserved individual characteristics, and η_{it} is the pure error term. The two error components are with mean zero, $E(\nu) = E(\eta) = 0$, and with variances σ^2 for ν_i and 1 for η_{it}, respectively. The ν_i are independent of the η_{it} for all t, and the η_{it} are assumed to be uncorrelated with a set of explanatory variables, X_{it}, which includes age, gender, marital status, the number of children, education, household size, employment, ethnicity, household income and region of residence. We also include the time effects as year dummy variables. H_{it}^{*} represents the unobserved 'true' level of health for individual i at time t and, therefore, the observed individual's SAH (H_{it}) is used as the dependent variable. In this case, a response to the SAH question lies in category j ($H_{it} = j$) if $\mu_{j-1} < H_{it}^{*} \leq \mu_j$, where μ_j is a set of unknown thresholds and j equals the number of ordered categories of SAH:

$$\begin{aligned}
H_{it} &= 0 \quad \text{(poor/very poor)} && \text{if } H_{it}^{*} \leq \mu_0 \\
H_{it} &= 1 \quad \text{(fair)} && \text{if } \mu_0 < H_{it}^{*} \leq \mu_1 \\
H_{it} &= 2 \quad \text{(good)} && \text{if } \mu_1 < H_{it}^{*} \leq \mu_2 \\
H_{it} &= 3 \quad \text{(excellent)} && \text{if } \mu_2 < H_{it}^{*}
\end{aligned} \tag{17}$$

Since the η_{it} are assumed to be normally distributed, $N(0,1)$, then the probability of an

individual i choosing the j^{th} category will be given by the following:

$$\Pr(H_{it} = j) = \Phi(\mu_j - \alpha' X_{it} - \nu_i) - \Phi(\mu_{j-1} - \alpha' X_{it} - \nu_i) \quad (18)$$

where $\Phi(\cdot)$ represents the cumulative standard normal distribution. However, as mentioned earlier, there is individual heterogeneity in the latent variable equation meaning that the individual effect (ν_i) cannot be separately identified from an individual-specific cut-point.[14] Previous work (see, e.g., Contoyannis et al., 2004) has attempted to control for these unobserved individuals effects by implementing the random effects estimator. Under the assumption of $\nu_i = \sigma\theta_i$ where θ_i is standard normally distributed, then the unobserved individual effects can then be integrated out using the log-likelihood function (Greene and Hensher, 2010):

$$\ln L = \sum_{i=1}^{N} \ln \int_{-\infty}^{+\infty} \prod_{t=1}^{T} \left[\Phi\left(\mu_j - \alpha' X_{it} - \sigma\theta_i\right) - \left(\mu_{j-1} - \alpha' X_{it} - \sigma\theta_i\right) \right] \phi(\theta_i) d\theta_i \quad (19)$$

where $\phi(\theta_i)$ is the standard normal density and, then, the method of Gauss-Hermite quadrature can be used to approximate the integrals.

Results

In the main text, the GOP model has been employed to allow for the thresholds of SAH to vary across individual characteristics. However, the GOP model does not include an objective health status or vignettes approach to adjust for the possibility of reporting bias in our study, which means that the estimated results can not separately identify the differences in reporting behaviour from genuine differences in latent health status. Therefore, the robustness of the results from the GOP model is explored by implementing a model allowing for individual unobserved heterogeneity[15], namely, Gaussian random effects (Greene and Hensher, 2010). All equations in Section 2.3.4 are re-estimated using the REOP model, and are presented in Table 2.24. The magnitude of the effects of individuals for the GOP model and the estimated coefficients for the random effects model are compared in this section.

In Table 2.24, the baseline model is shown in column (1); columns (2) and (3) show the

[14] This means that only the difference between the thresholds and the individual unobserved effect can be identified (van Doorslaer and Jones, 2003).

[15] In contrast, the GOP model was used with robust standard errors corrected for clustering within individuals.

findings for the sample of married individuals with and without their spouse's SAH, respectively; columns (4), (5) and (6) present the results for the sample of individuals whose mothers are alive for all individuals and married individuals only, with and without the spouse's SAH, respectively. We then re-estimate the models for those individuals whose fathers are alive (see columns (7), (8) and (9)) and the models where both of the individual's parents are alive (see columns (10) to (12)).

In the baseline model, in column (1), most of the findings are similar to the findings obtained using the GOP model. For example, the statistically significant positive relationships between all age categories and SAH are observed in the REOP model and a negative relationship with reporting *'poor'* SAH appears in the GOP model. Education has a statistically significant positive influence on SAH in both models, which suggests that the higher the level of education, the greater the likelihood of reporting better SAH. In addition, there is no statistically significant effect found for the number of children in either model. Being employed or self-employed is associated with being more likely to report being in better SAH. Although the same signs are observed for the marginal effects for these variables across the two models, the coefficients for the REOP model are larger than the marginal effects in the GOP model.

For married individuals, see columns (2) and (3), being male is positively correlated with SAH in both the REOP and GOP models. Chen et al.'s (2008) study provides evidence that there are different reporting behaviours between genders when reporting their SAH, but from the results in the REOP and GOP models, the empirical analysis presented in this chapter may go a step further in providing evidence to suggest that, for married individuals, there are gender differences in reporting behaviour. Married men are more likely to report better SAH than married women. With the exception of gender, the other estimated effects are found to be similar to the findings of the GOP model. A positive correlation is found if individuals are aged 45 to 54 compared to those in the over 65 group in the REOP model; however, this result is statistically insignificant in the GOP model after controlling for the spouse's SAH. In the GOP model, individuals living in the south of Taiwan are associated with a 3.3 percentage point lower likelihood of reporting *'excellent'* SAH themselves, but this effect is statistically insignificant in the REOP model. Turning to the spouse's SAH, this has a statistically significant influence on the respondent's SAH in the REOP model, but the effects of the spouse's SAH on the respondent's SAH are larger than the effects in the GOP model.

Turning to the models that focus on the sample of individuals whose mothers are alive, in columns (4), (5) and (6), for those relating to the education variables in the REOP model, individuals with a secondary or university and higher education are more likely to report better SAH which is consistent with the results in the GOP model, in the case of those individuals whose mothers are alive, or those married individuals whose mothers are alive either with the spouse's SAH or without the spouse's SAH included. On the contrary, the age categories are not statistically significant in any of the cases in the REOP model but they are statistically significant in the GOP model. This may be evidence of individuals from different age groups providing different assessments of health which is consistent with the study by Lindeboom and Doorslaer (2004). The regional dummy variables are statistically significant in the REOP model, but these are not the case in the GOP model. Respondents who report that their mothers are in the *'fair'*, *'good'* or *'excellent'* SAH categories are less likely to report *'poor'* SAH themselves, compared to those who report their mothers' SAH as *'poor'*, with probabilities of 4.8, 5.7 and 5.8 (see Table 2.10) percentage points less, respectively. In the REOP model, a positive correlation is observed, and it is also found that the estimated coefficients are smaller after controlling for the spouse's SAH. Both models provide evidence of a positive correlation between the mothers' SAH and their offspring's SAH.

We then focus on the sample of individuals whose fathers are alive in columns (7), (8), and (9). There are some findings that are quite different from the findings from the GOP model. While the 55-64 age group is found to be more likely to report better SAH for the full sample in the REOP model, however, the effect of 55-64 age group on SAH is statistically insignificant in the GOP model. The effect of the individual's education on SAH is statistically insignificant after controlling for the father's education in both the REOP and GOP models. Both models exhibit a statistically significant negative relationship between SAH and unemployment. Respondents who report their fathers' SAH as *'good'* or *'excellent'* are less likely to report *'poor'* SAH themselves, compared to individuals reporting their fathers' SAH as *'poor'*, with a fall of 6.7 percentage points and 4.5 (see Table 2.13) percentage points in the respective probabilities. In accordance with the GOP model, the effects of fathers' SAH diminish after controlling for the spouses' SAH.

Turning to columns (10), (11) and (12), the age categories are statistically insignificantly correlated with SAH in the REOP model after controlling for both parents' characteristics.

However, all age categories are statistically significantly inversely correlated with reporting *'poor'* SAH in the GOP model. It may be the case that different age groups in rating their SAH use systematically different threshold levels when assessing their health, despite having the same level of 'true' health. For example, older people rate their SAH in an optimistic way (Hernández-Quevedo, 2005). Married individuals have a statistically greater likelihood of having better SAH than non-married individuals in the REOP model. In addition, the probability of reporting *'good'* SAH is found to be higher if the individual is a Hakka or Mainlander in the GOP model, but these effects of ethnicity are insignificant in the REOP model. For the parents' characteristics, in general, the findings are consistent with those in the GOP model. The marginal effects of parents' education on their offspring's SAH differ between fathers and mothers. The effect of the fathers' education on their offspring's SAH appears to be positive, compared to individuals whose fathers have no education. On the contrary, the mothers' education has the opposite impact on their offspring's SAH. In accordance with the results from the GOP model, the marginal effects of the mothers' SAH on their offspring's SAH are larger than the marginal effects of the fathers' SAH. In addition, after controlling for the spouse's SAH, the marginal effects of both parents' SAH on the individuals' SAH are smaller than the results without controlling for the spouse's SAH. Our findings suggest that, for married individuals, the spouse's SAH explains more of the differences in the individuals' SAH perceptions than the parents' SAH. As in the case of the GOP model, these findings indicate that a shared living environment of the spouse and respondents may lead to this relatively high correlation between the spouse's SAH and the individual's SAH.

To sum up, these two models result in different effects of age groups, ethnicity and regional dummies on SAH. For example, in the case of married individuals whose mothers are alive, the age categories appear to be statistically insignificantly correlated with SAH in the REOP model. On the contrary, age groups have a statistically significant negative impact on reporting *'poor'* SAH in the GOP model. These findings are consistent with Lindeboom and Doorslaer (2004), meaning that individuals may provide different assessments of SAH for the different age groups. For example, older people may tend to rate their SAH in an optimistic way (Hernández-Quevedo, 2005). Nevertheless, education reveals a similar pattern in both models, which suggests that the higher the level of education, the more likely people are to report better SAH.

Table 2.24 Random Effects Ordered Probit Model

Dependent variable: SAH	(1) Baseline model	(2) Married Individuals	(3) Married Individuals (spouse's SAH)	(4) Mother Alive (full sample)	(5) Mother Alive (married sample)	(6) Mother Alive (married sample&spouse's SAH)	(7) Father Alive (full sample)	(8) Father Alive (married sample)	(9) Father Alive (married sample&spouse's SAH)	(10) Parents Both Alive (full sample)	(11) Parents Both Alive(married sample)	(12) Parents Both Alive(married sample&spouse's SAH)
Aged 25-34	0.531***	0.496***	0.297***	0.389*	0.336	0.179	0.762**	0.557	0.253	0.635	0.554	0.312
	(0.068)	(0.083)	(0.081)	(0.157)	(0.189)	(0.184)	(0.240)	(0.284)	(0.279)	(0.435)	(0.556)	(0.541)
Aged 35-44	0.354***	0.329***	0.199**	0.278	0.233	0.046	0.668**	0.480	0.170	0.480	0.396	0.135
	(0.059)	(0.068)	(0.067)	(0.151)	(0.179)	(0.174)	(0.237)	(0.278)	(0.273)	(0.432)	(0.551)	(0.537)
Aged 45-54	0.202***	0.171**	0.180**	0.209	0.167	0.078	0.627**	0.427	0.238	0.449	0.355	0.216
	(0.051)	(0.058)	(0.057)	(0.145)	(0.172)	(0.167)	(0.232)	(0.272)	(0.267)	(0.428)	(0.547)	(0.533)
Aged 55-64	0.015	-0.034	-0.021	0.056	0.042	0.016	0.520*	0.246	0.088	0.516	0.406	0.334
	(0.043)	(0.049)	(0.048)	(0.141)	(0.167)	(0.163)	(0.224)	(0.263)	(0.259)	(0.429)	(0.549)	(0.535)
Male	0.113***	0.143***	0.131***	0.158**	0.185***	0.142**	0.249***	0.303***	0.244***	0.246***	0.279***	0.227**
	(0.032)	(0.036)	(0.034)	(0.049)	(0.055)	(0.052)	(0.057)	(0.066)	(0.063)	(0.064)	(0.074)	(0.070)
Married	0.060			0.213***			0.122			0.190*		
	(0.037)			(0.061)			(0.071)			(0.080)		
Number of children aged 0-7	-0.005	-0.006	-0.093**	-0.069	-0.065	-0.056	-0.065	-0.069	-0.051	-0.091	-0.083	-0.051
	(0.031)	(0.033)	(0.032)	(0.046)	(0.049)	(0.047)	(0.051)	(0.054)	(0.052)	(0.055)	(0.058)	(0.056)
Number of children aged 8-12	0.020	0.028	-0.003	0.015	0.023	0.034	-0.005	-0.010	0.009	0.000	0.006	0.030
	(0.024)	(0.026)	(0.026)	(0.037)	(0.039)	(0.038)	(0.042)	(0.045)	(0.044)	(0.046)	(0.049)	(0.047)
Number of children aged 13-18	0.037	0.040*	0.034	0.003	-0.002	0.011	0.051	0.051	0.050	0.035	0.044	0.051
	(0.019)	(0.020)	(0.020)	(0.031)	(0.033)	(0.032)	(0.036)	(0.038)	(0.037)	(0.041)	(0.044)	(0.043)
Education: secondary	0.536***	0.616***	0.552***	0.479***	0.583***	0.522***	0.145	0.164	0.131	-0.171	-0.042	-0.030
	(0.059)	(0.067)	(0.064)	(0.130)	(0.150)	(0.143)	(0.167)	(0.183)	(0.174)	(0.238)	(0.272)	(0.262)
Education: university+	0.786***	0.841***	0.728***	0.695***	0.747***	0.645***	0.288	0.258	0.179	0.009	0.080	0.047
	(0.071)	(0.081)	(0.078)	(0.141)	(0.164)	(0.155)	(0.179)	(0.198)	(0.189)	(0.247)	(0.284)	(0.273)

Table 2.24 Random Effects Ordered Probit Model (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable: SAH	Baseline model	Married Individuals	Married Individuals (spouse's SAH)	Mother Alive (full sample)	Mother Alive (married sample)	Mother Alive (married sample&spouse's SAH)	Father Alive (full sample)	Father Alive (married sample)	Father Alive (married sample&spouse's SAH)	Parents Both Alive (full sample)	Parents Both Alive(married sample)	Parents Both Alive(married sample&spouse's SAH)
Household size	0.016**	0.013*	0.014*	0.013	0.012	0.011	0.030*	0.026	0.028	0.021	0.015	0.013
	(0.006)	(0.006)	(0.006)	(0.011)	(0.012)	(0.012)	(0.013)	(0.015)	(0.015)	(0.014)	(0.017)	(0.017)
Employed	0.191***	0.187***	0.225***	0.226***	0.240***	0.224***	0.123	0.120	0.120	0.135	0.117	0.098
	(0.031)	(0.034)	(0.034)	(0.059)	(0.064)	(0.063)	(0.071)	(0.079)	(0.077)	(0.084)	(0.092)	(0.090)
Self-employed	0.213***	0.185***	0.196***	0.079	0.073	0.091	0.051	0.043	0.059	0.056	0.029	0.022
	(0.034)	(0.037)	(0.036)	(0.065)	(0.071)	(0.069)	(0.079)	(0.087)	(0.085)	(0.095)	(0.104)	(0.102)
Unemployed	-0.125*	-0.105	-0.120	-0.297**	-0.245*	-0.283**	-0.276*	-0.263*	-0.242	-0.234	-0.347*	-0.333*
	(0.054)	(0.063)	(0.063)	(0.092)	(0.107)	(0.106)	(0.114)	(0.131)	(0.130)	(0.135)	(0.155)	(0.154)
Ethnic origin: Hokkien	0.252**	0.266**	0.206*	0.047	0.087	-0.003	-0.026	-0.093	-0.086	0.195	0.048	0.000
	(0.083)	(0.095)	(0.090)	(0.144)	(0.162)	(0.152)	(0.226)	(0.262)	(0.251)	(0.261)	(0.300)	(0.286)
Ethnic origin: Hakka	0.424***	0.377***	0.260**	0.252	0.217	0.098	0.274	0.135	0.083	0.531	0.296	0.219
	(0.093)	(0.106)	(0.101)	(0.159)	(0.178)	(0.167)	(0.241)	(0.277)	(0.265)	(0.276)	(0.316)	(0.301)
Ethnic origin: Mainlander	0.441***	0.455***	0.333**	0.299	0.330	0.186	0.309	0.231	0.146	0.489	0.335	0.178
	(0.099)	(0.114)	(0.108)	(0.163)	(0.184)	(0.173)	(0.244)	(0.282)	(0.270)	(0.281)	(0.322)	(0.307)
Log labour income	0.015***	0.016***	-0.001	0.010	0.008	-0.002	0.010	0.011	-0.003	0.004	0.002	-0.011
	(0.004)	(0.004)	(0.004)	(0.008)	(0.010)	(0.009)	(0.010)	(0.012)	(0.012)	(0.012)	(0.015)	(0.015)
Log unearned income	0.002	0.000	0.002	-0.004	-0.001	0.002	-0.014	-0.014	-0.008	-0.015	-0.013	-0.012
	(0.005)	(0.005)	(0.005)	(0.007)	(0.008)	(0.008)	(0.009)	(0.010)	(0.010)	(0.010)	(0.011)	(0.011)
Region: North	0.108	0.137*	0.157*	0.091	0.153	0.180	0.050	0.146	0.159	0.044	0.160	0.173
	(0.056)	(0.064)	(0.061)	(0.089)	(0.102)	(0.095)	(0.110)	(0.130)	(0.124)	(0.122)	(0.143)	(0.136)
Region: South	-0.121*	-0.119	-0.051	-0.172	-0.168	-0.088	-0.158	-0.088	-0.041	-0.158	-0.060	-0.025
	(0.058)	(0.066)	(0.063)	(0.093)	(0.105)	(0.099)	(0.115)	(0.134)	(0.128)	(0.128)	(0.149)	(0.141)
Region: Middle	0.090	0.089	0.101	0.126	0.183	0.199	0.086	0.166	0.149	0.112	0.240	0.223
	(0.064)	(0.073)	(0.070)	(0.099)	(0.113)	(0.107)	(0.121)	(0.142)	(0.135)	(0.135)	(0.158)	(0.150)

Table 2.24 Random Effects Ordered Probit Model (continued)

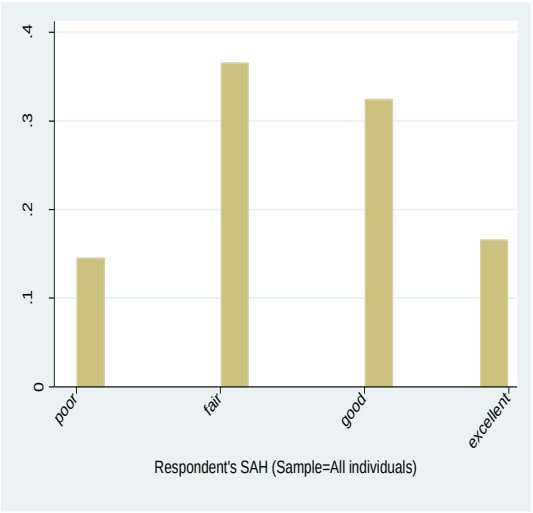
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable: SAH	Baseline model	Married Individuals	Married Individuals (spouse's SAH)	Mother Alive (full sample)	Mother Alive (married sample)	Mother Alive (married sample&spouse's SAH)	Father Alive (full sample)	Father Alive (married sample)	Father Alive (married sample&spouse's SAH)	Parents Both Alive (full sample)	Parents Both Alive(married sample)	Parents Both Alive(married sample&spouse's SAH)
Year 2000	0.061	0.113**	-0.248***									
	(0.046)	(0.036)	(0.039)									
Year 2001	-0.031	0.054	-0.304***									
	(0.046)	(0.034)	(0.037)									
Year 2002	-0.396***	-0.322***	-0.603***	-0.392***	-0.412***	-0.336***	-0.281***	-0.285***	-0.238***	-0.339***	-0.311***	-0.286***
	(0.047)	(0.034)	(0.037)	(0.050)	(0.054)	(0.055)	(0.062)	(0.067)	(0.068)	(0.074)	(0.079)	(0.080)
Year 2003	-0.085											
	(0.045)											
Year 2004	-0.311***	-0.234***	-0.515***	-0.298***	-0.304***	-0.253***	-0.177**	-0.157*	-0.117	-0.232***	-0.193*	-0.161*
	(0.046)	(0.032)	(0.035)	(0.049)	(0.053)	(0.054)	(0.059)	(0.065)	(0.066)	(0.069)	(0.076)	(0.077)
Year 2005	-0.458***	-0.412***	-0.658***	-0.399***	-0.437***	-0.344***	-0.282***	-0.279***	-0.191**	-0.297***	-0.307***	-0.244**
	(0.047)	(0.034)	(0.036)	(0.050)	(0.055)	(0.055)	(0.061)	(0.067)	(0.067)	(0.071)	(0.078)	(0.078)
Year 2006	-0.541***	-0.454***	-0.641***	-0.505***	-0.497***	-0.345***	-0.323***	-0.270***	-0.140	-0.393***	-0.326***	-0.201*
	(0.050)	(0.039)	(0.041)	(0.056)	(0.061)	(0.062)	(0.067)	(0.075)	(0.075)	(0.078)	(0.086)	(0.086)
Spouse health: fair			0.136***			0.392***			0.146			0.222*
			(0.032)			(0.072)			(0.090)			(0.111)
Spouse health: good			0.692***			0.969***			0.801***			0.831***
			(0.033)			(0.076)			(0.094)			(0.115)
Spouse health: excellent			1.458***			1.705***			1.587***			1.597***
			(0.039)			(0.084)			(0.104)			(0.125)
Father education: primary							0.101	0.113	0.027	0.233*	0.243*	0.159
							(0.074)	(0.083)	(0.079)	(0.095)	(0.106)	(0.101)
Father education: secondary+							0.054	0.011	-0.026	0.231*	0.241	0.201
							(0.086)	(0.097)	(0.092)	(0.113)	(0.129)	(0.122)

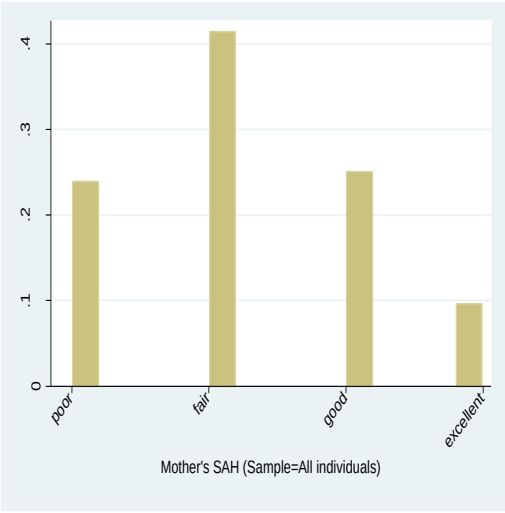
Table 2.24 Random Effects Ordered Probit Model (continued)

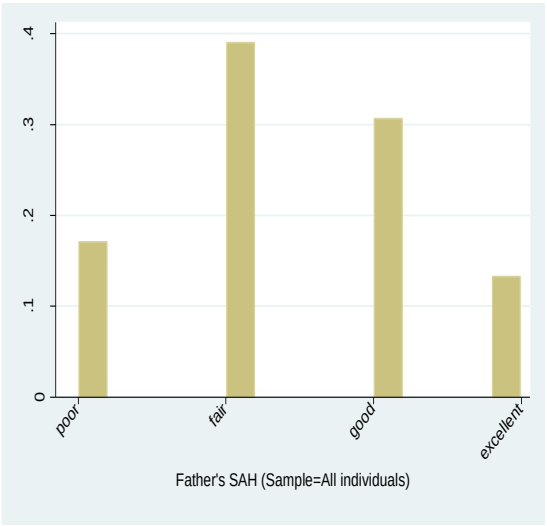
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable: SAH	Baseline model	Married Individuals	Married Individuals (spouse's SAH)	Mother Alive (full sample)	Mother Alive (married sample)	Mother Alive (married sample&spouse's SAH)	Father Alive (full sample)	Father Alive (married sample)	Father Alive (married sample&spouse's SAH)	Parents Both Alive (full sample)	Parents Both Alive(married sample)	Parents Both Alive(married sample&spouse's SAH)
Mother education: primary				-0.051	-0.076	-0.110				-0.213**	-0.260**	-0.231**
				(0.055)	(0.061)	(0.057)				(0.082)	(0.092)	(0.087)
Mother education: secondary+				-0.168*	-0.208*	-0.208*				-0.372**	-0.489***	-0.433***
				(0.083)	(0.095)	(0.089)				(0.116)	(0.134)	(0.127)
Father health: fair							0.168**	0.137*	0.168**	0.118	0.062	0.089
							(0.058)	(0.064)	(0.064)	(0.076)	(0.085)	(0.084)
Father health: good							0.578***	0.539***	0.449***	0.370***	0.320**	0.295**
							(0.063)	(0.070)	(0.070)	(0.088)	(0.099)	(0.098)
Father health: excellent							1.085***	1.082***	0.738***	0.492***	0.524***	0.256
							(0.077)	(0.087)	(0.088)	(0.119)	(0.138)	(0.137)
Mother health: fair				0.245***	0.219***	0.140**				0.230**	0.234**	0.180*
				(0.046)	(0.050)	(0.050)				(0.074)	(0.083)	(0.082)
Mother health: good				0.682***	0.642***	0.423***				0.516***	0.475***	0.324**
				(0.052)	(0.058)	(0.058)				(0.089)	(0.101)	(0.100)
Mother health: excellent				1.207***	1.224***	0.791***				1.080***	1.068***	0.852***
				(0.070)	(0.080)	(0.081)				(0.127)	(0.148)	(0.147)
Number of observations	20,607	16,542	16,542	6,866	5,504	5,504	4,876	3,848	3,848	3,899	3,033	3,033
P-value	p=0.00	p=0.00	p=0.00	p=0.00	p=0.00	p=0.00	p=0.00	p=0.00	p=0.00	p=0.00	p=0.00	p=0.00

Notes: (1)***p<0.001, **p<0.005, *p<0.05 (2) Standard errors in parentheses. (3) Omitted categories: Aged over 65; Female; Single; No education; Unemployed; Aborigine and other group; Eastern area; Poor health status. (4) Coefficients are presented.

Figure 2.1 The Distribution of the Respondent's, Mother's and Father's SAH







Chapter 3. The Determinants of Psychological Well-Being in Taiwan

3.1 Introduction

Over the last two decades, a substantial amount of technological progress has influenced the way people work. For example, the decline in manufacturing jobs, the growth of the global economy and the number of 'high-tech' jobs appear to have changed the working environment. Work that damages an employee's physical health has become less prevalent but the scope for psycho-social stressors has increased (Cappelli et al., 1997). As a result, an increasing number of studies by economists have investigated whether job characteristics affect psychological well-being (see, for example, Shields and Wheatley Price, 2005, for the UK). The vast majority of research on the relationship between psychological well-being and job characteristics has been conducted using UK data (see, for example, Llena-Nozal et al., 2004) and US data (see, for example, Blanchflower and Oswald et al., 2004). There has been relatively little attention paid to the case of Taiwan. Since adverse job characteristics, such as long working hours, are much more prevalent in East Asian countries such as Japan, Korea and Taiwan than in Western countries (Cheng and Luh, 2003; Cheng et al., 2011), According to a report by the OECD, working hours have been found to be at least 20% higher in Taiwan than in Germany and the U.S. each year on average. This phenomenon has attracted the Taiwan government's attention and it is considering reforming the maximum working hours policy. Therefore, it is important to gain a better understanding of the relationship between psychological well-being and job characteristics (i.e., long working hours and occupations). Our estimated results may in a way support the government's policy if a negative relationship between long working hours and occupations is found. In addition, we could help in the development of effective programmes to prevent stress-related health problems from arising among the Taiwanese population.

In the psychology literature some job characteristics have been found to be important determinants of psychological well-being in Taiwan. For example, Cheng et al. (2001) analyse cross-sectional data for employees and find that long working hours are harmful to psychological health. However, the relationship between occupation and psychological well-being is not so clear-cut. Although some studies find that a high-level occupational position is positively associated with psychological health (e.g., Cheng et al., 2011, for Taiwan), there are some studies suggesting that the relationship is

negative (e.g., Cheng et al., 2001, for Taiwan). Nevertheless, while it could be argued that these Taiwanese studies are mainly focused on job-related psychological well-being, the effects of occupational positions on psychological well-being might be due to other factors which are correlated with both psychological well-being and occupation. For example, smoking may be more prevalent among unskilled workers than skilled workers and the adverse effects of smoking behaviour on psychological well-being may dominate the effects of job characteristics on psychological well-being. Such life style factors have not attracted much interest in the existing studies for Taiwan.

We explore the effects of demographic and job characteristics on a measure of psychological well-being which is derived from the State-Trait Anxiety Inventory (STAI), see Spielberger et al. (1983).[16] The STAI is a self-reported measure containing 20 questions that were developed as a screening device for identifying mental disorders in clinical practice as well as in psychological health in general (Su et al., 2011). Each question has a choice of four levels (from *'1 =never'*, *'2=sometimes'*, *'3=often'*, and *'4 =always'*) in which the emphasis is frequently placed on the state of anxiety at the current moment or as felt in the recent past, thereby creating an overall score ranging from 20 to 80 points, where a higher STAI score represents better psychological well-being. The STAI has been shown to be highly reliable as a measure of mental disorder within Hawaiian adolescents, the Norwegian elderly and Taiwanese women (see Hishinuma et al., 2001; Kvaal et al., 2005; Su et al., 2011, respectively). Although it has been found that the STAI is characterised by internal consistency and reliability (Spielberger et al., 1983), to our knowledge, there are no existing studies in economics so far that have used the STAI as a psychological well-being measure. This may be due to a variety of reasons. Firstly, and perhaps most importantly, the STAI is rarely available in large scale surveys.[17] Secondly, the STAI refers to an individual's subjective assessment of his/her own well-being which can result in difficultly in interpreting such psychological outcomes and how to model such variables (McBride, 2001). Since it has been concluded that subjective well-being measures are meaningful (Easterlin, 1974; Diener,

[16] The form of the STAI has been refined by Spielberger et al. (1983). For details see the manual for the State-Trait Anxiety Inventory, Form Y, Self-evaluation questionnaire.

[17] This may be because the cost of the use of the STAI measure is high compared to that of the GHQ measure (see State-Trait Anxiety Inventory for Adults and MAPI Research Trust: GHQ retrieved September 1, 2012 from http://www. mindgarden.com/products/staisad.htm and from http://www.mapi-trust.org/services/questionnairelicensing/catalog-questionnaires/52, separately).

1984), economists have begun to analyse such subjective psychological well-being measures, which have been mainly based on the General Health Questionnaire (GHQ) in order to address economic issues (e.g. the study of the relationship between unemployment and mental health by Theodossiou, 1998, for the UK). We use the STAI, which is available in the Panel Study of Family Dynamics (PSFD) for Taiwan, as the indicator of psychological well-being in our empirical analysis. Indeed, it is the only available measure of well-being in the PSFD. We will compare the STAI measure with the more commonly used measure, the GHQ, by mapping the STAI onto the GHQ classifications, namely, anxiety, social dysfunction, loss of confidence, 15-STAI, and negative STAI later on in the chapter.

To investigate the determinants of psychological well-being in Taiwan, we employ cross-sectional data from the PSFD to estimate an Ordinary Least Squares (OLS) model. As shown in the findings reported in Section 3.5, jobs with standard working hours are positively associated with a worker's well-being. In addition, we find that a higher occupational position is associated with better psychological well-being. Finally, an individual's psychological well-being is found to be positively correlated with exercise, suggesting that those who maintain a healthy lifestyle are less prone to stress.

One drawback with the existing studies on Taiwan in this area is that they do not correct for potential sample selection bias when focusing on samples of employees only, when exploring the relationship between job characteristics and psychological well-being. This may lead to sample selection bias since it is likely that unobserved factors affect both psychological well-being and labour market status. For example, those individuals who have high levels of motivation to participate in the labour market may also be in better psychological health (Llena-Nozal et al., 2004, for the UK). Therefore, we control for sample selection bias in our empirical analysis of employees.

The structure of this chapter is as follows. In Section 3.2 we provide a review of the definition of STAI. Section 3.3 outlines the regression models estimated in this chapter. In Section 3.4 we describe the data. Section 3.5 presents the estimation results and finally Section 3.6 concludes and discusses the policy implications.

3.2 Literature Review

This section presents a review of the literature on the determinants of psychological well-being focusing on job characteristics. Firstly, the definition of the State-Trait

Anxiety Inventory (STAI) is described. Secondly, the literature exploring the key factors affecting psychological well-being is discussed. Finally, a detailed discussion of the Taiwanese studies related to this research area is presented.

3.2.1 The Measure of Psychological Well-Being: The State-Trait Anxiety Inventory

The State-Trait Anxiety Inventory (STAI)[18] is a self-reported measure of anxiety introduced by Spielberger et al. (1983). The STAI consists of two anxiety factors, namely, state (state-STAI) and trait (trait-STAI) anxiety. The state-STAI is a measure of how an individual feels in a specific situation or at a particular moment in time, that is, individuals may be asked to evaluate '*How do you feel now?*', both before and after, for example, a job interview or school test (Spielberger et al., 1983). In contrast, the trait-STAI is used to indicate how a person generally feels regarding the frequency and intensity of feeling stress; in other words, it captures a relatively stable and permanent characteristic of people (Spielberger et al., 1983). For example, for people with a stronger anxiety trait, the greater is the probability that he/she will experience more intense elevations in the state-STAI in a stressful situation (Spielberger et al., 1983). The state-STAI and trait-STAI both contain 20 items, and in order to improve the factor structure, both the state-STAI and trait-STAI include a balance between the number of negative items (e.g., I feel inadequate) and positive items (e.g., I feel calm) (Spielberger et al., 1983). In responding to the state-STAI and trait-STAI items, individuals are asked to rate themselves on a four-point scale from *'1=never'*, *'2=sometimes'*, *'3=often'*; *and '4=always'*. Given the rating of 1 to 4, a high rating indicates the absence of anxiety for the positive items. This means that the total scores for the state-STAI and trait-STAI can be simply aggregated for the 20 items, where the positive items are scored normally and the negative items are reverse scored. Consequently, for each sub-STAI, the total scores can vary from a minimum of 20 to a maximum of 80. It has also been found that both the state-STAI and the trait-STAI scales have internal consistency and that the STAI is characterized by reliability with Cronbach (1951) alpha coefficients of at least 0.86 being observed among many sample groups, for example, samples of male and female high school and college students, working adults, and military personnel (Spielberger et

[18] We focus on reviewing the STAI (Form Y) which is a revision of the STAI (Form X) since Form Y is the only version adopted in our survey. The reasons for revising the STAI were: (1) to create items of the anxiety measure related to more anxiety than depression; (2) to replace items for which the measures of the psychometric properties for younger adults, less-educated persons and lower socioeconomic status groups are relatively weak; and (3) to achieve a balanced number of negative and positive items (Spielberger et al., 1983).

al., 1983). The internal consistency and reliability of the STAI is found to be generally satisfactory for a broad range of studies (e.g., medical and nonmedical publications), and, it is recommended that the internal consistency and reliability for the STAI be calculated for each single piece of data to enhance the potential statistical power in the researchers' own study (Barnes et al., 2002).

The STAI scale has been widely used in clinical practice to distinguish persons with mental disorders, e.g., an anxiety disorder, from those without (Kvaal et al., 2005). For example, Kvaal et al. (2005) studied Norwegian elderly patients. Without knowing the diagnosis for those patients who had been suffering from psychiatric disorders according to DSM-IV-TR (Diagnostic and Statistical Manual of Mental Disorders)[19] examinations, the patients were asked to rate their score on the STAI scale and, then, the score was compared to the diagnosis results for the patients. It was found that an aggregate score above 39 on the STAI scale corresponded to significant anxiety symptoms, indicating that the STAI scale is a useful instrument for detecting mental disorders in older patients. In the epidemiological area, research has been based on the relationship between psychological factors (e.g., anxiety and depression) and those patients with chronic diseases such as ulcerative colitis (e.g., Addolorato et al., 1996; Addolorato et al., 1997). Addolorato et al. (1999) adopted the STAI scale as a psychological health measure to see whether the patients with allergies or with vasomotor rhinitis perceived more psychological disorders compared to healthy people. It was found that the patients have a higher prevalence of both the state-STAI and the trait-STAI scales than the non-allergic/non-vasomotor rhinitis individuals. However, no significant difference was found in the state-STAI and the trait-STAI scales between allergic and vasomotor rhinitis patients. This finding implies that psychological stress may lead to poor chronic disease since psychological stress may lead to neurotransmitter function disorder (Addolorato et al., 1999). This STAI scale is also successfully utilised in the investigation of general psychological stress, such as the anxiety that is associated with academic performance and achievement. For example, Zohar (1998) examined the differences in the levels of anxiety when Israeli students were facing a college entrance examination. These students were asked to respond by rating themselves on: the state-STAI items immediately before each exam; the

[19] The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) provides a diagnostic tool to promote the effective diagnosis, treatment, and quality of care for psychiatric illness patients (American Psychiatric Association, 2000).

trait-STAI items after the each exam grade was displayed; a self-efficacy (SE) for grade expectancy 3 days prior to each exam[20]; the expected grade (EG)[21] immediately after the exam; and, finally, the actual grade (AG) after the grades came out. A hierarchical multiple regression model was used. A baseline model was used to investigate the relationship between the state-STAI (i.e., it is treated as a dependent variable) and the trait-STAI (including the trait-STAI of students, the SE of students for the previous exam, and the SE of students for the current exam). Then, the baseline model was re-estimated with additional variables included for the EG of the student for the previous exam and for the current exam. Finally, a similar empirical model was employed as the baseline model but the dependent variable denoting the state-STAI was replaced by the AG. The results from the estimates show that those students who provided higher SE values for themselves, i.e., had higher expectations regarding their grades, had greater intensities of anxiety during the exam.

Investigation of the factors affecting the STAI scale is common among both psychologists and sociologists. For example, Fischer and Boer (2011) use three different indexes as psychological health measures across 63 countries employing Meta-analysis. The three psychological health measures are: the General Health Questionnaire (GHQ), 'burnout'[22] and the STAI. Meta-analysis is a technique in which the results of at least two or more independent existing studies are statistically combined to provide an overall answer to a question of interest. For example, for the STAI measure, existing studies (published between 1979 and 2006), which have employed the STAI as an outcome of interest, are collected. Therefore, a total of 164 samples including either the state-STAI or the trait-STAI are used in the empirical analysis in the study. The average of the STAI score over the sample size of 164 is calculated by dividing the standardized

[20] The entrance examination is divided into three sessions. As for the first session, the first exam was on quantitative skills, the second was on verbal skills and the third was an English test. Exams were given at intervals of three weeks and the grades were displayed before the start of the next session. In regard to self-efficacy, the students responded to the grades obtained in each exam. The students were asked to indicate the probabilities of their achieving different grades in the forthcoming exam for a series of grades, e.g., the probability of a grade of 50 or more, of 60 or more, of 70 or more, up to 100, with the responses being *'0=completely unconfident'* to *'10=completely confident'*. Then the average for the overall series was computed.

[21] The expected grade (EG) refers to a series of questions which asked the students to rate an expected grade for themselves, e.g., the probability of a grade of between 50 and 100, and these questions were assessed immediately after the exam with a 10-point scale from *'0=no chance at all'*, to *'10=completely certain'*.

[22] Three subscales including emotional exhaustion, depersonalization and a lack of personal accomplishment, made up the 'burnout' measure, with different numbers of items included for each subscale.

score[23] by the number of reported items. Therefore, all scores range between 0 and 1. In this study, the Meta-analysis is conducted using various models: the first model examines the effects on the STAI scores; the second and third examine the linear impact of wealth and individualism[24] on the STAI score, the fourth model examines the impact of both wealth and individualism on the STAI score and then examines the effects of the squared term of the wealth and individualism variables (model 5), the cubic term (model 6), and, finally, model 7 examines the effects of the interaction terms between wealth and individualism on the STAI score. Wealth is defined as the average normalized gross domestic product (GDP) and individualism is the average of the score of two types of index: The survival versus well-being dimension; and autonomy.[25] The findings suggest that individualism is a consistently better predictor of well-being than wealth. In addition, despite some emerging nonlinear trends and interactions between wealth and individualism, the overall pattern strongly suggests that greater individualism is consistently associated with higher well-being. It may be the case that wealth influences well-being only via its effect on individualism.

It has been argued that one reason why economists have been relatively less inclined to use self-reported psychological health measures is that it is difficult to model such psychological health measures and to interpret such variables (Bertrand and Mullainthan, 2001; Jahoda, 1988). However, recently, economic studies using psychological health measures have been more widely carried out, with the subjective psychometric health measure used being mainly based on the General Health Questionnaire (GHQ) which asks individuals *'How has your health been in general over the past few weeks?'*, for a series of questions with each of them having four choices of response given in four-point categories from, for example, *'better than usual'* to *'much less than usual'*. Interestingly, Aktekin et al. (2001) found that poor psychological health is more prevalent among Turkish medical students than among those students in economics and physical education regardless of whether the STAI scale or the GHQ is used as an instrument indicating that the STAI scale is as good a psychological health measure as the GHQ. Despite the widespread use of the STAI as a screening test for general practice and community samples in Britain and America (Spielberger and Reheiser,

[23] In order to obtain a comparable effect size, the STAI score is standardized. The mean is calculated by dividing the STAI aggregate score by the number of reported items.
[24] Individualism is defined as people being able to express, and being encouraged to pursue, their ideas to make their own life meaningful.
[25] The measures follow the study by Schwartz (1994).

2009; Bruder et al., 2002), however, its validity and other psychometric properties have not been established in the economics literature so far as a psychological well-being measure.

3.2.2 The Determinants of Psychological Well-Being

Since the conclusions made in the existing studies (e.g. Easterlin, 1974; Diener, 1984) suggest that psychological well-being measures (such as the STAI and the GHQ scales) are meaningful, there has been a growing number of studies on the determinants of psychological well-being in the economics literature (e.g. Theodossiou, 1998; Clark, 2003; Andrés, 2004; Shields and Wheatley Price, 2005). This sub-section reviews the micro-based approach used to determine the factors affecting psychological well-being in the economics literature. The literature review will be used to develop our empirical estimation strategy in the next section.

Many factors have been found to affect psychological well-being (e.g. unemployment, self-reported health status, age, gender and marital status) (see, e.g., Clark and Oswald, 1994; Clark and Oswald, 1996; Andrés, 2004; McBride, 2001; Shields and Wheatley Price, 2005). An inverse relationship between unemployment and psychological well-being has been consistently found in several existing studies. For example, Theodossiou (1998) employs cross-sectional British data to explore the effect of unemployment on psychological well-being. The six psychological well-being measures from the GHQ scale contained three positive questions and three negative questions. In the case of the positive questions[26], respondents were asked to answer the questions by choosing one of four possible answers: *'1=more so than usual', '2=about the same as usual'*, '3=*less than usual'*, and *'4=much less than usual'*. Whereas in the set of negative questions, respondents were asked to describe the frequency of their recent feelings of 'being under strain', 'losing confidence' or 'having low self-esteem', using a four-point scale: *'1=not at all'*, '2=*no more than usual'*, *'3=rather more than usual'*, and *'4=much more than usual'*. A logistic regression model is used for separately modelling the six discrete ordinal dependent variables. It was found that unemployment leads to a greater adverse impact on the level of happiness than being low-paid or not in

[26] The three positive questions are: *'Have you recently been able to enjoy your normal day-to-day activities?'*; *'Have you recently been able to face up to problems?'*, and *'Have you recently been feeling reasonably happy?'*.

the labour force. The finding is robust across multiple countries (e.g. Winkelmann and Winkelmann, 1998, for Germany) and also in the case of using panel data (e.g. Clark et al., 2001, for the UK).

Self-assessed health (SAH) has been found to be a powerful predictor of psychological well-being. In general, being in *'good'* or *'excellent'* SAH is associated with higher levels of psychological well-being (Andrés, 2004). In one of the existing UK studies, Clark and Oswald (1994) use cross-sectional data from the 1991 British Household Panel Study. In this study, the GHQ-12 scale is taken as the psychological well-being measure based on calculating the 'caseness scores' (i.e. the original four-point scales are assigned a score of 1 to a response indicating a high level of well-being and a score of 0 otherwise), '12' represents the lowest level of well-being and '0' represents the highest level of well-being. An ordered probit model is employed with the dependent variable treated as an ordinal variable which takes values between '0' and '-12' (i.e. the sumscore was multiplied by minus one). Individuals with *'excellent'* SAH[27] have higher levels of psychological well-being than those reporting *'poor'* SAH. However, it has been argued that SAH may be endogenous to psychological well-being (Andrés, 2004). For example, individuals' unobserved characteristics may be correlated with both SAH and psychological well-being. In addition, Kahneman et al. (1999) pointed out that one has to be careful about the adaptive effect over time. For example, an individual with years of poor health is more likely to get used to their poor physical health circumstances than those who just recently began suffering from a physical illness. A U-shaped relationship in psychological well-being with respect to age has been widely reported in the economic literature. For example, Clark and Oswald (1996), based on the same psychological well-being measure for a sample of British individuals, found that the GHQ score reaches the lowest levels for those individuals in their late 30s or early 40s.

A common finding among the existing studies mentioned earlier (e.g. Clark and Oswald, 1994; and Theodossious, 1998) is that marriage leads to an improvement in psychological well-being, although the mechanisms leading to possible benefits from marriage may be due to the 'selection effect' where happy people are more likely to be

[27] SAH refers to the respondent's health status, where respondents were asked to rate their health, with the possible responses being *'excellent'*, *'good'*, *'fair'* and *'poor'*. In the empirical studies, two binary measures of respondents' SAH corresponding to *'excellent'* and *'good'* health are included.

selected into a marriage (Joung et al., 1998). The positive correlation between marriage and psychological well-being is also supported by American data, where Blanchflower and Oswald (2004) employed pooled crossed-sectional data from the US General Social Surveys and use two psychological well-being measures including, life satisfaction[28] (based on a four-point response scale) and happiness[29] (based on a four-point response scale) and used an ordered logit model to estimate the marriage effect. The effect of marriage on happiness was equal in size to the effect from receiving an extra $100,000 dollars a year. The empirical analysis using panel data on well-being has found similarly large effects (e.g. Winkelmann and Winkelmann, 1998).

On the other hand, the relationship between well-being and other factors, such as education and gender, is less clear. For example, education had no effect on psychological well-being in Theodossiou's (1998) UK study, but Clark and Oswald's (1994) UK study provided evidence of a positive effect of education on psychological well-being. Turning to gender, Blanchflower and Oswald (2004) found that American men tend to report lower happiness scores than women, although the difference in scores between males and females appears to be small. However, Clark and Oswald (1994) found the opposite empirical result, where British men reported higher well-being than women.

It may, however, be the case that an individual's well-being is affected by the social support that is received from, for example the family. Shields and Wheatley Price (2005) investigated the determinants of psychological well-being at the household level rather than the individual level: this study looks at the effects of household-level characteristics on individual well-being. The GHQ total score is used as the psychological well-being measure and is based on a household random effects ordered probit model, which allows for the correlation between unobserved intra-household characteristics and psychological well-being, for cross-sectional data between 1998 and 1999 from the Health Survey for England. They find that individuals in households in poverty (i.e. where household annual income is less than £5200) have poorer psychological well-being than those in better-off households. Furthermore, females are

[28] The respondents were asked: *'On the whole, are you very satisfied, fairly satisfied, not very satisfied, or not at all satisfied with the life you lead?'*.

[29] The question asked is: *'Taken all together, how would you say things are these days—would you say that you are very happy, pretty happy, or not too happy?'*.

found to suffer more than males in this case. Having chronic physical illness is negatively correlated with psychological well-being and this is also the case for those individuals who are unemployed or out of the labour market.

The relationship between occupation and psychological well-being in the UK was investigated by Llena-Nozal et al. (2004). They employed cohort data from the UK National Child Development Survey (NCDS), using information available at ages 23, 33 and 42, to explore the relationship between occupation and psychological well-being. The dependent variable, a self-reported scale of the Malaise Inventory, includes 24 questions regarding symptoms such as anxiety, irritability, a depressed mood and psychosomatic illness, with a yes/no choice to each question. The value *'1'* indicates a *'yes'* response, and the value *'0'* indicates a *'no'* response. The dependent variable in the study is the summation across the 24 questions. Occupation is divided into four categories: professional, managerial and technical; skilled non-manual; skilled manual; and finally, semi-skilled and unskilled. Three estimation techniques were used. Firstly, a dynamic panel data model was used for the sample of employed individuals. Secondly, a fixed effects model was applied to control for unobserved time-invariant individual characteristics for the same sample of employed individuals. Finally, in order to investigate whether the effects on psychological well-being are a result of different occupations, the analysis focuses on those individuals who have changed occupation in any of the three waves (i.e. at ages 23, 33 or 42). A sample selection approach is employed to deal with selection into a particular occupation. The study finds that women have lower levels of psychological well-being than men. Furthermore, psychological well-being is found to deteriorate with age at a decreasing rate and also to decrease at a slower rate if individuals are employed as opposed to being out of the labour market. Importantly, evidence is provided that reveals the difference in the impact of different occupations, where the higher the occupational position, the better the mental health. Lifestyle factors including smoking, drinking, obesity and exercise are controlled for in the empirical analysis. It is found that currently smoking has an adverse effect on mental health for females. Such lifestyle variables are infrequently included in the empirical studies in economics. In contrast, the relationship between lifestyle factors and psychological well-being has been of significant interest among psychologists. For example, smoking and drinking are associated with poor psychological well-being (using the GHQ scale as the measure) for Japanese employees (Nakayama et al., 1997).

However, a negative impact of high occupational positions on psychological illness was found by Jones et al. (2011) using UK employee level data. This study differs from other studies for the UK (e.g. Llena-Nozal et al., 2004) in that Jones et al. (2011) considered different psychological well-being measures in which employees are asked *'Thinking of the past few weeks, how much of the time has your job made you feel each of the following?'* and where the six states to choose from are *'tense'*, *'calm'*, *'relaxed'*, *'worried'*, *'uneasy'* and *'content'*. Each response was recoded on a five-point scale from *'1=never'*, *'2=occasionally'*, *'3=some of the time'*, *'4=most of the time'* and *'5=all of the time'*. The scores were then added together to obtain a total score as a psychological well-being measure for each employee. The 2004 cross-sectional data drawn from the British Workplace Employment Relations Survey (WERS) is used. Occupational categories included: manager or senior official; professional, associate professional and technical; administrative and secretarial; skilled trades, personal services, sales and customer services; processing, plant and machine; and finally, elementary (the omitted category). An ordinary least squares (OLS) model is estimated with psychological well-being as the dependent variable. This study provides evidence that there is an adverse impact associated with more highly skilled occupations, namely managerial, professional and associate professional occupations. Moreover, it is found that working overtime is positively associated with poor psychological well-being. Using the same British data as Jones et al (2011), Bryson et al. (2012) also found that overtime hours are correlated with poor psychological well-being. However, the relationship follows an inverted u-shape, with psychological well-being declining with very long hours. The Bryson et al. (2012) study contains further discussion of a compensating wage effect, and their findings suggest that workers' preferences for harder work [30] or greater responsibility may not always require a compensating wage differential. However, one methodological problem with the Jones et al.'s (2011) and Bryson et al.'s (2012) studies is that the analysis is conducted on employees only, which may lead to biased estimates due to being unable to control for the effect of selection into employment.

3.2.3 The Determinants of Psychological Well-Being in Taiwan

Research on psychological well-being in Taiwan has attracted the attention of scholars from a wide range of disciplines, including sociology and psychology. However, there

[30] For hard work, a dummy variable equals '1'for those employees who agree with the statement 'My job requires that I work very hard'.

has been a lack of focus in economics on the determinants of psychological well-being in Taiwan. To date, a series of empirical studies conducted using data from Taiwan have focused on potential sources of work stress for employees (see, for example, Cheng et al., 2001), as well as occupational differences in psychological well-being (see, for example, Cheng et al., 2011).

Cheng et al. (2001) analyse a sample of Taiwanese employees aged between 25 and 65 years old to explore whether job stress is correlated with self-reported health. The cross-sectional data is from the Institute of Occupational Safety and Health (IOSH) of Taiwan which compiled a representative sample of paid employees. The job stress question asks respondents '*How often do you feel very stressed at work?*'. The response is recorded on a five-point scale, which comprises *'always*', '*often*', '*sometimes*', '*seldom*' and '*never*'. For the analysis in the study, '*always*' and '*often*' are coded into one 'high-stress' category and the last two '*seldom*' and '*never*' are coded as a 'low-stress' category, and, therefore, there are three categories overall. For self-reported health, respondents were asked if, over the past 12 months, they had experienced the following symptoms: strained eyes, ringing ears, chronic cough with phlegm, chest tightness, irritable stomach or peptic ulcers, headache, and musculoskeletal discomfort. Multivariate-adjusted beta coefficients and risk ratios of job insecurity models were analysed. Job stress was only found to exist among individuals aged between 25 and 35 years old. Workers who had higher levels of education were associated with a higher level of work stress than those who only had primary school education. With respect to job characteristics, long working hours per week had a positive association with stress and the same correlation was found for those holding a high position in a company.

Perceived job insecurity is an important source of stress (Cheng et al., 2011). Cheng et al. (2011) used cross-sectional data for workers aged between 25 and 65 years old from the 2010 Directorate-General of Budget, Accounting and Statistics of Taiwan (DBA), to estimate the effect of job insecurity on health. Job insecurity was defined by asking respondents whether or not they agreed with the statement '*my job is secure*'. The response was recorded on a five-point scale that covered '*strongly agree*', '*agree*', '*disagree*' and '*strongly disagree*'. The five responses were recoded into two categories, namely, 'agree' and 'disagree'. Health status includes three sub-scales of the standard

Taiwanese version of the Short-Form 36[31] (SF-36): the mental health measure, the vitality measure and, finally, general health status which was assessed based on five items for self-reported health conditions. Based on the Job Strain Model (Karasek and Theorell, 1990), it was found that job insecurity is associated with significantly lower levels of mental health. Occupational diseases due to long working hours (over 60 hours per week) were found to have a positive effect on work stress. In addition, the workers holding lower positions were more likely to perceive job insecurity.

Another existing study on the relationship between job stress and job characteristics is that by Yeh et al. (2009) who used the same dataset as Cheng et al. (2001) compiled by the IOSH, but they focus on a different year, 2004. The sample is restricted to those workers aged 25-65, and employs a multivariate regression model. The dependent variable, 'burnout', is based on the Copenhagen Burnout Inventory (CBI) (Borritz and Keistensen, 2001). Three dimensions of 'burnout' are classified: firstly, personal or generic burnout (6 items), which is designed to measure the degree of burnout experienced by the individual (e.g., *How often do you feel tired?*); secondly, work-related burnout (7 items), which is designed to measure the degree of burnout perceived by the individual at work (e.g., *Do you feel burnt out because of your work?*); and finally, client-related burnout (6 items), which is designed to measure the degree of burnout perceived by the individual[32] (e.g., *Do you find it hard to work with clients?*). The responses are based on five choices ranging from '*always*' (rating '100') to '*never*' (rating '0'). The job characteristics include: (1) earned income (split into three groups, fixed income, performance-based income and piece-rate income), (2) working hours per week and (3) employment grade, which is grouped into six categories: administrators and managers; professionals; non-manual skilled; non-manual low-skilled; manual skilled and, finally, manual low-skilled. It is found that performance-based income is strongly positively correlated with personal burnout and work-related burnout compared to those workers who earn a fixed income after controlling for other job characteristics.

In summary, the studies reviewed above suggest that socio-economic status and demographic characteristics as well as job characteristics are linked to well-being. Moreover, adverse job characteristics such as long working hours are associated with poor psychological well-being. In addition, the existing literature has identified certain

[31] The SF-36 is a multi-purpose, short-form health survey with only 36 questions (Ware et al., 1994).
[32] This is suitable only for those individuals whose work involves clients.

occupations such as managerial and professional occupations that are associated with greater risk of low levels of psychological well-being. In the economics literature, most studies have explored the effect of labour market status on GHQ outcomes rather than on the effect on the STAI due to the fact that the STAI is rarely available in large scale surveys. In contrast, the STAI is the only psychological well-being measure in our survey, which gives us the opportunity to explore a measure of well-being which to date is rarely used in the economics literature. Hence, we employ the STAI as our outcome of interest to explore whether job characteristics are related to the STAI measure and whether the results are in line with those in the existing economics literature from other countries using other measures of well-being. In addition, as far as the existing studies in Taiwan are concerned, most of the previous studies are based on datasets that contain information on employees only. In contrast, the use of the Panel Study of Family Dynamics (PSFD), which comprises individuals from all over Taiwan both in employment and not in employment, makes our conclusions more general and allows us to control for sample selection into employment.

3.3 Methodology

As stated above, the aim of this chapter is to explore the determinants of psychological well-being[33] in Taiwan. The regression equation can be represented as follows:

$$H_i = \alpha_1 L_i + \beta_1 X_i + \varepsilon_i \quad i = 1,2,3,...N \tag{1}$$

where H_i is a measure of the psychological well-being of individual i. X_i represents a vector of variables including socio-demographic characteristics, health status and lifestyle variables. More details on the explanatory variables are given in Section 3.4 below. The error term, ε_i, is assumed to be normally distributed with zero mean and constant variance. In order to explore the effect of job characteristics on well-being, equation (1) is estimated over a sample of all individuals (employed and unemployed) and a sample of employees only for comparison purposes. Hence, L_i represents a dummy variable for employment when we estimate equation (1) for all individuals, which is replaced by a set of dummy variables for occupations (with k categories described by $(k-1)$ dummy variables) when we estimate equation (1) for the sample

[33] Psychological well-being, H_i, can be thought of as a proxy for utility in a linear approximation to the utility function (Clark and Oswald, 1996).

of employed individuals only. The measure of psychological well-being, which is based on the STAI and is described in detail below, is a continuous variable. Hence equation (1) is estimated by ordinary least squares (OLS).

The probability of being in employment is potentially related to psychological well-being (see, for example, Clark, 1997). If this is the case, the OLS estimator for equation (1) will yield biased and inconsistent estimates of the parameters when estimated over employees only. The potential sample selection issue can be corrected using the Heckman approach[34] (Heckman, 1979). We firstly estimate a probit model, equation (2) below, with a dichotomous dependent variable indicating whether or not the individual is in employment. The employment probit equation includes all of the explanatory variables, X_i, in equation (1), as well as additional controls for the father's and mother's education, Z_i, which act as over-identifying instruments that help to determine the probability of employment, but are assumed not to influence psychological well-being. In the employment probit equation, these instruments are statistically significant determinants of the probability of being in employment.[35]

$$Y_i^* = \beta_2 X_i + \gamma_2 Z_i + \delta_i \qquad (2)$$

$$Y_i = 1 \text{ if } Y_i^* > 0 \quad ; \quad Y_i = 0 \text{ if } Y_i^* \leq 0$$

In equation (2), Y_i^* is the unobserved variable that determines whether individual i is in employment or not and Y_i is the observed variable. From equation (2), the inverse Mills ratio (IMR), is generated:

$$\varphi((\beta_2 X_i + \gamma_2 Z_i)/\sigma_\delta)/\Phi((\beta_2 X_i + \gamma_2 Z_i)/\sigma_\delta) \qquad (3)$$

where $\varphi(.)$ and $\Phi(.)$ represent the standard normal density and cumulative distribution functions, respectively. The IMR is then included as an additional explanatory variable in equation (1), the psychological well-being equation, to correct for potential selection bias under the assumption of the joint normality of ε_i and δ_i.

[34] The technique employed is a full maximum likelihood estimation of the Heckman selection model.

[35] The estimated coefficients of Z_i are found to be statistically significant in the probit model for the employment equation (see Table 3.5 in Appendix Three).

3.4 Data

The empirical analysis presented in this chapter is based on survey data drawn from the Panel Study of Family Dynamics (PSFD). The PSFD is a longitudinal survey of a representative sample of households for Taiwan and was started in 1999. The survey consists of three cohorts, namely, 1954-1963, 1934-1953 and 1964-1978, which joined the survey in 1999, 2000 and 2003, respectively. A single adult aged over 25 was selected from each household, who is re-interviewed annually. The PSFD includes rich information on socio-economic and demographic characteristics, as well as labour market status. Information on the psychological well-being of individuals is only available in one wave, namely 2005. The sample includes adults aged 25-65.[36] Hence, our empirical analysis focuses on the 2005 wave, with 2,629 observations for the sample of employed and unemployed adults, where 48% are women and 52% are men; and 1,971 observations for employed individuals, of which males account for 59% and 41% are female.

The Dependent Variable

The psychological well-being measure included in the PSFD is derived from the State-Trait Anxiety Inventory (STAI), see Spielberger et al. (1983), which was developed as a screening device for identifying mental disorders in clinical practice as well as in psychological health in general (Su et al., 2011). The original STAI is a self-reported measure containing two subscales, namely, state-STAI and trait-STAI, each with 20 questions. Individuals are asked to rate themselves on a four-point scale from *'never'*, which takes a value of 1, to *'always'*, which takes a value of 4, in which the emphasis is frequently on the state of anxiety at the current moment or as felt in the recent past. The 2005 PSFD questionnaire includes 15 out of the 20 trait-STAI questions with seven 'positive' and eight 'negative' questions. For example, 'positive' questions include *'I feel satisfied with myself'*, while 'negative' questions include *'I feel nervous and restless'*. The questions are classified in this way according to the wording and, hence, we regard questions 2, 3, 4, 7, 10, 12 and 14 as positively worded (see the list of questions below). The remaining questions are regarded as being negatively worded. Both positively and negatively worded questions have response choices from four categories: never (1), sometimes (2), often (3) or always (4). A rating of 4 denotes better mental health for the 'positive' questions; on the other hand, higher ratings for 'negative' questions denote

[36] The retirement age in Taiwan is 65 for both men and women.

poorer mental health. Hence, the ratings for the 'negative' questions are reversed in our study, i.e., the responses marked 1, 2, 3 or 4 are recoded as 4, 3, 2, 1, respectively. The main dependent variable used in this chapter is obtained by summing up all the ratings for the 15 questions, thereby creating a variable ranging from 15 to 60, so that a higher trait-STAI score indicates better psychological well-being. We omit observations where individuals missed at least one question (23 individuals are dropped from the sample). The overall trait-STAI score is treated as a continuous rather than ordinal dependent variable. The full list of questions is as follows:[37]

How do you generally feel?

1. I feel nervous and restless.
2. I feel satisfied with myself.
3. I feel rested.
4. I feel calm, cool, and collected.
5. I feel that difficulties are piling up so that I cannot overcome them.
6. I worry too much over something that really doesn't matter.
7. I am happy.
8. I have disturbing thoughts.
9. I lack self-confidence.
10. I feel secure.
11. I feel inadequate.
12. I am content.
13. I take disappointments so keenly that I cannot put them out of my mind.
14. I am a steady person.
15. I get in a state of tension or turmoil as I think over my recent concerns and interests.

There appears to be no research in economics using the STAI as a well-being measure, which may reflect the fact that STAI indicators are rarely available in large scale surveys. An alternative psychological well-being measure, the General Health Questionnaire (GHQ), is commonly used in existing studies. We therefore compare the trait-STAI with the GHQ by mapping the STAI onto the three GHQ categories, namely, social dysfunction, anxiety and loss of confidence. We separate the trait-STAI questions into the three categories by identifying similar content in relation to those questions reported in

[37] The five STAI questions which are not included in the PSFD are: I feel pleasant (related to *social dysfunction*); I wish I could be as happy as others seem to be (related to *loss of confidence*); I feel like a failure (related to *loss of confidence*); I make decisions easily (related to *social dysfunction*); Some unimportant thoughts run through my mind and bother me (related to *anxiety*). Unfortunately, no reasons are given regarding why these questions are not included in the PSFD.

each GHQ subscale which have been identified in other studies (for example, Goldberg and Hillier, 1979). The specific questions for the trait-STAI and GHQ are detailed in the table below, with the mean and standard deviation related to the average score for each of the 15 STAI questions and the average score and standard deviation for the three grouped categories also being presented in the table (for the two samples of all individuals and employees only). The social dysfunction category includes seven positively-worded questions, the anxiety category includes five negatively-worded questions and the loss of confidence category contains just three negatively-worded questions. The 15 STAI questions arguably match the three GHQ categories well suggesting that the STAI factor structure contains affective components, i.e., mood and emotions such as joy, happiness or depression, as well as the GHQ measure. In addition, we create a 'negative' category that contains eight negatively-worded questions. As a result, five different STAI categories, namely, 15-STAI, anxiety, social dysfunction, loss of confidence and negative STAI, are used as five dependent variables, the psychological well-being measures, in the empirical analysis. This allows us to explore the robustness of our findings.

We also calculate Cronbach's (1951) alpha reliability index in order to examine the internal consistency reliability of the questions in each category: 15-STAI, 0.87; negative STAI, 0.83; anxiety, 0.78; social dysfunction, 0.83; and loss of confidence, 0.64. For a scale to be reliable, a Cronbach's alpha index of 0.70 is recommended (Nunnaly, 1978). As a consequence, except for loss of confidence, the other four psychological well-being measures are found to be reliable. The relatively low alpha level for loss of confidence may be due to the low total number of items (i.e., there are only three questions), which may limit its validity as a measure of psychological well-being. Histograms for the five psychological well-being measures are shown in Figure 3.1 in Appendix Three. In our sample of all individuals, the mean value of the 15-STAI measure is 44.98. We find that employees have a higher mean level of 15-STAI (45.19). The means of the other four STAI measures for all individuals and employees are similar and the means for each category do not vary within each sample.

Table 3 Comparison of the STAI with the General Health Questionnaire Categories

Three GHQ categories	**GHQ Statements**	**STAI Statements**	**Mean *(Standard Deviation)*; All individuals**	**Mean *(Standard Deviation)*; Employed individuals**
Anxiety	1.Felt constantly under strain	1. I worry too much over something that really doesn't matter	3.2845 *(0.7613)*	3.2983 *(0.7337)*
	2.Feeling unhappy and depressed	2. I feel that difficulties are piling up so that I cannot overcome them	3.1609 *(0.7542)*	3.1659 *(0.7247)*
	3.Lost sleep over worry	3.I have disturbing thoughts	2.8246 *(0.6712)*	2.8437 *(0.6284)*
	4.Could not overcome difficulties	4. I get in a state of tension or turmoil as I think over my recent concerns and interests	3.2350 *(0.7626)*	3.2683 *(0.7332)*
		5. I feel nervous and restless	3.1353 *(0.6967)*	3.1481 *(0.6556)*
Overall Mean *(Standard Deviation)*			15.6406 *(2.6515)*	15.7245 *(2.5048)*
Social dysfunction	1.Feeling reasonably happy	1. I am happy	2.8813 *(0.8068)*	2.8954 *(0.7688)*
	2.Playing a useful part in things	2. I feel satisfied with myself	2.6070 *(0.7988)*	2.6073 *(0.7746)*
	3.Capable of making decisions	3. I feel rested	2.8147 *(0.8124)*	2.8234 *(0.7903)*
	4.Able to face up to problems	4. I feel calm, cool, and collected	2.7953 *(0.8150)*	2.7722 *(0.7878)*
	5.Being able to enjoy normal activities	5. I feel secure	2.8170 *(0.8531)*	2.8351 *(0.8178)*
	6.Able to concentrate	6. I am content	3.0699 (0.8496)	3.0781 *(0.8321)*
		7. I am a steady person	2.9524 *(0.8237)*	2.9483 *(0.8063)*
Overall Mean *(Standard Deviation)*			19.9380 *(4.0234)*	19.9599 *(3.8936)*
Loss of confidence	1.Losing confidence	1. I lack self-confidence	3.1445 *(0.7410)*	3.1659 *(0.6962)*
	2.Been thinking of oneself as worthless	2. I feel inadequate	3.1886 *(0.7495)*	3.2673 *(0.6856)*
		3. I take disappointments so keenly that I cannot put them out of my mind	3.0730 *(0.8075)*	3.0745 *(0.7772)*
Overall Mean *(Standard Deviation)*			9.4062 *(1.7554)*	9.5078 *(1.6418)*

Notes: (1) The scores for questions related to the anxiety and loss of confidence categories have been reversed. (2) The overall mean (Standard Deviation) of the other two measures are: negative STAI, 25.0467 *(3.9943)* and 15-STAI, 44.9848 *(7.0349)* for all individuals; 25.2323 *(3.7423)* and 45.1923 *(6.6660)* for the sample of employees.

The Explanatory Variables

This sub-section describes the variables used in our empirical analysis for all individuals and for employees only. The main difference between these two models is that controlling for the employment status in the model estimated over all individuals is replaced with a set of dummy variables for occupations and for working hours for the model estimated over employees only. The summary statistics related to the explanatory variables for both samples are reported in Table 3.1 in Appendix Three.

The mean value of age is 45 for the sample of all individuals, which is close to the mean age of 43 for the employees sample. A male dummy variable is included in the regression analysis: 52% of the full sample comprises males, and 59% for employees. For marital status, the dummy variable equals '1' for married and cohabiting individuals and '0' for single, separated, divorced and widowed individuals. Around 73% of both samples are married. The number of children aged 0 to 7, the number of children aged 8 to 12 and the number of children aged 13 to 18 within the household are also included, with a maximum value of '4' being reported in each category.

A set of five binary variables for the highest level of educational attainment is included. The categories are as follows: no education (the omitted category); elementary school education; junior high school education; senior high school education and, finally, university and higher education. The proportions of employed individuals in the senior high school and university or above education categories are significantly higher than the proportions for all individuals, perhaps a reflection that people who have higher education tend to be in employment. The survey also includes information on the health status of respondents. A set of dichotomous variables indicating the presence of health problems is included: we find that only 2% of the sample (employed and unemployed) report having heart disease; 3.46% report having diabetes; 6.35% report having high blood pressure and 0.65% report having cancer. However, the percentages of those reporting having these diseases are lower among employed individuals, indicating that poor health is less prevalent among employees. With respect to lifestyle, 35% of all individuals smoke, which includes those individuals who currently smoke and those who used to smoke. It is interesting to note that the employed sample has a higher proportion of smokers than in the sample of all individuals. Smoking among employees is predominant in the elementary (53% smokers relative to 47% non-smokers) and

operator (52% smokers relative to 48% non-smokers) occupational categories, indicating that smoking behaviour is slightly more prevalent among individuals working in jobs with low socio-economic status. This finding highlights the importance of controlling for such lifestyle variables in our empirical analysis. In addition, an exercise variable is created which takes the value of '1' if the respondent exercises at least one hour a week and '0' otherwise. Exercise is more common for the full sample than for the employed only sample. We have examined the correlation coefficients between the lifestyle and health variables and the coefficients appear to be around 0.2, which suggests that multicollinearity issues may not be problematic if both types of variables are included in the regression models.

In terms of the measure of income, this is averaged over monthly household income which includes asset income, investment income, unemployment benefits, rental income, salary (either from full-time or part-time work) and government subsidies.[38] Household income is then converted into sterling using an exchange rate of 47 NT/£1[39] and is taken as a natural logarithm.[40] As for labour market status, approximately 75% of the sample are employed. Occupations[41] are categorised using the International Standard Classification of Occupations (ISCO) and in our analysis we divide them into nine groups based on the Taiwanese classification of social classes (Tsai and Chiu, 1991): professional; senior managers; office workers; clerks; service workers; agricultural and fishery workers; craftsmen; machine operators; and elementary occupations. In our sample of employees, the highest proportion is found in the clerk category at 12.25%. On the other hand, the agriculture, managerial and craft categories with 5.52%, 5.21% and 4.22%, respectively, have the lowest proportions. With respect to weekly hours worked for the employees sample only, we include five categories: 1-15 hours (the omitted category), 16-35 hours, 36-45 hours, 46-59 hours and finally over 60 hours. The most populated group is the 36-45 hours category, accounting for about 39% of the sample. Just 4% and 11% of the sample of employees work 1-15 hours and 16-35 hours, respectively. Around 20% of the employees report working over 60 hours a week, on

[38] This includes: low- and middle-income benefits; household living allowances; social assistance for medical care; social insurance benefits; education subsidies; allowance for child care; allowance for the elderly; allowance for veterans; and subsidized living costs for the disabled.
[39] According to the Bank of Taiwan on 13/03/12.
[40] 8.67% of the sample reported zero household income. These values are recoded to zero after taking logarithms.
[41] The occupations in the PSFD are based on the standard 4-digit occupation categorical code.

average, indicating that long working hours are prevalent in Taiwan.

Finally, in order to deal with potential sample selection bias when analysing the mental health of employees only, the respondent's father's and mother's education are used as instruments in the selection equation (equation (2) in Section 3.3). The five categories of parental education are the same as those for the respondents. Since a large proportion of the respondents' parents have lived in a traditional agricultural society for most of their lives, most of them have only elementary education or no education. There are also large differences in education levels between the mothers and fathers. For example, for the sample of all individuals, 54% of mothers have no education, while only 36% of the fathers fall into this category. Interestingly, for employed individuals, the percentages of parents in the elementary/junior high/senior high/university education categories are higher than those for all individuals. This finding supports the use of parental education as instruments for modelling the probability of the respondent being in employment.

3.5 Results

This section discusses the results related to the determinants of psychological well-being using cross-sectional data for adults aged 25-65 using OLS. Two samples are explored: all individuals comprising employed and unemployed individuals; and employees only. In order to deal with the potential problem of sample selection bias, a Heckman approach is employed when we model psychological well-being for the employed sample only. For purposes of comparison, we explore five different dependent variables: namely, 15-STAI, anxiety, social dysfunction, loss of confidence and negative STAI as defined above. Although we analyse five different psychological well-being measures, in all cases, the higher is the score, the higher is the well-being. The results are presented in Tables 3.2, 3.3, 3.4, 3.5, 3.6 and 3.7 in Appendix Three.

3.5.1 The Full Sample (employed and unemployed individuals)

Table 3.2 presents the results of estimating the models for the five psychological well-being measures using OLS over the full sample. The sample size is 2,629 observations. As shown in column 1, the results with the '15-STAI' dependent variable are in line with expectations and accord with the existing literature. Age is found to exhibit a U-shaped relationship with psychological well-being; however, this relationship is only statistically significant at the 10% level. This finding has been found

for many countries. For example, well-being has been found to reach its lowest level in the late ’30s or early ’40s for the British (Clark et al., 1996). Males report better mental health than females. This finding is consistent with UK studies by Clark and Oswald (1994) and Clark (1996), in that men tend to report better mental health than women. Turning to marital status, the estimated coefficient for the married dummy variable is positive. The finding that married individuals have better psychological health than single individuals is well-documented in recent UK and US studies (see, for example, Blanchflower and Oswald, 2004). This may be due to a ‘selection effect’ which suggests that happy people are selected into marriage. In other words, healthier people are more likely to attract mates, and, therefore, more likely to be in a married relationship. Another possible explanation is that married individuals benefit either from financial or emotional support, which reduces the overall burden on married individuals which may affect their well-being (see Smock et al., 1999, for the US; Ross et al., 1990, for the US). The findings suggest a positive correlation between education and mental health, which accords with intuition, indicating that individuals with a degree have better psychological well-being.

It is not surprising to see that the set of health problems is negatively associated with psychological health. This result has also been found using British data (e.g., Shields and Wheatley Price, 2005). In addition, our results indicate that the psychological health of individuals who have heart problems is particularly adversely affected. Being in employment appears to positively affect an individual’s psychological health. This result can be explained by sample selection into employment which suggests that healthier individuals tend to have a job. For example, Andrés (2004) suggested that simultaneity exists between mental health and labour market status. For the lifestyle variables, smoking has no statistically significant impact on psychological health, while a positive correlation between exercise and mental health is found in our study. This finding is consistent with the findings from a UK study by Llena-Nozal et al. (2004). This relationship has been discussed in existing studies in that physical activity has been found to help to reduce stress among, for example, Canadian workers (Marchand et al., 2005).

Column 2 in Table 3.2 presents the results relating to the ‘anxiety’ dependent variable. The results are similar to those in column one. However, the number of children aged 13-18 is found to be negatively correlated with well-being and this result is supported

by Clark and Oswald's (1994) study for the UK. While marriage is found to have a positive impact on the anxiety measure, the effect is statistically insignificant. The results from estimating the 'social dysfunction' model are presented in column 3 in Table 3.2. The estimated coefficient for age is negative and statistically insignificant. However, a positive correlation between the squared age term and well-being is found. The results for the model with the 'loss of confidence' measure as the dependent variable are presented in column 4 of Table 3.2. None of the effects of age and health problems are statistically significant in this case. The estimated results for the 'negative STAI' measure (column 5 in Table 3.2) show that the only difference from the results based on the '15-STAI' measure is that the sizes of the coefficients are smaller than that estimated in the 15-STAI regression.

3.5.2 The Employed Sample

We now re-estimate all of the models for the employed-only sample, omitting the employed dummy variable, without (Table 3.3) and with (Table 3.4) controlling for potential sample selection into employment. In order to correct for sample selection bias, a Heckman approach (Heckman, 1979) is applied. The results from estimating the selection equation are presented in Table 3.5.[42] The estimated employment probit equation shows that the parents' education influences the offspring's probability of being in employment. There is a negative impact on the probability of being in employment if the father has a university or higher education degree compared to those individuals whose fathers received no education. However, the effect of the mother's education on an individual's employment has the opposite sign.[43] In Table 3.3 (without the sample selection correction), the results estimated over the sample of 1,971 employees are very similar to the results reported in Table 3.2, with changes only observed at the second decimal place; hence our basic story does not change. Turning to the model with the sample selection correction, the inverse mills ratio term created from the probit employment model is included as an additional explanatory variable in all five psychological well-being models presented in Table 3.4 estimated over the sample

[42] The selection equation is the same for each of the five psychological well-being models. Hence, we present the results for the employment probit for the case of '15-STAI' only, see Table 3.5 in Appendix Three.

[43] These findings suggest that the use of parents' education as instruments in determining the probability of employment is appropriate.

of employees only.[44] The estimated coefficient of the inverse mills ratio term is positive in all the models, except for 'anxiety' and 'negative STAI', suggesting that the absence of correcting for sample selection would exert a downward bias on psychological well-being. However, the estimated coefficient on the inverse mills ratio term is statistically insignificant in most of the models (only being statistically significant in the 'anxiety' model). This finding suggests that sample selection bias is not a problem for modelling mental health (except in the case of the 'anxiety' dependent variable).

Column 1 in Table 3.4 presents the results of estimating the model with the '15-STAI' as the dependent variable for the employed sample. In the '15-STAI' equation, there is no big difference in the results in the model without controlling for sample selection (Table 3.3): it appears that only age turns out to be statistically insignificant. Column 2 presents the results of estimating the 'anxiety' model. Overall, the estimated results have the expected signs after correcting for sample selection. Interestingly, the estimated coefficient for income is found to be statistically significant and has a negative impact on 'anxiety', whereas no effect has been found for the sample of all individuals. The relationship between income and well-being is not clear in the existing literature. Some studies find a positive relationship (e.g., Clark, et al., 2001, for Germany). However, other studies find that the relationship is nonexistent (e.g., Wildman and Jones, 2002, for the UK). Some studies have argued that it is the individual's relative income rather than absolute income that is related to mental health (see, e.g., Clark and Oswald, 1996, for the UK). The estimated coefficient on the inverse mills ratio term is negative and statistically significant in this case; the negative sign suggests that not controlling for sample selection would bias the estimated results.

The results from modelling 'social dysfunction' estimated over the employed sample are presented in column 3 in Table 3.4. The results suggest that the effect of education is larger than that based on the results estimated over all individuals. In Table 3.4 column 4, the same pattern of results for the model with 'loss of confidence' as the dependent variable is found as in the case of the sample of all individuals. Column 5 in Table 3.4 presents the results of the model with the 'negative STAI' as the dependent variable. In general, a wide range of individual characteristics are found to be important

[44] The selection equation is the same for each of the five psychological well-being model. Hence, we present the results for the employment probit model for the case of '15-STAI' only, see Table 3.5 in Appendix Three.

determinants of the ‘negative STAI’ measure. Overall, there appears to be very little difference between the estimates across the different well-being measures, as well as across those resulting from different samples and different specifications, i.e., with and without correcting for sample selection bias.

3.5.3 The Employed Sample – Additional Job Characteristic Controls

In order to investigate the effects of occupational position and working hours on well-being, we expand the set of explanatory variables used in the employees only model. We include additional control variables for occupational status and working hours. Table 3.6 presents the results of the five models for each of the psychological well-being measures estimated over employees only but not corrected for sample selection bias.

Column 1 in Table 3.6 presents the results where ‘15-STAI’ is the dependent variable. Focusing on occupational status, there are only statistically significant positive effects from the professional, manager and office worker occupational groups compared to those individuals in the elementary category (the omitted category). Thus, better well-being is significantly correlated with relatively high occupational positions. One possible explanation is that individuals have more freedom to choose the tasks they perform or make their own decisions independently if working in a high occupational position, and it seems reasonable to assume that the more freedom, the better the well-being. It is supported by Benz and Frey’s (2006) finding that the well-being of German employees depends on the working hierarchy, i.e., the level of freedom in making decisions. Clark (2003) studied the case of the UK and found that high-wage occupations are associated with high job satisfaction. With respect to working hours, the positive effects for all hours categories are associated with the ’15-STAI’ measure, but they are not statistically significant.

Column 2 in Table 3.6 presents the results from estimating the model with ‘anxiety’ as the dependent variable. With respect to the additional variables, occupation does not appear to influence well-being. This is also true for working hours, and none of the effects are statistically significant here. Column 3 in Table 3.6 presents the results for the ‘social dysfunction’ model. Working an average of 36 to 45 hours per week compared to those working less than 15 hours (the omitted category) is found to have a positive impact on the ‘social dysfunction’ score. This suggests that standard working

hours can bring benefits in terms of psychological health. Gottholmseder et al. (2009) found that working long hours each week is likely to induce stress. The estimated coefficient for working over 60 hours per week however is not found to be statistically significant here in the case of the 'social dysfunction' measure. In contrast to the 'anxiety' measure, in the case of 'social dysfunction', there appears to be substantial variation in terms of well-being across occupations. For example, we find that being a professional or manager leads to better well-being but the effects are statistically insignificant in the case of 'anxiety' measure. The results relating to 'loss of confidence' are presented in column 4 in Table 3.6. There appear to be differences in the effects of occupations on well-being. For example, we find that being a professional, a manager, an office worker, a clerk, a service worker or a machine operator leads to better well-being compared to being an elementary employee. However, there is no evidence to show that being in occupations such as agricultural work is correlated with high levels of well-being. Turning to the regression results related to the 'negative STAI' measure, as shown in column 5 in Table 3.6, for occupational categories, the estimated coefficient of being in a professional, office's or operator's occupation is positively associated with the level of psychological health. Working hours are found to exhibit a positive relationship with 'negative STAI' but the set of dummy variables for hours worked are not statistically significant.

3.5.4 The Employed Sample – Additional Job Characteristics Controls and Sample Selection

We repeat the analysis discussed in the previous sub-section including the inverse mills ratio terms to correct for potential sample selection bias associated with analysing a sample of employees only (see Table 3.7). We focus our discussion here once again on how the additional control variables related to job characteristics, hours worked and occupation, affect well-being. Table 3.7 presents all five models related to the five well-being measures.[45] The estimated coefficient on the inverse mills ratio term is positive in the models for '15-STAI', 'social dysfunction' and 'loss of confidence' and is negative in the model for 'negative STAI' measure. However, the estimated coefficients on the four inverse mills ratio terms are not statistically significant, suggesting that

[45] We present the results for the employment sample selection equation only in the case of the 15-STAI measure (see Table 3.5). The results are largely the same as those estimated in the case of the models based on the original set of explanatory variables.

sample selection is not a problem for these four models. However, negative estimated coefficients are observed in the models for 'anxiety', indicating that not controlling for sample selection would lead to bias, suggesting that sample selection does matter in the case of the 'anxiety' measure.

The results of modelling the '15-STAI' measure (column 1, Table 3.7) are found to be in line with expectations since the signs of most of the estimated coefficients follow the same pattern as the estimated coefficients in the OLS model for occupation and for worked hours. Column 2 in Table 3.7 presents the results with 'anxiety' as the dependent variable. The estimated coefficient on the inverse mills ratio term is negative at the 5% significance level and, therefore, ignoring sample selection into employment would lead to bias estimates. The results are largely in line with those presented in Table 3.6 exhibiting the same signs and levels of statistical significance. Specifically, controlling for sample selection does not appear to influence the results related to hours of work and occupation.

3.6 Conclusion

In this chapter we have investigated the determinants of psychological well-being with a particular focus on individuals aged 25-65 in Taiwan. The empirical analysis is based on survey data obtained from the 2005 Panel Study of Family Dynamics (PSFD). This chapter has contributed to the growing empirical literature on Taiwan in two respects. Firstly, we have adopted the State-Trait Anxiety Inventory (STAI) developed by Spielberger et al. (1983) in order to classify psychological well-being according to five factors, namely, 15-STAI, anxiety, social dysfunction, loss of confidence, and negative STAI. To our knowledge, this is the first economics study to adopt this measure for Taiwan. Secondly, existing studies for Taiwan generally focus on specific groups of individuals, such as those in specific occupations and hence focus on relatively small samples. In contrast, our study is the first for Taiwan to explore whether job characteristics affect individual psychological well-being based on a relatively large sample that is nationally representative.

The first main finding is that across the five different models of well-being, exercise is positively correlated with a higher level of individual well-being, even when a large number of job characteristics are controlled for. Secondly, working 36-45 hours per week is positively correlated with well-being, suggesting benefits from working a

standard number of hours. Working long hours (i.e. over 60 hours per week) does not appear to enhance well-being. In addition, in accordance with the well-documented relationship between well-being and labour market status, we also find evidence suggesting that the higher the occupational position, the better the well-being.

It is important to acknowledge that we recognise some limitations of this study. First, the findings are based on cross-sectional data which means that our analysis simply captures correlations and, hence, this raises the question of causality. The absence of panel data means that we are unable to control for time invariant unobserved individual characteristics, which may affect well-being. Secondly, the original STAI is a self-reported measure of anxiety which consists of 20 items. However, only 15 out of the 20 items are included in the PSFD. Therefore, the estimation results should be interpreted with caution given the 5 missing items for STAI and the resulting imbalance in the number of negative and positive items. Finally, because our sample is relatively small, we have not split the sample by gender, which may have revealed gender differences and may have helped to develop a better understanding of the determinants of well-being.

In summary, the results highlight a significant positive effect of working standard hours on psychological well-being. Our findings suggest that aiming to promote labour force participation based on standard working hours may positively benefit the psychological health of individuals. In addition, we find that doing exercise has a significant effect in terms of improving psychological well-being. These findings suggest that encouraging people to do regular exercise may also be an effective way of improving people's well-being.

Appendix Three

Figure 3.1 Five STAI categories (all individuals and employed individuals, respectively)

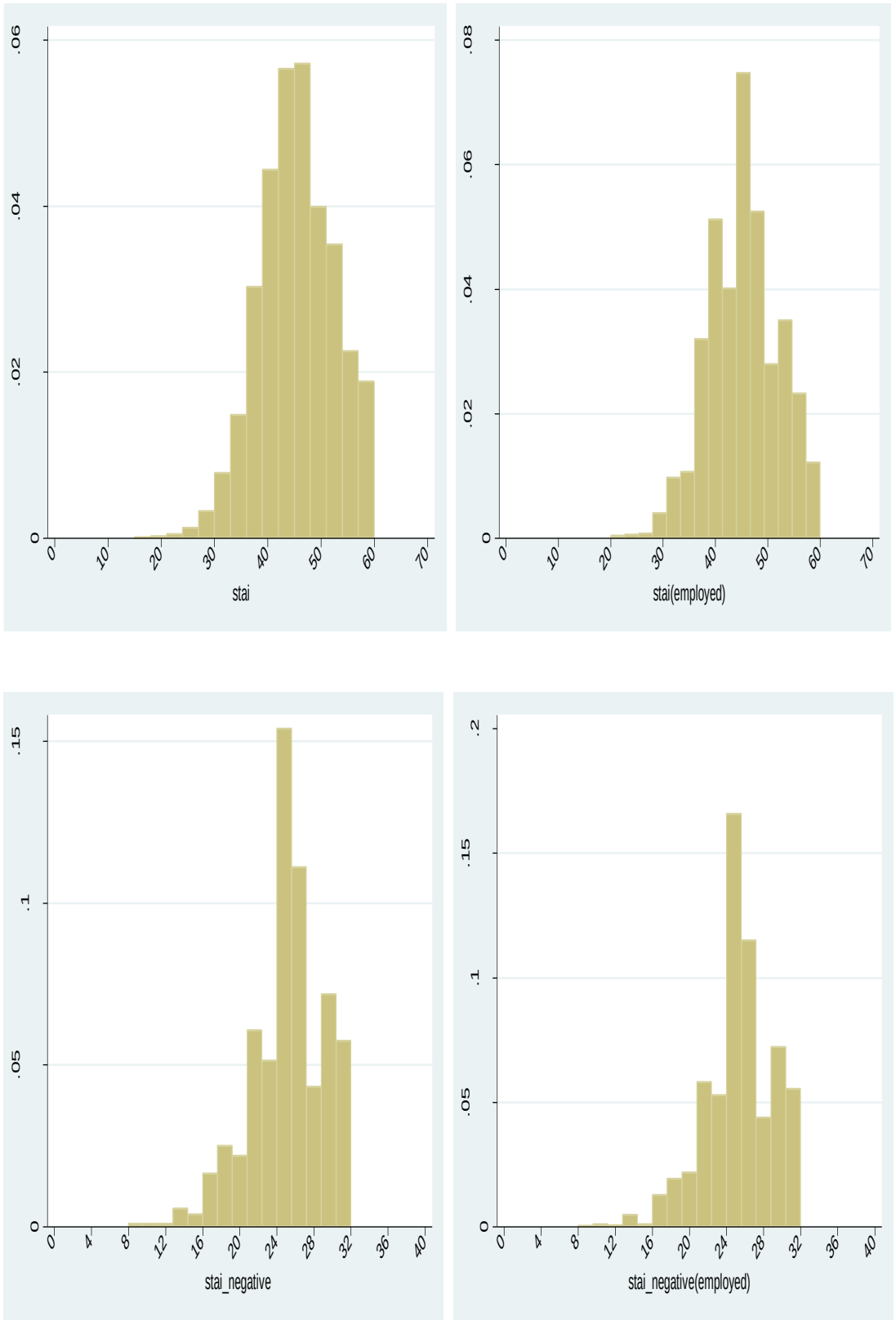


Figure 3.1 Five STAI categories (all individuals and employed individuals, continued)

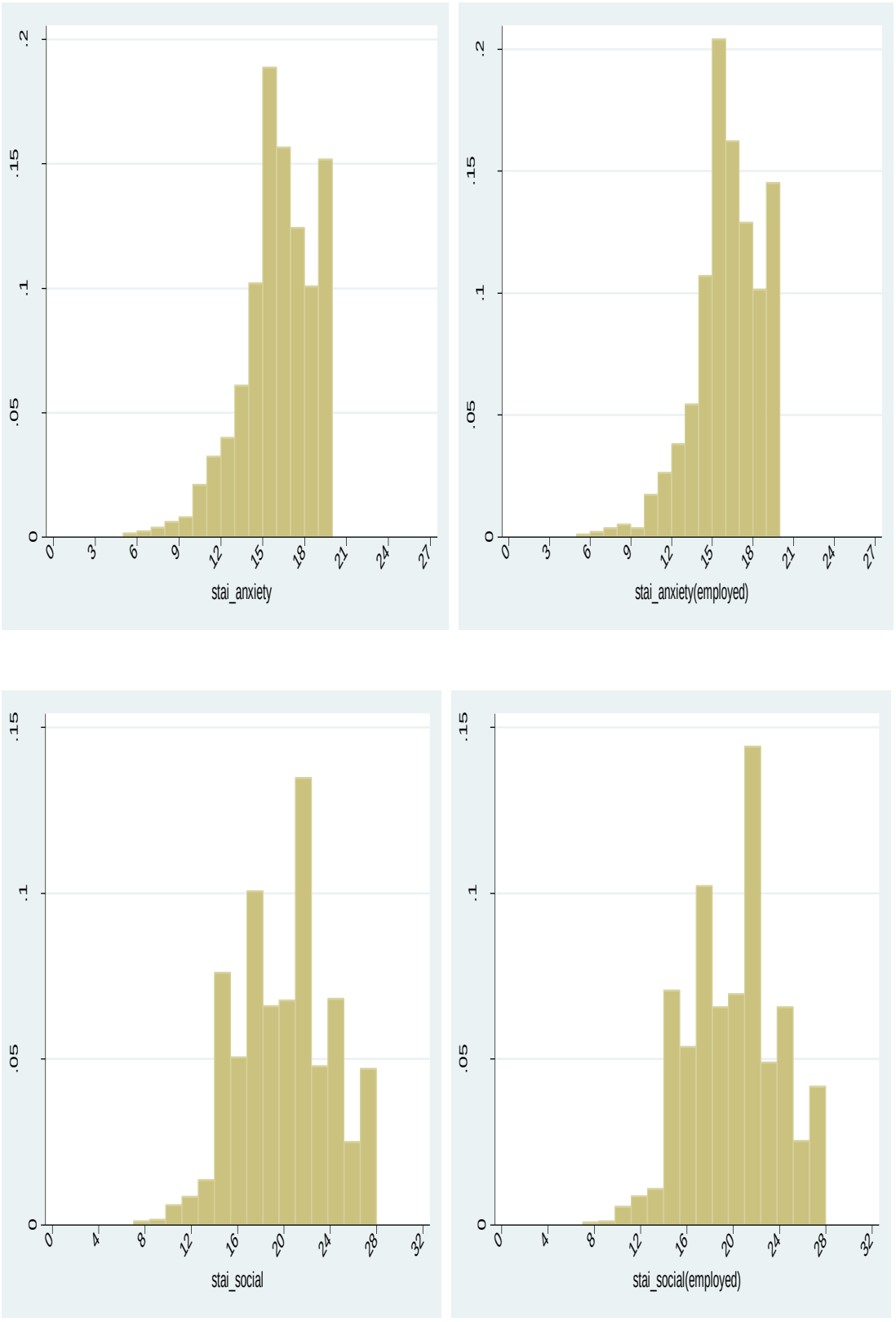


Figure 3.1 Five STAI categories (all individuals and employed individuals, continued)

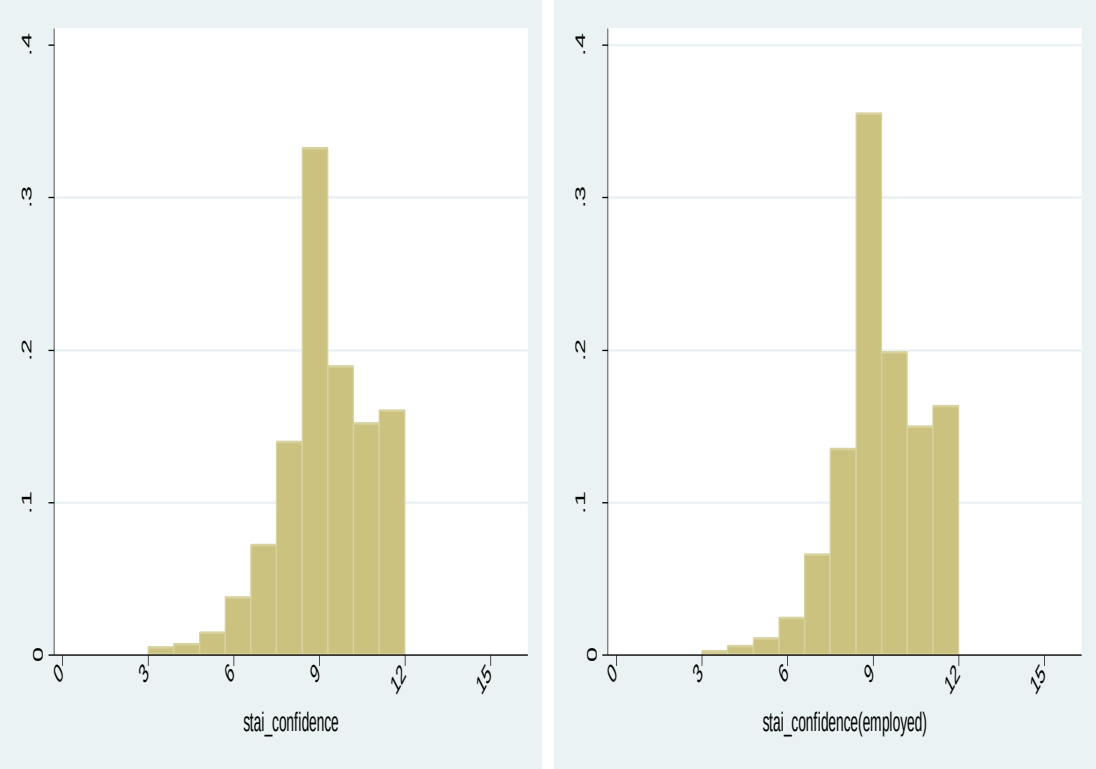


Table 3.1 Descriptive Statistics

	All individuals (N=2629)		Employed individuals (N=1971)	
Variable	Mean	STD	Mean	STD
Continuous and categorical				
Log household income	3.33	2.16	6.83	1.40
Number of children aged 0-7	0.22	0.55	0.25	0.58
Number of children aged 8-12	0.20	0.52	0.23	0.55
Number of children aged 13-18	0.25	0.60	0.29	0.64
Age	45.38	11.67	43.11	10.95
Dependent variable				
15-STAI	44.98		45.19	
Anxiety	15.64		15.72	
Social dysfunction	19.94		19.96	
Loss of confidence	9.41		9.50	
Negative STAI	25.05		25.23	
Binary (%)				
Health status				
Heart problem	2.85		1.88	
Diabetes	3.46		1.88	
High blood pressure	6.35		3.96	
Cancer	0.65		0.30	
Gender				
Male	51.96		59.21	
Marital status				
Married	72.96		72.40	
Education levels				
No education (omitted category)	6.81		4.92	
Elementary school education	23.01		17.10	
Junior high school education	13.43		13.80	
Senior high school education	32.10		35.21	
University or above education	24.65		28.97	
Father's education levels				
No education (omitted category)	36.33		30.85	
Elementary school education	38.04		40.64	
Junior high school education	9.85		11.26	
Senior high school education	11.07		12.28	
University or above education	4.72		4.97	
Mother's education levels				
No education (omitted category)	53.59		48.40	
Elementary school education	33.62		36.78	
Junior high school education	6.73		7.97	
Senior high school education	4.83		5.58	
University or above education	1.22		1.27	
Lifestyle				
Exercise (at least one hour per week)	29.14		26.64	
Smoking (current smokers or used to smoke)	35.45		38.56	
Labour force participation				
Employed	74.97			
Occupational categories				
Professional			10.65	
Managers			5.21	
Office workers			11.18	
Clerk			12.25	
Services			7.87	
Agricultural/ fishery			5.52	
Craft men			4.22	
Operator workers			6.31	
Elementary workers (omitted category)			11.75	
Weekly working hours				
Worked 1-15 hours (omitted category)			4.36	
Worked 16-35 hours			10.81	
Worked 36-45 hours			38.71	
Worked 46-59 hours			26.08	
Worked over 60 hours			20.04	

Table 3.2 Results of Ordinary Least Squares (Sample=All individuals)

	(1)	(2)	(3)	(4)	(5)
Dependent variable	15-stai	anxiety	social dysfunction	loss of confidence	negative STAI
Age	-0.216*	-0.092*	-0.105	-0.019	-0.111*
	(0.12)	(0.04)	(0.07)	(0.03)	(0.07)
Age sq	0.004**	0.001**	0.002**	0.000	0.002**
	(0.00)	0.00	(0.00)	0.00	(0.00)
Male	1.107**	0.585**	0.224	0.298**	0.883**
	(0.33)	(0.13)	(0.19)	(0.09)	(0.19)
Married	0.762*	0.165	0.376*	0.221*	0.386*
	(0.39)	(0.15)	(0.22)	(0.10)	(0.22)
Elementary	0.505	0.359	0.091	0.055	0.414
	(0.60)	(0.23)	(0.34)	(0.15)	(0.34)
Junior high	1.521*	0.654**	0.691*	0.176	0.830*
	(0.66)	(0.25)	(0.38)	(0.17)	(0.38)
Senior high	1.537*	0.494*	0.753*	0.290*	0.784*
	(0.62)	(0.23)	(0.35)	(0.16)	(0.35)
University	1.988**	0.506*	1.117**	0.365*	0.871*
	(0.63)	(0.24)	(0.36)	(0.16)	(0.36)
Num of children aged 0-7	-0.077	-0.118	0.031	0.010	-0.108
	(0.28)	(0.11)	(0.16)	(0.07)	(0.16)
Num of children aged 8-12	-0.183	-0.096	-0.125	0.038	-0.058
	(0.28)	(0.11)	(0.16)	(0.07)	(0.16)
Num of children aged 13-18	-0.210	-0.179*	-0.018	-0.013	-0.192
	(0.24)	(0.09)	(0.14)	(0.06)	(0.14)
Log household income	-0.038	-0.011	-0.008	-0.018	-0.029
	(0.07)	(0.03)	(0.04)	(0.02)	(0.04)
Heart problem	-1.851*	-0.708*	-0.803	-0.341	-1.049*
	(0.86)	(0.33)	(0.50)	(0.22)	(0.49)
Diabetes	-1.421*	-0.435	-0.771*	-0.215	-0.650
	(0.76)	(0.29)	(0.44)	(0.19)	(0.43)
Blood pressure	-1.061*	-0.927**	-0.006	-0.127	-1.054**
	(0.62)	(0.23)	(0.35)	(0.16)	(0.35)
Cancer	-2.404	-0.778	-1.093	-0.533	-1.311
	(1.66)	(0.63)	(0.95)	(0.42)	(0.95)
Exercise	1.499**	0.392**	0.806**	0.301**	0.693**
	(0.30)	(0.12)	(0.17)	(0.08)	(0.17)
Smoke	-0.213	0.007	-0.262	0.041	0.049
	(0.34)	(0.13)	(0.20)	(0.09)	(0.19)
Employ	1.691**	0.490**	0.742**	0.458**	0.949**
	(0.37)	(0.14)	(0.21)	(0.09)	(0.21)
Constant	42.308**	15.508**	18.337**	8.463**	23.970**
	(2.36)	(0.90)	(1.36)	(0.60)	(1.35)
Number of observations	2,629	2,629	2,629	2,629	2,629
F-value	12.03	9.45	10.74	7.10	9.68
p-value	0.00	0.00	0.00	0.00	0.00

Notes: (1)***p<0.01, **p<0.05, *p<0.10 (2) Standard errors in parentheses. (3) Omitted categories: Female; Single; No education; Not being in employment.

Table 3.3 Results of Ordinary Least Squares (Sample=Employed individuals)

	(1)	(2)	(3)	(4)	(5)
Dependent variable	15-stai	anxiety	social dysfunction	loss of confidence	negative STAI
Age	-0.234*	-0.110*	-0.086	-0.037	-0.147*
	(0.135)	(0.051)	(0.079)	(0.034)	(0.076)
Age sq	0.004**	0.002**	0.002*	0.001	0.002*
	(0.002)	(0.001)	(0.001)	0.000	(0.001)
Male	1.295**	0.617**	0.357*	0.322**	0.939**
	(0.359)	(0.136)	(0.210)	(0.090)	(0.203)
Married	0.808*	0.147	0.402	0.258*	0.406
	(0.441)	(0.167)	(0.259)	(0.111)	(0.250)
Elementary	1.117	0.548*	0.299	0.270	0.818*
	(0.773)	(0.292)	(0.453)	(0.194)	(0.437)
Junior high	1.762*	0.683*	0.806*	0.273	0.957*
	(0.817)	(0.309)	(0.479)	(0.205)	(0.462)
Senior high	1.670*	0.505*	0.852*	0.313*	0.818*
	(0.756)	(0.286)	(0.444)	(0.190)	(0.428)
University	2.101**	0.465	1.269**	0.367*	0.832*
	(0.764)	(0.289)	(0.448)	(0.192)	(0.433)
Num of children aged 0-7	-0.267	-0.169	-0.095	-0.002	-0.172
	(0.298)	(0.113)	(0.175)	(0.075)	(0.169)
Num of children aged 8-12	-0.297	-0.132	-0.187	0.022	-0.110
	(0.286)	(0.108)	(0.168)	(0.072)	(0.162)
Num of children aged 13-18	-0.146	-0.164*	0.010	0.007	-0.156
	(0.255)	(0.097)	(0.149)	(0.064)	(0.144)
Log household income	0.058	0.013	0.031	0.014	0.027
	(0.108)	(0.041)	(0.063)	(0.027)	(0.061)
Heart problem	0.775	0.526	0.018	0.231	0.757
	(1.151)	(0.436)	(0.675)	(0.289)	(0.651)
Diabetes	-1.926*	-0.329	-1.161*	-0.436	-0.765
	(1.099)	(0.416)	(0.644)	(0.276)	(0.622)
Blood pressure	-1.355*	-1.167**	-0.024	-0.164	-1.331**
	(0.819)	(0.310)	(0.480)	(0.205)	(0.464)
Cancer	-2.592	-0.611	-1.778	-0.203	-0.814
	(2.653)	(1.004)	(1.556)	(0.665)	(1.502)
Exercise	1.406**	0.372**	0.769**	0.265**	0.638**
	(0.341)	(0.129)	(0.200)	(0.086)	(0.193)
Smoke	-0.133	0.030	-0.207	0.044	0.074
	(0.362)	(0.137)	(0.212)	(0.091)	(0.205)
Constant	43.704**	16.261**	18.381**	9.062**	25.323**
	(2.727)	(1.032)	(1.599)	(0.684)	(1.543)
Number of observations	1,971	1,971	1,971	1,971	1,971
F-value	8.65	6.91	7.75	4.50	6.72
p-value	0.00	0.00	0.00	0.00	0.00

Notes: (1)***p<0.001, **p<0.005, *p<0.05 (2) Standard errors in parentheses. (3) Omitted categories: Female; Single; No education; Not being in employment.

Table 3.4 Heckman Sample Selection Models (Sample=Employed individuals)

	(1)	(2)	(3)	(4)	(5)
Dependent variable	15-stai	anxiety	social dysfunction	loss of confidence	negative STAI
Age	-0.232	-0.219**	-0.062	-0.037	-0.161*
	(0.141)	(0.055)	(0.085)	(0.035)	(0.081)
Age sq	0.004*	0.003**	0.002	0.001	0.002*
	(0.002)	(0.001)	(0.001)	0.000	(0.001)
Male	1.305**	-0.099	0.516*	0.327**	0.847**
	(0.456)	(0.165)	(0.288)	(0.111)	(0.268)
Married	0.808*	0.171	0.399	0.258*	0.407
	(0.439)	(0.178)	(0.258)	(0.110)	(0.249)
Elementary	1.116	0.579*	0.291	0.269	0.822*
	(0.769)	(0.302)	(0.451)	(0.193)	(0.436)
Junior high	1.763*	0.596*	0.821*	0.274	0.948*
	(0.813)	(0.324)	(0.478)	(0.204)	(0.460)
Senior high	1.671*	0.412	0.867*	0.314*	0.810*
	(0.753)	(0.300)	(0.442)	(0.189)	(0.427)
University	2.105**	0.177	1.328**	0.369*	0.799*
	(0.768)	(0.307)	(0.453)	(0.192)	(0.435)
Num of children aged 0-7	-0.268	-0.069	-0.117	-0.003	-0.159
	(0.299)	(0.123)	(0.176)	(0.075)	(0.170)
Num of children aged 8-12	-0.298	-0.081	-0.197	0.021	-0.104
	(0.285)	(0.118)	(0.168)	(0.071)	(0.161)
Num of children aged 13-18	-0.146	-0.188*	0.015	0.007	-0.159
	(0.254)	(0.105)	(0.149)	(0.064)	(0.144)
Log household income	0.061	-0.207**	0.079	0.016	-0.001
	(0.138)	(0.047)	(0.087)	(0.034)	(0.081)
Heart problem	0.771	0.786*	-0.039	0.229	0.791
	(1.150)	(0.448)	(0.676)	(0.288)	(0.652)
Diabetes	-1.935*	0.360	-1.307*	-0.441	-0.681
	(1.124)	(0.428)	(0.667)	(0.281)	(0.640)
Blood pressure	-1.358*	-0.976**	-0.064	-0.165	-1.309**
	(0.818)	(0.319)	(0.481)	(0.205)	(0.464)
Cancer	-2.606	0.267	-2.019	-0.211	-0.678
	(2.674)	(0.989)	(1.578)	(0.669)	(1.517)
Exercise	1.403**	0.607**	0.715**	0.263**	0.669**
	(0.353)	(0.140)	(0.210)	(0.088)	(0.202)
Smoke	-0.134	0.133	-0.224	0.043	0.084
	(0.361)	(0.149)	(0.213)	(0.091)	(0.205)
Constant	43.645**	20.565**	17.412**	9.027**	25.882**
	(3.217)	(1.189)	(1.998)	(0.789)	(1.874)
Number of observations	1,971	1,971	1,971	1,971	1,971
Inverse mills ratio term	0.116	-2.187	0.630	0.237	-0.265
(p-value)	(0.903)	(0.002)	(0.359)	(0.911)	(0.617)

Notes: (1)***p<0.01, **p<0.05, *p<0.10 (2) Standard errors in parentheses. (3) Omitted categories: Female; Single; No education; Not being in employment.

Table 3.5 Results of Probit Employment Equation (Sample=All individuals)

	(1)
Dependent variable	employment
Age	0.123**
	(0.026)
Age sq	-0.002**
	0.000
Male	0.870**
	(0.080)
Married	-0.051
	(0.089)
Elementary	-0.161
	(0.127)
Junior high	-0.100
	(0.151)
Senior high	-0.108
	(0.145)
University	0.173
	(0.158)
Num of children aged 0-7	-0.073
	(0.072)
Num of children aged 8-12	-0.025
	(0.071)
Num of children aged 13-18	0.041
	(0.060)
Log household income	0.199**
	(0.015)
Heart problem	-0.243
	(0.181)
Diabetes	-0.553**
	(0.157)
Blood pressure	-0.137
	(0.129)
Cancer	-0.743*
	(0.347)
Exercise	-0.286**
	(0.069)
Smoke	-0.110
	(0.084)
Fathetr:Elementary	0.032
	(0.089)
Father:Junior high	0.175
	(0.139)
Father:Senior high	-0.175
	(0.142)
Father:University	-0.528*
	(0.207)
Mothetr:Elementary	0.058
	(0.088)
Mother:Junior high	0.348*
	(0.169)
Mother:Senior high	0.373*
	(0.205)
Mother:University	0.312
	(0.336)
Constant	-2.690**
	(0.566)
Number of observations	2,639
χ^2 test	821.52
p-value	0.00

Notes: (1)***p<0.01, **p<0.05, *p<0.10 (2) Standard errors in parentheses. (3) Omitted categories: Female; Single; No education; Not being in employment.

Table 3.6 Results of Ordinary Least Squares (Sample=Employed individuals, job characteristic controls)

	(1)	(2)	(3)	(4)	(5)
Dependent variable	15-stai	anxiety	social dysfunction	loss of confidence	negative STAI
Age	-0.314*	-0.127*	-0.133	-0.054	-0.181*
	(0.139)	(0.053)	(0.081)	(0.035)	(0.079)
Age sq	0.005**	0.002**	0.002**	0.001*	0.003**
	(0.002)	(0.001)	(0.001)	0.000	(0.001)
Male	1.226**	0.615**	0.302	0.309**	0.924**
	(0.375)	(0.142)	(0.220)	(0.094)	(0.213)
Married	0.813*	0.152	0.399	0.262*	0.414*
	(0.443)	(0.168)	(0.260)	(0.111)	(0.251)
Elementary	1.145	0.534*	0.294	0.317	0.851*
	(0.780)	(0.296)	(0.457)	(0.195)	(0.442)
Junior high	1.623*	0.643*	0.705	0.275	0.918*
	(0.826)	(0.314)	(0.484)	(0.207)	(0.469)
Senior high	1.236	0.420	0.578	0.238	0.659
	(0.769)	(0.292)	(0.451)	(0.193)	(0.436)
University	1.229	0.327	0.712	0.191	0.517
	(0.798)	(0.303)	(0.468)	(0.200)	(0.453)
Num of children aged 0-7	-0.191	-0.147	-0.057	0.012	-0.134
	(0.300)	(0.114)	(0.176)	(0.075)	(0.170)
Num of children aged 8-12	-0.227	-0.114	-0.149	0.036	-0.078
	(0.287)	(0.109)	(0.168)	(0.072)	(0.163)
Num of children aged 13-18	-0.081	-0.145	0.043	0.022	-0.123
	(0.256)	(0.097)	(0.150)	(0.064)	(0.145)
Worked 16-35 hours	0.626	0.195	0.447	-0.016	0.179
	(0.832)	(0.316)	(0.488)	(0.209)	(0.472)
Worked 36-45 hours	1.220	0.328	0.892*	0.000	0.328
	(0.761)	(0.289)	(0.446)	(0.191)	(0.432)
Worked 46-59 hours	1.004	0.183	0.738	0.083	0.266
	(0.774)	(0.294)	(0.454)	(0.194)	(0.439)
Worked more than 60 hours	0.969	0.293	0.643	0.033	0.326
	(0.795)	(0.302)	(0.466)	(0.199)	(0.451)
Log household income	0.015	0.000	0.010	0.006	0.005
	(0.109)	(0.041)	(0.064)	(0.027)	(0.062)
Heart problem	0.787	0.514	0.054	0.219	0.733
	(1.153)	(0.438)	(0.675)	(0.289)	(0.654)
Diabetes	-1.912*	-0.317	-1.134*	-0.462*	-0.778
	(1.100)	(0.417)	(0.644)	(0.276)	(0.624)
Blood pressure	-1.564*	-1.202**	-0.158	-0.204	-1.406**
	(0.822)	(0.312)	(0.482)	(0.206)	(0.466)
Cancer	-2.359	-0.579	-1.622	-0.158	-0.737
	(2.658)	(1.009)	(1.557)	(0.666)	(1.507)
Exercise	1.292**	0.339**	0.715**	0.238**	0.577**
	(0.344)	(0.131)	(0.202)	(0.086)	(0.195)
Smoke	0.038	0.051	-0.101	0.088	0.139
	(0.365)	(0.138)	(0.214)	(0.091)	(0.207)
Professional	1.622**	0.265	0.842*	0.516**	0.780*
	(0.606)	(0.230)	(0.355)	(0.152)	(0.344)
Managers	1.509*	0.023	0.992*	0.494**	0.516
	(0.701)	(0.266)	(0.411)	(0.176)	(0.398)
Office workers	0.992*	0.199	0.409	0.384**	0.583*
	(0.589)	(0.224)	(0.345)	(0.148)	(0.334)
Clerks	0.587	0.138	0.207	0.242*	0.380
	(0.536)	(0.204)	(0.314)	(0.134)	(0.304)
Services	0.673	0.041	0.375	0.257*	0.298
	(0.594)	(0.226)	(0.348)	(0.149)	(0.337)
Agricultural/fishery workers	-0.836	-0.238	-0.494	-0.104	-0.341
	(0.721)	(0.274)	(0.422)	(0.181)	(0.409)
Craftsman	0.504	0.212	0.033	0.259	0.471
	(0.720)	(0.273)	(0.422)	(0.181)	(0.409)
Operators	0.662	0.300	0.019	0.342*	0.643*
	(0.631)	(0.239)	(0.370)	(0.158)	(0.358)
Constant	44.057**	16.295**	18.606**	9.157**	25.452**
	(2.943)	(1.117)	(1.724)	(0.738)	(1.669)
Number of observations	1,971	1,971	1,971	1,971	1,971
F-value	5.80	4.39	5.37	3.36	4.40
p-value	0.00	0.00	0.00	0.00	0.00

Notes: (1)***p<0.01, **p<0.05, *p<0.10 (2) Standard errors in parentheses. (3) Omitted categories: Female; Single; No education; Not being in employment; Worked 1-15 hours; Elementary occupation.

Table 3.7 Heckman Sample Selection Models (Sample=Employed individuals, job characteristic controls)

	(1)	(2)	(3)	(4)	(5)
Dependent variable	15-stai	anxiety	social dysfunction	loss of confidence	negative STAI
Age	-0.309*	-0.230**	-0.105	-0.053	-0.193*
	(0.144)	(0.056)	(0.086)	(0.036)	(0.082)
Age sq	0.005**	0.003**	0.002*	0.001*	0.003**
	(0.002)	(0.001)	(0.001)	0.000	(0.001)
Male	1.261**	-0.090	0.491*	0.317**	0.845**
	(0.468)	(0.170)	(0.297)	(0.113)	(0.271)
Married	0.812*	0.173	0.395	0.262*	0.415*
	(0.440)	(0.179)	(0.258)	(0.110)	(0.250)
Elementary	1.144	0.552*	0.284	0.317	0.855*
	(0.774)	(0.305)	(0.454)	(0.194)	(0.439)
Junior high	1.626*	0.553*	0.722	0.276	0.911*
	(0.820)	(0.327)	(0.482)	(0.206)	(0.465)
Senior high	1.239	0.334	0.592	0.239	0.652
	(0.763)	(0.304)	(0.448)	(0.191)	(0.433)
University	1.241	0.070	0.775*	0.193	0.490
	(0.798)	(0.318)	(0.470)	(0.200)	(0.453)
Num of children aged 0-7	-0.196	-0.052	-0.082	0.012	-0.124
	(0.300)	(0.123)	(0.177)	(0.075)	(0.170)
Num of children aged 8-12	-0.229	-0.068	-0.160	0.035	-0.073
	(0.285)	(0.118)	(0.168)	(0.072)	(0.162)
Num of children aged 13-18	-0.080	-0.171	0.048	0.022	-0.126
	(0.254)	(0.105)	(0.149)	(0.064)	(0.144)
Worked 16-35 hours	0.625	0.294	0.444	-0.016	0.181
	(0.826)	(0.293)	(0.483)	(0.207)	(0.468)
Worked 36-45 hours	1.221	0.398	0.897*	0.000	0.327
	(0.755)	(0.268)	(0.442)	(0.189)	(0.428)
Worked 46-59 hours	1.004	0.308	0.736	0.083	0.267
	(0.768)	(0.274)	(0.449)	(0.193)	(0.436)
Worked more than 60 hours	0.968	0.372	0.641	0.033	0.327
	(0.788)	(0.281)	(0.461)	(0.198)	(0.447)
Log household income	0.026	-0.217**	0.067	0.008	-0.019
	(0.138)	(0.047)	(0.087)	(0.033)	(0.080)
Heart problem	0.775	0.768*	-0.012	0.217	0.762
	(1.148)	(0.448)	(0.674)	(0.288)	(0.652)
Diabetes	-1.944*	0.367	-1.308*	-0.468*	-0.705
	(1.122)	(0.427)	(0.666)	(0.280)	(0.638)
Blood pressure	-1.572*	-1.011**	-0.206	-0.206	-1.386**
	(0.819)	(0.320)	(0.481)	(0.205)	(0.465)
Cancer	-2.411	0.325	-1.911	-0.168	-0.619
	(2.671)	(0.991)	(1.577)	(0.668)	(1.516)
Exercise	1.280**	0.578**	0.650**	0.235**	0.605**
	(0.355)	(0.141)	(0.212)	(0.088)	(0.202)
Smoke	0.035	0.147	-0.121	0.087	0.148
	(0.363)	(0.150)	(0.214)	(0.091)	(0.206)
Professional	1.622**	0.233	0.841*	0.516**	0.781*
	(0.601)	(0.228)	(0.353)	(0.151)	(0.341)
Managers	1.508*	0.003	0.991*	0.494**	0.516
	(0.696)	(0.263)	(0.408)	(0.174)	(0.394)
Office workers	0.993*	0.184	0.415	0.384**	0.581*
	(0.585)	(0.218)	(0.343)	(0.147)	(0.332)
Clerks	0.587	0.200	0.205	0.242*	0.381
	(0.532)	(0.198)	(0.312)	(0.133)	(0.302)
Services	0.670	0.140	0.359	0.257*	0.304
	(0.590)	(0.217)	(0.346)	(0.148)	(0.334)
Agricultural/fishery workers	-0.838	-0.144	-0.508	-0.104	-0.337
	(0.716)	(0.253)	(0.419)	(0.179)	(0.406)
Craftsman	0.503	0.198	0.028	0.259	0.472
	(0.715)	(0.262)	(0.419)	(0.179)	(0.405)
Operators	0.662	0.283	0.019	0.342*	0.644*
	(0.626)	(0.239)	(0.367)	(0.157)	(0.355)
Constant	43.848**	20.339**	17.476**	9.114**	25.929**
	(3.379)	(1.236)	(2.091)	(0.824)	(1.944)
Number of observations	1,971	1,971	1,971	1,971	1,971
Inverse Mills ratio	0.116	-2.187	0.630	0.023	-0.265
(p-value)	(0.902)	(0.002)	(0.359)	(0.911)	(0.617)

Notes: (1)***p<0.01, **p<0.05, *p<0.10 (2) Standard errors in parentheses. (3) Omitted categories: Female; Single; No education; Not being in employment; Worked 1-15 hours; Elementary occupation.

Chapter 4. Informal Care and Employment in Taiwan

4.1 Introduction

Taiwan is undergoing rapid population aging, which is leading to an increase in the number of elderly individuals. The percentage of the population above the age of 65 is projected to rise from 10.4 percent in 2008 to 20 percent by 2018.[46] Meanwhile, there is a projected decrease in the fertility rate from 1.05 in 2008 to 0.89 in 2010.[47] This means that working-age individuals are facing a greater probability than before of providing care for sick, disabled and elderly parents living within their households. This is not just a problem faced by Taiwan. In the US, for example, with the increased aging of the population, roughly one in five adults between the ages of 35 and 64 have been observed as providing care to an ill or disabled family member (Marks, 1996). In addition, a negative correlation between employment and informal caregiving responsibilities has often been found in a number of studies for the US (e.g., Ettner, 1996) and the UK (e.g., Carmichael and Charles, 2003). The issue of how to deal with the labour market costs associated with caring resulting from fewer working hours and more people being out of the labour force has attracted considerable interest in Taiwan amongst policy makers. Nevertheless, little is known about the relationship between informal care and employment in Taiwan, which is the focus of the empirical analysis presented in this chapter. Understanding this relationship is crucial as this is likely to shed light on a number of policy issues particularly those related to labour supply.

Caring responsibility has been viewed as an obligation or filial piety[48] in Taiwan. For example, in Taiwan, sons are expected to live with their parents in their old age and to provide financial support (Hsu and Shyu, 2003). On the other hand, daughters-in-law are expected to be the major carers for parents-in-law (Hsu and Shyu, 2003). Taiwanese statistics have shown that 90% of the disabled elderly are looked after by family members and among them around 70% of these carers are females (Wu and Lin, 1999). Therefore, informal care is the main source of help for the Taiwanese elderly and is generally left to family members. In addition, Taiwanese men and women face different

[46] Source: Council for Economic Planning and Development (CEPD), Taiwan: Population Projections for the Taiwan Area: 2006-2051 (2006).
[47] Source: Ministry of the Interior, Department of Statistics, Taiwan (2010).
[48] Filial piety is one of the virtues in Confucianism, whereby it is deemed that children have the responsibility to respect and take care of their parents as they age.

traditional cultural roles, meaning that women make up the majority of informal caregivers within a household while men are considered to be the breadwinners (Hsu and Shyu, 2003; Chen 2008). With regard to the traditional view, Taiwan may be an interesting case for studying the gender differences in the effects of informal caring on labour market outcomes, with a significant gender difference existing in the labour market participation rate (e.g., about 48% for women and 70% for men[49] in 2009). As the demand for informal care is likely to grow, the challenge of balancing the demands of caring for a disabled person and female employment becomes increasingly important. Hence, understanding the determinants of Taiwanese women's labour market participation decisions may help to inform policy focusing on raising female labour force participation. Males may provide additional caring to help their female counterparts. From a policy point of view, since men are a potential alternative source of caring work, it is also therefore crucial to understand how informal care responsibility impacts on men's employment decisions. Therefore, the empirical analysis presented in this chapter is also conducted separately by gender.

While there is no existing Taiwanese study that explores the relationship between informal care and employment decisions, we can use the findings from existing studies for other countries to provide a context for our analysis of Taiwan. In particular, there are three major factors that influence this association in either a positive or negative way identified in the UK studies (e.g., Heitmueller and Michaud, 2006; Heitmueller, 2007). First, the care decision may be negotiated amongst family members or with the person who needs to be looked after, depending on the household size or the demand for care. For example, a negative effect of household size on the probability of assuming caring responsibility may be observed under the hypothesis that individuals may reduce their caring work if they have more family members who can do the work: in this case, family members are substitutes for each other. This negative effect is supported by Knoef and Kooreman (2011), who found that the more siblings that individuals have, the fewer the visits to parents that take place across European countries. However, Bernheim et al. (1985) found a positive correlation which indicates that, in the US, the amount of care provided by a sibling positively depends on the amount of care given by

[49] Source: Directorate-General of Budget, Account and Statistics (DGBAS, 2009; Bureau of Labour Statistics, 2010).

the other siblings based on the view of a strategic bequest motive. Second, a trade-off between caring activity and paid work exists given the time constraints. Ettner (1995) provided evidence of reduced propensities of employment and of reduced hours of work, due to the provision of informal care in the US. As in Carmichael and Charles (2003), informal care was observed to reduce employment participation in Britain. Third, formal care serves as a substitute for informal care. This issue has been investigated in European countries and it has been found that informal care is a substitute for formal care (Viitanen, 2007).

Several studies have focused on dealing with the endogeneity problem[50] when attempting to estimate the relationship between informal care and labour market outcomes. There are two broad estimation strategies. For example, a simultaneous equations model for both informal care and labour force participation has been used and the two decisions have been estimated jointly in the US studies (e.g., Boaz and Muller, 1992; Börsch-Supan et al., 1992). Alternatively, a single equation using instrumental variable (IV) estimators has been more commonly employed within the more recent existing studies, such as a UK study by Heitmueller (2007). However, the IV approach is hard to apply in practice since it is difficult to obtain convincing instruments that are correlated with the endogenous caring variable but are independent of the employment outcome (Jones, 2007). Therefore, in order to investigate the relationship between caring and the employment decision for the Taiwanese, we estimate a series of probit models. First, we explore the determinants of employment and caring decisions separately using univarite probit models as our baseline models; we then estimate the relationship between the two decisions jointly via a bivariate probit model, accounting for unobserved factors which affect both decisions simultaneously; finally, a recursive bivariate probit model, which allows for the potential endogeneity of caring in the

[50] We do not have the same instruments as studies which were identified in the literature review, for example, the age of the three closest friends (Heitmuller, 2007). For this reason, we used a set of co-residence variables as instruments and these are were assumed to be unconnected with employment but connected with caring. Although the IV approach would involve addressing the possible endogeneity by means of a two-step Instrumental Variable regression (see, for example, Heitmueller, 2007), this approach ignores any correlation between the disturbances of the two equations, and, therefore, running bivariate probit and recursive bivariate probit models is a more efficient estimation procedure (Greene, 1998). Therefore, using bivariate probit and recursive bivariate probit models provides a better fit for our data since both models are based on the assumption of a binomial distribution between the error terms of the employment and caring equations, meaning that both models are identified even without instruments.

employment equation is employed.

Almost all disabled elderly people in Taiwan are cared for by their family members. This study has examined family caregivers' characteristics and the care of the disabled elderly being entrusted to caregivers. Family care for the disabled elderly is a long-term intensive commitment more likely to be undertaken by women. Caregivers also have other competing demands at the same time. These findings should be very important in decision making for the development of a long-term care system in Taiwan. The empirical analysis focuses on individuals aged between 50 and 65 using panel data from the Health and Living Status of the Middle Aged and Elderly in Taiwan. In the empirical analysis presented in this chapter, four types of carer are defined according to the survey questions. Individuals are classified as the first type of carer if they provide assistance to anyone within their family – adults or children – with everyday activities of daily living (ADLs), which include tasks such as eating, bathing and dressing; and/or with physical activities of daily living restrictions (IADLs), which include tasks such as shopping, meal preparation, using the telephone, and medication management. The second type of carer is where individuals look after their grandchildren. The third type of carer is where the individuals provide assistance to adult family members with either ADLs or IADLs. Finally, the last type of carer is where individuals provide financial support, including the provision of money, food, and clothing for their daily needs.

The findings suggest that caring responsibility is endogenous for women's employment but not for men's. A negative effect of informal care on labour market outcomes only applies to females. However, there is evidence that education is the most important factor determining female employment. On the other hand, financial support is observed to be endogenous in relation to men's employment and to have a positive effect on the male's employment.

The structure of this chapter is as follows. Section 4.2 reviews the relevant existing studies on informal caregiving and labour market outcomes, including the methodologies employed. Section 4.3 describes the data and the variables used in the estimation, Section 4.4 describes the econometric approach used and explains the estimation strategy, and Section 4.5 discusses the estimation results. Finally, Section 4.6 concludes, discusses policy implications, and highlights avenues for future research.

4.2 Literature Review

A small but growing number of studies explore the effect of caring on labour market participation in the economics literature.[51] An important theory related to this issue is the allocation of time to hours of work and hours of caring (see Wolf and Soldo, 1994; Ettner, 1995; Ettner, 1996; Bolin et al., 2008; Do, 2008). Overall, the empirical studies analysing the relationship between employment and caregiving differ due to the different samples and methodologies used by the various authors. In this section, we will review the relevant existing studies focusing on the methodologies employed in this research area.

It is assumed that labour market participation and informal care compete for an individual's scarce time (Heitmueller, 2007). Since caregivers potentially face a decision as to how to allocate time between employment and the caring responsibility, individuals must choose whether to provide care, to participate in the labour market, or to engage in both activities. There exist several studies which have sought to estimate the effect of caring on employment. For example, the study by Stone and Short (1990) was based on the time allocation theory and focused on nonspousal caregivers below the age of 65 in estimating the determinants of the caregiver's decision to work using a nested logit model. It is based on cross-sectional data from the 1982 US National Long Term Care Survey. The nested logit model assumed that caregivers maximized their utility by making choices among six alternatives: rearranging their schedules, reducing their work hours, taking time off without pay, working without a rearranged work schedule, and whether or not to be in employment. Since the first four choices were similar alternatives, Stone and Short (1990) grouped these four choices together and the last two choices were grouped as the 'other' category. As a result, a two-level nested logit model was modelled with two decisions: whether employed caregivers accommodated their work schedule and whether caregivers were employed. The nested model was estimated as a two-part model. The first step focused on employed caregivers and estimated the probability of rearranging the work schedule. The second step was to estimate the probability of employment for the entire sample of caregivers including the estimated probability of

[51] The other main branches of the existing literature examine, for example: whether formal (paid) and informal (unpaid) care are substitutes or complements (e.g., Van Houtven and Norton, 2004; Viitannen, 2007); the strategic use of bequests by parents in order to extract caring services from their children (e.g., Bernheim et al., 1985); the determinants of family care arrangements (e.g., Stern, 1995); and the approach to family bargaining (e.g., Engers and Stern, 2002).

re-arranging the work schedule in the first step as an additional regressor. Their findings suggested that younger, white and highly educated caregivers are more likely to choose to combine both work and care activities. In addition, they found that the group of caregivers who also chose to work are more likely to reduce their working hours and to take time off without pay.

Some existing studies focus on the simultaneous relationship between hours of paid work and hours of unpaid informal care because the decision about how much time should be allocated to paid work is arguably made jointly with the decision about how much time is to be devoted to caregiving. In other words, both paid work and unpaid caregiving are jointly determined. A variety of methodologies have been applied in the case of the jointly determined variables for example: the instrumental variable (IV) method and the two-stage least squares (2SLS) method (see e.g., Boaz and Muller, 1992; Ettner, 1995, 1996; Bolin et al., 2008; Do, 2008).

Boaz and Muller (1992) focused on adults providing unpaid care for a period of over three months to a nationally representative sample of the functionally impaired elderly (e.g., needing assistance with activities of daily living, ADLs). The cross-sectional data from two linked national surveys in the US, namely, the 1982 National Long-Term Care Survey (NLTCS) was used, which provides information on the characteristics of care recipients, and the National Informal Caregivers Survey (ICS), which provides information on the characteristics of their caregivers who helped with ADLs. Two labour market outcomes of interest were analysed: part-time work and full-time work, both represented by dummy variables. Since the hours of informal caring and labour market outcomes were jointly determined, two simultaneous models consisting of the two equations were employed. For example, one of the models contained two dependent variables of caring and part-time work and these two variables also appeared on the right-hand side of the other equation. Boaz and Muller (1992) also assumed that the care recipient's decision of whether to use formal care or not was influenced by their own caregiver's allocation of time. Therefore, the use of formal care was an endogenous variable in the informal caring equation and the labour market outcome model. In order to deal with the three potential endogenous variables (i.e., informal care hours, the use of formal care and labour market outcomes) in the model, a two-stage least squares

(2SLS) method was used. In the first stage, the predicted parameters for the three endogenous variables were estimated using the reduced-form equations. In the second stage, the right-hand side endogenous variables were replaced by these predicted parameters and then, the informal care equation was estimated using ordinary least squares (OLS) and the equation for part-time work was estimated via a logit model.[52] The results indicated that, as hours of parent care increase, the probability of full-time employment (compared to non full-time employment) falls. Also full-time employees provide substantially fewer hours of parent care per week, while there is no such effect for part-time employees. Additionally, the results show that gender differences exist in employment status where women are far less likely than men to have a full-time job. The findings also suggested that caregivers with more schooling are more likely to work full time than part time.

Börsch-Supan et al. (1992) matched cross-sectional data on the Massachusetts elderly with data for their children, which were drawn from the US 1986 Hebrew Rehabilitation Centre for the Aged (HRCA) and the 1986 HRC-NBER survey of their children, respectively. The children's survey (HRC-NBER) involved an interview with only one of the children of each elderly individual (the child was selected by the elderly individual). Two empirical approaches were used to control for factors such as the parents' age, parents' income, number of siblings, and a dummy variable for parental transfers of money to children. First, a tobit model was used to estimate the effects of the provision of time by children and then a structural model was used to estimate the joint decision of the children to work and to provide time to care for their parents. Wage rates were regarded as the opportunity cost of providing time to parents and were thus treated as an outcome of interest in the structural model, which indicated how wage rates influenced the allocation of time by children to the elderly. The structural model was derived by maximizing the children's utility subject to time and consumption constraints. In other words, the joint decisions of children to work and to provide time to their parents were modelled. Overall, their findings provided evidence that the provision of time was strongly correlated with the age of the elderly parents, with the oldest parents receiving over twice the amount of time as the other age group. Furthermore, male children and younger

[52] Boaz and Muller (1992) used OLS to estimate the informal caring equation due to the continuous nature of the dependent variable. On the other hand, for the binary dependent variables relating to labour market outcomes (i.e., full-time or part-time work), the logit model was used.

children spend relatively less time with their parents. Single children spend more time caring than married children, but the difference was only statistically significant for co-resident children. Children with higher incomes appeared to provide fewer hours of time to their parents than poorer children but the standard errors are large. An analysis of financial transfers from parents to children indicated that there was no strong evidence to suggest that richer parents receive more time from their children than poorer parents. On the other hand, more time provided by siblings will lead to substantially less time provided by the child is found in the structural model. This, however, was not apparent in the tobit estimation, which provided no evidence that siblings free ride on each others' provision of time. The results also indicated that gender, age, income level and the health status of children were all found to be important determinants of the amount of time provided to the elderly.

However, in both of the above studies, i.e., Boaz and Muller (1992) and Börsch-Supan et al. (1992), the analysis contains only a particular group of caregivers, and, therefore, cannot address the more fundamental tradeoffs of whether to work or provide care potentially faced by the general population. For example, Boaz and Muller (1992) concentrated on active caregivers and, hence, their findings apply only to actual caregivers. The same limitation is apparent in the study of Börsch-Supan et al. (1992) based on a sample drawn from a county in Massachusetts. A similar sample selection issue appears in the study by Stone and Short (1990), who modelled the employment decisions of nonspousal caregivers. Overall, the primary limitation of these three studies is that they focus on specific groups of carers and this implies that the findings observed from these analyses may not necessarily be generalised to the overall population. Analysing a particular group within the population may give rise to sample selection bias. For example, caregivers living in Massachusetts may devote more hours to care giving because they are a self-selected group with regard to observable characteristics. Therefore, a lack of control of sample selection issues may lead to inconsistent estimates (Heckman, 1979).

While Wolf and Soldo (1994) extend the sample to a US nationally representative survey, they focus on married women to explore the association between the time spent caring for their parents and/or parents-in-law and the time spent in employment. The

cross-sectional data were drawn from the 1987-1988 National Survey of Families and Households in the US. The structural model contained three equations: caregiving (a latent binary variable), employment (a latent binary variable) and hours of work. In addition, the latent caregiving variable was included on the right-hand side of the employment equation and vice versa, while the observed caregiving variable appeared as a regressor in the equation for hours of work. They used a double-selection model to correct for the likely existence of selection bias from two sources: (1) work hours were observed only when individuals were employed and (2) self-selection into caregiving activity was assumed to influence hours of work. Therefore, in order to deal with selection bias, a two-step procedure was used. In the first step, both the caregiving and employment decisions were modelled simultaneously to obtain the selection correction terms, which were then included in the hours of work equation, as additional regressors in the second stage to correct for the selectivity bias. Their findings indicated that there was a negative effect of parental caregiving on hours worked and the probability of being employed but both effects were statistically insignificant. However, in this study, even though the sample is nationally representative, it focuses on females only. In addition, although selection bias has been accounted for, if ignoring caring and hours of work are self-selected with regard to unobservable characteristics, then the estimates may be inconsistent.

A number of interesting additional issues are raised by correcting for endogeneity in either cross-sectional data or panel data using the instrumental variables (IV) approach. For example, Ettner (1995) did not restrict the sample to married female caregivers, but rather to all women who care for their own parents and/or parents-in-law. The data are obtained from the 1986, 1987 and 1988 panels of the Survey of Income and Program Participation (SIPP). This study took two potential problems into account in order to estimate the effect of providing parental care hours on women's work hours. The first problem was that a significant proportion of the women in the sample did not work and, therefore, there were many zero values for work hours. In order to deal with the problem of zero work hours, a two-part model, which used two separate equations including labour force participation (which took a value of one if the woman has positive work hours) and work hours conditional on labour force participation was employed. In the first equation, the probability of labour force participation was estimated using a probit

model. Then, in the second equation, hours of work were estimated using OLS conditional on labour force participation. Therefore, the estimated results for the two-part model were obtained by combining the estimated parameters in the first equation with the estimated parameters in the second equation.

The second problem, the potential endogeneity of informal care in modelling labour market outcomes, was tackled by applying an instrumental variable approach. The instrumental variables identified for caregiving were the number of siblings and the parent's education level. Caregiving was defined as an index which equals: 0 if the woman does not provide care; 1 if the woman spends less than 10 hours caring per week; 2 if the woman spends 10 or more than 10 hours caring per week; and 3 if the woman co-resides with a disabled parent. It was assumed that an adult child co-residing with a disabled parent is likely to provide informal care in the family. It was found that co-residing with disabled parents had the largest and most statistically significant impact on work hours without instrumenting for caregiving. However, after instrumenting for caregiving, the results suggested that, for caregivers who co-reside with their disabled parents, there may have been a slight reduction in hours worked. Furthermore, Ettner (1996) expanded upon the previous study using arguably a better instrument, namely a measure of the health of the care receiver, with the parents' health status serving as a proxy for the parents' care needs. An IV approach was used, but different cross-sectional data from the US National Survey of Families and Households (NSFH) for the year 1987 were employed. The indicator of informal care used in this analysis was a dummy variable which equals 0 if the respondent did not live with a disabled parent and 1 if the respondent lived with a disabled parent. The results indicated that the caregiving effect was larger for women than for men and that both coresidence and non-coresidence with a parent have negative effects on work hours. However, these two studies assumed that respondents who were living with disabled parents were potential caregivers, which may not always be the case.

The traditionally held view is that women are more likely to be involved in informal care than men, and, hence, many existing studies have focused on female carers. One of the first UK studies on the effect of male caring on labour market outcomes was introduced by Carmichael and Charles (2003). The cross-sectional data for carers of

working age used in this study were obtained from the 1990 UK General Household Survey (GHS). In order to investigate the relationship between labour market outcomes and informal care for males and females, this study employed a two-equation recursive model with employment as the dependent variable of one of the equations, and the wage rate as the dependent variable of the other equation, where the two equations were estimated separately by gender. Caring was defined by two dummy variables indicating whether a carer was providing care for less than 10 hours a week or at least 10 hours a week. These dummy variables were included on the right-hand side of the equations for the labour market outcomes. The wage equation was corrected for potential sample selection bias by including a Heckman correction term.[53] In addition, the wage equation was used to predict the unobserved wage rate for the non-workers, which was included as an instrumental variable in the employment equation to avoid potential systematic measurement bias.[54] The findings indicated that both male and female carers were less likely to be in paid employment and, when they were working, they tended to earn less than the non-carers.

The results relating to the relationship between providing care and employment status were found to be mixed across Europe. For example, Viitanen (2005) used longitudinal data from the European Community Household Panel (ECHP) and focused on a sample of women aged 20-59 to estimate the effect of caring undertaken by women on labour force participation across European countries using both a static and dynamic panel data approach. The main focus was on measuring state dependence and allowing for unobserved heterogeneity, and thus a dynamic random effects probit model was employed. In other words, participation in the labour market may have been due to state dependence: increasing human capital accumulation may lead to individuals remaining in the labour market. However, persistence in the labour market may also be accounted for by unobserved heterogeneity, reflecting, for example, a strong preference for work. Therefore, if unobserved heterogeneity is not accounted for in the estimation, caring activity may have a large negative impact on employment. The dynamic approach allows for unobserved heterogeneity, and past labour market participation (i.e., state dependence) is included using a lagged dependent variable in the model. The dependent

[53] Further details of this method can be found in Heckman (1976).
[54] The systematic measurement bias refers to the fact that the wage rate is only observed among those individuals who are in paid work.

variable, labour force participation, was given a value of 1 if the individuals reported participating in paid employment and the key explanatory variable, informal care, was defined as taking a value of 1 for individuals who reported that they were looking after a sick person. The results indicated that there was a statistically significant negative effect on employment for Germany, but not for the other European countries. However, in the analysis conducted separately for each European country, a negative impact on employment was found in Germany, Greece, Italy and the Netherlands. In addition, the findings provided evidence that state dependence and unobserved heterogeneity are important factors in determining female labour force participation.

A dynamic approach was also applied in a UK study by Heitmueller and Michaud (2006) who used data from the British Household Panel Survey (BHPS) between 1991 and 2003 to explore the relationship between informal care and employment. They employed a dynamic bivariate panel data model to account for state dependence and unobserved heterogeneity. Informal care was assumed to be dichotomous and equal to '1' if individuals were caregivers, and similarly for the labour market participation variable, which was defined as '1' if individuals were in employment. In the dynamic bivariate probit model, the decisions regarding caring and employment were estimated simultaneously. In order to capture state dependence, a lagged caring variable appeared on the right-hand side of the caring equation and, similarly, the lagged employment variable appeared on the right-hand side of the employment equation. After controlling for unobserved heterogeneity using a fixed effects approach, the study provided evidence that there is a negative association between informal care and employment. However, this effect was only found for co-residential carers.

Do (2008) explored the relationship between informal caregiving and labour market outcomes at the family level using cross-sectional data from the South Korean Longitudinal Study of Aging (KLoSA) by focusing on the working-age population aged below 65. A different measure of employment status as compared to that in other studies was used: a binary variable of any type of market work which included self-employed or unpaid family work as well as employed work. In addition to labour force participation, the wage rate and hours worked were defined as outcomes of interest. Since hours were observed only when individuals were employed, expected work hours conditional on

market work were calculated to correct for this selection bias. A similar measure was used for the expected wage conditional on market work. The informal caring variables were created as three dummy variables representing: any informal caring; less than 10 hours of caring per week; and more than 10 hours of caring per week. Thus, the probit models were characterised by market work or employed work as dependent variables with the dummy variables for caring on the right-hand side; and ordinary least squares (OLS) models were employed to estimate the effect of caring on the hours of work and wages, separately. The study not only dealt with selection bias, but also dealt with the potential problem of endogeneity. Since Do (2008) assumed that informal care may be correlated with unobserved family characteristics[55], which also affect labour market outcomes, a family-level instrumental variables approach was used to account for the endogeneity problem. Three variables were used as instruments for caring: whether parents have any activities of daily living (ADL) limitations; whether parents-in-law have any ADL limitations; and whether any sibling or relatives have any ADL limitations. The number of the parents' ADL limitations was found to be a strong instrument for informal care. The findings suggested that there exist negative effects of informal caregiving on labour market outcomes among women, but not among men. For females, those caregivers who provided more than 10 hours of care per week tended to be out of the labour market.

A cross-country study was conducted by Bolin et al. (2008), who investigated the effect of caring on labour market outcomes based on the differences among European regions (that were defined as the Northern, Central and Southern parts of Europe). The data was based on a sample of individuals over the age of 50 using the Survey of Health, Ageing and Retirement in Europe (SHARE). Three different labour market outcomes were analysed: being in paid employment, hours worked and the hourly wage rate. Informal care was measured in terms of hours spent caring. Two different probit and OLS models were employed and the same estimation process was applied as used by Do (2008). The endogeneity problem was dealt with by using four variables to instrument for caring: the health status of the respondents' parents, the ages of their parents, the distance between where they and their parents lived, and the number of siblings. They found that the

[55] For example, informal caring may occur more often among disadvantaged families and individuals who come from disadvantaged families may be more likely to have lower employability than individuals from wealthy families.

relationship between informal care provision and labour market outcomes differed from one European country to another. Informal caring was found to reduce the probability of being employed for men, and also to reduce the number of hours worked for both men and women in central Europe as compared to those in southern Europe. The results suggest that providing informal care is associated with significant opportunity costs relating to participation in the labour force and these adverse effects vary between countries.

In summary, there are no existing studies so far which explore the relationship between caring and employment in Taiwan. However, most studies for other countries analyse this issue from the perspective of time allocation, which basically assumes that time devoted to caring reduces the time spent in the labour market and vice versa. Many studies have indicated that caring is potentially endogenous when modelling labour market outcomes and, therefore, the estimated parameters may be inconsistent if it is not accounted for. It is common to address the possible endogeneity of caring using a two-step instrumental variable (IV) approach. However, finding a good instrumental variable that is assumed to be correlated with caring but not associated with labour participation is not easy. Therefore, an important contribution of the empirical analysis presented in this chapter is based on a recursive bivariate probit model of caring and employment that allows us to deal with the presence of a potentially endogenous caring regressor. In addition, gender differences in the relationship between caring and labour market outcomes have been well-documented in the literature (see, for example, Ettner, 1996; Carmichael and Charles, 2003; Heitmueller and Michaud, 2006; Do, 2008;) and the effects are also likely to vary by type of carer (Heitmueller, 2007). Hence, our empirical analysis will be split by gender and will also include more types of carer than have been considered in the existing studies.

4.3 Data

The data used in this chapter are from the Survey of the Health and Living Status of the Middle Aged and Elderly in Taiwan, which was designed and coordinated firstly by the University of Michigan and then by the Taiwan Bureau of Health Promotion. The aim of the survey is to gather information on individuals' characteristics in order to analyse relevant policy issues and formulate programs in regard to the elderly in Taiwan, such as

caring arrangements for the elderly and health care programs associated with the trend towards a rapidly aging population. The survey consists of individuals aged 50 and over with only two respondents being selected from a given township.

This is a longitudinal survey that began in 1989 with a target sample of 4,412 respondents aged 60 and over (denoted as group A) drawn from the entire elderly population, although only 4,049 interviews were completed. Since the initial interview, respondents have been re-interviewed face-to-face at three- to four-year intervals. The sample was extended in 1996 to include a target sample of 3,041 individuals aged between 50 and 66 (denoted as group B) in 1996 and the survey successfully interviewed 2,462 individuals. In 2003, not only were these two cohorts followed, but in addition those born in the 1947-1953 cohort joined the survey with a target number of 2,026 interviews taking place (denoted as group C) and 1,599 interviews were completed. This is summarised in Table 4.1 in Appendix Four.

The survey adopted a three-stage probability sample in which townships were the primary sampling unit.[56] In the first stage, a number of geographical areas were selected from the 331 administrative townships in Taiwan, although 30 mountainous areas with mainly aboriginal populations were excluded. The 331 townships were stratified by administrative level (divided on the basis of large cities or smaller cities; urban cities or rural cities), and three levels of education[57] into 27 strata of roughly equal size. The townships were arranged geographically within each stratum. The 56 townships were systematically randomly selected out of the 331 townships.

In the second stage, smaller administrative townships, called 'blocks', within the selected townships were selected with probabilities proportional to their size by the overall population size across the townships. In the last stage, two respondents were selected by systematic random sampling from each block. However, if a selected respondent was no longer residing at the listed address within the selected block, he or she would be interviewed at the new address.

The survey has a standard multi-purpose design and covers a wide range of topics on

[56] For further details of the survey see http://www.bhp.doh.gov.tw/BHPNET/English/ClassShow.aspx?No=200803270009.

[57] Education is divided into three levels, which are higher education, middle education and lower education.

living conditions such as socio-economic and demographic status, health conditions, health care utilization, health-related behaviours, well-being, leisure, activities and general attitudes, residence history, family structure, kinship and visits between kin, financial status, the social support of the elderly and socio-economic and demographic characteristics of the respondents' children. Data were also linked to a death register that provides the exact date and causes of death, and, therefore, provides rich information to investigate socio-demographic and health status differentials in, for example, the relationship between lifestyles and mortality.

Respondents who did not respond to the first follow-up in 1993 were re-contacted in 1996, and hence non-response for the second wave does not imply non-response for the third wave. The first survey (in 1989) achieved a 92% response rate. However, the response rates dropped from 71% to 48% between 1993 and 2007 because of deaths and sample attrition, as shown in Table 4.1 in Appendix Four. By the end of the six waves, 3,109 of the original respondents were deceased. Therefore, we perform our analysis using an unbalanced sample after deleting cases where the individuals have died. The sample used in the analysis focuses on those individuals aged between 50 and 65, the working age population, because 65 is the retirement age in Taiwan and very few individuals work after reaching that age. The definitions of the variables and descriptive statistics for the sample are described as follows.

A set of alternative dependent variables is based on the following questions:

1. *Are you helping anyone in your family or a friend who needs assistance to get into/out of bed, have a meal, take a bath, get dressed, go to the bathroom, or get around inside the house because of their health problems?*
2. *Are you helping anyone in your family or friends who needs assistance for grocery shopping, preparing meals, laundry, household chores, taking medication, or making phone calls because of their health problems?*
3. *Do you currently provide assistance to babysit your grandchild or another person's child?*
4. *Do you currently provide financial assistance to any member of your family or others?*

Four types of carer are distinguished according to these questions. The first type, 'carer', is defined as such if the respondent provides help to any individuals in a household, and is related to whether the individual responds 'yes' to any of questions 1, 2 and 3; the second

type 'grandchildren carer', is where the respondent looks after his/her grandchildren, according to the answer 'yes' to question 3. The third type 'adult carer', is where the respondent provides physical help to any adults living in the household, which is based on the 'yes' response to either questions 1 or 2. Finally, the last type 'financial support', is where the respondent provides financial support to their family or to others, according to the 'yes' response to question 4. Table 4.2 in Appendix Four gives the percentages for the caring variables: 35.46% of the overall sample are engaged in the first type of 'caring', 22.36% in 'grandchildren caring', 13.10% in 'adult caring' and 8.58% provide financial support. The other binary dependent variable analysed in this chapter, labour force participation, is defined by the question *'Are you currently employed?'*: 47.83% of the sample are employed and more males have a job than females (63.39% of the males sample are employed and 31.34% of females sample are employed).

The explanatory variables used in the econometric analysis, and described in Section 4.4 below, include health status, age, gender, marital status, household size, household labour income, number of children, education, ethnicity, region of residence, co-residence with other family members and having parents who are alive. In terms of health status, a respondent is considered to be in ill health based on the responses to the question *'Do you have any of the following health problems?'* Table 4.2 provides information related to a series of measures that signify current health status. High blood pressure, arthritis, diabetes, heart trouble and digestion are the most common health conditions in our sample. In particular, about one-quarter of the respondents have high blood pressure and more females report having this condition than males[58], the corresponding proportions being 27% and 24%, respectively. The next most common health condition concerns digestion problems, which include ulcers, stomach disorders, and other digestive tract disorders followed by problems with arthritis. Around 18% of our sample report having at least one of these two health problems and more females report having been affected by arthritis than males. However, the opposite is true for digestion problems which affect more males than females.

As Table 4.2 indicates, over 10% of respondents in the overall sample report having diabetes and the percentages are quite even across males and females. This is almost the

[58] Some existing studies, for example, Chen et al. (2008), state that women generally report poorer health than men.

same proportion as for those reporting heart trouble, but the proportion of females reporting heart problems is higher than that for males by around 5%. Liver problems refer to liver disease and gall bladder problems with the proportions being approximately 9% and 7% for females and males, respectively. More females report sight problems, which include cataracts and glaucoma, than males, the proportions being 12% and 7%, respectively. We include stroke, asthma and kidney disease as single health items with 3%, 9% and 8% of the overall sample having them, respectively. There are several other conditions not included because they are items not repeated in every survey year. The small number of individuals who did not reply to these questions are coded as not having a health condition.[59]

As for the age groups, it can be seen that the vast majority of the respondents are in the oldest group, which consists of those aged between 61 and 65, and the youngest age group accounts for the smallest number of respondents in our sample. There are more males than females in the oldest group but the opposite applies for the other two age groups where there are more females than males. A male dummy variable is included and there is a slightly higher percentage of male respondents relative to females in the sample with respect to the gender distribution for the total population aged over 50.[60] Marital status distinguishes between respondents who are married and those who are single (which is the reference category and includes never married, widowed, divorced and separated), and about 68% of respondents are married overall.

Two dimensions of socio-economic characteristics (SES) are included in the analysis, which are household labour income and education. Household income is measured by asking respondents *'How much total income did you and your spouse receive in the past year?'* Household income is converted into sterling using an exchange rate of 47.02NT/£1[61], deflated by the retail price index (year 2006=100) and then transformed into natural logarithms. Some 35% of the overall sample reported a zero value due to less

[59] About 0.04% of the individuals have missing values in regard to blood, heart problems, stroke and asthma; 0.07% of individuals have missing values in regard to diabetes; around 0.10% of the individuals have missing values in regard to arthritis, ulcers and sight; and 0.06% have missing values in regard to kidney health. In order to explore the robustness of the findings, the univariate probit models discussed in Section 4.4 below are estimated by excluding observations with missing values from the sample and the results are presented in Table 4.13 and Table 4.14 in Appendix Four.

[60] Source: Ministry of the Interior, Department of Statistics, Taiwan (2007).

[61] The exchange rate of 47.02 (NT dollars/pound) is based on that for the Bank of Taiwan on 29/06/11.

than half of the sample being in employment, and 0.95% reported a value of between 0 and 1. After taking logarithms, those zero values and the values between 0 and 1 are recoded to zero in our analysis. Education is measured by the highest educational qualification that is attained by the end of the sample period and is grouped into no education (the omitted category), elementary education, junior high school education (including junior vocational school), senior high school education (including vocational high school) and university or above education (including two years of college, three years of college, a master's degree or a doctoral degree).

We control for four groups of ethnicity: Aboriginal or other origin (the omitted category), the Hokkien group, the Hakka group and the Mainlander group. The sample shows that the vast majority of the elderly population are Hokkien, there being three times as many of them as those in the Hakka group and those in the Mainlander group. As for region of residence, the country is divided into the northern, central, southern and eastern areas, in accordance with the definitions established by Taiwan's Executive Yuan.[62] One thing of particular note in our data is that over sixty percent of the elderly live in central or southern Taiwan, which are both less developed areas as compared to the northern area. The eastern region is the least developed and is the omitted category. The variables related to co-residence with the respondent include son, daughter, parents and grandchildren. It appears that a high proportion (about 40%) of the elderly live with their grandchildren, and about 10% more females than males live with their grandchildren. We also include a dummy variable indicating whether the respondent has either one of his/her parents still living. The number of individuals in the household including the respondent has a maximum value of 10 if there are ten or more people in a household. The same rule is applied where the number of children in the household exceeds a value of 10.

Table 4.3 in Appendix Four presents summary statistics relating to the first type of 'carer' which is defined based on responding 'yes' to questions 1 to 3 of the survey, based on employment status, age groups and education levels. A comparison by gender reveals a significantly higher percentage of female carers relative to male carers. The majority of carers are hence female in our data. While the incidence of caring decreases with education, it increases with age for both males and females. Since the percentage of

[62] It is equivalent to the Cabinet in the UK. It is the highest level of the executive branch and is made up of the politicians with important positions in the government.

individuals who are carers decreases with education, this indicates that education level and caring responsibility are negatively correlated. A similar pattern appears in Table 4.4 in Appendix Four for the other three types of carer and employment, with very large percentages of female carers compared to male carers. Overall, caring for grandchildren (based on question 3) represents the primary source of caring responsibility, followed by financial support and then adult carer (based on questions 1 and 2). It is interesting to note, however, that the relative percentages of these different types of carer differ across males and females. For example, the percentage of female adult carers increases significantly with education, but this is not the case for male adult carers. In terms of financial support, females with elementary or higher education are more likely to provide financial support than those with no education. However, the proportion falls dramatically for those having a university degree or above.

Strong persistence in female and male labour force participation can be seen in Table 4.5 in Appendix Four, which presents the percentage of transitions between the employment state in year *t-1* and the employment state in year *t*. The diagonals in Table 4.5 indicate both persistence outside the labour market, and persistence in the labour market. It is more common for males to move from outside the labour market to participation in the labour market. However, the patterns in the transition rate for females are consistent with a negative association between the participation rate and persistence (see Table 4.7 in Appendix Four). For example, more females are out of the labour market compared to males (see Table 4.2), and more females move from employment into non employment compared to males (see Table 4.5). This is also the case for males who are caring (relating to the first type of 'carer') for a relative (see Table 4.6 in Appendix Four), where more males are non-carers compared to females, and males are more likely to move from being carers in year *t-1* to being non-carers in year *t* compared to female carers.

4.4 Methodology

This section describes the estimation methodology used to investigate the relationship between the caring and employment decisions. Consider the decision of whether an individual will choose to take responsibility for providing care, and the decision of whether an individual will be in employment. In each case, the decision is dichotomous, such as 'yes' or 'no'. We therefore need an estimation technique for a binary dependent

variable. Three different probit models are used in this analysis to explore the relationship between caring responsibility and the employment of Taiwanese men and women aged 50-65. The choice of model depends on the assumptions that are made regarding the correlation between the errors of the equations for caring and employment. If the error terms are assumed to be uncorrelated between two equations, a univariate probit approach is appropriate. On the other hand, correlation may exist between the errors of the two equations due to unobserved factors affecting both decisions simultaneously; in this case, a bivariate probit model is employed to allow for the correlation between the errors of the two equations. Finally, a recursive bivariate probit model is used to allow for the possibility that caring may be an endogenous variable in the employment equation.

4.4.1 The Univariate Probit Model

The univariate probit model for the single employment equation is specified as follows (Greene, 2008):

$$L_{it}^{*} = \beta_1' X_{it} + \varepsilon_{1it} \qquad i = 1,...,N, \;\; t = 1,...,6$$

$$L_{it} = 1, \text{ if } \; L_{it}^{*} > 0$$

$$L_{it} = 0, \text{ otherwise} \qquad (1)$$

where L_{it}^{*} is an unobserved continuous latent variable measuring individual $i's$ propensity to participate in the labour market at time t. L_{it} is an observed binary variable that takes the value of one if the individual is employed and zero otherwise. X_{it} is a set of explanatory variables including age, education, marital status, health status, household income, household size, number of children, ethnicity, region of residence and having parents who are alive. We allow for clustering of the unobserved variables at the individual level and also control for time fixed effects using year dummy variables in this model and any models that are discussed below. β_1 is a set of coefficients, and ε_{1it} is a normally distributed random error that reflects unobserved factors.

In our initial analysis, caring is modelled as a univariate probit specification as follows (Greene, 2008):

$$C_{it}^{*} = \beta_2' X_{it} + \beta_3' Z_{it} + \varepsilon_{2it} \qquad i = 1,...,N, \;\; t = 1,...,6$$

$$C_{it} = 1, \text{ if } \; C_{it}^{*} > 0$$

$$C_{it} = 0, \text{ otherwise} \qquad (2)$$

where C_{it}^{*} is an unobserved continuous latent variable indicating individual $i's$ propensity to be a carer at time t. C_{it} equals one if the individual is a carer and zero otherwise. X_{it} consists of the same set of explanatory variables as in equation (1). Z_{it} is an additional set of variables that may affect the individual's decision to provide care including coresidence with their spouse, son, daughter, parents or grandchildren. The error term ε_{2it} in the care equation, which is assumed to be normally distributed, represents unobserved factors and is assumed to be uncorrelated with X_{it} and Z_{it}.

Four single caring equations are estimated according to the different types of caring: 'Type 1 carer' refers to where the respondent provides help to any individual who needs to be looked after in a household. 'Type 2 grandchildren carer' is where the individual looks after his/her grandchildren. 'Type 3 adult carer' is defined where the individual provides physical help to any adult living in the household. Finally, 'Type 4 financial support' is where the individual provides financial help to those who need care in the household.

4.4.2 The Bivariate Probit Model

The use of a bivariate probit model is an attempt to allow for the possible correlation between the error terms of the caring and employment equations. Due to the likely existence of unobservable factors jointly determining both the employment and caring decisions (Heitmueller, 2007), the two dependent variables, L_{it}^{*} and C_{it}^{*}, are modelled jointly and the bivariate probit model is specified as follows (see Greene, 2008):

$$L_{it}^{*} = \beta_1' X_{it} + \varepsilon_{1it} \qquad L_{it} = 1, \text{ if } \; L_{it}^{*} > 0, \; 0 \text{ otherwise} \qquad (3)$$

$$C_{it}^{*} = \beta_2' X_{it} + \beta_3' Z_{it} + \varepsilon_{2it} \qquad C_{it} = 1, \;\; \text{if } \; C_{it}^{*} > 0, \;\; 0 \text{ otherwise} \qquad (4)$$

$i = 1,...,N, \quad t = 1,...,6$

$$E[\varepsilon_{1it} \mid X_{it}, Z_{it}] = E[\varepsilon_{2it} \mid X_{it}, Z_{it}] = 0 \tag{5}$$

$$Var[\varepsilon_{1it} \mid X_{it}, Z_{it}] = Var[\varepsilon_{2it} \mid X_{it}, Z_{it}] = 1 \tag{6}$$

$$Cov[\varepsilon_{1it}, \varepsilon_{2it} \mid X_{it}, Z_{it}] = \rho_2 \tag{7}$$

where L_{it}^*, C_{it}^*, L_{it}, C_{it}, X_{it} and Z_{it} are as defined in the univariate probit model. ε_{1it} and ε_{2it} are assumed to follow a bivariate normal distribution with zero mean and unit variance. ρ_2 is the correlation coefficient between the errors of the two equations. If there is a positive correlation coefficient between the errors of the equations for caring and employment, it indicates that there is a same-sign association with both the employment decision and caring decision. For example, an influence such as unobserved personal motivation that is positively related to a high degree of preference for being in employment might also reveal a commitment to caregiving due to the ability to provide an extra room for a disabled person in the household. However, a negative correlation coefficient indicates that caring and employment are affected in the opposite direction by unobserved factors. In this case, personal motivation may positively influence employment, but may increase the opportunity cost of time resulting in a person being less likely to take on the caring role. In the bivariate probit model, the two equations are identified since the errors are assumed to be bivariate normally distributed (Jones, 2007). There are four different caring measures as mentioned earlier and, therefore, four sets of bivariate probit models are analysed.

4.4.3 The Recursive Bivariate Probit Model

So far, caring has not been included in the employment equation. We now include the caring variable on the right-hand side of the employment equation in order to explore the impact of caring on the probability of being in employment. Since caring is potentially an endogenous variable, we use a recursive bivariate probit model to tackle this endogeneity problem. Under the recursive system, in the employment equation, the endogenous caring variable can be assumed to be correlated with the error term which also affects the employment propensity. Thus, a hierarchical recursive bivariate probit model is specified since C_{it}^* is assumed to be affected only by the exogenous variables (as shown in equation (9)) and employment L_{it}^*, is affected by a vector of exogenous

variables and the endogenous caring variable (as shown in equation (8)) as follows (see Maddala, 1983; Greene, 2008):

$$L_{it}^{*} = \beta_1' X_{it} + \alpha C_{it} + \varepsilon_{1it} \qquad L_{it} = 1, \text{ if } L_{it}^{*} > 0, \ 0 \text{ otherwise} \tag{8}$$

$$C_{it}^{*} = \beta_2' X_{it} + \gamma' Z_{it} + \varepsilon_{2it} \qquad C_{it} = 1, \text{ if } C_{it}^{*} > 0, \ 0 \text{ otherwise} \tag{9}$$

$$i = 1,...,N, \ \ t = 1,...,6$$

$$E[\varepsilon_{1it} \mid X_{it}, Z_{it}] = E[\varepsilon_{2it} \mid X_{it}, Z_{it}] = 0$$

$$Var[\varepsilon_{1it} \mid X_{it}, Z_{it}] = Var[\varepsilon_{2it} \mid X_{it}, Z_{it}] = 1$$

$$Cov[\varepsilon_{1it}, \varepsilon_{2it} \mid X_{it}, Z_{it}] = \rho_3$$

where ε_{1it} and ε_{2it} are assumed to be identically distributed as bivariate normal with zero mean, unit variance and correlation coefficient, ρ_3. ρ_3 measures the correlation between the two error terms and can be used in a likelihood ratio test of the endogeneity of caring (see Knapp and Seaks ,1998). If the likelihood ratio statistic is significant, we can thus reject the null hypothesis of the independence of errors (where $H_0 = \rho_3 = 0$). This means that the exogeneity of the caring variable is rejected. Furthermore, in the recursive model, identification is achieved even if the same exogenous regressors appear in both equations given the bivariate normal distribution assumption (Wilde, 2000). However, we do include exclusion restrictions in equation (9), namely, living parents, co-residence with a spouse, son, daughter, parents and grandchildren to improve identification (Jones, 2007).

4.4.4 Mundlak Fixed Effects

Finally, the use of panel data provides the opportunity to account for any unobserved individual characteristics, ν_{1i}, which are part of the error term, $\varepsilon_{1it} = \nu_{1i} + \mu_{1it}$. However, it is not possible to account for unobserved individual factors in the case of a probit model, owing to the incidental parameter problem (Jones et al., 2006). Mundlak (1978) suggests a method which controls for the potential correlation between the unobserved individual effects and explanatory variables by including the average of the time-varying variables as additional regressors in the model. We include such averages as additional explanatory variables in the analysis and, therefore, the Mundlak fixed effects approach is used to estimate the relationship between caring and the employment

decisions in all the models described above. In order to explore the robustness of the findings, results with and without Mundlak fixed effects are presented in this chapter for purposes of comparison.

4.5 Results

This section summarizes the estimation results derived from the three different probit models in three sub-sections. In the first sub-section, the marginal effects of the employment and caring equations derived via separate univariate probit models, which are regarded as our baseline models, are presented. In the second sub-section, the results of estimating bivariate probit models allowing for the possible correlation between the error terms of the employment and caring equations are discussed. Finally, the last sub-section presents the results of estimating the recursive bivariate probit models, which include a possible endogenous caring variable in the employment equation. In addition, to explore the robustness of our findings, all models discussed above are estimated with and without Mundlak fixed effects and are also split by gender. The marginal effects are focused on here and presented in Table 4.8 to Table 4.12 in Appendix Four[63].

4.5.1 The Univariate Probit Model

Table 4.8 presents the marginal effects of modelling the employment equation and the four types of carer equations via univariate probit models without controlling for Mundlak fixed effects, for the full sample (i.e., including both males and females), as well as estimates for the sample of males and the sample of females, separately. The determinants of each equation are discussed below.

The Employment Equation (Full Sample)

Focusing firstly on the estimates relating to the employment equation, see column 1, for the full sample, all age categories are found to be associated with an increased probability of being in employment compared to those who are over the age of 60 (the omitted category). This finding is consistent with existing studies such as studies for the

[63] A brief summary of the results and we have emphasized the importance policy implications from the main findings in Appendix Five.

UK (e.g., Heitmueller and Michaud, 2006; Heitmueller, 2007), and for Taiwan (e.g., Yi and Chien, 2002; Hung, 2003), where younger individuals are more likely to participate in the labour force than older individuals. In addition, being male is positively associated with being employed, which is in line with findings from Hung (2003) using data for Taiwan. Turning to household income, such income is positively associated with the likelihood of being in employment.[64] This is in accordance with the findings of Heitmueller (2007) for the UK that individuals with higher income are more likely to be in paid employment. On the other hand, it is surprising that individuals with junior high school education are less likely to be employed than those individuals with no education (the omitted category). Nevertheless, those with a university or higher degree are more likely to be in paid employment than those without a degree. This result may reflect the possibility that individuals with university education are more likely to be employed because their wage rates are, on average, higher than those of individuals with no education, which has been used to explain the findings in the US (e.g. Boaz et al., 1992), the UK (e.g. Heitmueller, 2007) and Taiwan (e.g. Hung, 2003). With respect to the health variables, having any health problem related to blood, diabetes, heart, stroke, asthma and sight means that the individual has a 5%, 12%, 6%, 30%, 6% and 7%, respectively, reduced probability of being in employment. These findings are consistent with existing studies in Taiwan, which found that poor health has a negative effect on labour market participation (e.g., Hung, 2003; Hu et al., 2005).

The Employment Equation (Split by Gender)

Columns 2 and 3 in Table 4.8 show the marginal effects of the employment equation estimated for males and females, separately. The effects of the age categories on the probability of employment for females are smaller compared to the effects of the age categories on the probability of employment for males. Moreover, being in the age 56-60 category has a smaller effect on the probability of being in employment for both males and females than being in the age 50-55 category. These findings are consistent with other empirical studies such as a UK study by Drinkwater (2011) and a Taiwanese study by Hung (2003), in which older individuals were found to be less likely to be in employment compared to younger individuals. The effect of household income on the probability of

[64] Another possible explanation is that household labour income may be endogenous in relation to the employment equation.

employment for males is larger than the effect of income on the probability of employment for females. There is a substantial gender difference in the effect of marital status on the probability of being in employment, where the effect on the probability of being in employment is positive for males but negative for females. This finding is consistent with existing studies: females who have a spouse to support a family may be less likely to work for pay when they have responsibility for housework than those unmarried females who have no such financial support (e.g. Boaz et al., 1992, for the US; Kao et al., 1994, for Taiwan). In addition, the findings suggest that the number of children has negative impact on the probability of being in employment for females, but this is not the case for males. One possible explanation is that Taiwanese women often take on more caring responsibilities than men (Chen et al., 2008).

Some existing studies, such as Ettner (1995) for the US and Drinkwater (2011) for the UK, report a statistically significant positive correlation between being more highly educated and the probability of being in employment for both men and women. However, our results suggest that males, who have at least a university degree, are more likely to be in employment than those with no education, but this is not the case for females. Turning to health, having a health problem has a strong negative effect on the probability of being in employment for both men and women as found in the overall sample. This is in line with Chen's (2008) finding that individuals with poor health are less likely to engage in employment in Taiwan. There appear to be ethnic differences between men and women in terms of the probability of being in employment: being a Mainlander has an inverse association with the probability of being in employment for females, compared to being in the aboriginal or other ethnic category (the omitted category). However, this is not the case for males. A possible explanation is that Mainlanders (i.e., including both males and females) arrived in Taiwan during the Chinese Civil War between 1940 and 1950. These Mainlanders made up 15% of our sample overall aged 50 and older, and, thus, the female Mainlanders may have come from Mainland China with their husbands who were soldiers and officials. These female Mainlanders as migrants may have had to spend some time to get adjusted to the new Taiwanese environment.

The Carer Equation (Full Sample)

In column 4 of Table 4.8, the marginal effects of the model for the first type of 'carer' (defined as providing help to any individual in the household) relating to the full sample are presented. A negative correlation between being male and the probability of caring is found: males are less likely to be carers than females. This is as expected based on the traditional role among the Taiwanese that males play compared to females, where females take responsibility for most of the housework in a household (Chen et al., 2008). It is also found that those who are married are more likely to take responsibility for caring than unmarried individuals. This may be because married individuals in Taiwan have more opportunities to provide care to their spouse, especially in times of illness, than those unmarried individuals who have fewer family responsibilities (Chen et al., 2008). In addition, a positive relationship between the number of children and the probability of being a carer is found. As to the effect of education, the results show that those individuals who have junior high school education are more likely to be carers than those who have no education. On the other hand, having a university or higher degree is inversely associated with the probability of being a caregiver. A possible explanation is that higher levels of education mean greater potential returns from working, and a higher opportunity cost of earnings may lead people being less likely to become carers. Turning to health, there is only one type of health problem that appears to be statistically significant, and that is where a negative correlation is found between those individuals who have had a stroke and the probability of their engaging in caring activity. Similar evidence has been reported in Huang et al. (2006) for Taiwan.

An individual is more likely to provide care if he/she is a Mainlander than if he/she is of the aboriginal or other ethnicities category. There appear to be differences in the probability of being a carer depending on with which family member the individual is co-residing. For example, individuals who live with a spouse, a son, or a daughter are less likely to be carers. On the other hand, an individual living with a grandchild or having parents who are alive is more likely to have caring responsibilities. It may be the case that individuals who co-reside with a spouse or a son or daughter may have other family members who provide help with looking after a person in the household. In

contrast, co-residing with grandchildren or having living parents potentially have positive impacts on the probability of being a carer for these family members.

The Carer Equation (Split by Gender)

The first type of 'carer' equation is then estimated separately for males and females and the results are shown in columns 5 and 6 of Table 4.8. Focusing first on marital status, being married exerts a positive effect on the probability of caring for both men and women. Moreover, the magnitude of the effect on the probability of caring is larger for women than for men. A possible interpretation of the strong effect of being married on the probability of caring for women but not for men is that a married woman may be the primary caregiver and a married man a secondary helper; that is, married women take the main responsibility for caring in the household. A similar finding has been shown using US data (Stone and Short, 1990). The probability of providing care increases if the number of children increases for female respondents, and a positive sign is also observed for males but it is statistically insignificant. Turning to education, female respondents who have elementary or junior high school education are more likely to be carers than those without education, although a negative sign is observed for those females with at least university education but it is statistically insignificant. On the other hand, having a university or a higher degree decreases the probability of being a carer for males. Such findings suggest that higher education is an important determinant of the decision for males as to whether to provide care or not.

The health problem associated with having suffered a stroke is found to exhibit a negative association with the probability of providing care for both men and women; however, for males, having arthritis is associated with a higher probability of providing care. One possible explanation for this inconsistency may be that poor health may lower the probability of caring, but it is also the case that the caring responsibility may give rise to a health problem, which has been found in empirical studies for the US (Stone and Short, 1990; Boza et al., 1992; Starrels et al., 1997), Taiwan (Huang et al., 2006; Chen et al., 2008) and South Korea (Do, 2008). Being a Mainlander is likely to result in males taking responsibility for caring. We also find that co-residence with a spouse or son reduces the likelihood of caring for both men and women but it is only statistically significant for women if they co-reside with their daughters. In addition, co-residence

with grandchildren or having parents who are alive increases the probability of providing care for both men and women. One possible explanation for the negative effect of living with a spouse, son or daughter on the probability of providing care is that the respondent may not be the primary carer looking after an ill person: other family members in the household might also provide help in caring.

Grandchildren Carer Equation (Full Sample)

Turning to the second type of carer, 'caring for grandchildren', column 7 in Table 4.8 shows the estimates based on estimating the grandchildren carer equation for the full sample. The probability of caring for grandchildren is reduced by 13 percentage points by being male. This implies that males are less likely than females to be grandchildren carers. In addition, being married increases the probability of caring for grandchildren by around 8 percentage points. Our analysis also provides evidence that the number of children is positively associated with the probability of caring for grandchildren, probably because having more children means that there are more opportunities to have grandchildren to look after. As for the education categories, having elementary or junior high school education increases the probability of caring for grandchildren. On the other hand, having at least university education lowers the probability of caring for grandchildren. While individuals with a low level of education have a relatively low opportunity cost of labour time compared to that for caring time, the opposite is true for highly-educated individuals. With respect to health, having suffered a stroke reduces the probability of being a grandchildren carer by 11 percentage points, which is in line with expectations that a negative correlation exists between poor health and caring for grandchildren. While the marginal effects of co-residence decrease the probability of caring for grandchildren in terms of living with a spouse, a son or parents, the effects of living with grandchildren, however, increase the probability of caring for grandchildren. These findings imply that if respondents live with other family members, other family members may take responsibility for caring for grandchildren.

Grandchildren Carer Equation (Split by Gender)

In columns 8 (male sample) and 9 (female sample) of Table 4.8, the marginal effects of estimating the grandchildren carer equation by gender may be observed. The probability of caring for grandchildren increases with respect to being married for both men and

women. It may be because married individuals are more likely than unmarried individuals to have grandchildren to look after. It is, however, surprising to find that the number of children increases the probability of caring for grandchildren for males, but not for females. Turning to education, a female who has elementary or junior high school education is more likely to be a grandchildren caregiver than a female who has no education. Meanwhile, a negative association between having a university or higher degree and the probability of being a grandchildren carer is observed for both men and women, and the effect of higher education on the probability of caring for grandchildren is smaller for males than for females. These findings imply that having a university or higher degree is an important determinant of the probability of females caring for their grandchildren.

The probability of caring for grandchildren is at least six percentage points lower for both males and females if an individual has had a stroke. This finding is consistent with the previous literature, as for example for the US (Starrels et al., 1997) and Taiwan (Huang et al., 2006), poor health is negatively correlated with caring. The effects of co-residence give rise to differences in the probability of caring for grandchildren. For example, living with a spouse, a son or parents decreases the probability of caring for grandchildren for both men and women. However, having a living parent increases the probability of caring for grandchildren, whereas co-residence with a daughter decreases the probability of being a grandchildren caregiver for females, but not for males. These findings imply that those living with other family members may not be the primary grandchildren caregivers.

Adult Carer Equation (Full Sample)

Column 10 of Table 4.8 reports the results of modelling the third type of carer, 'adult caring', for the full sample. The marginal effect of the age 56-60 category on the probability of being an adult carer is negative and the magnitude of the effect is smaller than that for the age 50-55 category. This means that younger individuals are less likely to be adult carers than older individuals, and the result is in accordance with Stone and Short (1990) for the US. Those who are male are around 6 percentage points less likely to engage in adult caring than females. This finding is consistent with the traditional view that Taiwanese males are less likely to assume caring responsibilities (Chen et al.,

2008). However, being married increases the likelihood of being an adult carer, and this may be because married individuals have greater opportunities to provide adult caring to their spouse than unmarried individuals. Turning to the effect of household size, this is in fact quite small, leading to a 0.1 percentage point higher probability of adult caring. Since there is no effect of household size on either the probability of the first type of 'caring' (in column 4) or the probability of 'caring for grandchildren' (in column 7), it suggests that household size may influence the adult caring decision, but not the other two types of care. This is in line with Heitmueller and Michaud (2006) for the UK who find that there are different determinants of different types of carer.

In accordance with several studies, such as for the US (Stone and Short, 1990; Boaz and Muller, 1992), Taiwan (Huang et al., 2006) and South Korea (Do, 2008), those having diabetes or having had a stroke are less likely to provide adult caring. There are also ethnic differences in the probability of engaging in adult caring. For example, being a Hokkien or a Mainlander is associated with a higher probability of being an adult carer than being of an aboriginal or other ethnic group. It is interesting to observe that an individual co-residing with a son/daughter is less likely to be an adult carer. This may imply that living with the younger generation is associated with less adult caring, because the respondents' offspring may be the primary source of adult caregiving. On the other hand, living with parents or having parents who are alive increases the probability of taking care of an adult. This finding is in line with Carmichael and Charles (2003) for the UK and Spitze and Logan (1991) for the US, with both studies suggesting that the major determinants of the caring decision are likely to be the attitudes of the respondents towards exercising a filial responsibility for their parents.

Adult Carer Equations (Split by Gender)

Columns 11 and 12 of Table 4.8 present the marginal effects relating to the adult caring equation estimated for males and females, separately. A negative effect of being aged 50-55 on the probability of adult caring is found for males. This indicates that younger males are less likely to be adult caregivers than older males. However, negative signs appear for both age categories with regard to the probability of adult caring for females, but neither are statistically significant. In addition, there are substantial gender differences in the effect of being married on the probability of being an adult carer. For

example, the effects of being married on the probability of being adult carers for females are greater compared to the effects for males. This suggests that married women are more likely to care for adults than married men, which is related to the traditional view that daughters-in-law are the main caregivers in the household in Taiwan (Hsu and Shyu, 2003). It appears that household size has a positive impact on the probability of adult caring for males, but not for females.

Turning to the health variables, a female individual having diabetes or a stroke condition is less likely to be an adult caregiver. However, a positive impact on the probability of adult caring is observed if females have a heart condition, which may reflect an inverse effect of adult caring on health, which has been found for the US (Starrels et al., 1997), Taiwan (Huang et al., 2006) and South Korea (Do, 2008). It is also found that being a Hokkien increases a woman's likelihood of caring for adults which is in line with Drinkwater (2011) who shows that ethnic differences in caring activity are found for British women. The probability of adult caring is influenced by the person(s) with whom an individual co-resides. For example, co-residence with a son or a daughter has a negative impact on the probability of adult caring, with a reduction of at least 2 percentage points for both men and women. However, an increase in the probability of being an adult caregiver appears for females, but not for males, when there is co-residence with parents. Moreover, it is found that having parents who are still alive increases the probability of adult caring for males. Since co-residing with parents affects the probability of adult caring for women only and having parents who are alive only affects the probability of adult caring for men, these findings may lead one to conclude that males play a traditional role of caring for their parents, but it is the daughters-in-law who are the primary adult caregivers in the household.

Financial Support Equation (Full Sample)

Turning to the estimates for the last type of carer in the 'financial support' equation, these are presented in column 13 of Table 4.8. A negative correlation between being male and the probability of providing financial support is observed. This implies that males are less likely than females to provide financial support to the person needing to be looked after in a household. One explanation is related to the traditional ideal of Taiwanese family continuity through the sons (Lee et al., 1994). According to this

traditional ideal, elderly parents might continue residing with their sons and sharing the family property. These sons may thus not provide extra intergenerational money transfers to their parents due to already having a shared life. This result is in line with Lei et al. (2011) for China, in that children who live away from their parents transfer money to them. A positive effect of being married is observed in relation to the probability of providing financial support. This indicates that married individuals are more likely to provide financial transfers than unmarried individuals. Household size leads to a small increase in the probability of providing financial support, which may reflect the possibility that having more family members living in a household increases the opportunities for providing financial support. As for household income, income lowers the probability of financial support by 0.4 percentage points. This finding is different from that of Couch et al. (1999) for the US, where individuals with higher incomes are found to be more likely to transfer money. One possible explanation for our finding is that individuals with higher income may have wealthy parents due to the intergenerational transmission of employability attributes and, therefore, a wealthy parent can afford to pay for his or her own care. A similar finding is reported by Börsch-Supan et al. (1992) using US data.

Individuals having junior high school education are more likely to provide financial support than those without education. Perhaps those individuals who have junior high school education can arrive at an appropriate trade-off between the time spent on caring and financial support. The substitution between financial transfers and time transfers in regard to caring responsibility has been observed in existing studies such as for the US (e.g., Couch et al., 1999; Sloan et al., 2002). There also appears to be an increase in the probability of providing financial transfers of around 1% if individuals suffer from arthritis. This may be because, for example, individuals with poor health spend less time with their parents, resulting in money transfers from those individuals to their parents instead. This is in accordance with Börsch-Supan et al.'s (1992) finding for the US. Finally, there is an almost 4 percentage points increase in the probability of providing financial support for those individuals whose parents are still alive, suggesting that the provision of financial support is strongly influenced by having parents who are still alive.

Financial Support Equation (Split by Gender)

There are some financial support differences in terms of gender as shown in columns 14 and 15 of Table 4.8 for men and women, respectively. The first point to note from the table is that the magnitude of the effect of being married on the probability of financial support is larger for males than for females, by 3 percentage points versus 0.5 percentage points, respectively. Furthermore, the marginal effect is only statistically significant for males. This may be because a man with a spouse is expected to support not only his own parents, but also to have the responsibility for supporting his parents-in-law. The sizes of the marginal effects of household income on the probability of financial support are similar for both men and women, where increasing income lowers the probability of financial support. Gender differences also appear in relation to education. Male individuals who have elementary education are less likely to provide financial support, with the probability of financial support being 1.4 percentage points lower than for those without education. On the other hand, the opposite is found for female individuals who have elementary, junior high school or senior high school education, with the probability of financial support being around 4, 6 and 7 percentage points higher than for those without education, respectively. These findings may imply that women with higher education have a high opportunity cost of work time and, therefore, they may prefer to provide financial support rather than spending time caring compared to those women with no education.

Turning to health, those females who have diabetes are less likely to provide financial support, but the opposite correlations are observed for those women who have arthritis or kidney-related problems. This may be evidence that the relationship between financial support and poor health is ambiguous for women. It is observed that co-residence with a daughter leads to a reduced likelihood of financial support being provided by females. However, if male individuals have parents who are still alive, an increased likelihood of providing financial support is found. These results lead to the conclusion that there are gender differences in the determinants of financial support depending on the co-residence with family members.

Mundlak Fixed Effects

In order to examine the robustness of the findings in all the models discussed above, all the equations have been re-estimated with Mundlak fixed effects and split by gender. Table 4.9 presents the marginal effects with Mundlak fixed effects for the employment equation and four types of carer equations for the full sample, male sample and female sample, separately. There are some differences in the estimates between the models with and without Mundlak fixed effects which we comment on below.

Employment Equations with Mundlak Fixed Effects

The results of the employment equation are presented in columns 1, 2 and 3 of Table 4.9 for the full sample, male sample and female sample, respectively. Turning to the male sample (column 2), the marginal effect of having at least university education turns out to be statistically insignificant, while there is a positive impact on the probability of being in employment in the model without controlling for the averages of the time-varying variables (column 2 of Table 4.8 for the male sample). This suggests that there are some unobserved individual characteristics that are correlated with the explanatory variables in the employment equation.

Four Types of Carer Equations with Mundlak Fixed Effects

Columns 4, 5 and 6 of Table 4.9 present the results of estimating the first type of 'caring' equation for the full sample, male sample and female sample, respectively. For the full sample (column 4), most of the marginal effects of regressors in the 'caring' equation are smaller after controlling for Mundlak fixed effects than the marginal effects without controlling for Mundlak fixed effects for all three samples (columns 4, 5 and 6 in Table 4.8). With respect to the co-residential variables, for those individuals who live with a spouse or a son or daughter, there is a larger reduction in the probability of being a carer after controlling for Mundlak fixed effects, compared to without controlling for Mundlak fixed effects, for all three samples. In addition, the results become statistically insignificant for those individuals who have a parent still living for all of the samples (i.e., for the full sample, the male sample and the female sample). These results indicate that it is important to control for unobserved individual characteristics if parents' characteristics are considered in the first type of 'caring' model.

A similar finding appears when estimating the ‘caring for grandchildren’ equation with Mundlak fixed effects for all three samples as shown in columns 7, 8 and 9 of Table 4.9, in which case the sizes of the marginal effects turn out to be smaller than the sizes of those obtained from the benchmark models (i.e., columns 7, 8 and 9 in Table 4.8). In addition, the effects of having a living parent are statistically insignificant in the case of the full sample (column 7 in Table 4.9) and female sample (column 9 in Table 4.9), whereas the effects are statistically significant without taking Mundlak fixed effects into account (columns 7 and 8 in Table 4.8). Moreover, regarding the effect of co-residence on the probability of caring for grandchildren, it is found that living with a spouse, a son or parents makes it significantly less likely for a respondent to be a grandchildren caregiver (column 7 in Table 4.8), compared to the results obtained from the model that accounts for Mundlak fixed effects (column 7 in Table 4.9). It is also found that the magnitude of the marginal effect of living with grandchildren is smaller when accounting for Mundlak fixed effects (column 7 in Table 4.9), compared to not accounting for Mundlak fixed effects (column 7 in Table 4.8) for all the samples. In addition, the negative effect of co-residing with a daughter on the probability of caring for grandchildren turns out to be statistically significant when the averages of the time-varying variables are included for the full sample and the male sample. These findings imply that unobserved individual characteristics do exist and affect the decision of caring for grandchildren in terms of the co-residential variables.

The results related to the ‘adult caring’ equation with Mundlak fixed effects are presented in columns 10, 11 and 12 of Table 4.9 for the full sample, male sample and female sample, respectively. There exist co-residence differences in the probability of adult caring in the estimates between the models with and without Mundlak fixed effects, in that there appears to be no effect of co-residence with a son or a parent on the probability of caring for adults for the full sample (column 10 in Table 4.9) and the female sample (column 12 in Table 4.9) after Mundlak fixed effects are taken into account. Furthermore, the effect of having parents who are alive turns out to be statistically significant for the full sample and the male sample after Mundlak fixed effects are controlled for, compared to the model without Mundlak fixed effects. However, co-residing with a daughter has an effect of a larger magnitude on the probability of being in employment, compared to the magnitude of the effect based on

the model without Mundlak fixed effects. This, again, implies that unobserved individual characteristics exist in terms of the parents' characteristics in the grandchildren caring equation.

As for the 'financial support' equation with Mundlak fixed effects, for all the samples as shown in columns 13, 14 and 15 in Table 4.9, the marginal effect of co-residence with a daughter turns out to be statistically significant for the full sample when Mundlak fixed effects are controlled for, whereas it is statistically insignificant in the model without Mundlak fixed effects. In addition, the opposite is observed for the effect of having parents who are alive; the effect turns out to be statistically insignificant after controlling for Mundlak fixed effects for the full sample and the male sample, whereas it is statistically significant without accounting for Mundlak fixed effects. Such findings indicate that unobserved time-varying factors exist in our data which have to be controlled for in terms of the co-residence variables.

Finally, as compared to the size of marginal effects in the model without controlling for Mundlak fixed effects, household size appears to have a statistically significant negative effect on adult caring, grandchildren caring and financial support for the female sample after taking into account Mundlak fixed effects. These findings are consistent with the idea that the caring decision can be negotiated within a family depending on the household's size.

4.5.2 The Bivariate Probit Model

The results presented in this sub-section are based on estimating the bivariate probit models of employment and caring that allow for correlated errors between the two equations. There are four different caring measures, namely, caring, grandchildren caring, adult caring and providing financial support and, therefore, four sets of results derived from the bivariate probit models are discussed. Again, all the models are estimated separately by gender and with and without Mundlak fixed effects. The correlation coefficients, ρ, of the error terms between the two equations are found to be negative for all the models except for the model for employment and financial support. This suggests that unobserved factors simultaneously affect the probability of being employed and the probability of caring (i.e., 'caring', 'grandchildren caring' and 'adult

caring') in opposite directions. However, in the case of financial support, the correlation coefficients are positive and statistically insignificant[65], implying that there are no efficiency gains if the bivariate probit model is used for this case. Therefore, with the exception of the 'financial support' model, the results relating to the relationship between employment and the other three types of caring are discussed in what follows and presented in Table 4.10 (without Mundlak fixed effects) and Table 4.11 (with Mundlak fixed effects).

The Employment and Carer Equations (Full Sample)

Column 1 of Table 4.10 presents the results from the estimation of the bivariate probit model for employment and the first type of 'carer' (defined as respondents providing help to any person in the household) for the full sample. In general, the estimates from the bivariate probit model have the same signs as the signs from the univariate probit analysis. However, the magnitudes of the marginal effects are smaller in the bivariate probit model than the effects in the univariate probit model. Nevertheless, there is one exception, which is that the marginal effects relating to the number of children exhibit opposite signs in the caring and employment equations, whereas the effect is statistically insignificant in the univariate probit models. These findings suggest that the number of children has a negative impact on the probability of being in employment but a positive impact on the probability of caring when correlated errors between the two equations are accounted for. In addition, it is interesting that the magnitudes of the effects of co-residence with a spouse, a son, a daughter or grandchildren are smaller compared to the estimated magnitudes for the univariate probit model. Our findings suggest that a failure to allow for the correlation between errors of the two equations may overestimate the effect of co-residing on caring in the case of Taiwan.

The Employment and Carer Equations (Split by Gender)

The results for the bivariate model described above estimated for males and females, separately, are summarised in columns 2 and 3 of Table 4.10. For both the male and

[65] The correlation coefficients for the employment and financial support models are statistically insignificant at 5% level: the p-values for the full sample without and with Mundlak fixed effects are 0.113 and 0.10, respectively; for the sample of males without Mundlak and with Mundlak fixed effects, they are both 0.25; for the female sample, without and with the Mundlak are fixed effects, they are 0.07 and 0.06, respectively.

female samples, the effects on the probability of being in employment and on the probability of caring are smaller in absolute terms for all regressors than the effects obtained from the univariate probit models. With respect to co-residence, a similar pattern is found in that the size of the effect of co-residence on the probability of caring is smaller than the size of the effect based on the univariate probit models for both men and women. However, there is one exception, namely, that the effect of co-residing with a spouse on the probability of caring for males is stronger in the bivariate framework than the effect from the univariate probit model. This result seems reasonable since husbands are less likely to be caregivers than wives from a traditional role point of view. Finally, the results suggest that taking a univariate approach possibly leads to overestimates of the impact of co-residence on the caring decision for females.

The Employment and Grandchildren Carer Equations (Full Sample)

Turning to the bivariate model of the employment equation and the equation for 'caring for grandchildren', column 4 in Table 4.10 shows the marginal effects for the overall sample. Basically, the results show that the sizes of the regressors are smaller for both the employment and grandchildren caring equations compared to the signs based on the univariate probit models. However, in terms of household size, the sign turns out to be negative and the effect on the probability of being employed is statistically significant in the bivariate model, whereas the effect is statistically insignificant in the univariate probit model. Regarding income, it is found that a statistically significant effect on the probability of being in employment exists for the univariate probit model, but it is surprising that the positive sign becomes statistically insignificant in the case of the bivariate model.

In addition, in the bivariate framework, the number of children is negatively related to the probability of being employed but positively related to the probability of engaging in grandchildren caring, whereas the effect on the probability of being in employment in the univariate probit model is found to be statistically insignificant. Since we do not observe that a higher number of children leads to a higher number of grandchildren to be looked after, the results suggest that the existence of such omitted variable has an opposite effect on the probability of being in employment and on the probability of grandchildren caring. With respect to the set of dummy variables that measures

co-residence, the same signs are found between the univariate probit and bivariate probit models. However, most of the effects of co-residence on the probability of grandchildren caring obtained using the bivariate probit model are smaller than the effects obtained using the univariate probit models, except for the effects of living with a spouse or parents which are found to be stronger. This means that those living with a spouse or parents are significantly less likely to engage in grandchildren caring after controlling for correlated errors between two equations.

The Employment and Grandchildren Carer Equations (Split by Gender)

Columns 5 and 6 of Table 4.10 report the estimated results of estimating two equations for employment and caring for grandchildren for males and females, respectively. There are no differences in the signs of the regressors, but the sizes of the marginal effects are slightly smaller for both equations in the bivariate model than for the univariate probit models. Regarding income, it is found that higher income increases the probability of being in employment for males based on the univariate probit model, but this is not the case when the bivariate model is specified. In addition, it is interesting to note the effect of the set of co-residence variables on the probability of grandchildren caring: for the male sample, the effect of co-residing with a spouse, a son or parents significantly reduces the probability of engaging in grandchildren caring. However, a positive effect of having living parents on the probability of providing care for grandchildren is observed for males when using the bivariate model but not when using the univariate probit model. This result would benefit from further analysis but we do not have information regarding whether parents live with the respondent's siblings. If the parents live with siblings, this may reduce the need to look after the elderly and, therefore, it may increase the available time to care for grandchildren. For the female sample, again, the marginal effects are smaller in absolute terms for all of the co-residence variables. These findings suggest that ignoring the joint model may lead to an overestimation of the effects of co-residence on the probability of caring for grandchildren for females while underestimating the same effects for males.

The Employment and Adult Carer Equations (Full Sample)

The results of estimating the bivariate probit model for employment and 'adult caring' for the full sample are shown in column 7 of Table 4.10. Regarding the number of

children, there is a negative effect on the probability of being in employment in the bivariate model while this variable has a statistically insignificant effect in the univariate probit model. This means that the number of children is inversely associated with the probability of being in employment. As the results show, the effects are smaller in absolute terms for most of the regressors with respect to the probability of being employed compared to the effects based on the univariate probit models. On the other hand, most of the regressors have a larger effect on the probability of adult caring. For the co-residing variables, the signs are the same for both the univariate probit and bivariate probit models. However, the negative effect of living with a son or a daughter on the probability of adult caring is larger than the effect based on the univariate probit model. The results indicate that the impact on adult caring is underestimated for the co-residence variables if using a univariate approach.

The Employment and Adult Carer Equations (Split by Gender)

Columns 8 and 9 in Table 4.10 present the results of estimating the equations for employment and adult caring for the samples of males and females, respectively. Similar patterns of results are found. The magnitudes of the marginal effects on the probability of being employed are smaller than the magnitudes based on the univariate probit models. However, there are larger effects on the probability of adult caring using the bivariate model than for the case of the univariate probit model for both men and women. With respect to the co-residence variables, a significant increase in the probability of adult caring in terms of co-residence with a son and/or a daughter is found, compared to the results obtained from the univariate probit models for both males and females. Nevertheless, a slight decrease in the probability of adult caring is observed if there is co-residence with parents, compared to the results obtained from the univariate probit model for females. These findings are consistent with the findings obtained from the univariate framework and suggest that members of the younger generation seem to be close substitutes for the respondents in terms of the provision of adult caring.

Mundlak Fixed Effects

All of the models discussed above are re-estimated with Mundlak fixed effects to explore the robustness of the findings. Table 4.11 presents the marginal effects of the

bivariate probit models with Mundlak fixed effects for the overall sample, male sample and female sample, separately.

The Employment and Carer Equations with Mundlak Fixed Effects

For employment and the first type of 'carer' variable (columns 1, 2 and 3 in Table 4.11), the same signs are found as in the bivariate probit model without Mundlak fixed effects. However, after including Mundlak fixed effects, the magnitudes of the marginal effects are slightly smaller across all regressors for both the employment and caring equations for the full sample, male sample and female sample. In addition, the effects of the co-residence variables, the negative effects of living with a spouse and/or a daughter on the probability of caring, are larger in absolute terms than the effects without Mundlak fixed effects. Those living with grandchildren are more likely to provide care, but the effect is slightly smaller than the effects of providing care without controlling for Mundlak fixed effects. For those having living parents, the effects appear to be statistically significant in the bivariate model without Mundlak fixed effects, but turn out to be statistically insignificant after Mundlak fixed effects are accounted for, for the overall sample, the male sample and the female sample. These findings reflect the importance of controlling for unobserved individual characteristics, which are consistent over time, but vary across individuals.

The Employment and Grandchildren Carer Equations with Mundlak Fixed Effects

Turning to columns 4, 5 and 6 in Table 4.11, the estimates derived from the equations for employment and 'caring for grandchildren' are presented. Again, most of the signs of the marginal effects are the same as the signs in the bivariate probit model without Mundlak fixed effects but the magnitudes of effects are slightly smaller for most of the regressors in both the employment and grandchildren caring equations after taking the Mundlak fixed effects into account. For the set of dummy variables that measure co-residence, the effects are mixed. For example, compared to the bivariate model without Mundlak fixed effects, the negative effects are larger in absolute terms for co-residing with a spouse or parents for all three samples. However, for those living with a son, a stronger negative effect is found for the male sample and a smaller negative effect is found for the female sample after including the average of the time-varying variables. Furthermore, although the signs of the effects for having living

parents appear to be statistically insignificant with Mundlak fixed effects, the effect turns out to be statistically significant with regard to the probability of caring for grandchildren after without Mundlak fixed effects are controlled for. This indicates the importance of controlling for unobserved individual characteristics.

The Employment and Adult Carer Equations with Mundlak Fixed Effects

Focusing on the results relating to 'adult caring' and employment, columns 7, 8 and 9 in Table 4.11 show that the same pattern is found as in the case of the bivariate probit model without Mundlak fixed effects. However, the magnitudes are smaller across most of the regressors in both equations for all three samples. However, we find that the effects of the co-residence variables on the probability of adult caring vary since larger sizes appear in the case of co-residing with sons or daughters but statistically insignificant effects appear in the case of co-residing with parents or having parents who are alive after controlling for Mundlak fixed effects, compared to the sizes of the effects in the case of the bivariate probit model without Mundlak fixed effects, for all three samples. This implies that it is necessary to control for unobserved time-varying variables in the provision of adult caring, otherwise the impact of co-residence variables on the probability of adult caring will be underestimated for both men and women.

4.5.3 The Recursive Bivariate Probit Model

In the recursive bivariate probit model, the caring variable is included on the right-hand side of the employment equation. The effects of caring on the probability of being in employment are presented in Table 4.12 which includes four sets of results based on estimating the employment equation and the equations for the four types of carer, namely, caring for any individual, adult caring, grandchildren caring and financial support. In addition, a likelihood ratio (LR) test is used to determine whether the correlation coefficient, ρ, is statistically significantly different from zero at the 1% level. If ρ is statistically significant, this indicates that caring is endogenous in the employment equation (see Knapp and Seaks, 1998). The LR test results are also shown in Table 4.12. All the recursive bivariate probit models are estimated with and without Mundlak fixed effects and split by gender.

Employment and Carer Equations

Columns 1, 2 and 3 in Table 4.12 show the marginal effects of the recursive bivariate probit model with and without Mundlak fixed effects for employment and the first type of 'carer' for all three samples. Focusing first on column 1, the correlation coefficient for caring is found to be statistically significant both with and without Mundlak fixed effects. Thus, caring is an endogenous variable in the employment equation. The negative effect shows that, for the full sample, caring reduces the probability of being in employment by about 30 percentage points. Therefore, our findings provide evidence of a trade-off between caring and the probability of being employed for the full sample, meaning that individuals who engage in providing care are less likely than non-carers to be in employment.

For the results of the male sample in column 2 and the results of the female sample in column 3 of Table 4.12, the correlation coefficients are statistically significant for the female sample only, suggesting that caring is endogenous in the case of female employment but not for the case of male employment. Thus, these results suggest that failing to account for the endogenous caring variable may lead to biased estimates in the analysis of women's employment status. This finding is in line with Ettner (1995) for the US, Crespo (2006) for Europe and Heitmueller (2007) for the UK who argue that caring responsibility is more likely to compete for the use of time for women.

Employment and Grandchildren Carer

We now turn to the results of the recursive bivariate probit model for employment and 'caring for grandchildren' with and without Mundlak fixed effects in columns 4, 5, and 6 of Table 4.12 for the full sample, the male sample and the female sample, respectively. For the full sample (column 4): the ρ parameters are statistically significant with and without controlling for Mundlak fixed effects. In addition, the effect of caring for grandchildren appears to have a negative impact on the probability of being employed. The probability of being in employment decreases by about 26 percentage points if individuals care for grandchildren regardless of whether the averages of the time-varying variables are taken into account or not. As for the male sample (column 5), there is evidence of a negative effect of caring for grandchildren on the probability of

being in employment, but the ρ parameters are not statistically significant regardless of whether the Mundlak fixed effects are accounted for or not. However, this is not the case for the female sample (column 6), in which the correlation coefficients are found to be statistically significant with or without controlling for Mundlak fixed effects. These findings suggest that grandchildren caring has a negative effect on the probability of being employed for females, but not for males. It could be due to the small sample for males. Or another explanation is that women may devote themselves to care for grandchildren more than men due to the social expectations regarding the different roles of women and men, in that women are the primary grandchildren caregivers in the household (see, e.g., Arber and Ginn, 1994 for the UK; Chen, 2008 for Taiwan). The findings suggest that a negative effect on female employment is dominant in regard to caring for grandchildren.

Employment and Adult Carer

Columns 7, 8 and 9 in Table 4.12 show the results of estimating the 'adult caring' and employment models with and without Mundlak fixed effects for the full sample, male sample and female sample, respectively. In all three samples, the ρ parameters are statistically insignificant with and without controlling for Mundlak fixed effects, indicating that adult caring is exogenous in the model for the probability of being in employment. As for the full sample (column 7), a negative effect of caring for adults on the probability of being in employment is found, but the ρ parameters are statistically insignificant. The same impacts of adult caring on the probability of being employed are found for men (column 8) and women (column 9), which exhibit decreases of about 46 and 28 percentage points, respectively, but are statistically insignificant.

Employment and Financial Support

The regression results from modelling the recursive bivariate probit models for the last type of carer, 'financial support' and employment with and without Mundlak fixed effects are presented in columns 10, 11 and 12 in Table 4.12 for all three samples, respectively. In the full sample, a positive relationship between financial support and the probability of being in employment is found given the statistically significant correlation coefficients regardless of whether Mundlak fixed effects are accounted for.

These findings indicate that providing financial support is positively associated with the probability of being in paid employment. This is in accordance with Cough et al. (1999) and Sloan et al. (2002) for the US who provide evidence that financial transfers and time spent on caring are substitutes. Therefore, larger money transfers are associated with less time devoted to caring and more time spent on work. Another possible explanation is that for individuals with a high opportunity cost of time (e.g. those who are working), informal care is more costly and, therefore, such individuals are more likely to provide financial support (Heitmueller, 2007 for the UK). For example, those who are employed and accumulate human capital through their work experience are more likely to have a high opportunity cost of time and this inversely affects the time spent on informal care and it may increase the opportunity to provide financial support. Do (2008) also argues that, as employability is unobserved in the data, this may be the factor that leads to an increase in the probability of being in employment and increases the probability of providing financial support in South Korea.

With regard to the male sample (column 11) and the female sample (column 12), financial support is found to be endogenous in the employment equation for the male sample, but not for the female sample, since ρ is statistically significant for the male sample only. These results suggest that financial transfers have a significant positive impact on male employment. Therefore, failing to control for the endogeneity of financial support would bias the results for the male employment model. This finding is arguably not surprising and is consistent with the traditional bread winner role for males, with a stronger employment propensity existing among males as opposed to females.

4.6 Conclusion

In this chapter we have examined the impact of informal caring on labour market outcomes in Taiwan. The panel data set which is used includes six waves (1989-2007) from the Survey of the Health and Living Status of the Middle Aged and Elderly in Taiwan with a particular focus on men and women aged 50 to 65. The empirical analysis presented in this chapter differs from that of the existing studies in two main respects. Firstly, since the effects of caring responsibility on labour market participation have been found to differ depending on the care-type (Heitmueller, 2007 for the UK), it is important to have a better understanding of the relationship between each type of care

and labour market outcomes from a policy point of view. The effects of different types of care on labour market outcomes have been previously explored in the context of other countries such as care provided for a disabled person either inside or outside the household (see Heitmueller, 2007 for the UK). Our analysis concentrates on a wider range of types of caring than in the previous literature with four types of carer analysed, namely, caring for any individual, caring for grandchildren, adult caring and financial support. Therefore, our study contributes to the Taiwanese literature and also to the literature more generally in seeking to determine the impact of the four types of carer on labour market outcomes which has so far not been examined for Taiwan. Secondly, this is the first Taiwanese study to use the recursive bivariate probit model to account for the potential endogeneity of caring in the employment equation.

To estimate the effects of caring on employment status, a comparison of the estimation results derived from three different probit models split by gender is conducted. Firstly, to obtain the baseline estimates, univariate probit models are used to explore the determinants of labour force participation and the four types of carer. We find that a gender difference appears in caring activities. For example, males are less likely to be carers for each type of care than females. In addition, the effect of being married is greater for women than for men, a finding that is in line with Ettner (1995; 1996) for the US. However, a negative correlation is found for women between having a university degree and caring. Furthermore, the co-residence variables are found to be important determinants for each type of caring responsibility which ties in with the findings of the UK study by Heitmueller (2007). For example, living with a spouse, a son or a daughter is related to a lower probability of providing care. However, the opposite effect of co-residence with grandchildren and parents on the probability of being employed is found.

Secondly, bivariate probit models that allow for the possible correlated errors between the employment and caring equations are explored. The findings suggest that specifying a univariate probit model will result in under-estimation of the marginal effects of most of the observed variables for men's employment and over-estimation of the marginal effects for women's employment. Finally, the recursive bivariate probit models are employed to take the potential endogeneity of caring in labour market outcomes into

account. The findings suggest that women are seriously affected in terms of the probability of being employed by taking on caring which causes women to withdraw from employment or to remain out of the labour market. In addition, financial support is found to be endogenous in the employment equation only for males.

It is important to note that there are limitations to the analysis presented in this chapter. First, Heitmueller and Michaud (2006) provide evidence that state dependence exists in the provision of caring, meaning that those who are carers have a higher probability of being carers in the next period. However, due to data limitations (i.e., the sample comprises mainly elderly individuals and, therefore, not many individuals are present in all six survey years) the effects of such state dependence on the probability of caring are not controlled for in our analysis. Secondly, the findings are based on the elderly population in Taiwan due to lack of data which may raise the question as to whether it is possible for the findings to be generalized to the national population. Thirdly, the results of estimating the relationship between labour force participation and caring would be more informative if we had data on hours spent on both working and caring. Future studies may include different measures of informal care and labour market outcomes to estimate the relationship between these two decisions and to substantiate the findings in this chapter.

From a policy perspective, the findings show that women face a large trade-off between labour force participation and caring responsibility. Therefore, if policies are to be aimed at increasing the female labour force participation rate, these findings might suggest that one way to do this is by encouraging women to have higher levels of education or by providing more options for formal care which may increase their probability of participating in the labour market.

Appendix Four

Table 4.1 Target and Completed Sample Size in Each Wave

Year	Number of complete responses	Age	Number of incomplete responses	Cumulative number of death	Response rates
1989	4,049 (A)	60+	363	-	91.8%
1993	3,155(A)	64+	312	582	91.0%
1996	2,669(A)	67+	333	1,047	88.9%
	2,462(B)	50-66	570	9	81.2%
1999	2,310(A)	70+	253	1,486	90.1%
	2,131(B)	53-69	222	110	90.6%
2003	1,743(A)	74+	173	2,133	91.0%
	2,035(B)	57-73	174	253	92.1%
	1,599(C)	50-56	423	4	79.1%
2007	1,268(A)	78+	120	2,661	91.4%
	1,864(B)	61-77	188	410	90.8%
	1,402(C)	54-60	159	38	89.8%

Note: (1)‘A’ refers to the respondents in Taiwan aged 60 or over in 1989; ‘B’ refers to the respondents aged between 50 and 66 in 1996; ‘C’ refers to the respondents aged 50-56 in 2003. (2) The data source is the Taiwan Bureau of Health Promotion.

Table 4.2 Descriptive Statistics

	Total				Male				Female			
Variable	Mean	STD	Min	Max	Mean	STD	Min	Max	Mean	STD	Min	Max
Continuous and categorical												
Log household income	6.35	6.84	0	21.46	6.15	6.84	0	21.46	6.45	6.82	0	21.46
Household size	4.56	6.53	1	10.00	4.39	6.20	1	10.00	4.73	6.82	1	10.00
Number of children	3.62	1.51	0	10.00	3.46	1.47	0	10.00	3.80	1.55	0	10.00
Binary (%)												
Carer	35.46				24.09				41.33			
Adult carer	13.10				3.54				9.15			
Grandchildren carer	22.36				18.33				34.27			
Financial support	8.58				8.77				8.38			
Employed	47.83				63.39				31.34			
Health status												
Blood pressure	25.36				24.26				26.52			
Diabetes	11.18				10.53				11.86			
Heart trouble	12.24				9.89				14.73			
Stroke	2.90				3.51				2.25			
Asthma	9.12				10.49				7.67			
Arthritis	18.87				13.67				24.39			
Digestion	18.59				17.83				19.40			
Liver illness	8.40				9.29				7.46			
Sight problem	9.10				6.71				11.64			
Kidney disease	7.59				7.78				7.40			
Age groups												
Aged 5055	27.69				26.98				28.45			
Aged 5660	31.79				30.67				32.99			
Aged 6165 (omitted)	40.51				42.35				38.56			
Gender												
Male	51.60											
Marital status												
Married	67.97				76.98				55.51			
Education levels												
None (omitted)	22.03				10.67				34.15			
Elementary education or self-taught	46.23				47.83				44.53			
Junior high school or above education	11.22				13.49				8.79			
Senior high school education	11.69				15.09				8.07			
University or above education	8.82				12.92				4.46			
Ethnicity												
Aborigine/other(omitted)	1.60				1.37				2.09			
Hokkien	66.67				71.12				75.84			
Hakka	16.29				16.58				17.67			
Mainlander	15.44				10.93				4.40			
Resident regions												
Northern	26.97				25.67				26.33			
Central	31.63				32.23				31.43			
Southern	35.28				36.74				36.99			
Eastern (omitted)	6.12				5.36				5.15			
Co-residence												
Son	12.76				30.45				26.04			
Daughter	10.37				15.29				8.00			
Parent(s)	2.25				6.46				3.61			
Grandchildren	40.78				29.34				41.61			
Living parents	5.93				11.97				13.29			
Number of Observations	9,913				5,103				4,810			

Table 4.3 Caring by Employment, Age and Education

	Female		Male		Total	
	Non-carer row %	Carer row %	Non-carer row %	Carer row %	Non-carer row %	Carer row %
Employment						
no	53.00	47.00	69.50	30.50	59.00	41.00
employed	71.20	28.80	79.80	20.20	77.10	22.90
Age						
aged 50-55	64.30	35.70	80.10	19.90	72.30	27.70
aged 56-60	60.00	40.00	75.20	24.80	67.60	32.40
aged 61-65	53.60	46.40	74.00	26.00	64.50	35.50
Education						
none	69.10	30.90	79.00	21.00	72.10	27.90
elementary	63.70	36.30	76.50	23.40	71.30	28.70
junior-high	61.50	38.50	76.50	23.50	72.00	28.00
senior-high	70.00	30.00	77.40	22.60	75.50	24.50
university+	77.50	22.50	80.80	19.20	80.20	19.80

Note: ‘Caring’ is defined as where the respondent provides help to any individuals in the household (relating to whether the individual responded ‘yes’ to any of questions 1, 2 and 3 i.e., the first type of carer).

Table 4.4 Carer Types by Employment, Age and Education

	Female				Male				Total			
	None row %	Grandchild row %	Adult row %	Financial row %	None row %	Grandchild row %	Adult row%	Financial row %	None row %	Grandchild row %	Adult row %	Financial row %
Employment												
no	50.40	35.60	5.00	8.90	65.30	21.40	3.80	9.50	55.80	30.50	4.60	9.10
employed	68.60	18.20	6.20	7.00	75.30	11.70	4.70	8.30	73.20	13.70	5.20	7.90
Age												
aged 50-55	62.10	23.30	7.10	7.50	77.80	9.30	7.10	5.80	70.00	16.20	7.10	6.70
aged 56-60	56.80	30.20	5.70	7.30	72.30	17.20	4.40	6.10	64.50	23.70	5.00	6.70
aged 61-65	51.20	35.20	4.00	9.60	67.30	17.70	2.60	12.40	59.90	25.80	3.20	11.10
Education												
none	69.10	11.60	4.00	15.30	79.00	8.10	3.70	9.20	64.60	9.50	3.50	22.50
elementary	63.70	19.10	5.50	11.70	76.60	11.50	4.80	7.10	66.30	13.60	4.80	15.30
junior-high	61.50	18.90	6.90	12.70	76.50	11.20	5.50	6.80	67.00	12.60	5.50	14.90
senior-high	70.00	8.60	11.40	9.90	77.30	9.90	5.70	7.10	70.90	9.00	6.80	13.30
university+	77.50	5.00	14.80	2.70	80.80	8.20	4.80	6.20	75.00	7.10	6.20	11.70

Note: 'None' refers to a person who is not a carer. 'Grandchild' is where the respondent looks after his/her grandchildren, related to question 3. 'Adult' is where the respondent provides physical help to any adults living in the household based on either question 1 or 2. 'Financial' accords with the response to question 4, i.e., financial support.

Table 4.5 Employment Transitions (row percentage)

		Female		Male		Total	
		year=t		year=t		year=t	
		0	1	0	1	0	1
year=t-1	0	82.65	17.35	53.67	46.33	89.20	10.80
	1	35.09	64.91	25.40	74.60	30.97	69.03

Note: '0' indicates that a respondent was out of employment and '1' indicates that the respondent was in employment.

Table 4.6 Care responsibility Transitions (row percentage)

		Female		Male		Total	
		year=t		year=t		year=t	
		0	1	0	1	0	1
year=t-1	0	67.32	32.68	61.39	38.61	70.84	29.16
	1	41.51	58.49	47.64	52.36	28.48	71.52

Note: '0' indicates that a respondent was not a carer and '1' indicates that he/she was a carer (defined as respondent provides help to any individuals in the household i.e., the first type of carer).

Table 4.7 Persistence in Employment or Care Responsibility (%)

Persistence in work			Persistence in non-work		
Female	Male	Total	Female	Male	Total
8.22	20.38	14.48	30.15	15.69	22.7

Persistence as carer			Persistence as non-carer		
Female	Male	Total	Female	Male	Total
2.01	1.17	1.58	18.47	30.52	24.68

Table 4.8 Marginal Effects of Univariate Probit Model without Mundlak Fixed Effects

Dependent variables	Employed			Carer			Grandchild Carer			Adult Carer			Financial Support		
	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Aged 50-55	0.332***	0.301***	0.293***	0.002	-0.006	0.002	-0.011	-0.024	0.004	-0.014*	-0.013*	-0.016	0.016	0.016	0.013
	(0.016)	(0.016)	(0.026)	(0.017)	(0.020)	(0.026)	(0.015)	(0.016)	(0.026)	(0.006)	(0.005)	(0.012)	(0.010)	(0.014)	(0.013)
Aged 56-60	0.191***	0.195***	0.142***	0.009	0.005	0.010	0.012	0.003	0.024	-0.012*	-0.007	-0.018	0.008	0.013	0.001
	(0.013)	(0.016)	(0.018)	(0.013)	(0.016)	(0.019)	(0.011)	(0.013)	(0.019)	(0.005)	(0.005)	(0.009)	(0.007)	(0.010)	(0.009)
Male	0.341***			-0.157***			-0.133***			-0.055***			-0.012*		
	(0.013)			(0.011)			(0.010)			(0.005)			(0.005)		
Married	0.021	0.137***	-0.043*	0.110***	0.109***	0.118***	0.081***	0.067***	0.103***	0.026***	0.012*	0.042***	0.015*	0.033***	0.005
	(0.019)	(0.028)	(0.021)	(0.013)	(0.017)	(0.019)	(0.011)	(0.013)	(0.018)	(0.004)	(0.005)	(0.008)	(0.007)	(0.008)	(0.009)
Household size	-0.001	-0.001	-0.001	0.000	0.002	-0.002	0.000	0.001	-0.002	0.001**	0.001***	0.000	0.001*	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	0.000	0.000	0.000	0.000	0.000	0.000
Log household income	0.010***	0.013***	0.005*	-0.002	-0.003	-0.002	0.000	0.001	-0.003	-0.001	-0.001	-0.001	-0.004***	-0.004**	-0.004**
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Number of children	-0.010	-0.001	-0.017**	0.008*	0.004	0.013*	0.008*	0.009*	0.007	0.000	-0.003	0.005	-0.002	-0.003	0.003
	(0.005)	(0.006)	(0.007)	(0.004)	(0.005)	(0.006)	(0.003)	(0.004)	(0.006)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Education: elementary	-0.018	-0.019	-0.005	0.016	0.002	0.047*	0.022*	0.005	0.055**	0.000	0.002	0.005	0.004	-0.014*	0.040***
	(0.014)	(0.016)	(0.022)	(0.010)	(0.016)	(0.020)	(0.010)	(0.014)	(0.019)	(0.004)	(0.006)	(0.010)	(0.005)	(0.006)	(0.009)
Education: junior high	-0.041*	-0.030	-0.039	0.037*	0.009	0.109**	0.033*	0.004	0.095**	-0.004	-0.004	0.005	0.017*	0.010	0.064**
	(0.020)	(0.021)	(0.035)	(0.015)	(0.020)	(0.034)	(0.015)	(0.018)	(0.036)	(0.007)	(0.008)	(0.018)	(0.007)	(0.008)	(0.022)
Education: senior high	0.019	0.006	0.064	0.003	-0.007	0.050	-0.001	-0.001	-0.002	0.008	0.001	0.038	0.001	-0.008	0.072**
	(0.019)	(0.020)	(0.040)	(0.015)	(0.020)	(0.036)	(0.015)	(0.018)	(0.038)	(0.006)	(0.008)	(0.024)	(0.007)	(0.008)	(0.024)
Education: university	0.063**	0.050*	0.082	-0.055**	-0.057*	-0.015	-0.086***	-0.056**	-0.170***	-0.004	-0.009	0.033	-0.009	-0.005	0.028
	(0.022)	(0.023)	(0.050)	(0.018)	(0.022)	(0.042)	(0.018)	(0.020)	(0.035)	(0.007)	(0.009)	(0.026)	(0.008)	(0.009)	(0.028)
Health: blood	-0.052***	-0.038*	-0.051**	-0.006	-0.005	-0.005	-0.002	0.005	-0.015	-0.002	-0.007	0.003	0.005	0.006	0.002
	(0.015)	(0.019)	(0.019)	(0.012)	(0.015)	(0.019)	(0.011)	(0.013)	(0.018)	(0.005)	(0.005)	(0.009)	(0.006)	(0.009)	(0.008)
Health: diabetes	-0.126***	-0.139***	-0.090***	-0.027	-0.038	-0.015	-0.025	-0.028	-0.023	-0.014*	-0.003	-0.025*	-0.009	0.007	-0.020*
	(0.020)	(0.027)	(0.025)	(0.016)	(0.020)	(0.025)	(0.014)	(0.016)	(0.024)	(0.006)	(0.007)	(0.011)	(0.008)	(0.012)	(0.010)
Health: heart problem	-0.061**	-0.094***	-0.019	0.000	-0.034	0.028	0.000	-0.023	0.024	0.010	-0.002	0.026*	-0.008	-0.005	-0.007
	(0.019)	(0.027)	(0.023)	(0.016)	(0.020)	(0.024)	(0.014)	(0.016)	(0.023)	(0.007)	(0.007)	(0.013)	(0.007)	(0.011)	(0.010)
Health: stroke	-0.303***	-0.367***	-0.179***	-0.161***	-0.093**	-0.265***	-0.110***	-0.057*	-0.193***	-0.024**	0.003	-0.072***	-0.002	0.004	-0.001
	(0.031)	(0.047)	(0.042)	(0.026)	(0.030)	(0.041)	(0.023)	(0.024)	(0.038)	(0.009)	(0.011)	(0.007)	(0.014)	(0.017)	(0.025)

Table 4.8 Marginal Effects of Univariate Probit Model without Mundlak Fixed Effects (continued)

Dependent variables	Employed			Carer			Grandchild Carer			Adult Carer			Financial Support		
	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Health: asthma	-0.064**	-0.059*	-0.055*	0.018	0.016	0.023	0.020	0.018	0.037	-0.002	-0.009	0.013	0.008	0.006	0.013
	(0.020)	(0.025)	(0.027)	(0.017)	(0.020)	(0.029)	(0.016)	(0.017)	(0.029)	(0.007)	(0.005)	(0.015)	(0.009)	(0.010)	(0.014)
Health: arthritis	-0.010	-0.017	-0.003	0.023	0.042*	0.009	0.011	0.016	0.008	0.000	0.002	-0.002	0.014*	-0.001	0.026**
	(0.015)	(0.022)	(0.018)	(0.013)	(0.019)	(0.018)	(0.012)	(0.015)	(0.018)	(0.005)	(0.006)	(0.009)	(0.007)	(0.009)	(0.009)
Health: ulcer	-0.004	-0.020	0.011	-0.020	-0.011	-0.032	-0.012	-0.007	-0.023	-0.003	0.003	-0.012	0.004	-0.001	0.012
	(0.015)	(0.020)	(0.019)	(0.013)	(0.016)	(0.020)	(0.012)	(0.013)	(0.019)	(0.005)	(0.006)	(0.010)	(0.007)	(0.009)	(0.010)
Health: gall	-0.025	-0.016	-0.032	0.008	0.012	0.004	0.009	0.003	0.022	-0.001	0.002	-0.006	0.003	0.010	-0.008
	(0.021)	(0.027)	(0.028)	(0.019)	(0.022)	(0.031)	(0.018)	(0.018)	(0.032)	(0.008)	(0.008)	(0.015)	(0.010)	(0.013)	(0.013)
Health: sight	-0.067**	-0.020	-0.091***	0.016	0.002	0.023	0.027	0.029	0.026	0.008	0.008	0.009	0.004	0.007	0.002
	(0.021)	(0.030)	(0.022)	(0.018)	(0.025)	(0.025)	(0.016)	(0.022)	(0.024)	(0.008)	(0.009)	(0.013)	(0.009)	(0.013)	(0.011)
Health: kidney	-0.035	-0.022	-0.039	0.013	0.027	0.001	0.015	0.017	0.004	0.002	0.001	0.004	0.022	0.002	0.047**
	(0.022)	(0.029)	(0.028)	(0.020)	(0.024)	(0.031)	(0.018)	(0.021)	(0.029)	(0.008)	(0.008)	(0.015)	(0.011)	(0.013)	(0.018)
Ethic origin: Hokkien	-0.061	-0.075	-0.050	0.049	0.065	0.037	0.008	0.028	-0.003	0.034*	0.013	0.057*	0.029	0.008	0.049*
	(0.052)	(0.063)	(0.067)	(0.043)	(0.058)	(0.064)	(0.037)	(0.044)	(0.060)	(0.016)	(0.020)	(0.027)	(0.019)	(0.031)	(0.022)
Ethic origin: Hakka	-0.004	-0.003	-0.014	0.064	0.091	0.040	0.016	0.049	-0.008	0.062	0.023	0.099	0.050	0.013	0.090
	(0.054)	(0.069)	(0.066)	(0.049)	(0.074)	(0.068)	(0.040)	(0.056)	(0.062)	(0.037)	(0.036)	(0.063)	(0.032)	(0.036)	(0.051)
Ethic origin: Mainlander	-0.089	-0.047	-0.134*	0.151**	0.205*	0.095	0.094	0.165*	0.039	0.119*	0.085	0.087	0.089*	0.066	0.001
	(0.055)	(0.073)	(0.057)	(0.056)	(0.087)	(0.078)	(0.051)	(0.078)	(0.078)	(0.056)	(0.070)	(0.073)	(0.041)	(0.052)	(0.037)
Region: North	-0.061	-0.026	-0.072	0.004	0.005	0.005	0.017	0.021	0.010	-0.003	0.001	-0.004	-0.014	0.003	-0.029
	(0.033)	(0.038)	(0.044)	(0.026)	(0.031)	(0.043)	(0.023)	(0.025)	(0.041)	(0.011)	(0.010)	(0.021)	(0.012)	(0.017)	(0.015)
Region: Middle	0.010	0.044	-0.018	0.015	0.017	0.011	0.005	0.012	-0.006	0.013	0.002	0.028	-0.005	0.020	-0.025
	(0.033)	(0.037)	(0.045)	(0.026)	(0.030)	(0.042)	(0.022)	(0.024)	(0.039)	(0.012)	(0.010)	(0.023)	(0.013)	(0.018)	(0.016)
Region: South	-0.015	0.000	-0.019	0.050	0.044	0.058	0.031	0.034	0.024	0.008	0.004	0.015	0.015	0.043*	-0.009
	(0.032)	(0.037)	(0.045)	(0.026)	(0.030)	(0.042)	(0.023)	(0.024)	(0.039)	(0.011)	(0.010)	(0.022)	(0.013)	(0.019)	(0.017)
Year 1996	-0.016	0.008	-0.027	0.017	0.099***	-0.081*	-0.084***	-0.041*	-0.148***	-0.046***	-0.029***	-0.067***	-0.074***	-0.069***	-0.074***
	(0.021)	(0.026)	(0.029)	(0.022)	(0.029)	(0.033)	(0.016)	(0.018)	(0.026)	(0.005)	(0.005)	(0.010)	(0.006)	(0.008)	(0.008)
Year 1999	-0.145***	-0.185***	-0.085**	-0.014	0.068	-0.102**	-0.020	0.038	-0.092**	-0.046***	-0.023***	-0.074***	-0.082***	-0.079***	-0.075***
	(0.026)	(0.039)	(0.033)	(0.026)	(0.037)	(0.037)	(0.022)	(0.029)	(0.033)	(0.005)	(0.006)	(0.010)	(0.005)	(0.007)	(0.008)
Year 2003	-0.166***	-0.234***	-0.084**	0.031	0.127***	-0.079*	-0.020	0.066*	-0.127***	-0.046***	-0.015	-0.083***	-0.079***	-0.081***	-0.067***
	(0.026)	(0.036)	(0.032)	(0.026)	(0.036)	(0.038)	(0.021)	(0.028)	(0.032)	(0.007)	(0.009)	(0.013)	(0.008)	(0.011)	(0.012)

Table 4.8 Marginal Effects of Univariate Probit Model without Mundlak Fixed Effects (continued)

Dependent variables	Employed			Carer			Grandchild Carer			Adult Carer			Financial Support		
	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Year 2007	-0.188***	-0.261***	-0.102*	0.078*	0.124*	0.016	0.025	0.055	-0.021	-0.031***	-0.016	-0.048**	-0.010	-0.029	0.014
	(0.033)	(0.049)	(0.041)	(0.035)	(0.049)	(0.051)	(0.030)	(0.038)	(0.046)	(0.009)	(0.010)	(0.017)	(0.015)	(0.018)	(0.023)
Coresidence: spouse				-0.119***	-0.082**	-0.164***	-0.123***	-0.071***	-0.194***	-0.010	0.001	-0.026	0.003	-0.009	0.017
				(0.021)	(0.025)	(0.032)	(0.015)	(0.019)	(0.025)	(0.009)	(0.011)	(0.015)	(0.014)	(0.019)	(0.020)
Coresidence: son				-0.167***	-0.122***	-0.215***	-0.172***	-0.107***	-0.248***	-0.028***	-0.020**	-0.037**	0.005	-0.004	0.011
				(0.019)	(0.023)	(0.029)	(0.015)	(0.019)	(0.024)	(0.008)	(0.007)	(0.014)	(0.013)	(0.018)	(0.017)
Coresidence: daughter				-0.071**	-0.028	-0.112**	-0.040	-0.003	-0.084*	-0.051***	-0.034***	-0.074***	-0.001	0.004	-0.030*
				(0.024)	(0.031)	(0.038)	(0.021)	(0.027)	(0.034)	(0.004)	(0.004)	(0.008)	(0.014)	(0.020)	(0.014)
Coresidence: parents				0.021	0.014	0.037	-0.135***	-0.080***	-0.209***	0.041*	0.017	0.077*	0.009	0.004	0.009
				(0.030)	(0.034)	(0.051)	(0.017)	(0.019)	(0.030)	(0.018)	(0.015)	(0.036)	(0.018)	(0.023)	(0.027)
Coresidence: grandchild				0.253***	0.226***	0.273***	0.271***	0.247***	0.290***	-0.010	-0.005	-0.014	0.005	0.002	0.009
				(0.022)	(0.032)	(0.031)	(0.021)	(0.033)	(0.029)	(0.009)	(0.008)	(0.016)	(0.012)	(0.018)	(0.016)
Living parents				0.055***	0.047*	0.060*	0.043**	0.032	0.050*	0.021**	0.019*	0.023	0.039***	0.074***	0.004
				(0.016)	(0.020)	(0.024)	(0.015)	(0.017)	(0.024)	(0.008)	(0.009)	(0.014)	(0.010)	(0.016)	(0.012)
Obs	9,905	5,103	4,806	9,913	5,103	4.802	9,865	5,103	4,806	9,865	5,097	4,768	9,861	5,094	4,767

Notes: (1)***p<0.001, **p<0.005, *p<0.01; Standard errors in parentheses. (2) Omitted categories: Aged 61-65, Single, No education, Aborigine and other groups, Eastern area, Year1989, Live alone. (3) 'Carer' refers to provide help to any individuals in the household, related to any of questions 1, 2 and 3. 'Grandchild' is where the respondent looks after his/her grandchildren, related to question 3. 'Adult' is where the respondent provides physical help to any adults living in the household based on either question 1 or 2. 'Financial Support' accords with the response to question 4.

Table 4.9 Marginal Effects of Univariate Probit Model with Mundlak Fixed Effects

Dependent variables	Employed			Carer			Grandchild Carer			Adult Carer			Financial Support		
	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Aged 50-55	0.207***	0.168***	0.206***	0.041	0.046	0.024	0.034	0.049	0.007	-0.021*	-0.011	-0.033	0.011	0.026	-0.005
	(0.030)	(0.035)	(0.042)	(0.029)	(0.037)	(0.044)	(0.027)	(0.034)	(0.043)	(0.009)	(0.009)	(0.017)	(0.016)	(0.023)	(0.020)
Aged 56-60	0.124***	0.112***	0.101***	0.029	0.032	0.020	0.034*	0.041*	0.024	-0.015*	-0.005	-0.026*	0.006	0.017	-0.007
	(0.019)	(0.023)	(0.025)	(0.017)	(0.021)	(0.026)	(0.016)	(0.018)	(0.026)	(0.007)	(0.007)	(0.012)	(0.009)	(0.013)	(0.012)
Male	0.343***			-0.158***			-0.135***			-0.055***			-0.013*		
	(0.013)			(0.011)			(0.010)			(0.005)			(0.005)		
Married	0.019	0.135***	-0.044*	0.105***	0.100***	0.115***	0.080***	0.061***	0.102***	0.025***	0.011*	0.042***	0.015*	0.033***	0.004
	(0.019)	(0.028)	(0.021)	(0.013)	(0.018)	(0.019)	(0.011)	(0.014)	(0.018)	(0.004)	(0.005)	(0.008)	(0.007)	(0.008)	(0.009)
Household size	0.001	0.001	0.000	-0.002*	-0.001	-0.005**	-0.001	0.000	-0.003*	0.001*	0.001*	0.001	0.001*	0.001	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	0.000	0.000	(0.001)	0.000	(0.001)	0.000
Log household income	0.006**	0.009**	0.003	-0.003	-0.004	-0.003	-0.001	0.001	-0.005	-0.001	-0.001	0.000	-0.005***	-0.005***	-0.006***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Number of children	-0.007	0.002	-0.016*	0.008*	0.005	0.012*	0.009*	0.009*	0.008	0.000	-0.002	0.005	-0.002	-0.002	0.003
	(0.005)	(0.006)	(0.007)	(0.004)	(0.005)	(0.006)	(0.003)	(0.004)	(0.006)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Education: elementary	-0.018	-0.015	-0.006	0.016	0.004	0.045*	0.022*	0.006	0.055**	0.000	0.002	0.004	0.005	-0.012*	0.040***
	(0.014)	(0.016)	(0.022)	(0.010)	(0.015)	(0.020)	(0.010)	(0.012)	(0.019)	(0.004)	(0.005)	(0.010)	(0.005)	(0.006)	(0.009)
Education: junior high	-0.041*	-0.029	-0.039	0.036*	0.009	0.107**	0.032*	0.006	0.094*	-0.004	-0.004	0.003	0.016*	0.009	0.063**
	(0.020)	(0.021)	(0.035)	(0.015)	(0.019)	(0.034)	(0.014)	(0.015)	(0.037)	(0.007)	(0.007)	(0.017)	(0.007)	(0.008)	(0.021)
Education: senior high	0.016	0.002	0.062	0.005	-0.004	0.053	0.002	0.003	0.004	0.007	0.002	0.036	0.000	-0.009	0.071**
	(0.019)	(0.020)	(0.040)	(0.015)	(0.019)	(0.037)	(0.015)	(0.015)	(0.039)	(0.006)	(0.007)	(0.023)	(0.007)	(0.008)	(0.024)
Education: university	0.058**	0.044	0.080	-0.054**	-0.055**	-0.014	-0.082***	-0.050**	-0.166***	-0.005	-0.008	0.027	-0.009	-0.006	0.030
	(0.022)	(0.023)	(0.050)	(0.018)	(0.021)	(0.043)	(0.017)	(0.016)	(0.036)	(0.007)	(0.008)	(0.025)	(0.008)	(0.009)	(0.028)
Health: blood	-0.051***	-0.037	-0.052**	-0.006	-0.005	-0.006	-0.002	0.004	-0.013	-0.002	-0.007	0.002	0.005	0.007	0.002
	(0.015)	(0.019)	(0.019)	(0.012)	(0.015)	(0.019)	(0.011)	(0.013)	(0.018)	(0.005)	(0.004)	(0.009)	(0.006)	(0.008)	(0.008)
Health: diabetes	-0.125***	-0.137***	-0.089***	-0.029	-0.041*	-0.017	-0.028	-0.032*	-0.025	-0.014*	-0.003	-0.025*	-0.008	0.007	-0.019
	(0.020)	(0.027)	(0.025)	(0.016)	(0.020)	(0.025)	(0.014)	(0.015)	(0.024)	(0.006)	(0.006)	(0.011)	(0.008)	(0.011)	(0.010)
Health: heart problem	-0.059**	-0.093***	-0.018	0.000	-0.031	0.026	0.002	-0.020	0.024	0.011	0.000	0.027*	-0.008	-0.005	-0.007
	(0.019)	(0.027)	(0.023)	(0.016)	(0.020)	(0.024)	(0.014)	(0.015)	(0.023)	(0.007)	(0.007)	(0.013)	(0.007)	(0.011)	(0.010)
Health: stroke	-0.302***	-0.365***	-0.179***	-0.165***	-0.097***	-0.267***	-0.112***	-0.060**	-0.194***	-0.024**	0.000	-0.071***	-0.003	0.004	-0.003
	(0.031)	(0.048)	(0.042)	(0.025)	(0.029)	(0.040)	(0.022)	(0.023)	(0.036)	(0.008)	(0.010)	(0.008)	(0.014)	(0.017)	(0.025)

Table 4.9 Marginal Effects of Univariate Probit Model with Mundlak Fixed Effects (continued)

Dependent variables	Employed			Carer			Grandchild Carer			Adult Carer			Financial Support		
	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Health: asthma	-0.062**	-0.055*	-0.055*	0.017	0.012	0.025	0.021	0.014	0.042	-0.001	-0.009	0.013	0.009	0.006	0.014
	(0.020)	(0.026)	(0.027)	(0.017)	(0.020)	(0.029)	(0.016)	(0.016)	(0.029)	(0.007)	(0.005)	(0.015)	(0.009)	(0.010)	(0.014)
Health: arthritis	-0.009	-0.014	-0.004	0.025	0.045*	0.010	0.012	0.015	0.009	0.000	0.001	-0.002	0.013	-0.001	0.025**
	(0.015)	(0.022)	(0.018)	(0.013)	(0.019)	(0.019)	(0.012)	(0.015)	(0.018)	(0.005)	(0.006)	(0.009)	(0.007)	(0.009)	(0.009)
Health: ulcer	-0.003	-0.016	0.011	-0.018	-0.009	-0.029	-0.011	-0.006	-0.021	-0.003	0.003	-0.012	0.005	-0.002	0.013
	(0.015)	(0.020)	(0.019)	(0.013)	(0.016)	(0.020)	(0.012)	(0.013)	(0.020)	(0.005)	(0.005)	(0.009)	(0.007)	(0.008)	(0.010)
Health: gall	-0.027	-0.020	-0.033	0.008	0.015	0.002	0.008	0.004	0.020	-0.001	0.003	-0.006	0.003	0.010	-0.009
	(0.021)	(0.027)	(0.028)	(0.019)	(0.022)	(0.031)	(0.018)	(0.018)	(0.032)	(0.008)	(0.007)	(0.015)	(0.010)	(0.013)	(0.012)
Health: sight	-0.064**	-0.013	-0.090***	0.013	0.000	0.020	0.024	0.025	0.022	0.008	0.007	0.008	0.005	0.007	0.002
	(0.021)	(0.030)	(0.023)	(0.018)	(0.025)	(0.025)	(0.016)	(0.021)	(0.024)	(0.008)	(0.009)	(0.013)	(0.009)	(0.013)	(0.011)
Health: kidney	-0.037	-0.024	-0.040	0.014	0.028	0.002	0.016	0.017	0.004	0.002	0.000	0.003	0.021	0.001	0.045*
	(0.022)	(0.030)	(0.028)	(0.020)	(0.024)	(0.031)	(0.018)	(0.020)	(0.029)	(0.008)	(0.007)	(0.015)	(0.011)	(0.013)	(0.018)
Ethic origin: Hokkien	-0.061	-0.080	-0.047	0.048	0.073	0.035	0.007	0.030	-0.002	0.034*	0.014	0.058*	0.028	0.011	0.046*
	(0.053)	(0.064)	(0.068)	(0.042)	(0.055)	(0.063)	(0.037)	(0.042)	(0.060)	(0.016)	(0.017)	(0.026)	(0.019)	(0.030)	(0.022)
Ethic origin: Hakka	-0.004	-0.009	-0.010	0.066	0.104	0.041	0.016	0.055	-0.007	0.063	0.026	0.101	0.048	0.016	0.085
	(0.055)	(0.070)	(0.067)	(0.048)	(0.072)	(0.068)	(0.040)	(0.055)	(0.062)	(0.037)	(0.034)	(0.062)	(0.031)	(0.037)	(0.050)
Ethic origin: Mainlander	-0.083	-0.038	-0.131*	0.142**	0.204*	0.095	0.079	0.151*	0.040	0.116*	0.082	0.090	0.085*	0.069	-0.002
	(0.056)	(0.074)	(0.058)	(0.055)	(0.085)	(0.078)	(0.049)	(0.074)	(0.078)	(0.055)	(0.064)	(0.072)	(0.041)	(0.054)	(0.035)
Region: North	-0.059	-0.017	-0.072	0.007	0.009	0.009	0.020	0.022	0.016	-0.002	0.001	-0.002	-0.014	0.002	-0.029
	(0.033)	(0.038)	(0.044)	(0.027)	(0.031)	(0.043)	(0.024)	(0.025)	(0.041)	(0.011)	(0.010)	(0.022)	(0.012)	(0.017)	(0.015)
Region: Middle	0.010	0.050	-0.018	0.016	0.019	0.012	0.007	0.013	-0.004	0.013	0.002	0.029	-0.006	0.020	-0.026
	(0.033)	(0.037)	(0.045)	(0.026)	(0.031)	(0.042)	(0.023)	(0.024)	(0.039)	(0.012)	(0.009)	(0.023)	(0.012)	(0.018)	(0.016)
Region: South	-0.013	0.009	-0.019	0.050	0.044	0.056	0.035	0.038	0.027	0.009	0.005	0.017	0.014	0.043*	-0.010
	(0.032)	(0.037)	(0.045)	(0.026)	(0.031)	(0.042)	(0.023)	(0.025)	(0.040)	(0.011)	(0.010)	(0.022)	(0.013)	(0.019)	(0.017)
Year 1996	-0.026	0.004	-0.040	0.002	0.082*	-0.095**	-0.071***	-0.031	-0.136***	-0.042***	-0.025***	-0.063***	-0.081***	-0.076***	-0.080***
	(0.024)	(0.030)	(0.032)	(0.024)	(0.032)	(0.035)	(0.018)	(0.020)	(0.030)	(0.006)	(0.005)	(0.012)	(0.006)	(0.008)	(0.009)
Year 1999	-0.157***	-0.201***	-0.093**	0.004	0.091*	-0.087*	0.011	0.072*	-0.060	-0.045***	-0.024***	-0.070***	-0.081***	-0.079***	-0.075***
	(0.028)	(0.040)	(0.034)	(0.028)	(0.041)	(0.040)	(0.025)	(0.034)	(0.038)	(0.005)	(0.005)	(0.010)	(0.006)	(0.007)	(0.008)
Year 2003	-0.209***	-0.292***	-0.112**	0.038	0.141***	-0.076	0.015	0.106**	-0.096*	-0.046***	-0.013	-0.087***	-0.084***	-0.088***	-0.073***
	(0.029)	(0.041)	(0.037)	(0.030)	(0.042)	(0.043)	(0.026)	(0.035)	(0.039)	(0.008)	(0.009)	(0.014)	(0.009)	(0.011)	(0.013)

Table 4.9 Marginal Effects of Univariate Probit Model with Mundlak Fixed Effects (continued)

Dependent variables	Employed			Carer			Grandchild Carer			Adult Carer			Financial Support		
	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Year 2007	-0.246***	-0.347***	-0.135**	0.102*	0.156**	0.034	0.080*	0.116*	0.031	-0.033***	-0.015	-0.058**	-0.014	-0.036*	0.008
	(0.036)	(0.053)	(0.045)	(0.041)	(0.059)	(0.059)	(0.037)	(0.050)	(0.057)	(0.010)	(0.010)	(0.018)	(0.017)	(0.018)	(0.026)
Age(M)	-0.019***	-0.024***	-0.011*	0.005	0.007	0.003	0.006	0.009*	0.002	-0.002	0.000	-0.004	0.000	0.002	-0.001
	(0.004)	(0.006)	(0.005)	(0.004)	(0.005)	(0.006)	(0.003)	(0.004)	(0.006)	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)	(0.003)
Hhsize(M)	-0.004	-0.006*	-0.002	0.007***	0.006***	0.007**	0.002	0.003	0.001	-0.001	0.000	-0.002	0.000	0.000	0.000
	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Hhincome(M)	0.004	0.005*	0.003	0.002	0.002	0.002	0.001	0.000	0.003	0.000	0.000	0.000	0.002**	0.002	0.002*
	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Living parents(M)	0.013	0.076*	-0.044	0.113***	0.124**	0.091	0.037	0.070*	0.004	0.002	-0.026	0.042	0.027	0.029	0.014
	(0.024)	(0.032)	(0.031)	(0.033)	(0.041)	(0.049)	(0.029)	(0.034)	(0.047)	(0.014)	(0.015)	(0.024)	(0.018)	(0.023)	(0.025)
Coresidence: spouse	-0.019***			-0.191***	-0.170***	-0.204***	-0.150***	-0.105***	-0.217***	-0.013	-0.016	-0.011	-0.001	0.010	-0.001
	(0.004)			(0.026)	(0.026)	(0.046)	(0.020)	(0.020)	(0.034)	(0.013)	(0.009)	(0.025)	(0.022)	(0.035)	(0.029)
Coresidence: son	-0.004			-0.198***	-0.197***	-0.190***	-0.198***	-0.165***	-0.237***	-0.023	-0.032**	-0.009	-0.028	-0.024	-0.022
	(0.002)			(0.028)	(0.032)	(0.046)	(0.022)	(0.023)	(0.037)	(0.013)	(0.010)	(0.027)	(0.018)	(0.025)	(0.025)
Coresidence: daughter	0.004*			-0.226***	-0.217***	-0.217***	-0.195***	-0.165***	-0.223***	-0.061***	-0.053***	-0.065***	-0.041*	-0.005	-0.057***
	(0.002)			(0.027)	(0.027)	(0.050)	(0.017)	(0.016)	(0.034)	(0.005)	(0.007)	(0.015)	(0.017)	(0.037)	(0.014)
Coresidence: parents	0.013			0.015	-0.003	0.018	-0.145***	-0.095***	-0.222***	0.018	-0.006	0.045	-0.023	-0.022	-0.020
	(0.024)			(0.053)	(0.056)	(0.093)	(0.023)	(0.023)	(0.042)	(0.026)	(0.014)	(0.058)	(0.021)	(0.026)	(0.035)
Coresidence: grandchild				0.232***	0.158**	0.290***	0.227***	0.149**	0.276***	0.000	-0.012	0.012	0.003	0.049	-0.014
				(0.036)	(0.051)	(0.048)	(0.034)	(0.046)	(0.048)	(0.015)	(0.013)	(0.027)	(0.021)	(0.038)	(0.027)
Living parents				-0.026	-0.040	-0.007	0.018	-0.017	0.046	0.018	0.055	-0.011	0.014	0.038	-0.006
				(0.026)	(0.031)	(0.040)	(0.025)	(0.027)	(0.039)	(0.014)	(0.029)	(0.019)	(0.018)	(0.028)	(0.022)
Spouse(M)				0.149**	0.212***	0.076	0.066	0.098	0.052	0.006	0.035	-0.024	0.007	-0.029	0.025
				(0.049)	(0.063)	(0.073)	(0.045)	(0.054)	(0.072)	(0.020)	(0.021)	(0.036)	(0.028)	(0.040)	(0.037)
Son(M)				0.056	0.145*	-0.043	0.052	0.129**	-0.030	-0.010	0.024	-0.045	0.056*	0.036	0.055
				(0.044)	(0.057)	(0.067)	(0.040)	(0.048)	(0.065)	(0.019)	(0.019)	(0.035)	(0.026)	(0.036)	(0.034)
Daughter(M)				0.286***	0.379***	0.183*	0.337***	0.375***	0.299***	0.052*	0.093***	-0.034	0.067*	0.007	0.078
				(0.057)	(0.073)	(0.085)	(0.050)	(0.060)	(0.081)	(0.026)	(0.024)	(0.046)	(0.031)	(0.045)	(0.043)

Table 4.9 Marginal Effects of Univariate Probit Model with Mundlak Fixed Effects (continued)

Dependent variables	Employed			Carer			Grandchild Carer			Adult Carer			Financial Support		
	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Parents(M)				0.014	0.044	0.024	0.043	0.064	0.048	0.024	0.031	0.032	0.051	0.038	0.044
				(0.064)	(0.073)	(0.112)	(0.059)	(0.063)	(0.109)	(0.025)	(0.023)	(0.050)	(0.034)	(0.044)	(0.053)
Grandchild(M)				0.035	0.098	-0.023	0.063	0.116*	0.030	-0.012	0.012	-0.033	0.010	-0.050	0.038
					(0.059)	(0.064)	(0.040)	(0.049)	(0.062)	(0.019)	(0.020)	(0.033)	(0.026)	(0.038)	(0.034)
Obs	9,905	5,103	4,806	9,913	5,103	4.802	9,865	5,103	4,806	9,865	5,097	4,768	9,861	5,094	4,767

Notes: (1)***p<0.001, **p<0.005, *p<0.01; Standard errors in parentheses. (2) Omitted categories: Aged 61-65, Single, No education, Aborigine and other groups, Eastern area, Year1989, Live alone. (3) (M) indicates Mundlak Fixed Effects. (4) 'Carer' relates to whether the individual responded to any of questions 1, 2 and 3 (refers to provide help to any individuals in the household). 'Grandchild' is where the respondent looks after his/her grandchildren, related to question 3. 'Adult' is where the respondent provides physical help to any adults living in the household based on either question 1 or 2. 'Financial Support' accords with the response to question 4.

Table 4.10 Marginal Effects of Bivariate Probit Model without Mundlak Fixed Effects

Dependent variables	Employed	Carer	Employed	Carer	Employed	Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Adult Carer	Employed	Adult Carer	Employed	Adult Carer
	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)	
Aged 50-55	0.289***	-0.001	0.320***	-0.009	0.255***	-0.001	0.289***	-0.014	0.320***	-0.027	0.255***	-0.002	0.290***	-0.019*	0.320***	-0.019*	0.255***	-0.020
	(0.015)	(0.015)	(0.021)	(0.019)	(0.021)	(0.022)	(0.015)	(0.013)	(0.021)	(0.017)	(0.021)	(0.021)	(0.015)	(0.008)	(0.021)	(0.009)	(0.021)	(0.014)
Aged 56-60	0.160***	0.007	0.181***	0.004	0.130***	0.008	0.160***	0.009	0.181***	0.003	0.130***	0.018	0.160***	-0.015*	0.181***	-0.009	0.130***	-0.020
	(0.011)	(0.011)	(0.015)	(0.014)	(0.016)	(0.016)	(0.011)	(0.010)	(0.015)	(0.012)	(0.016)	(0.015)	(0.011)	(0.006)	(0.015)	(0.006)	(0.016)	(0.010)
Male	0.294***	-0.138***					0.293***	-0.116***					0.293***	-0.061***				
	(0.010)	(0.009)					(0.010)	(0.009)					(0.010)	(0.006)				
Married	0.017	0.101***	0.118***	0.119***	-0.040*	0.103***	0.017	0.076***	0.119***	0.077***	-0.040*	0.086***	0.018	0.035***	0.117***	0.018	-0.037	0.053***
	(0.016)	(0.013)	(0.023)	(0.022)	(0.019)	(0.017)	(0.016)	(0.011)	(0.023)	(0.019)	(0.019)	(0.016)	(0.016)	(0.007)	(0.024)	(0.009)	(0.019)	(0.012)
Household size	-0.001	0.000	-0.001	0.002	-0.001	-0.002	-0.001***	0.000	-0.001	0.001	-0.001	-0.001	-0.001	0.001**	-0.001	0.001***	-0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)
Log household income	0.008***	-0.002	0.012***	-0.003	0.005*	-0.002	0.008	-0.001	0.012	0.001	0.005*	-0.002	0.009***	-0.001	0.012***	-0.001	0.005*	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Number of children	-0.008**	0.007***	-0.001	0.004	-0.016**	0.011*	-0.008**	0.007**	-0.001	0.008*	-0.016*	0.006	-0.008**	0.000	-0.001	-0.003	-0.017*	0.006
	(0.004)	(0.003)	(0.005)	(0.005)	(0.006)	(0.005)	(0.004)	(0.003)	(0.005)	(0.004)	(0.006)	(0.005)	(0.004)	(0.002)	(0.005)	(0.002)	(0.006)	(0.003)
Education: elementary	-0.015	0.014	-0.016	0.004	-0.005	0.039*	-0.015	0.020**	-0.016	0.006	-0.004	0.043**	-0.014	0.000	-0.015	0.003	-0.003	0.004
	(0.011)	(0.009)	(0.014)	(0.013)	(0.020)	(0.017)	(0.011)	(0.008)	(0.014)	(0.013)	(0.020)	(0.015)	(0.012)	(0.005)	(0.014)	(0.006)	(0.021)	(0.010)
Education: junior high	-0.034**	0.032*	-0.027	0.010	-0.037	0.089***	-0.034*	0.028	-0.027	0.005	-0.036	0.071*	-0.035**	-0.005	-0.028	-0.004	-0.037	0.004
	(0.017)	(0.013)	(0.019)	(0.017)	(0.035)	(0.028)	(0.017)	(0.013)	(0.019)	(0.016)	(0.035)	(0.027)	(0.017)	(0.008)	(0.019)	(0.008)	(0.035)	(0.018)
Education: senior high	0.016	0.002	0.005	-0.005	0.058	0.037	0.016	-0.002	0.005	-0.001	0.058	-0.005	0.016	0.009	0.005	0.002	0.059	0.034
	(0.016)	(0.013)	(0.018)	(0.017)	(0.035)	(0.030)	(0.016)	(0.013)	(0.018)	(0.016)	(0.035)	(0.031)	(0.016)	(0.007)	(0.018)	(0.008)	(0.035)	(0.019)
Education: university	0.052***	-0.049***	0.045*	-0.052**	0.074	-0.017	0.052**	-0.075***	0.045*	-0.054**	0.074	-0.171***	0.052**	-0.006	0.045*	-0.011	0.074	0.029
	(0.018)	(0.015)	(0.020)	(0.019)	(0.042)	(0.037)	(0.018)	(0.015)	(0.020)	(0.017)	(0.043)	(0.045)	(0.018)	(0.008)	(0.020)	(0.009)	(0.043)	(0.022)

Table 4.10 Marginal Effects of Bivariate Probit Model without Mundlak Fixed Effects (continued)

Dependent variables	Employed	Carer	Employed	Carer	Employed	Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Adult Carer	Employed	Adult Carer	Employed	Adult Carer
	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)	
Health: blood	-0.043***	-0.005	-0.033*	-0.005	-0.048**	-0.004	-0.043***	-0.002	-0.034*	0.005	-0.048*	-0.010	-0.043***	-0.003	-0.033	-0.009	-0.048**	0.003
	(0.013)	(0.011)	(0.017)	(0.014)	(0.019)	(0.016)	(0.013)	(0.010)	(0.017)	(0.013)	(0.019)	(0.015)	(0.013)	(0.006)	(0.017)	(0.006)	(0.019)	(0.010)
Health: diabetes	-0.107***	-0.024	-0.120***	-0.038	-0.089***	-0.013	-0.107**	-0.023	-0.120***	-0.031	-0.088***	-0.019	-0.108***	-0.017**	-0.121***	-0.004	-0.090***	-0.029*
	(0.017)	(0.015)	(0.022)	(0.020)	(0.026)	(0.022)	(0.017)	(0.013)	(0.022)	(0.017)	(0.026)	(0.020)	(0.017)	(0.008)	(0.022)	(0.009)	(0.027)	(0.015)
Health: heart problem	-0.051***	-0.001	-0.082***	-0.035	-0.017	0.022	-0.051***	-0.001	-0.082***	-0.027	-0.017	0.019	-0.050**	0.012	-0.081***	-0.002	-0.016	0.026*
	(0.016)	(0.014)	(0.023)	(0.020)	(0.022)	(0.020)	(0.016)	(0.012)	(0.023)	(0.017)	(0.022)	(0.018)	(0.016)	(0.007)	(0.023)	(0.009)	(0.022)	(0.012)
Health: stroke	-0.288***	-0.167***	-0.321***	-0.102**	-0.201**	-0.270***	-0.288***	-0.117***	-0.320***	-0.066	-0.204***	-0.195**	-0.291***	-0.037**	-0.321***	0.002	-0.209**	-0.166**
	(0.039)	(0.034)	(0.045)	(0.038)	(0.066)	(0.058)	(0.038)	(0.032)	(0.045)	(0.034)	(0.066)	(0.055)	(0.039)	(0.017)	(0.045)	(0.012)	(0.066)	(0.056)
Health: asthma	-0.053***	0.016	-0.051	0.015	-0.054*	0.020	-0.053**	0.017	-0.051*	0.017	-0.054*	0.030	-0.055***	-0.002	-0.054**	-0.012	-0.053*	0.013
	(0.017)	(0.015)	(0.022)	(0.018)	(0.027)	(0.025)	(0.017)	(0.013)	(0.022)	(0.016)	(0.027)	(0.022)	(0.017)	(0.008)	(0.022)	(0.009)	(0.027)	(0.015)
Health: arthritis	-0.008	0.020	-0.015	0.037*	-0.002	0.008	-0.008	0.010	-0.015	0.014	-0.002	0.006	-0.008	0.000	-0.015	0.002	-0.003	-0.001
	(0.013)	(0.011)	(0.019)	(0.017)	(0.017)	(0.016)	(0.013)	(0.010)	(0.019)	(0.014)	(0.017)	(0.014)	(0.013)	(0.006)	(0.019)	(0.007)	(0.017)	(0.010)
Health: ulcer	-0.003	-0.019	-0.017	-0.012	0.011	-0.027	-0.003	-0.012	-0.017	-0.009	0.010	-0.018	-0.004	-0.004	-0.018	0.003	0.010	-0.013
	(0.013)	(0.012)	(0.018)	(0.015)	(0.018)	(0.017)	(0.013)	(0.010)	(0.018)	(0.013)	(0.018)	(0.016)	(0.013)	(0.006)	(0.018)	(0.006)	(0.018)	(0.011)
Health: gall	-0.020	0.006	-0.014	0.012	-0.029	0.001	-0.020	0.007	-0.014	0.003	-0.029	0.016	-0.021	0.000	-0.014	0.003	-0.031	-0.006
	(0.018)	(0.016)	(0.024)	(0.020)	(0.028)	(0.026)	(0.018)	(0.015)	(0.024)	(0.018)	(0.028)	(0.024)	(0.018)	(0.009)	(0.024)	(0.009)	(0.028)	(0.017)
Health: sight	-0.056***	0.014	-0.017	0.003	-0.091***	0.020	-0.056**	0.023	-0.017	0.028	-0.091***	0.020	-0.055**	0.009	-0.018	0.009	-0.088***	0.010
	(0.018)	(0.015)	(0.027)	(0.023)	(0.024)	(0.021)	(0.018)	(0.013)	(0.027)	(0.019)	(0.024)	(0.019)	(0.018)	(0.008)	(0.027)	(0.009)	(0.024)	(0.013)
Health: kidney	-0.029	0.011	-0.020	0.024	-0.037	0.001	-0.029	0.013	-0.019	0.017	-0.038	0.004	-0.030	0.002	-0.020	0.000	-0.038	0.004
	(0.019)	(0.017)	(0.026)	(0.021)	(0.028)	(0.026)	(0.019)	(0.015)	(0.026)	(0.019)	(0.028)	(0.023)	(0.019)	(0.009)	(0.026)	(0.010)	(0.028)	(0.016)
Ethic origin: Hokkien	-0.051	0.045	-0.069	0.068	-0.048	0.032	-0.052	0.008	-0.069	0.034	-0.048	-0.003	-0.051	0.046	-0.067	0.020	-0.048	0.073
	(0.043)	(0.039)	(0.059)	(0.059)	(0.060)	(0.055)	(0.043)	(0.033)	(0.059)	(0.047)	(0.060)	(0.048)	(0.043)	(0.025)	(0.059)	(0.029)	(0.061)	(0.041)

Table 4.10 Marginal Effects of Bivariate Probit Model without Mundlak Fixed Effects (continued)

Dependent variables	Employed	Carer	Employed	Carer	Employed	Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Adult Carer	Employed	Adult Carer	Employed	Adult Carer
	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)	
Ethic origin: Hakka	-0.004	0.056	-0.004	0.084	-0.014	0.035	-0.004	0.016	-0.004	0.051	-0.014	-0.006	-0.004	0.055*	-0.003	0.025	-0.013	0.082
	(0.045)	(0.040)	(0.062)	(0.060)	(0.063)	(0.057)	(0.045)	(0.034)	(0.062)	(0.048)	(0.063)	(0.050)	(0.045)	(0.026)	(0.061)	(0.029)	(0.063)	(0.042)
Ethic origin: Mainlander	-0.076	0.121**	-0.042	0.168**	-0.145*	0.077	-0.076	0.074**	-0.042	0.134**	-0.146*	0.025	-0.077	0.083**	-0.043	0.059*	-0.145*	0.069
	(0.047)	(0.043)	(0.064)	(0.063)	(0.072)	(0.064)	(0.048)	(0.037)	(0.064)	(0.051)	(0.072)	(0.059)	(0.047)	(0.027)	(0.063)	(0.030)	(0.073)	(0.046)
Region: North	-0.051	0.000	-0.023	0.002	-0.069	0.001	-0.051	0.010	-0.023	0.017	-0.069	0.003	-0.049	-0.004	-0.022	0.000	-0.068	-0.004
	(0.028)	(0.023)	(0.034)	(0.028)	(0.043)	(0.036)	(0.028)	(0.020)	(0.034)	(0.023)	(0.043)	(0.032)	(0.028)	(0.013)	(0.034)	(0.012)	(0.044)	(0.023)
Region: Middle	0.009	0.012	0.040	0.016	-0.016	0.007	0.009	0.002	0.040	0.010	-0.016	-0.009	0.010	0.014	0.041	0.001	-0.014	0.029
	(0.027)	(0.022)	(0.033)	(0.028)	(0.043)	(0.036)	(0.027)	(0.019)	(0.033)	(0.023)	(0.043)	(0.031)	(0.027)	(0.012)	(0.033)	(0.012)	(0.043)	(0.023)
Region: South	-0.012	0.043	0.000	0.040	-0.017	0.048	-0.012	0.026	0.000	0.032	-0.017	0.018	-0.012	0.008	0.001	0.005	-0.018	0.016
	(0.027)	(0.022)	(0.033)	(0.027)	(0.042)	(0.035)	(0.027)	(0.019)	(0.033)	(0.023)	(0.042)	(0.031)	(0.027)	(0.012)	(0.033)	(0.012)	(0.043)	(0.023)
Year 1996	-0.012	0.014	0.006	0.087***	-0.023	-0.072*	-0.011	-0.079***	0.007	-0.042*	-0.023	-0.130***	-0.017	-0.070***	0.003	-0.048	-0.030	-0.090***
	(0.018)	(0.019)	(0.024)	(0.024)	(0.028)	(0.029)	(0.018)	(0.016)	(0.024)	(0.020)	(0.028)	(0.025)	(0.018)	(0.010)	(0.024)	(0.010)	(0.028)	(0.017)
Year 1999	-0.123***	-0.013	-0.159***	0.060**	-0.083*	-0.091*	-0.122***	-0.017	-0.159***	0.036	-0.083*	-0.079*	-0.129***	-0.077***	-0.164	-0.040	-0.090**	-0.111***
	(0.023)	(0.023)	(0.032)	(0.030)	(0.034)	(0.034)	(0.023)	(0.020)	(0.032)	(0.025)	(0.034)	(0.030)	(0.023)	(0.013)	(0.032)	(0.014)	(0.034)	(0.021)
Year 2003	-0.139***	0.028	-0.204***	0.112***	-0.079*	-0.067*	-0.139***	-0.015	-0.203***	0.062*	-0.079*	-0.106***	-0.146***	-0.064***	-0.208	-0.020	-0.088**	-0.109***
	(0.022)	(0.022)	(0.031)	(0.029)	(0.033)	(0.033)	(0.022)	(0.019)	(0.031)	(0.023)	(0.033)	(0.029)	(0.022)	(0.012)	(0.031)	(0.013)	(0.033)	(0.021)
Year 2007	-0.160***	0.068*	-0.225***	0.108**	-0.099*	0.015	-0.160***	0.025	-0.224***	0.054	-0.099*	-0.014	-0.167***	-0.042**	-0.229	-0.024	-0.108*	-0.059*
	(0.030)	(0.029)	(0.042)	(0.039)	(0.043)	(0.043)	(0.030)	(0.025)	(0.042)	(0.032)	(0.043)	(0.038)	(0.030)	(0.016)	(0.042)	(0.018)	(0.043)	(0.027)
Coresidence: spouse		-0.116***		-0.088**		-0.149***		-0.130***		-0.086***		-0.184***		-0.013		0.001		-0.031
		(0.022)		(0.029)		(0.031)		(0.020)		(0.026)		(0.029)		(0.012)		(0.013)		(0.021)

Table 4.10 Marginal Effects of Bivariate Probit Model without Mundlak Fixed Effects (continued)

Dependent variables	Employed	Carer	Employed	Carer	Employed	Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Adult Carer	Employed	Adult Carer	Employed	Adult Carer
	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)	
Coresidence: son		-0.153***		-0.123***		-0.188***		-0.170***		-0.119***		-0.224***		-0.034**		-0.028*		-0.042*
		(0.019)		(0.025)		(0.028)		(0.017)		(0.024)		(0.026)		(0.011)		(0.011)		(0.019)
Coresidence: daughter		-0.064**		-0.028		-0.097**		-0.035		-0.004		-0.069*		-0.101***		-0.074***		-0.136***
		(0.023)		(0.031)		(0.036)		(0.020)		(0.027)		(0.031)		(0.015)		(0.015)		(0.027)
Coresidence: parents		0.020		0.010		0.038		-0.149***		-0.100**		-0.208***		0.038**		0.016		0.066**
		(0.025)		(0.031)		(0.042)		(0.027)		(0.032)		(0.048)		(0.013)		(0.012)		(0.023)
Coresidence: grandchild		0.205***		0.183***		0.224***		0.210***		0.193***		0.220***		-0.015		-0.009		-0.018
		(0.018)		(0.025)		(0.026)		(0.016)		(0.022)		(0.022)		(0.010)		(0.011)		(0.018)
Living parents		0.048***		0.047**		0.047*		0.037**		0.035*		0.036		0.021**		0.020*		0.022
		(0.013)		(0.017)		(0.020)		(0.012)		(0.015)		(0.019)		(0.007)		(0.007)		(0.012)
rho	-0.194		-0.192		-0.207		-0.219		-0.212		-0.234		-0.158		-0.168		-0.147	
	Pvalue= 0.000		Pvalue= 0.000		Pvalue = 0.000		Pvalue= 0.000		Pvalue = 0.000		Prob > chi2 = 0.0000		Pvalue= 0.000		Pvalue= 0.000		Pvalue 0.000	
Obs	9,913	9,913	5,103	5,103	4,802	4,802	9,865	9,865	5,103	5,103	4,806	4,806	9,865	9,865	5,097	5,097	4,768	4,768

Notes: (1)***p<0.001, **p<0.005, *p<0.01; Standard errors in parentheses. (2) Omitted categories: Aged 61-65, Single, No education, Aborigine and other groups, Eastern area, Year1989, Live alone. (3) 'Carer' relates to whether the individual responded to any of questions 1, 2 and 3 (refers to provide help to any individuals in the household). 'Grandchild' is where the respondent looks after his/her grandchildren, related to question 3. 'Adult' is where the respondent provides physical help to any adults living in the household based on either question 1 or 2. 'Financial Support' accords with the response to question 4.

Table 4.11 Marginal Effects of Bivariate Probit Model with Mundlak Fixed Effects

Dependent variables	Employed	Carer	Employed	Carer	Employed	Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Adult Carer	Employed	Adult Carer	Employed	Adult Carer
	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)	
Aged 50-55	0.175***	0.034	0.160***	0.040	0.183***	0.020	0.174***	0.027	0.160***	0.044	0.182***	0.003	0.173***	-0.029*	0.160***	-0.018	0.181***	-0.040
	(0.026)	(0.025)	(0.037)	(0.032)	(0.036)	(0.037)	(0.026)	(0.022)	(0.037)	(0.029)	(0.036)	(0.034)	(0.026)	(0.013)	(0.037)	(0.015)	(0.036)	(0.023)
Aged 56-60	0.103***	0.025	0.102***	0.029	0.094***	0.018	0.103***	0.030*	0.101***	0.039*	0.093***	0.020	0.102***	-0.019*	0.101***	-0.007	0.092***	-0.029*
	(0.016)	(0.015)	(0.022)	(0.019)	(0.023)	(0.022)	(0.016)	(0.013)	(0.022)	(0.017)	(0.023)	(0.020)	(0.016)	(0.008)	(0.022)	(0.009)	(0.023)	(0.014)
Male	0.294***	-0.138***					0.294***	-0.118***					0.294***	-0.062***				
	(0.010)	(0.009)					(0.010)	(0.009)					(0.010)	(0.006)				
Married	0.015	0.096***	0.115***	0.107***	-0.042*	0.099***	0.015	0.075***	0.116***	0.070***	-0.041*	0.085***	0.016	0.035***	0.114***	0.016	-0.038*	0.052***
	(0.016)	(0.013)	(0.023)	(0.022)	(0.019)	(0.017)	(0.016)	(0.011)	(0.023)	(0.019)	(0.019)	(0.016)	(0.016)	(0.007)	(0.023)	(0.009)	(0.019)	(0.012)
Household size	0.000	-0.002*	0.000	0.000	0.000	-0.004**	0.000	-0.001	0.000	0.000	0.000	-0.002*	0.001	0.001*	0.001	0.001*	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)
Log household income	0.005***	-0.003	0.008***	-0.004	0.003	-0.003	0.005***	-0.001	0.008**	0.001	0.003	-0.004	0.005***	-0.001*	0.008	-0.001	0.003	0.000
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.003)	(0.001)	(0.002)	(0.002)
Number of children	-0.006	0.007*	0.002	0.004	-0.014*	0.011*	-0.006	0.007*	0.002	0.009*	-0.014*	0.007	-0.006	0.001	0.002	-0.003	-0.015*	0.006
	(0.004)	(0.003)	(0.005)	(0.005)	(0.006)	(0.005)	(0.004)	(0.003)	(0.005)	(0.004)	(0.006)	(0.005)	(0.004)	(0.002)	(0.006)	(0.002)	(0.006)	(0.003)
Education: elementary	-0.015	0.014	-0.013	0.005	-0.005	0.037*	-0.015	0.020*	-0.013	0.006	-0.004	0.043**	-0.014*	0.000	-0.012	0.003	-0.004	0.003
	(0.011)	(0.009)	(0.014)	(0.013)	(0.020)	(0.017)	(0.011)	(0.008)	(0.014)	(0.011)	(0.020)	(0.015)	(0.011)	(0.005)	(0.014)	(0.006)	(0.021)	(0.010)
Education: junior high	-0.034*	0.031*	-0.026	0.009	-0.038	0.087**	-0.034*	0.028*	-0.026	0.006	-0.037	0.070*	-0.035	-0.005	-0.026	-0.005	-0.037	0.002
	(0.016)	(0.013)	(0.018)	(0.016)	(0.035)	(0.028)	(0.016)	(0.012)	(0.018)	(0.014)	(0.035)	(0.027)	(0.016)	(0.008)	(0.018)	(0.008)	(0.035)	(0.018)
Education: senior high	0.013	0.003	0.001	-0.003	0.056	0.039	0.013	0.001	0.002	0.003	0.056	0.000	0.014	0.009	0.001	0.003	0.057	0.032
	(0.016)	(0.013)	(0.018)	(0.016)	(0.035)	(0.030)	(0.016)	(0.013)	(0.018)	(0.014)	(0.035)	(0.031)	(0.016)	(0.007)	(0.018)	(0.008)	(0.035)	(0.019)
Education: university	0.048*	-0.048***	0.039	-0.051**	0.072	-0.016	0.049*	-0.071***	0.039	-0.048***	0.072	-0.166***	0.048*	-0.006	0.039	-0.011	0.072	0.024
	(0.018)	(0.015)	(0.020)	(0.018)	(0.042)	(0.037)	(0.018)	(0.015)	(0.020)	(0.015)	(0.043)	(0.045)	(0.018)	(0.008)	(0.020)	(0.009)	(0.043)	(0.022)

Table 4.11 Marginal Effects of Bivariate Probit Model with Mundlak Fixed Effects (continued)

Dependent variables	Employed	Carer	Employed	Carer	Employed	Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Adult Carer	Employed	Adult Carer	Employed	Adult Carer
	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)	
Health: blood	-0.042***	-0.004	-0.032	-0.005	-0.048*	-0.004	-0.042***	-0.001	-0.033	0.004	-0.048*	-0.009	-0.042***	-0.003	-0.031	-0.009	-0.049*	0.003
	(0.013)	(0.011)	(0.017)	(0.014)	(0.019)	(0.016)	(0.013)	(0.010)	(0.017)	(0.013)	(0.019)	(0.015)	(0.013)	(0.006)	(0.017)	(0.006)	(0.019)	(0.010)
Health: diabetes	-0.106***	-0.026	-0.117***	-0.040*	-0.088***	-0.014	-0.105***	-0.026	-0.117***	-0.035*	-0.087***	-0.021	-0.106***	-0.018*	-0.118***	-0.005	-0.089***	-0.030*
	(0.017)	(0.015)	(0.022)	(0.020)	(0.026)	(0.022)	(0.017)	(0.013)	(0.022)	(0.017)	(0.026)	(0.020)	(0.017)	(0.008)	(0.022)	(0.009)	(0.027)	(0.014)
Health: heart problem	-0.049**	-0.001	-0.080***	-0.032	-0.016	0.021	-0.049**	0.001	-0.080***	-0.023	-0.016	0.018	-0.048**	0.013	-0.080***	0.000	-0.016	0.026*
	(0.016)	(0.014)	(0.023)	(0.020)	(0.022)	(0.020)	(0.016)	(0.012)	(0.023)	(0.017)	(0.022)	(0.018)	(0.016)	(0.007)	(0.023)	(0.009)	(0.022)	(0.012)
Health: stroke	-0.285***	-0.171***	-0.316***	-0.107**	-0.202**	-0.272***	-0.285***	-0.120***	-0.316***	-0.071*	-0.204	-0.197***	-0.289***	-0.037*	-0.316***	-0.001	-0.210***	-0.161**
	(0.039)	(0.033)	(0.045)	(0.038)	(0.066)	(0.057)	(0.038)	(0.031)	(0.045)	(0.034)	(0.066)	(0.053)	(0.039)	(0.017)	(0.045)	(0.012)	(0.066)	(0.055)
Health: asthma	-0.052**	0.015	-0.047*	0.011	-0.055*	0.022	-0.052**	0.018	-0.047*	0.013	-0.055	0.033	-0.054**	-0.001	-0.050*	-0.013	-0.054*	0.014
	(0.017)	(0.015)	(0.022)	(0.018)	(0.027)	(0.025)	(0.017)	(0.013)	(0.022)	(0.015)	(0.027)	(0.022)	(0.017)	(0.008)	(0.022)	(0.009)	(0.027)	(0.015)
Health: arthritis	-0.007	0.021	-0.012	0.039*	-0.003	0.009	-0.007	0.011	-0.012	0.014	-0.003	0.008	-0.008	0.000	-0.012	0.001	-0.004	-0.001
	(0.013)	(0.011)	(0.019)	(0.016)	(0.017)	(0.016)	(0.013)	(0.010)	(0.019)	(0.014)	(0.017)	(0.014)	(0.013)	(0.006)	(0.019)	(0.007)	(0.017)	(0.010)
Health: ulcer	-0.003	-0.017	-0.014	-0.010	0.011	-0.024	-0.003	-0.011	-0.014	-0.009	0.010	-0.017	-0.004	-0.004	-0.016	0.004	0.010	-0.013
	(0.013)	(0.012)	(0.018)	(0.015)	(0.018)	(0.017)	(0.013)	(0.010)	(0.018)	(0.013)	(0.018)	(0.016)	(0.013)	(0.006)	(0.018)	(0.006)	(0.018)	(0.011)
Health: gall	-0.022	0.006	-0.017	0.014	-0.031	-0.001	-0.022	0.006	-0.017	0.004	-0.031	0.014	-0.023	-0.001	-0.017	0.003	-0.033	-0.006
	(0.018)	(0.016)	(0.023)	(0.020)	(0.028)	(0.026)	(0.018)	(0.015)	(0.023)	(0.018)	(0.028)	(0.024)	(0.018)	(0.009)	(0.023)	(0.009)	(0.028)	(0.017)
Health: sight	-0.054**	0.012	-0.012	0.001	-0.090***	0.017	-0.053**	0.020	-0.012	0.024	-0.090***	0.017	-0.052**	0.008	-0.012	0.008	-0.086***	0.009
	(0.018)	(0.015)	(0.027)	(0.023)	(0.024)	(0.021)	(0.018)	(0.013)	(0.027)	(0.019)	(0.024)	(0.019)	(0.018)	(0.008)	(0.027)	(0.009)	(0.024)	(0.013)
Health: kidney	-0.030	0.012	-0.021	0.025	-0.038	0.001	-0.030	0.014	-0.021	0.017	-0.038	0.003	-0.031	0.001	-0.022	0.000	-0.039	0.003
	(0.019)	(0.017)	(0.026)	(0.021)	(0.028)	(0.026)	(0.019)	(0.015)	(0.026)	(0.018)	(0.028)	(0.023)	(0.019)	(0.009)	(0.026)	(0.009)	(0.028)	(0.015)

Table 4.11 Marginal Effects of Bivariate Probit Model with Mundlak Fixed Effects (continued)

Dependent variables	Employed	Carer	Employed	Carer	Employed	Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Adult Carer	Employed	Adult Carer	Employed	Adult Carer
	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)	
Ethic origin: Hokkien	-0.051	0.044	-0.073	0.075	-0.044	0.029	-0.051	0.007	-0.074	0.035	-0.044	-0.002	-0.051	0.047*	-0.072	0.023	-0.044	0.075
	(0.044)	(0.038)	(0.060)	(0.056)	(0.061)	(0.054)	(0.044)	(0.032)	(0.060)	(0.045)	(0.061)	(0.047)	(0.044)	(0.025)	(0.060)	(0.027)	(0.061)	(0.040)
Ethic origin: Hakka	-0.004	0.057	-0.008	0.094	-0.010	0.035	-0.004	0.015	-0.009	0.056	-0.011	-0.006	-0.004	0.056**	-0.007	0.028	-0.010	0.084
	(0.046)	(0.039)	(0.062)	(0.058)	(0.063)	(0.057)	(0.046)	(0.033)	(0.062)	(0.046)	(0.063)	(0.050)	(0.046)	(0.025)	(0.062)	(0.027)	(0.064)	(0.041)
Ethic origin: Mainlander	-0.071	0.114**	-0.034	0.166*	-0.141	0.076	-0.070	0.062	-0.034	0.123*	-0.142	0.025	-0.071	0.082	-0.034	0.059*	-0.141	0.070*
	(0.048)	(0.042)	(0.064)	(0.061)	(0.073)	(0.064)	(0.048)	(0.036)	(0.064)	(0.049)	(0.073)	(0.059)	(0.048)	(0.027)	(0.064)	(0.028)	(0.073)	(0.045)
Region: North	-0.049	0.003	-0.015	0.005	-0.069	0.004	-0.049	0.013	-0.015	0.017	-0.069	0.007	-0.047	-0.002	-0.014	-0.001	-0.067	-0.001
	(0.028)	(0.023)	(0.034)	(0.028)	(0.043)	(0.036)	(0.028)	(0.020)	(0.034)	(0.023)	(0.043)	(0.032)	(0.028)	(0.013)	(0.034)	(0.012)	(0.044)	(0.023)
Region: Middle	0.009	0.013	0.045	0.017	-0.017	0.008	0.009	0.004	0.045	0.012	-0.017	-0.007	0.010	0.014	0.046	0.002	-0.015	0.030
	(0.027)	(0.022)	(0.033)	(0.028)	(0.043)	(0.036)	(0.027)	(0.019)	(0.033)	(0.023)	(0.043)	(0.031)	(0.027)	(0.012)	(0.033)	(0.012)	(0.043)	(0.023)
Region: South	-0.011	0.041	0.007	0.039	-0.018	0.045	-0.011	0.028	0.008	0.035	-0.018	0.020	-0.010	0.010	0.009	0.005	-0.018	0.018
	(0.027)	(0.022)	(0.033)	(0.027)	(0.042)	(0.035)	(0.027)	(0.019)	(0.033)	(0.023)	(0.042)	(0.031)	(0.027)	(0.012)	(0.033)	(0.012)	(0.043)	(0.023)
Year 1996	-0.021	0.002	0.002	0.073**	-0.036	-0.083*	-0.020	-0.066***	0.003	-0.031	-0.035	-0.117***	-0.026	-0.063***	-0.002	-0.042***	-0.044	-0.083***
	(0.020)	(0.020)	(0.026)	(0.026)	(0.031)	(0.031)	(0.020)	(0.018)	(0.026)	(0.022)	(0.031)	(0.028)	(0.020)	(0.011)	(0.026)	(0.012)	(0.031)	(0.019)
Year 1999	-0.133***	0.003	-0.172***	0.078*	-0.092	-0.077*	-0.132***	0.010	-0.171***	0.064*	-0.092*	-0.050	-0.140***	-0.075***	-0.176***	-0.046**	-0.099*	-0.105***
	(0.025)	(0.024)	(0.033)	(0.033)	(0.036)	(0.036)	(0.024)	(0.021)	(0.033)	(0.027)	(0.036)	(0.032)	(0.025)	(0.013)	(0.033)	(0.015)	(0.036)	(0.022)
Year 2003	-0.176***	0.035	-0.252***	0.123***	-0.107	-0.063	-0.176***	0.016	-0.252***	0.095***	-0.106*	-0.077*	-0.184***	-0.064***	-0.257***	-0.019	-0.116**	-0.115***
	(0.026)	(0.025)	(0.035)	(0.033)	(0.038)	(0.038)	(0.026)	(0.022)	(0.035)	(0.027)	(0.038)	(0.034)	(0.026)	(0.014)	(0.035)	(0.015)	(0.039)	(0.024)
Year 2007	-0.213***	0.087**	-0.298***	0.131**	-0.134	0.032	-0.213***	0.070*	-0.298***	0.101**	-0.134*	0.030	-0.221***	-0.047*	-0.303***	-0.024	-0.144**	-0.075*
	(0.035)	(0.033)	(0.047)	(0.044)	(0.050)	(0.049)	(0.035)	(0.029)	(0.047)	(0.036)	(0.050)	(0.044)	(0.035)	(0.018)	(0.047)	(0.020)	(0.050)	(0.031)

Table 4.11 Marginal Effects of Bivariate Probit Model with Mundlak Fixed Effects (continued)

Dependent variables	Employed	Carer	Employed	Carer	Employed	Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Adult Carer	Employed	Adult Carer	Employed	Adult Carer
	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)	
Age(M)	-0.015***	0.005	-0.021***	0.007	-0.010	0.003	-0.015***	0.006*	-0.021***	0.009*	-0.010*	0.002	-0.016***	-0.002	-0.021***	0.000	-0.010*	-0.004
	(0.004)	(0.003)	(0.005)	(0.004)	(0.005)	(0.005)	(0.004)	(0.003)	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)	(0.002)	(0.005)	(0.002)	(0.005)	(0.003)
Hhsize(M)	-0.003	0.006***	-0.005*	0.006***	-0.002	0.006*	-0.004	0.002	-0.005*	0.003	-0.002	0.001	-0.004	-0.001	-0.005*	0.000	-0.002	-0.002*
	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)
Hhincome(M)	0.003*	0.001	0.004*	0.001	0.002	0.001	0.003*	0.001	0.004*	0.000	0.002	0.002	0.003*	0.000	0.004*	-0.001	0.002	-0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Living parents(M)	0.011	0.096***	0.067*	0.112**	-0.042	0.076	0.011	0.031	0.067*	0.068*	-0.041	0.003	0.009	0.002	0.066*	-0.033	-0.044	0.043
	(0.020)	(0.028)	(0.028)	(0.038)	(0.029)	(0.041)	(0.020)	(0.025)	(0.028)	(0.034)	(0.029)	(0.037)	(0.020)	(0.016)	(0.028)	(0.019)	(0.029)	(0.026)
Coresidence: spouse		-0.201***		-0.208***		-0.195***		-0.169***		-0.142***		-0.215***		-0.018		-0.027		-0.014
		(0.032)		(0.043)		(0.048)		(0.029)		(0.038)		(0.044)		(0.018)		(0.020)		(0.029)
Coresidence: son		-0.187***		-0.209***		-0.167***		-0.202***		-0.200***		-0.213***		-0.029		-0.051**		-0.010
		(0.029)		(0.039)		(0.043)		(0.027)		(0.035)		(0.040)		(0.018)		(0.018)		(0.030)
Coresidence: daughter		-0.244***		-0.279***		-0.209***		-0.250***		-0.275***		-0.236***		-0.153***		-0.171***		-0.114*
		(0.039)		(0.055)		(0.056)		(0.035)		(0.048)		(0.051)		(0.030)		(0.033)		(0.043)
Coresidence: parents		0.008		-0.013		0.017		-0.173***		-0.135**		-0.234***		0.016		-0.012*		0.041
		(0.045)		(0.052)		(0.077)		(0.042)		(0.048)		(0.071)		(0.024)		(0.022)		(0.045)
Coresidence: grandchild		0.185***		0.126**		0.239		0.176***		0.119***		0.211***		-0.003		-0.019		0.009
		(0.029)		(0.041)		(0.041)		(0.026)		(0.035)		(0.037)		(0.017)		(0.019)		(0.028)
Living parents		-0.022		-0.036		-0.004		0.016		-0.015		0.036		0.019		0.043		-0.011
		(0.023)		(0.032)		(0.033)		(0.021)		(0.029)		(0.030)		(0.014)		(0.016)		(0.022)
Spouse(M)		0.133**		0.195***		0.073		0.060		0.094		0.047		0.009		0.044		-0.022
		(0.042)		(0.058)		(0.062)		(0.039)		(0.054)		(0.057)		(0.024)		(0.027)		(0.039)

Table 4.11 Marginal Effects of Bivariate Probit Model with Mundlak Fixed Effects (continued)

Dependent variables	Employed	Carer	Employed	Carer	Employed	Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Grandchild Carer	Employed	Adults Carer	Employed	Adults Carer	Employed	Adults Carer
	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females	All	All	Males	Males	Females	Females
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)	
Son(M)		0.052		0.135*		-0.030		0.047		0.128*		-0.021		-0.009		0.032		-0.046
		(0.038)		(0.053)		(0.056)		(0.035)		(0.047)		(0.051)		(0.022)		(0.024)		(0.037)
Daughter(M)		0.247***		0.342***		0.164*		0.293***		0.363***		0.246***		0.064*		0.117***		-0.028
		(0.048)		(0.067)		(0.071)		(0.043)		(0.058)		(0.064)		(0.030)		(0.032)		(0.049)
Parents(M)		0.021		0.051		0.027		0.045		0.070		0.043		0.031		0.043		0.037
		(0.056)		(0.067)		(0.094)		(0.051)		(0.062)		(0.086)		(0.029)		(0.029)		(0.054)
Grandchild(M)		0.033		0.095		-0.020		0.056		0.118*		0.021		-0.012		0.017		-0.035
		(0.038)		(0.055)		(0.054)		(0.034)		(0.049)		(0.049)		(0.022)		(0.025)		(0.036)
rho	-0.193		-0.186		-0.209		-0.220		-0.207		-0.239		-0.161		-0.160		-0.147	
	Pvalue= 0.000		Pvalue= 0.000		Pvalue = 0.000		Pvalue= 0.000		Pvalue = 0.000		Prob > chi2 = 0.0000		Pvalue= 0.000		Pvalue= 0.000		Pvalue 0.000	
Obs	9,913	9,913	5,103	5,103	4,802	4,802	9,865	9,865	5,103	5,103	4,806	4,806	9,885	9,865	5,097	5,097	4,768	4,768

Notes: (1)***p<0.001, **p<0.005, *p<0.01; Standard errors in parentheses. (2) Omitted categories: Aged 61-65, Single, No education, Aborigine and other groups, Eastern area, Year1989, Live alone.(3) (M) indicates Mindlak fixed effects. (3) 'Carer' relates to whether the individual responded to any of questions 1, 2 and 3 (refers to provide help to any individuals in the household). 'Grandchild' is where the respondent looks after his/her grandchildren, related to question 3. 'Adult' is where the respondent provides physical help to any adults living in the household based on either question 1 or 2. 'Financial Support' accords with the response to question 4.

Table 4.12 Marginal Effects of Recursive Bivariate Probit Model with and without Mundlak Fixed Effects

	Carer			Grandchild Carer			Adult Carer			Financial Support		
	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Without Mundlak Fixed Effects												
Dependent variables												
Employment	-0.298***	-0.271	-0.273***	-0.265***	-0.252	-0.234**	-0.341	-0.462	-0.283	0.365***	0.321***	-0.221
rho	0.269	0.222	0.292	0.177	0.156	0.199	0.339	0.417	0.477	-0.554	-0.666	0.353
LR-test	0.000	0.022	0.000	0.000	0.052	0.002	0.026	0.316	0.060	0.000	0.000	0.479
With Mundlak Fixed Effects												
Dependent variables												
Employment	-0.288***	-0.272	-0.264***	-0.251**	-0.235	-0.228*	-0.334	-0.517	-0.285	0.364***	0.295*	-0.143
rho	0.252	0.229	0.273	0.153	0.137	0.174	0.321	0.523	0.488	-0.555	-0.589	0.170
LR-test	0.000	0.013	0.000	0.002	0.088	0.008	0.031	0.042	0.071	0.000	0.009	0.844
Obs	9,913	5,103	4,810	9,909	5,103	4,806	9,865	5,097	4,768	9,861	5,094	4,767

Note: (1)***p<0.001, **p<0.005, *p<0.01 (2) Controls for: In the employment equation, age, marital status, education, health, household size, log household income, number of children, elementary education, junior high education, senior high education, ethnic groups, regional dummies and year dummies. In the care/financial support equation, controls for most of the same variables as in the employment equation with additional controls for the set of dummy variables for co-residing with a spouse, son, daughter, grandchild or parents. (3) Omitted categories: Aged 61-65, Single, No education, Aborigine and other groups, Eastern area, Year1989, Live alone. (4)'Carer' relates to whether the individual responded to any of questions 1, 2 and 3 (refers to provide help to any individuals in the household). 'Grandchild' is where the respondent looks after his/her grandchildren, related to question 3. 'Adult' is where the respondent provides physical help to any adults living in the household based on either question 1 or 2. 'Financial Support' accords with the response to question 4.

Table 4.13 Marginal Effects of Univariate Probit Model without Mundlak Fixed Effects

Dependent Variables	Employed			Carer			Grandchild Carer			Adult Carer			Financial Support		
	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Aged 50-55	0.338***	0.303***	0.304***	0.005	-0.006	0.006	-0.009	-0.024	0.005	-0.015*	-0.013*	-0.016	0.014	0.015	0.012
	(0.016)	(0.016)	(0.026)	(0.017)	(0.020)	(0.026)	(0.015)	(0.016)	(0.026)	(0.006)	(0.005)	(0.012)	(0.010)	(0.014)	(0.013)
Aged 56-60	0.194***	0.196***	0.148***	0.010	0.005	0.012	0.013	0.004	0.025	-0.012*	-0.007	-0.018	0.007	0.013	0.001
	(0.013)	(0.016)	(0.018)	(0.013)	(0.016)	(0.019)	(0.011)	(0.013)	(0.019)	(0.005)	(0.005)	(0.009)	(0.007)	(0.010)	(0.009)
Male	0.336***			-0.159***			-0.134***			-0.055***			-0.012*		
	(0.013)			(0.011)			(0.010)			(0.005)			(0.005)		
Married	0.022	0.138***	-0.042*	0.110***	0.110***	0.119***	0.081***	0.067***	0.103***	0.025***	0.012*	0.041***	0.015*	0.033***	0.004
	(0.019)	(0.028)	(0.021)	(0.013)	(0.017)	(0.019)	(0.011)	(0.013)	(0.018)	(0.004)	(0.005)	(0.008)	(0.007)	(0.008)	(0.009)
Household size	-0.001	-0.001	-0.001	0.000	0.002	-0.002	0.000	0.001	-0.002	0.001**	0.001***	0.000	0.001*	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	0.000	0.000	0.000	0.000	0.000	0.000
Log household income	0.010***	0.013***	0.005*	-0.002	-0.003	-0.002	0.000	0.001	-0.003	-0.001	-0.001	-0.001	-0.004***	-0.004**	-0.004**
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Number of children	-0.010*	-0.001	-0.018**	0.007	0.004	0.012	0.008*	0.009*	0.007	0.000	-0.003	0.005	-0.002	-0.003	0.003
	(0.005)	(0.006)	(0.007)	(0.004)	(0.005)	(0.006)	(0.003)	(0.004)	(0.006)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Education:elementary	-0.019	-0.019	-0.001	0.016	0.002	0.050*	0.023*	0.006	0.057**	0.000	0.002	0.004	0.004	-0.013*	0.038***
	(0.014)	(0.016)	(0.022)	(0.010)	(0.017)	(0.020)	(0.010)	(0.014)	(0.019)	(0.004)	(0.006)	(0.010)	(0.005)	(0.006)	(0.009)
Education:junior high	-0.042*	-0.030	-0.035	0.037*	0.008	0.113***	0.034*	0.005	0.099**	-0.004	-0.004	0.004	0.017*	0.009	0.061**
	(0.020)	(0.021)	(0.035)	(0.015)	(0.021)	(0.033)	(0.014)	(0.017)	(0.036)	(0.007)	(0.008)	(0.017)	(0.007)	(0.008)	(0.022)
Education: senior high	0.019	0.006	0.070	0.003	-0.008	0.057	0.000	-0.001	0.004	0.008	0.001	0.038	0.001	-0.008	0.070**
	(0.019)	(0.020)	(0.040)	(0.015)	(0.020)	(0.036)	(0.015)	(0.017)	(0.039)	(0.006)	(0.008)	(0.023)	(0.007)	(0.008)	(0.024)
Education:university	0.064**	0.050*	0.087	-0.053**	-0.058*	-0.005	-0.084***	-0.055**	-0.164***	-0.004	-0.010	0.032	-0.009	-0.006	0.025
	(0.022)	(0.023)	(0.050)	(0.018)	(0.023)	(0.043)	(0.017)	(0.019)	(0.036)	(0.007)	(0.009)	(0.026)	(0.008)	(0.009)	(0.027)
Health:blood	-0.064***	-0.032	-0.069***	-0.011	-0.009	-0.013	-0.007	0.003	-0.022	-0.002	-0.007	0.003	0.005	0.005	0.003
	(0.015)	(0.018)	(0.020)	(0.012)	(0.014)	(0.019)	(0.011)	(0.012)	(0.018)	(0.005)	(0.005)	(0.009)	(0.006)	(0.007)	(0.008)
Health:diabetes	-0.114***	-0.139***	-0.073*	-0.015	-0.037	-0.004	-0.012	-0.026	-0.007	-0.014*	-0.002	-0.026*	-0.011	0.006	-0.023*
	(0.027)	(0.025)	(0.033)	(0.014)	(0.022)	(0.019)	(0.012)	(0.018)	(0.018)	(0.007)	(0.007)	(0.013)	(0.008)	(0.010)	(0.012)

Table 4.13 Marginal Effects of Univariate Probit Model without Mundlak Fixed Effects (continued)

Dependent Variables	Employed			Carer			Grandchild Carer			Adult Carer			Financial Support		
	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Health:heart problem	-0.070***	-0.097***	-0.026	0.002	-0.034	0.031	0.004	-0.022	0.027	0.009	-0.003	0.025*	-0.008	-0.007	-0.006
	(0.019)	(0.025)	(0.023)	(0.015)	(0.020)	(0.023)	(0.013)	(0.016)	(0.022)	(0.006)	(0.006)	(0.011)	(0.008)	(0.010)	(0.010)
Health:stroke	-0.123	-0.367***	0.003	-0.089*	-0.091**	-0.095	-0.057	-0.056*	-0.071	-0.032*	0.003	-0.154**	-0.009	0.005	-0.020
	(0.071)	(0.047)	(0.042)	(0.037)	(0.030)	(0.052)	(0.029)	(0.025)	(0.045)	(0.015)	(0.011)	(0.050)	(0.010)	(0.018)	(0.015)
Health:asthma	-0.071***	-0.060*	-0.065*	0.023	0.016	0.029	0.023	0.018	0.038	-0.001	-0.010	0.010	0.006	0.005	0.007
	(0.020)	(0.025)	(0.027)	(0.016)	(0.019)	(0.025)	(0.014)	(0.016)	(0.023)	(0.007)	(0.007)	(0.011)	(0.007)	(0.010)	(0.010)
Health:arthritis	-0.003	-0.016	-0.004	0.024*	0.019	0.025	0.013	0.008	0.014	0.003	0.001	0.005	0.011*	-0.004	0.023**
	(0.014)	(0.016)	(0.016)	(0.011)	(0.013)	(0.016)	(0.009)	(0.011)	(0.016)	(0.004)	(0.004)	(0.008)	(0.005)	(0.007)	(0.007)
Health:ulcer	0.003	-0.015	0.001	-0.012	-0.005	-0.020	-0.007	-0.004	-0.013	-0.005	0.003	-0.014	0.002	-0.002	0.006
	(0.015)	(0.019)	(0.015)	(0.011)	(0.015)	(0.016)	(0.010)	(0.012)	(0.015)	(0.004)	(0.005)	(0.009)	(0.005)	(0.008)	(0.006)
Health:gall	0.008	0.007	0.012	0.002	0.008	-0.007	0.006	0.005	0.006	-0.003	0.000	-0.009	-0.003	0.004	-0.011
	(0.017)	(0.021)	(0.022)	(0.014)	(0.017)	(0.021)	(0.012)	(0.015)	(0.020)	(0.006)	(0.006)	(0.011)	(0.006)	(0.009)	(0.010)
Health:sight	-0.023	0.000	-0.037	0.021	0.016	0.019	0.024	0.026	0.019	0.003	0.003	0.004	-0.002	0.002	-0.006
	(0.016)	(0.021)	(0.023)	(0.014)	(0.019)	(0.020)	(0.013)	(0.014)	(0.019)	(0.005)	(0.005)	(0.010)	(0.007)	(0.009)	(0.010)
Health:kidney	0.000	-0.006	0.011	0.009	0.009	0.012	0.000	-0.007	0.006	-0.002	-0.001	-0.004	0.016*	-0.002	0.034**
	(0.019)	(0.023)	(0.028)	(0.016)	(0.020)	(0.024)	(0.014)	(0.016)	(0.024)	(0.006)	(0.006)	(0.011)	(0.008)	(0.010)	(0.011)
Ethic origin:Hokkien	-0.064	-0.076	-0.051	0.049	0.066	0.040	0.009	0.029	-0.001	0.034*	0.013	0.057*	0.030	0.009	0.048*
	(0.052)	(0.063)	(0.067)	(0.044)	(0.058)	(0.065)	(0.037)	(0.044)	(0.061)	(0.016)	(0.020)	(0.027)	(0.019)	(0.031)	(0.022)
Ethic origin:Hakka	-0.004	-0.005	-0.011	0.066	0.092	0.045	0.018	0.051	-0.003	0.063	0.024	0.097	0.049	0.013	0.087
	(0.053)	(0.069)	(0.066)	(0.049)	(0.073)	(0.069)	(0.041)	(0.056)	(0.064)	(0.037)	(0.037)	(0.062)	(0.032)	(0.036)	(0.051)
Ethic origin:Mainlander	-0.093	-0.049	-0.132*	0.148**	0.207*	0.095	0.094	0.168*	0.038	0.119*	0.086	0.085	0.090*	0.067	0.001
	(0.054)	(0.073)	(0.058)	(0.056)	(0.087)	(0.079)	(0.051)	(0.078)	(0.078)	(0.056)	(0.070)	(0.072)	(0.041)	(0.053)	(0.037)
Region: North	-0.057	-0.024	-0.071	0.006	0.002	0.013	0.018	0.018	0.016	-0.003	0.001	-0.004	-0.014	0.002	-0.029
	(0.033)	(0.038)	(0.044)	(0.026)	(0.031)	(0.043)	(0.023)	(0.025)	(0.041)	(0.011)	(0.010)	(0.021)	(0.012)	(0.017)	(0.015)
Region: Middle	0.014	0.047	-0.016	0.016	0.013	0.019	0.006	0.008	0.000	0.013	0.002	0.028	-0.006	0.019	-0.026
	(0.033)	(0.036)	(0.045)	(0.026)	(0.030)	(0.042)	(0.022)	(0.024)	(0.039)	(0.012)	(0.010)	(0.023)	(0.012)	(0.018)	(0.016)
Region: South	-0.014	0.002	-0.022	0.051*	0.040	0.065	0.032	0.031	0.029	0.008	0.004	0.016	0.014	0.042*	-0.010
	(0.032)	(0.036)	(0.045)	(0.026)	(0.030)	(0.042)	(0.023)	(0.024)	(0.040)	(0.011)	(0.010)	(0.022)	(0.013)	(0.019)	(0.017)

Table 4.13 Marginal Effects of Univariate Probit Model without Mundlak Fixed Effects (continued)

Dependent Variables	Employed			Carer			Grandchild Carer			Adult Carer			Financial Support		
	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Year 1996	-0.015	0.009	-0.030	0.017	0.095**	-0.078*	-0.084***	-0.043*	-0.147***	-0.046***	-0.029***	-0.065***	-0.075***	-0.069***	-0.074***
	(0.021)	(0.026)	(0.029)	(0.022)	(0.029)	(0.033)	(0.016)	(0.018)	(0.026)	(0.005)	(0.005)	(0.010)	(0.006)	(0.008)	(0.008)
Year 1999	-0.150***	-0.185***	-0.091**	-0.015	0.066	-0.099**	-0.021	0.037	-0.090**	-0.046***	-0.023***	-0.072***	-0.082***	-0.079***	-0.075***
	(0.026)	(0.039)	(0.032)	(0.025)	(0.037)	(0.037)	(0.021)	(0.029)	(0.033)	(0.005)	(0.006)	(0.010)	(0.005)	(0.007)	(0.008)
Year 2003	-0.172***	-0.237***	-0.092**	0.030	0.127***	-0.076*	-0.021	0.066*	-0.125***	-0.046***	-0.015	-0.081***	-0.078***	-0.081***	-0.067***
	(0.025)	(0.036)	(0.032)	(0.026)	(0.035)	(0.038)	(0.021)	(0.028)	(0.032)	(0.007)	(0.009)	(0.013)	(0.008)	(0.011)	(0.012)
Year 2007	-0.196***	-0.263***	-0.111**	0.077*	0.123*	0.023	0.025	0.055	-0.017	-0.031**	-0.016	-0.046**	-0.010	-0.028	0.013
	(0.033)	(0.049)	(0.040)	(0.035)	(0.049)	(0.051)	(0.030)	(0.038)	(0.047)	(0.009)	(0.010)	(0.017)	(0.015)	(0.018)	(0.023)
Coresidence: spouse				-0.117***	-0.083**	-0.159***	-0.122***	-0.070***	-0.192***	-0.010	0.001	-0.025	0.004	-0.009	0.019
				(0.021)	(0.025)	(0.032)	(0.015)	(0.019)	(0.025)	(0.009)	(0.011)	(0.015)	(0.014)	(0.019)	(0.020)
Coresidence: son				-0.165***	-0.124***	-0.212***	-0.171***	-0.108***	-0.248***	-0.028***	-0.020**	-0.037**	0.005	-0.004	0.012
				(0.019)	(0.023)	(0.029)	(0.015)	(0.019)	(0.024)	(0.008)	(0.007)	(0.014)	(0.013)	(0.018)	(0.017)
Coresidence: daughter				-0.069**	-0.031	-0.108**	-0.039	-0.004	-0.081*	-0.051***	-0.034***	-0.072***	-0.001	0.004	-0.029*
				(0.024)	(0.031)	(0.038)	(0.021)	(0.027)	(0.034)	(0.004)	(0.004)	(0.007)	(0.014)	(0.020)	(0.014)
Coresidence: parents				0.023	0.014	0.041	-0.134***	-0.079***	-0.208***	0.041*	0.017	0.076*	0.009	0.004	0.006
				(0.030)	(0.034)	(0.051)	(0.017)	(0.019)	(0.030)	(0.018)	(0.015)	(0.035)	(0.018)	(0.023)	(0.026)
Coresidence: grandchild				0.255***	0.225***	0.277***	0.273***	0.247***	0.292***	-0.010	-0.005	-0.014	0.005	0.002	0.010
				(0.022)	(0.032)	(0.031)	(0.021)	(0.033)	(0.029)	(0.009)	(0.008)	(0.016)	(0.012)	(0.018)	(0.016)
Living parents				0.056***	0.047*	0.061*	0.044**	0.033	0.051*	0.021**	0.019*	0.023	0.039***	0.074***	0.004
				(0.016)	(0.020)	(0.024)	(0.015)	(0.017)	(0.024)	(0.008)	(0.009)	(0.013)	(0.010)	(0.016)	(0.012)
Obs	9,905	5,103	4,802	9,905	5,103	4,802	9,905	5,103	4,802	9,865	5,097	4,768	9,861	5,094	4,767

Notes: (1)***p<0.001, **p<0.005, *p<0.01; Standard errors in parentheses. (2) Omitted categories: Aged 61-65, Single, No education, Aborigine and other groups, Eastern area, Year1989, Live alone. (3) 'Carer' refers to provide help to any individuals in the household, related to any of questions 1, 2 and 3. 'Grandchild' is where the respondent looks after his/her grandchildren, related to question 3. 'Adult' is where the respondent provides physical help to any adults living in the household based on either question 1 or 2. 'Financial Support' accords with the response to question 4.

Table 4.14 Marginal Effects of Univariate Probit Model with Mundlak Fixed Effects

Dependent Variables	Employed			Carer			Grandchild Carer			Adult Carer			Financial Support		
	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Aged 50-55	0.213***	0.169***	0.219***	0.040	0.045	0.025	0.033	0.049	0.005	-0.021*	-0.012	-0.032*	0.010	0.026	-0.007
	(0.029)	(0.035)	(0.042)	(0.029)	(0.037)	(0.044)	(0.027)	(0.034)	(0.043)	(0.009)	(0.009)	(0.016)	(0.016)	(0.023)	(0.020)
Aged 56-60	0.126***	0.113***	0.108***	0.029	0.032	0.021	0.034*	0.041*	0.023	-0.015*	-0.005	-0.026*	0.005	0.018	-0.008
	(0.019)	(0.023)	(0.025)	(0.017)	(0.021)	(0.026)	(0.016)	(0.018)	(0.026)	(0.007)	(0.007)	(0.012)	(0.009)	(0.013)	(0.012)
Male	0.338***			-0.160***			-0.136***			-0.055***			-0.013*		
	(0.013)			(0.011)			(0.010)			(0.005)			(0.005)		
Married	0.020	0.135***	-0.043*	0.105***	0.101***	0.116***	0.080***	0.061***	0.103***	0.025***	0.011*	0.041***	0.014*	0.033***	0.003
	(0.019)	(0.028)	(0.021)	(0.013)	(0.017)	(0.019)	(0.011)	(0.014)	(0.018)	(0.004)	(0.005)	(0.008)	(0.007)	(0.008)	(0.009)
Household size	0.000	0.000	0.000	-0.002*	0.000	-0.005**	-0.001	0.000	-0.002*	0.001*	0.001*	0.001	0.001*	0.001	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	0.000	0.000	(0.001)	0.000	(0.001)	0.000
Log household income	0.006**	0.009**	0.003	-0.003	-0.004	-0.003	-0.001	0.001	-0.005	-0.001	-0.001	0.000	-0.005***	-0.005***	-0.006***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Number of children	-0.008	0.003	-0.017*	0.007	0.005	0.011	0.008*	0.009*	0.007	0.000	-0.002	0.005	-0.002	-0.003	0.004
	(0.005)	(0.006)	(0.007)	(0.004)	(0.005)	(0.006)	(0.003)	(0.004)	(0.006)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Education:elementary	-0.018	-0.015	-0.001	0.016	0.005	0.049*	0.023*	0.007	0.057**	0.000	0.002	0.003	0.004	-0.012*	0.038***
	(0.014)	(0.016)	(0.022)	(0.010)	(0.015)	(0.020)	(0.009)	(0.011)	(0.019)	(0.004)	(0.006)	(0.010)	(0.005)	(0.006)	(0.009)
Education:junior high	-0.041*	-0.029	-0.036	0.036*	0.008	0.111***	0.033*	0.006	0.098**	-0.004	-0.004	0.003	0.016*	0.009	0.060**
	(0.020)	(0.021)	(0.035)	(0.015)	(0.019)	(0.034)	(0.014)	(0.015)	(0.037)	(0.007)	(0.007)	(0.017)	(0.007)	(0.008)	(0.021)
Education:senior high	0.016	0.002	0.068	0.004	-0.005	0.060	0.002	0.003	0.010	0.007	0.002	0.036	0.000	-0.009	0.068**
	(0.019)	(0.020)	(0.040)	(0.015)	(0.019)	(0.037)	(0.015)	(0.014)	(0.039)	(0.006)	(0.007)	(0.023)	(0.007)	(0.008)	(0.024)
Education:university	0.059**	0.044	0.085	-0.052**	-0.056**	-0.004	-0.080***	-0.049**	-0.161***	-0.005	-0.008	0.027	-0.009	-0.006	0.027
	(0.022)	(0.023)	(0.050)	(0.017)	(0.021)	(0.043)	(0.017)	(0.016)	(0.037)	(0.007)	(0.008)	(0.025)	(0.008)	(0.009)	(0.028)
Health:blood	-0.064***	-0.032	-0.069***	-0.011	-0.009	-0.013	-0.007	0.001	-0.021	-0.002	-0.007	0.003	0.005	0.005	0.004
	(0.015)	(0.018)	(0.020)	(0.012)	(0.014)	(0.019)	(0.011)	(0.012)	(0.018)	(0.005)	(0.005)	(0.009)	(0.006)	(0.007)	(0.008)
Health:diabetes	-0.113***	-0.137***	-0.072*	-0.016	-0.040	-0.005	-0.014	-0.031	-0.009	-0.015*	-0.003	-0.027*	-0.010	0.006	-0.022
	(0.027)	(0.025)	(0.033)	(0.014)	(0.021)	(0.019)	(0.013)	(0.018)	(0.018)	(0.007)	(0.007)	(0.013)	(0.007)	(0.010)	(0.011)
Health:heart problem	-0.068***	-0.096***	-0.026	0.003	-0.031	0.029	0.005	-0.018	0.026	0.009	-0.001	0.025*	-0.008	-0.007	-0.005
	(0.019)	(0.025)	(0.023)	(0.015)	(0.020)	(0.023)	(0.013)	(0.016)	(0.022)	(0.005)	(0.005)	(0.011)	(0.008)	(0.010)	(0.010)

Table 4.14 Marginal Effects of Univariate Probit Model with Mundlak Fixed Effects (continued)

Dependent Variables	Employed			Carer			Grandchild Carer			Adult Carer			Financial Support		
	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Health:stroke	-0.122	-0.365***	0.003	-0.089*	-0.094**	-0.095	-0.058	-0.059*	-0.071	-0.032*	0.000	-0.150**	-0.008	0.005	-0.021
	(0.071)	(0.047)	(0.042)	(0.038)	(0.029)	(0.053)	(0.030)	(0.023)	(0.046)	(0.014)	(0.010)	(0.049)	(0.010)	(0.018)	(0.015)
Health:asthma	-0.070***	-0.056*	-0.065*	0.022	0.013	0.031	0.024	0.015	0.041	-0.001	-0.010	0.010	0.006	0.005	0.008
	(0.020)	(0.025)	(0.028)	(0.016)	(0.019)	(0.025)	(0.014)	(0.016)	(0.023)	(0.007)	(0.007)	(0.011)	(0.007)	(0.009)	(0.010)
Health:arthritis	-0.002	-0.014	-0.005	0.025*	0.019	0.027	0.013	0.007	0.016	0.003	0.001	0.005	0.010*	-0.005	0.022**
	(0.014)	(0.016)	(0.016)	(0.011)	(0.013)	(0.016)	(0.009)	(0.010)	(0.016)	(0.004)	(0.004)	(0.008)	(0.005)	(0.007)	(0.007)
Health:ulcer	0.004	-0.012	0.001	-0.012	-0.003	-0.019	-0.006	-0.003	-0.013	-0.005	0.003	-0.014	0.003	-0.002	0.006
	(0.015)	(0.019)	(0.015)	(0.011)	(0.015)	(0.016)	(0.010)	(0.012)	(0.015)	(0.004)	(0.005)	(0.009)	(0.005)	(0.008)	(0.006)
Health:gall	0.007	0.003	0.011	0.002	0.009	-0.007	0.006	0.006	0.005	-0.003	0.001	-0.009	-0.004	0.004	-0.012
	(0.017)	(0.021)	(0.022)	(0.014)	(0.017)	(0.021)	(0.012)	(0.015)	(0.020)	(0.006)	(0.005)	(0.011)	(0.006)	(0.009)	(0.010)
Health:sight	-0.019	0.005	-0.034	0.019	0.014	0.016	0.022	0.024	0.017	0.003	0.003	0.004	-0.001	0.002	-0.005
	(0.017)	(0.021)	(0.023)	(0.015)	(0.019)	(0.021)	(0.013)	(0.014)	(0.020)	(0.005)	(0.005)	(0.010)	(0.007)	(0.009)	(0.010)
Health:kidney	-0.001	-0.008	0.011	0.009	0.010	0.011	0.001	-0.005	0.008	-0.002	-0.001	-0.003	0.015*	-0.002	0.033**
	(0.019)	(0.023)	(0.028)	(0.016)	(0.020)	(0.025)	(0.014)	(0.016)	(0.024)	(0.006)	(0.006)	(0.011)	(0.008)	(0.010)	(0.011)
Ethic origin:Hokkien	-0.065	-0.082	-0.048	0.048	0.074	0.037	0.007	0.031	0.000	0.035*	0.014	0.058*	0.028	0.011	0.045*
	(0.052)	(0.064)	(0.067)	(0.043)	(0.055)	(0.065)	(0.037)	(0.042)	(0.061)	(0.016)	(0.017)	(0.026)	(0.019)	(0.030)	(0.022)
Ethic origin:Hakka	-0.004	-0.009	-0.008	0.068	0.105	0.046	0.018	0.057	-0.003	0.063	0.026	0.100	0.047	0.016	0.082
	(0.054)	(0.070)	(0.067)	(0.049)	(0.072)	(0.069)	(0.040)	(0.056)	(0.064)	(0.037)	(0.035)	(0.061)	(0.031)	(0.037)	(0.049)
Ethic origin:Mainlander	-0.087	-0.039	-0.130*	0.140*	0.206*	0.095	0.078	0.154*	0.039	0.116*	0.083	0.087	0.086*	0.070	-0.002
	(0.055)	(0.074)	(0.059)	(0.055)	(0.085)	(0.079)	(0.049)	(0.075)	(0.079)	(0.055)	(0.065)	(0.071)	(0.041)	(0.054)	(0.035)
Region: North	-0.055	-0.015	-0.070	0.010	0.006	0.017	0.022	0.019	0.022	-0.002	0.001	-0.002	-0.015	0.001	-0.029
	(0.033)	(0.038)	(0.044)	(0.027)	(0.031)	(0.043)	(0.023)	(0.025)	(0.041)	(0.011)	(0.010)	(0.021)	(0.012)	(0.017)	(0.015)
Region: Middle	0.014	0.052	-0.017	0.018	0.015	0.019	0.008	0.010	0.002	0.013	0.002	0.029	-0.007	0.019	-0.027
	(0.033)	(0.037)	(0.045)	(0.026)	(0.031)	(0.042)	(0.022)	(0.024)	(0.040)	(0.012)	(0.009)	(0.023)	(0.012)	(0.018)	(0.016)
Region: South	-0.013	0.010	-0.022	0.051	0.041	0.063	0.035	0.035	0.032	0.009	0.004	0.018	0.013	0.042*	-0.011
	(0.032)	(0.037)	(0.045)	(0.026)	(0.031)	(0.042)	(0.023)	(0.025)	(0.040)	(0.011)	(0.010)	(0.022)	(0.013)	(0.019)	(0.017)

Table 4.14 Marginal Effects of Univariate Probit Model with Mundlak Fixed Effects (continued)

Dependent Variables	Employed			Carer			Grandchild Carer			Adult Carer			Financial Support		
	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Year 1996	-0.027	0.002	-0.043	0.004	0.079*	-0.090*	-0.070***	-0.032	-0.134***	-0.042***	-0.025***	-0.061***	-0.081***	-0.076***	-0.081***
	(0.024)	(0.030)	(0.032)	(0.024)	(0.032)	(0.035)	(0.018)	(0.020)	(0.030)	(0.006)	(0.005)	(0.012)	(0.006)	(0.008)	(0.009)
Year 1999	-0.162***	-0.201***	-0.100**	0.003	0.089*	-0.082*	0.010	0.070*	-0.057	-0.045***	-0.024***	-0.069***	-0.081***	-0.078***	-0.075***
	(0.027)	(0.040)	(0.034)	(0.028)	(0.041)	(0.040)	(0.025)	(0.034)	(0.038)	(0.005)	(0.005)	(0.010)	(0.006)	(0.007)	(0.008)
Year 2003	-0.215***	-0.295***	-0.120**	0.036	0.140***	-0.073	0.013	0.106**	-0.095*	-0.045***	-0.013	-0.085***	-0.083***	-0.087***	-0.074***
	(0.029)	(0.041)	(0.037)	(0.030)	(0.042)	(0.043)	(0.025)	(0.034)	(0.039)	(0.008)	(0.009)	(0.014)	(0.009)	(0.011)	(0.013)
Year 2007	-0.254***	-0.349***	-0.144**	0.099*	0.154**	0.039	0.078*	0.115*	0.033	-0.033***	-0.016	-0.056**	-0.013	-0.036	0.006
	(0.036)	(0.053)	(0.044)	(0.041)	(0.058)	(0.059)	(0.037)	(0.050)	(0.057)	(0.010)	(0.010)	(0.018)	(0.017)	(0.018)	(0.026)
Age (M)	-0.019***	-0.024***	-0.011*	0.005	0.007	0.002	0.006	0.009*	0.001	-0.002	0.000	-0.004	0.000	0.002	-0.002
	(0.004)	(0.006)	(0.005)	(0.004)	(0.005)	(0.006)	(0.003)	(0.004)	(0.006)	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)	(0.003)
Hhsize (M)	-0.004	-0.006*	-0.002	0.006***	0.006***	0.007**	0.002	0.003	0.001	-0.001	0.000	-0.002	0.000	0.000	0.000
	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Hhincome (M)	0.004*	0.005*	0.002	0.002	0.001	0.001	0.001	0.000	0.002	0.000	0.000	-0.001	0.002**	0.002	0.002*
	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Living parents (M)	0.013	0.076*	-0.042	0.112***	0.122**	0.094	0.036	0.069*	0.006	0.003	-0.027	0.042	0.026	0.029	0.013
	(0.024)	(0.032)	(0.031)	(0.033)	(0.041)	(0.049)	(0.029)	(0.034)	(0.047)	(0.014)	(0.015)	(0.024)	(0.018)	(0.023)	(0.025)
Coresidence: spouse				-0.190***	-0.170***	-0.198***	-0.149***	-0.105***	-0.214***	-0.012	-0.016	-0.010	-0.001	0.011	-0.001
				(0.026)	(0.026)	(0.046)	(0.020)	(0.020)	(0.034)	(0.013)	(0.009)	(0.025)	(0.022)	(0.036)	(0.030)
Coresidence: son				-0.196***	-0.198***	-0.183***	-0.197***	-0.166***	-0.234***	-0.022	-0.032**	-0.009	-0.028	-0.024	-0.024
				(0.028)	(0.032)	(0.046)	(0.022)	(0.023)	(0.038)	(0.013)	(0.010)	(0.026)	(0.018)	(0.025)	(0.025)
Coresidence: daughter				-0.224***	-0.219***	-0.211***	-0.194***	-0.166***	-0.221***	-0.061***	-0.053***	-0.064***	-0.041*	-0.005	-0.057***
				(0.027)	(0.026)	(0.051)	(0.017)	(0.016)	(0.034)	(0.005)	(0.007)	(0.014)	(0.017)	(0.038)	(0.014)
Coresidence: parents				0.016	-0.004	0.021	-0.146***	-0.095***	-0.221***	0.018	-0.006	0.044	-0.023	-0.022	-0.023
				(0.053)	(0.056)	(0.092)	(0.023)	(0.023)	(0.042)	(0.026)	(0.014)	(0.057)	(0.021)	(0.026)	(0.033)
Coresidence:grandchild				0.234***	0.159**	0.295***	0.230***	0.149**	0.279***	0.001	-0.011	0.011	0.004	0.049	-0.014
				(0.035)	(0.051)	(0.047)	(0.034)	(0.046)	(0.048)	(0.015)	(0.013)	(0.026)	(0.021)	(0.039)	(0.027)

Table 4.14 Marginal Effects of Univariate Probit Model with Mundlak Fixed Effects (continued)

Dependent Variables	Employed			Carer			Grandchild Carer			Adult Carer			Financial Support		
	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females	All	Males	Females
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Living parents				-0.024	-0.038	-0.008	0.019	-0.015	0.046	0.017	0.056	-0.011	0.015	0.038	-0.005
				(0.026)	(0.031)	(0.040)	(0.025)	(0.028)	(0.039)	(0.014)	(0.029)	(0.018)	(0.018)	(0.028)	(0.022)
Spouse (M)				0.150**	0.211***	0.073	0.066	0.098	0.050	0.006	0.035	-0.023	0.006	-0.031	0.028
				(0.049)	(0.063)	(0.073)	(0.045)	(0.054)	(0.071)	(0.020)	(0.022)	(0.035)	(0.028)	(0.040)	(0.037)
Son (M)				0.056	0.144*	-0.048	0.052	0.130**	-0.034	-0.010	0.023	-0.045	0.056*	0.036	0.059
				(0.044)	(0.057)	(0.067)	(0.040)	(0.047)	(0.065)	(0.019)	(0.019)	(0.034)	(0.026)	(0.036)	(0.034)
Daughter (M)				0.284***	0.379***	0.181*	0.335***	0.376***	0.297***	0.052*	0.093***	-0.032	0.068*	0.006	0.080
				(0.056)	(0.073)	(0.085)	(0.050)	(0.059)	(0.081)	(0.026)	(0.024)	(0.045)	(0.031)	(0.045)	(0.043)
Parents (M)				0.016	0.043	0.025	0.046	0.067	0.047	0.023	0.031	0.031	0.051	0.038	0.047
				(0.064)	(0.073)	(0.111)	(0.059)	(0.063)	(0.108)	(0.025)	(0.023)	(0.050)	(0.034)	(0.044)	(0.053)
Grandchild (M)				0.036	0.095	-0.024	0.063	0.115*	0.029	-0.012	0.012	-0.032	0.010	-0.051	0.042
				(0.044)	(0.059)	(0.064)	(0.039)	(0.049)	(0.062)	(0.019)	(0.020)	(0.033)	(0.026)	(0.038)	(0.034)
Obs	9,905	5,103	4,802	9,905	5,103	4,802	9,905	5,103	4,802	9,865	5,097	4,768	9,861	5,094	4,767

Notes: (1)***p<0.001, **p<0.005, *p<0.01; Standard errors in parentheses. (2) Omitted categories: Aged 61-65, Single, No education, Aborigine and other groups, Eastern area, Year1989, Live alone. (3) (M) indicates Mundlak Fixed Effects. (4) 'Carer' relates to whether the individual responded to any of questions 1, 2 and 3 (refers to provide help to any individuals in the household). 'Grandchild' is where the respondent looks after his/her grandchildren, related to question 3. 'Adult' is where the respondent provides physical help to any adults living in the household based on either question 1 or 2. 'Financial Support' accords with the response to question 4.

Appendix Five

Summary of Main Results

This chapter explored the relationship between caring and employment using a series of probit models, namely, univariate probit, bivariate probit and recursive bivariate probit models. We first related employment and caring to socio-demographic characteristics and health status, separately. We then estimated bivariate and recursive bivariate probit models which allow us to examine whether unobservable individual heterogeneity influences both caring and employment and whether caring is endogenous in the employment equation. In this section, we summarise the main results from the three models. We found that unobserved factors affect both caring and employment decisions, and, therefore, not controlling for this correlation will bias the results.

We found that the results for males and females differ in some ways. For example, married men are more likely to be in employment but the opposite effect is found for married women who are less likely to be employed. On the other hand, providing care to an elderly or disabled person and/or grandchild has the greatest negative impact on the labour force participation of women. The number of children also has a negative effect on women's employment but its effect on men's employment is insignificant. Socio-economic factors impact the labour force participation of women and men in a manner consistent with the breadwinner theory, in which men have a greater commitment to work compared to women. Poor health has an adverse effect on both caring and labour force participation for both men and women.

These results as described above hold for both the bivariate and recursive bivariate probit models. However, the most important results in this respect are those derived from the recursive bivariate probit regression of caring on the employment of men and women. We found that caring responsibilities are endogenous in relation to employment and have adverse effects on the labour force participation of female carers but not of male carers. Our results suggest that there is a reduction of approximately 27 percentage points in the probability of being in employment for women taking on caring responsibilities (i.e., in the cases of caring for grandchildren or adults). In other words, caring responsibilities may lead to a lower degree of attachment to the women's labour

force. However, the situation is different for men, for the probability of being in employment is found to increase by 32 percentage points in the case of the provision of financial support.

Policy Implications

Taiwan has a high co-residential rate in that those aged over 60 living with their children and/or grandchildren accounted for 68% of the total. This compares with 48% for Japan and 18% for the U.S.[66] Taiwanese women have been found to be the primary co-residential informal carers (Hsu and Shyu, 2003), which may lead to a reduction in the female labour force in terms of the reduced birthrate over the next several years. Challenged by the need for informal carers for family members in terms of the aging population, caring responsibilities are mainly placed on women in a household (Wu and Lin, 1999), which may negatively affect the increased female labour force participation (which increased from 20% to 47% between 1980 and 2000). In this chapter we investigated the impact of informal care responsibility on employment and found that providing informal care to those persons who need to be looked after has an impact on employment for women. Moreover, we showed that the caring responsibility is endogenous and, therefore, that more flexible working arrangements and/or more formal care home provision may be a way of boosting women's employment. Caregivers also have other competing demands at the same time. These findings should be very important in decision making in regard to the development of a long-term care system in Taiwan.

[66] According to the Statistics in 2002 from Ministry of the Interior. The statistics for Japan and America in 2000 relates to the report from the United Nations.

Chapter 5. Conclusion

This thesis has explored self-assessed health, caring and labour market outcomes in Taiwan. In contrast to the existing studies for Taiwan, in Chapter Two, we used the generalized ordered probit (GOP) model to estimate the determinants of self-assessed health (SAH). To explore the intergenerational transmission of health, we used the parents' SAH to capture such a correlation, which has seldom been studied in previous papers arguably due to a lack of data. In Chapter Three, the determinants of psychological well-being with a focus on the role of job characteristics, such as working hours, were explored. The psychological well-being measure is based on the State-Trait Anxiety Inventory (STAI) which has not been commonly used in the economics literature but has been more widely used, for example, in the psychology literature. Finally, Chapter Four investigated the relationship between informal care and labour market outcomes. We used panel data from the Health and Living Status of the Middle Aged and Elderly to explore the relationship between caring and labour market outcomes.

In the following sections, the results of each chapter are firstly summarized. Then, the policy implications of the findings are discussed. Finally, a discussion of the general limitations of the analysis presented in the thesis is given and avenues for future research are suggested.

5.1 Summary of Results

Chapter 2: The Determinants of Self-Assessed Health in Taiwan

In this chapter, we explored the determinants of self-assessed health based on a GOP model using panel data from the Panel Study of Family Dynamics (PSFD). This chapter contributes to ascertaining a better understanding of the relationship between the health status of one generation and the health status of the following generation. When using the GOP model as an alternative approach that allows for the fact that individuals may use different threshold levels when reporting SAH, despite having the same 'true' level of SAH, we found, in line with Trannoy et al. (2010), that the parents' SES and SAH both influence the SAH of their children in adulthood. However, the effects of parents' characteristics on SAH are moderated after controlling for the spouse's SAH. The

finding implies that a shared living environment is an important determinant of an adult's SAH. In addition, this chapter provides an assessment of potential reporting bias by including additional explanatory variables, namely, the parents-in-law's health status, in the empirical models. Our findings suggest that reporting bias in the measure for SAH may exist in the PSFD.

Chapter 3: The Determinants of Psychological Well-Being in Taiwan

This chapter carried out an investigation into the determinants of psychological well-being. To be specific, we focused on the influence of job characteristics, i.e., working hours, on well-being, using a representative sample of the working-age population for Taiwan from the 2005 PSFD. In an effort to control for the potential effects of sample selection bias due to only observing job-related data for those who work, we adopted the Heckman approach. Furthermore, the State-Trait Anxiety Inventory (STAI) developed by Spielberger et al. (1983) was used as a proxy for the measure of subjective well-being. We classified the STAI measure into five factors according to the General Health Questionnaire (GHQ), which has been widely adopted as a reliable well-being measure in the economics literature: 15-STAI, anxiety, social dysfunction, loss of confidence and negative STAI. Our results are in line with those of existing studies in that well-being is related to employment status, age, marital status and health status. We also found that working a standard number of hours, i.e. 36-45 hours per week, has a positive association with well-being.

Chapter 4: The Relationship Between Informal Care and Employment in Taiwan

With the growing concerns of policy-makers about the provision of care as we face an aging population and reduced birth-rate in Taiwan, it is crucial to understand the link between caring and employment decisions. In this chapter, we have contributed to the small yet growing empirical literature analyzing informal care and labour market outcomes through univariate, bivariate probit and recursive bivariate probit models. This analysis was based on panel data from the Health and Living Status of the Middle Aged and Elderly from 1989 to 2007. Four types of informal carers were identified. In contrast to existing studies, which often ignore men's caring responsibilities, our empirical analysis modelled both men and women. We found that caring responsibility has a significant adverse effect on women's labour force participation, but that the

effects are lessened for highly-educated women. In addition, our results provided evidence that the caring decision is endogenous to the participation decision for women and that providing financial support is endogenous with respect to men's labour market participation.

5.2 Policy Implications, Limitations and Future Research

To sum up, this thesis has three main contributions to existing studies on Taiwan. Firstly, we employ an alternative econometric methodology for modelling SAH and include the parents' SAH to enhance our understanding of the determinants of SAH. The parents' health could be used to capture the genetic inheritance and explain the common family characteristics influencing health status. However, there is a strong effect of the spouse's SAH on adult health and the robustness of the results despite controlling for other factors, for example, socio-demographic characteristics and family characteristics, which indicate that a shared living environment is important when determining health in adulthood. The findings help us to identify priorities in terms of the most important factors of SAH. From a policy point of view, the results suggest that one way to improve the health of the public is to encourage people to live healthy lifestyles as families such as by eating healthy food within the family.

Secondly, we explore the determinants of well-being based on a measure of well-being not commonly used in the economics literature. We find that the standard working hours (i.e., 36-45 worked hours per week) results in a rise in well-being for employees; however, long working hours (i.e., over 46 hours worked per week) does not harm well-being. Since Taiwan is one of the countries with long working hours, our conclusion has important implications for policy. The Taiwan government launched a plan for setting a law for a maximum of 260 working hours per month in May 2012. However, our findings suggest that policy should focus on goals other than setting the maximum working hours. For example, policy-makers should concern themselves with overtime pay so that employers have to pay a reasonable wage to their employees and that this may be an effective way of improving the well-being of the workforce. In addition, we also found that exercise is strongly positively correlated with well-being, and, therefore, encouraging people to do exercise may be another effective way of enhancing well-being.

Thirdly, to our knowledge, there have been no econometric studies on the influence of informal care on labour market outcomes for Taiwan and we have explored the relationship between informal care and employment for four types of carer. We have found that the caring decision is endogenous to women's labour force participation, which means that a lack of job employment opportunities or employability reflects the fact that firms in Taiwan may be less likely to hire women. Thus policies to improve the carer's access to job opportunities are more important. This finding is in a way supported by evidence that a low female labour force participation rate may be driven by the demand side and not just by the supply side (Vandenberghe, 2013). Moreover, our conclusion is enhanced in the case of the male's employment where we found that the provision of financial support is endogenous to the male's employment, indicating that more financial support will assist the potential informal carers in participating in the labour market.

Finally, the limitations of the analysis presented in this thesis should also be noted. Firstly, the use of parents' health status as reported by the respondents in Chapter Two could be criticized as this variable may suffer from reporting bias. It would have been preferable to have the parents' health as reported by the respondents' parents themselves. In addition, we have shown that people living in the north, which is the most developed area in Taiwan compared to the least developed area, the eastern area, reported better SAH. However, the contributions of rich and poor regions may be related to socio-economic inequality in health which raises important issues that go beyond the scope of this chapter. This remains, however, an area for future data collection and research. Secondly, in Chapter Three, the other five STAI questions ideally would have been included in the well-being model. Data restrictions, however, meant that this was not possible. The mix of positive and negative questions of well-being is potentially important and more research on the categories of the different questions of psychological well-being is needed in order to check the robustness of the results presented here. Thirdly, although we controlled for unobserved individual characteristics, the effects of dynamic factors such as state dependence are not included in the analysis of the relationship between informal care and employment in Chapter Four, which may bias the estimated effects of caring on employment. Since past working or caring experiences are important factors in explaining labour market participation, especially

for females, dealing with such issues remains another area for future research. Although our results showed that poor health has a negative effect on both employment and caring, caring responsibilities may cause burnout and stress, and lead to a low attachment to the labour force that is not properly captured by our data. More research in this area is certainly needed.

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