Effects of Informal Care on Caregivers' Labor Market Outcomes and Health in South Korea

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ABSTRACT

YOUNG KYUNG DO: Effects of Informal Care on Caregivers' Labor Market Outcomes and Health in South Korea
(Under the direction of Edward C. Norton, Ph.D.)

This dissertation investigates the effects of informal care on caregiver's labor market outcomes and health in South Korea. Although dramatic demographic transitions in Asian countries have been well documented, less is known about working and caring lives of informal caregivers in this region. Embedded in traditional culture perpetuating family-centered elderly care, informal care still remains invisible as a policy issue. Using newly available microdata from the Korean Longitudinal Study of Aging, this dissertation not only fills the gap in the international literature but also provides evidence to inform current policy debates on elderly long-term care in South Korea. Studies on the two distinct but related outcomes address methodological issues by controlling for the potential endogeneity of informal care, by examining an extensive set of outcome measures, and by employing various functional forms of care intensity. Robust findings suggest negative effects of intensive caregiving on labor force participation, work hours, and wage rates for female caregivers but not for male caregivers. Furthermore, caregivers appear to experience negative mental and physical health outcomes. These findings suggest that informal caregiving is already an important economic and public health issue in South Korea even before the full effects of recent rapid population aging have appeared.

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LIST OF ABBREVIATIONS

ADL	Activity of Daily Living
BHPS	British Household Panel Study
CAPI	Computer-Assisted Personal Interviewing
CES-D	Center for Epidemiologic Studies-Depression
ECHP	European Community Household Panel
HRS	Health and Retirement Study
IADL	Instrumental Activity of Daily Living
IOM	Institute of Medicine (the United States of America)
IV	Instrumental variable
IV-2SLS	Instrumental variable-2 stage least squares
IV-FE	Instrumental variable-fixed effects
IVP	Instrumental variable probit
KLoSA	Korean Longitudinal Study of Aging
KRW	Korean Won
LFP	Labor force participation
LMO	Labor market outcome
MOHW	Ministry of Health and Welfare (the Republic of Korea)
NHI	National Health Insurance
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary least squares
OOP	Out-of-pocket
SHARE	Survey of Health, Aging, and Retirement in Europe

CHAPTER 1: BACKGROUND AND SIGNIFICANCE

Introduction

The world population is rapidly aging. In most parts of the world, mortality and fertility are decreasing dramatically, and both trends accelerate population aging. In 2000, the number of persons aged 60 or over was estimated to be 606 million worldwide. This number is projected to grow to 2 billion in 2050 (United Nations, 2002a). In 2047, the number of persons aged 60 or over is expected to exceed the number of children under the age of 14 for the first time in human history (United Nations, 2007). The phenomenon of population aging has been more pronounced in the developed world, and the developed world still has higher percentages of older persons. For these reasons, until recently discussions have focused on aging in the developed world. The magnitude and speed of population aging in the developing world are staggering, however. In the developing world, the older population will increase more than four times, from 374 million in 2000 to 1.6 billion in 2050, and will account for four fifths of the world's older population (United Nations, 2002b). In other words, the largest increases in absolute numbers of older persons will occur in the developing world (United Nations, 2002b). Furthermore, the speed of aging is much faster in developing countries, particularly in East Asia and Southeast Asia (Kinsella and Velkoff, 2002).

In many Asian countries experiencing rapid population aging, elderly care emerges as one of the most pressing policy issues. Increases in life expectancy come with

increases in life-years in disability in the developing world (Murray and Lopez, 1996, Goulding *et al*., 2003), thus resulting in an increased demand for elderly long-term care. Despite this trend, the supply of elderly care by family members is decreasing for a number of reasons. Declining fertility rates have already diminished the pool of family caregivers. Further reducing the availability of family caregivers is an array of socioeconomic changes, such as increased migration, decreasing intergenerational co-residence, and increasing female labor force participation rates. Without an established formal long-term care system (Chan, 2005), the conflict between these opposing forces has created insecure prospects for elderly populations and placed heavy strain on their families. This conflict raises a critical question on the sustainability of the traditional way of elder care, where families were entirely responsible for caring for the elderly.

As one of the newly industrialized countries in Asia, South Korea has experienced dramatic population aging coupled with equally dramatic socioeconomic changes. Life expectancy at birth increased from 62.3 in 1971 to 78.6 in 2005, and is projected to further increase to 86.0 in 2050 (Korea National Statistical Office, 2006). At the same time, the total fertility rate decreased from 4.53 in 1970 to 1.08 in 2005. This rate is among the lowest in the world (Korea National Statistical Office, 2006). Because of such changes in life expectancy and fertility, South Korea has become one of the fastest aging societies in the world. Whereas 115 years (1865-1980) were required in France for the percent of population aged 65 and over to rise from 7 percent to 14 percent, only 18 years (2000-2018) are expected to be needed for the comparable change to occur in South Korea. More strikingly, at current rates only 8 years (2018-2026) will be required for the increase from 14 percent to 20 percent (Korea National Statistical Office, 2006). The

aged dependency ratio, defined as the number of persons aged 65 or older divided by the number of persons aged 15-64, captures part of the socioeconomic effects of the population aging. The aged dependency ratio grew from 5.7% in 1970 to 12.6% in 2005, and is projected to increase to 72.0% in 2050 (Korea National Statistical Office, 2006). This demographic transition reflects an increasing burden on the working-age population for the support of the elderly population at the macroeconomic level. The increases in the aged dependency ratio also suggest that working-age persons will have to assume a greater responsibility for caring for their parents. Thus, the working-age population has an increasing dual burden of supporting the elderly population at the macroeconomic level and of caring for their own parents in their family lives. This situation implies that the working-age population may experience growing conflicts between labor market work and informal elderly care.

From the viewpoint of elderly care, the demographic transition and increasing conflicts on the working-age population raise the question of whether the current system of elderly long-term care, which is almost entirely dependent on the families, can be sustained. This question is particularly salient because South Korea experienced rapid industrialization, modernization, and urbanization (Palley, 1992) and compressed modernity (Chang, 1999). Intergenerational co-residence is no longer the norm, and the number of parents-only or single-parent households has increased. Female labor force participation rates have risen steadily. Such socioeconomic transitions changed the traditional model of family-centered elderly care in South Korea. Anecdotal evidence suggests that family-centered elderly care is at risk for many South Korean families. Disabled elderly parents are sometimes abandoned or abused, and parental care may

become a source of conflicts between siblings (Oh and Warnes, 2001; Lee and Kolomer, 2005). The elderly suicide rate more than tripled between 1995 and 2005, reaching a much higher level than that of Japan (The Hankyoreh, 2008). Middle-income families caring for a demented parent for a long period often fall into poverty because their income-earners give up work for parental caring and because they paid for expensive formal care for at least some period of time. In addition, under the lack of a well-established formal long-term care system, the current acute care system suffers from inappropriate hospital use by long-term elderly patients, referred to as social admission (Chang, 2000; Chang *et al.*, 2001).

Public long-term care insurance starts in South Korea in July 2008. However, the introduction of public long-term care insurance is only the beginning of establishing a long-term care system. In addition to immediate implementation issues with respect to workforce and facilities, many significant challenges lie ahead (Sunwoo, 2004). Unfortunately, the current knowledge base in South Korea is inadequate to address some of the most critical issues. Given the planned introduction of formal long-term care, many of the critical issues involve the interface between informal and formal care or the relationship between the private and public sectors (Kwon, 2006; Park, 2007). Despite the importance of having a better understanding informal care, informal care has not yet received due attention in the policy and research arena in South Korea. One reason is that relevant data with rich information on informal care were previously not available from well-designed, nationally representative population-based studies. Because informal care is not paid, existing administrative data provide little help. Also, informal care is embedded in culture and values. Thus informal care is viewed as a family or moral issue

rather than a social and policy issue. Policymakers even rely on the cultural tradition of filial piety as policy measures to address issues of aged society (Shin and Shaw, 2003), as exemplified by the legislation of *Promoting and Supporting Filial Piety Act* (Ministry of Health and Welfare, 2007). While the tradition of respect and care for elderly parents may have been a great asset to complement the current and future formal long-term care system, promoting filial piety alone without careful examination to the benefits and costs of informal care might deter more effective policy formulation.

Although informal care was also socially and politically invisible for a long time in the Western world (Arno *et al.*, 1999), recent decades have seen critical progress in research efforts in the coordination of long-term care, such as the National Long-Term Care Demonstration conducted between 1981 and 1985 in the United States (US), also known as Channeling (Carcagno and Kemper, 1988). Such studies enabled examining a wide range of issues with informal caregiving in the community (Stephens and Christianson, 1986) and considering the role of public policy (Doty, 1986). More recent years have witnessed further development in quantifying the benefits and costs of informal care. For example, in the US and European context, informal care is found to substitute for formal long-term care, thereby providing benefits for public long-term care financing (Van Houtven and Norton, 2004, 2008; Bolin *et al.*, 2007). Macro-level analysis of Organization of Economic Cooperation and Development (OECD) countries also finds that the availability of informal caregivers is negatively associated with the growth in long-term care expenditures (Yoo *et al.*, 2004). On the other hand, costs of informal care have been studied as well, particularly with respect to labor market opportunity costs (Ettner, 1996; Carmichael and Charles, 1998, 2003; Heitmueller and

Inglis, 2007; Bolin *et al.*, 2008). A substantial body of literature has examined caregivers' health (Schulz *et al*., 1995; Walker *et al*., 1995; Bookwala *et al*., 2000; Dilworth-Anderson *et al.*, 2002; Pinquart and Sörensen, 2003; Vitaliano *et al*., 2003) and its economic consequences (Van Houtven *et al*., 2005; Wilson *et al*., 2007). Given the high prevalence and enduring health effects of caregiving, caregiving is increasingly recognized as a public health issue (Talley and Crews, 2007). Studies on caregivers' labor market outcomes and health have policy implications for helping design better benefits for informal caregivers, finding the optimal mix of formal and informal care, and even formulating labor market policies. In a recent publication, the Institute of Medicine (IOM) clearly recognizes informal caregivers as an important issue of the health care workforce for the aging population in the US (IOM, 2008).

With this background, this dissertation studies informal care in South Korea, using newly available, nationally representative data from the Korean Longitudinal Study of Aging (KLoSA). I examine two distinct but related outcomes of informal caregiving: caregivers' labor market outcomes and health. These two broadly-defined outcomes reflect two of the most important consequences of informal caregiving that have been relatively well studied in other nations in the previous literature. Further justification for examining these two outcomes can be provided from some of the literature. In the taxonomy of the hidden costs of informal care, Fast *et al*. (1999) classify costs to informal caregivers into economic and non-economic costs. For economic costs, employment-related costs are considered in addition to out-of-pocket costs accompanying caregiving, such as incontinence supplies and mobility aids. Non-economic costs consist of emotional, physical, and social well-being, which can be encapsulated as health.

Moreover, White-Means (1997) examines long-term consequences of caregiving using two outcome measures, 1) depletion of financial resources due to accommodation in the labor market and 2) depletion of health because of caregiving, suggesting that labor market outcomes and health are two of the most important costs to informal caregivers. Interestingly, these two broad outcomes are not independent. Negative health effects of caregiving further compromise caregivers' working lives (Burton *et al*., 2004; Wilson *et al*., 2007). Caregivers with greater concerns for the financial and health impacts of caregiving are at an increased risk for depression (Yoon, 2003).

The results of this dissertation will have important policy implications for South Korea. Given that a shrinking working-age population is a major concern in South Korea, it is increasingly important that policies take into account the effects of informal care on labor market outcomes. Informal caregiving may also have negative health effects on caregivers, often referred to as the "hidden patients" (Schulz, 1990). Policies for informal caregivers may therefore need to consider more comprehensive support programs that take also into account their emotional and physical well-being, than only considering primarily economic consequences.

These policy implications have greater relevance when externalities and equity considerations are incorporated. As evident from the dual burden placed on the working-age population, individual caregivers' foregone incomes also mean reduced income tax revenue, decreased contribution to pension funds, and increased societal expenditures to support caregivers out of the labor force (Ettner, 1995; Latif, 2006). Moreover, negative health consequences arising from informal caregiving would not only incur caregivers'

out-of-pocket health spending but also increase expenditures from the National Health Insurance (NHI).

Equity implications involve at least two dimensions: socioeconomic and gender. Given a certain price for formal care, substituting formal care is financially more difficult among poor families; thus, they have few choices other than providing informal care at the expense of their own employment or health. Thus, informal caregiving can exacerbate old-age poverty and income inequality (Harrington Meyer, 1996; Viitanen, 2005). Negative health consequences of informal caregiving can further aggravate socioeconomic inequalities in health and burden of out-of-pocket spending. Caregiving puts disproportionately more women at risk of giving up work for caregiving, settling for a less favored employment trajectory, and suffering negative health effects. These effects collectively may lead to an increased probability of older women's living in poverty (Wakabayashi and Donato, 2005).

In addition to such policy implications for South Korea, this dissertation contributes to the international literature using data from an Asian country. In a recent systematic review of the international literature on informal caregivers' labor supply published in English between 1986 and 2006 (Lilly *et al*., 2007), thirty-five articles included for their final review are all from North America and Europe. The dearth of related research from other regions is even more contrasted with the increasingly heightened research interest in cultural and institutional differences between the northern and southern European countries with respect to family-ties and long-term care arrangements (Viitanen, 2005; Crespo, 2006; Bolin *et al*., 2007; Bolin *et al*., 2008). Crespo (2006) and Bolin *et al.* (2007, 2008) exploited recently released cross-national

data from Europe: the Survey of Health, Aging, and Retirement in Europe (SHARE). This dissertation uses data from the KLoSA, pre-designed to be comparable to the SHARE, to provide results from an Asian country, where different cultural norms affect individual and family decisions on living arrangements, informal caregiving, and labor supply.

The study on caregiver health effects will also provide results from a less studied culture. Different cultures present informal caregivers with different normative and institutional contexts for caregiving. South Korea has strong cultural norms for elderly support, a large fraction of daughter-in-law caregivers, and minimally available formal long-term care. Moreover, symptoms of caregiver health effects could be expressed in different ways due to cultural differences in disease manifestations (Kleinman, 1980; Kleinman, 1982), such as a higher tendency to somatize emotional conflicts (Rhi, 1983; Kim, 1992; Yong & McCallion, 2003) and greater acceptance of medication use for health problems. The rich information on individuals' health in the KLoSA allows for examining multiple health outcomes in a population-based survey.

In the remainder of this chapter, I describe the cultural background on informal care in South Korea, review the existing literature separately for each study, and finally summarize the significance of this dissertation.

Cultural Background on Informal Care in South Korea

This section provides a sketch of the cultural background on informal care in South Korea, focusing on critical changes to the family. In an agrarian society, the Korean extended family served as a production unit as well as a communal living unit.

Traditional Korean extended families continued with the eldest son's marriage and intergenerational co-residence with his parents. An eldest son inherited a larger share of bequests than his younger siblings, in the form of house, farming land and other real estate assets. The disproportionately larger bequest to the eldest son implied that the eldest son assumed the greatest role in familial responsibilities, which included co-residing with, supporting, and caring for elderly parents. Even after the parents died, the eldest son's responsibility persisted in such ways as performing regular memorial services for parents and other ancestors, and taking care of major family occasions. Daughters typically did not receive bequests from their own parents because they were viewed as "a person out of the original family once married" to others' families. However, the daughter-in-law married to the eldest son in a new family played a central role in familial responsibilities, including caring for their ill and disabled parent. In a sense, the extended Korean family started with a designated future caregiver, daughter-in-law, for aging parents. Even when the father-in-law was available for caring for his disabled wife, the caring responsibility was regarded as more of the responsibility of the daughter-in-law (eldest son's wife), because of the generational and gendered role division (Choi, 1993). The material life of traditional Korean families was reinforced by filial piety as an essential element of Confucianism. Filial piety served as the major principle for the everyday lives of ordinary people, helping keep the family as well as the society in harmony (Chee, 2000). Informal caregiving for disabled parents was embedded as an inseparable component of old-age support in traditional Korean culture (Sung, 1990) as in other East Asian cultures (Litwin, 1994; Yeh, 1995; Yamamoto and Wallhagen, 1997).

Rapid industrialization since the 1960s has dismantled the economic infrastructure for family-centered elderly care. Farming as a family business has lost its once-dominant role. As a result, family structure experienced substantial changes. Younger generations migrated from rural to urban areas for better education and job opportunities. Because of the increased migration, more and more eldest sons start their own families far away from their parents who remain in rural areas. Therefore, the traditional living arrangement of intergenerational co-residence has become a choice rather than a norm. In a ten-year period (1984-1994), the proportion of older adults living with their child decreased from 78 percent to 54 percent (Institute for Gender Research, 2001). Daughters-in-law often no longer assume their traditional role of caring for their parents-in-law in the historically patrilineal society. Moreover, as South Korea has seen a marked improvement in female education levels, female labor force participation rates have gradually increased. Increasing divorce rates are also changing a family structure.

While these socioeconomic changes weakened the link between downstream transfers of family wealth to the eldest son and his co-residence, attitudes and behaviors surrounding the traditional family have not changed completely. Rather, downstream transfers and family relations now take different forms. The most important is to invest in children's human capital. Most parents are willing to pay for their children's education to the highest level possible. For that purpose, parents in rural areas often sell out their farming land and livestock. Another common form of downstream transfers is for the parents to buy a house for their sons on their marriage. Such downstream transfers often leave so little wealth with many parents that they often would not be able to save money for their retirement plans. Such saving behavior is probably a legacy of traditional old-

age support based on intergenerational co-residence. Moreover, the old-age pension system did not play a major role until very recently (Ko *et al.*, 2007). Thus, elderly people in South Korea are generally poor, unless they co-reside with their children or receive substantial financial transfers. For older generations, old-age security was sought in their own children, neither in their own savings nor in the society, and older generations still have greater expectations about financial support and care from their children. While industrialization has changed the economic infrastructure for traditional old-age support, the current older generations are not yet ready to be fully independent of their children, both financially and physically (Chee, 2000). The two heterogeneous cultures collide with each other, creating conflicts between older and younger generations (Yoon *et al*., 2000).

Although many adult children still co-reside with their elderly parents, older generations' needs for and expectations about support from their children are increasingly in disharmony with adult children's lives. In a family with a single, disabled parent, siblings increasingly face a difficult decision about who cares for their disabled parent. Still, eldest sons will generally assume the greatest responsibility for parental care. Typically, the eldest son had better conditions for parental care than any other sons in the past, in part because disproportionately more educational or other types of investments were made in the eldest son than in his siblings. Also, at a given point in time, the eldest son was likely to have accumulated greater wealth than their younger siblings. However, recent surveys from South Korea show changes in attitudes to parental support. There is a growing consensus that a "more able" child, not necessarily the eldest son, should take care of their parents. Children with higher incomes and spacious houses are increasingly

pressured to providing parental care. Furthermore, daughters increasingly play a greater role in the care of their own parents. Another emerging attitude is that adult children caring for their parents should receive more bequests than other siblings (JOINS, 2007). A caregiving sibling may also receive financial transfers from other siblings as a compensation for his or her parental caregiving. Such a decision-making process among siblings may often lead to a serious family conflict. The bargaining often fails, and the disabled parent may not receive any care from their children. Under the lack of culturally appropriate formal long-term care system, elderly people institutionalized at facilities often carry the stigma of abandonment by children. The attitudes to institutional care, however, appear to be changing. In a 2006 survey of the general public (MOHW, 2006), 68.6 percent of the respondents reported that they would prefer institutional care, while 31.4 percent preferred home health care. The preference for institutional care was stronger among residents of urban areas and high income groups.

In summary, after industrialization changed the economic infrastructure and hence intergenerational co-residence for traditional family-centered elderly care, both older and younger generations increasingly face challenges with care for the elderly.

Literature Review

Effects of informal care on caregivers' labor market outcomes

Informal caregivers' labor market outcomes have been a continuing area of research in the Western world. In the US, although earlier studies can be traced back to the 1980s (Muurinen, 1986), the majority of studies have been published during the past twenty years (for a list of articles, see Lilly *et al.*, 2007). The heightened research interest

in the US in 1990s reflects continued demographic changes and their implications for labor force. As Ettner (1995) points out, economics research had previously been more interested in child care and its effect on female labor supply than in elderly parent care, which played an increasingly important role with population aging. In more recent years, the literature on this issue proliferated from Europe (Carmichael and Charles, 1998; Carmichael and Charles, 2003; Heitmueller, 2006; Crespo, 2006; Heitmueller and Inglis, 2007; Casado *et al.*, 2007; Bolin *et al.*, 2008).

Two major limitations were identified in earlier empirical work linking caregiving and paid work (Ettner, 1995; Stern, 1995; Norton, 2000). First, the issue of the endogeneity between caregiving and labor force participation was not addressed explicitly; therefore, it was hard to establish the causal effect of caregiving on labor force participation. The second major limitation with earlier studies was that they used only actual caregiver samples (Stone and Short, 1990; Boaz and Muller, 1992), thus limiting the generalizability of study results because of the selection bias (Ettner, 1995; Norton, 2000). Both limitations are related to the availability of a large sample of potential caregivers. Many recent studies from North America and Europe exploit data from large, population-based studies and also account for endogeneity (Wolf and Soldo, 1994; Stern, 1995; Ettner, 1995, 1996; Heitmueller, 2006; Latif, 2006; Crespo, 2006; Bolin *et al.*, 2008). In the following review, I focus on key findings and major methodological issues in these more recent papers.

Wolf and Soldo (1994) use data from the National Survey of Families and Households and find no effect of informal caregiving on the probability of being employed or on conditional hours of work among married women in the US, although the

authors acknowledge that the binary measure of caregiving may not reflect the wide variability of time commitments to care. Ettner (1995) uses data from the 1986-1988 Survey of Income and Program Participation and employs a three-dummy specification of informal caregiving: co-residing with a disabled parent; extra-residential care hours 10 per week or more; and extra-residential care hours less than 10 hours per week. Co-residing with a disabled parent is assumed to be the most intensive form of caregiving and thus treated as endogenous in addition to the other two dummy variables for extra-residential care. Using the number of siblings and parental education as instrumental variables (IVs), she finds that co-residing with a disabled parent has a negative and statistically significant effect on the probability of women's participating in the labor force and on work hours. Due to data limitations, parental education, predicting parental care needs only indirectly, was used as the instrumental variable. Exploiting better measures of parental health status in the 1987 NSHF, Ettner (1996) employs a similar IV approach and corroborates her previous results that co-residence with a disabled parent and extra-residential caregiving have negative effects on the labor supply, although their statistical significance varies. Both studies assume that an adult child co-residing with a disabled parent actually provides informal care in the home.

More recent studies from non-US settings largely attest to the negative effects of caregiving on labor supply, although sub-group differences were noted. Viitanen (2005) uses panel data from the European Community Household Panel (ECHP) to examine the relationship between informal care for the elderly and labor force participation among female adults across Europe. Exploiting the panel data, Viitanen (2005) finds substantial state dependence and unobserved heterogeneity in explaining the dynamics of female

labor force participation. Sub-group analysis revealed the greatest negative effects on middle-aged women and single women. Combining the methodological finding on state dependence on labor force participation, the policy implication is that informal caregiving could contribute ultimately to old-age poverty among females assuming caregiving responsibilities in their midlife. Casado *et al*. (undated) also use the Spanish subsample of the ECHP to examine the effects of informal care on female labor force participation. Their study results suggest that labor opportunity costs exist for co-residing caregivers but not for extra-residential caregivers. Using the longitudinal nature of the data, they also find that only caregiving lasting for more than a year has negative effects on labor force participation.

Several recent studies were conducted in the British context. Heitmueller (2007) uses data from the British Household Panel Study (BHPS) and estimates the effects of caregiving on labor force participation using both IV and panel data estimation. Results from both estimation methods show that the negative effects of caregiving exist only for co-residential carers and for caregivers providing more than 20 hours of care per week. In a different study using the BHPS, Heitmueller and Inglis (2007) also show that informal caregivers face wage penalties even when participating in the labor force, supporting previous findings from another UK study (Carmichael and Charles, 2003).

Release of the SHARE data provided the opportunity to examine the issue of the conflicts between caregiving and employment in a multi-national European context. Crespo (2006) derives two different but largely comparable samples from the SHARE and employs a bivariate probit model to account for the joint decision between care and paid work. She focuses on the effect of intensive caregiving on labor force participation

of midlife women, and finds substantial negative effects, ranging from approximately 30 to 50 percentage points, for both the northern and southern European countries. Interestingly, accounting for the endogeneity of intensive caregiving produced more statistically significant and much stronger negative estimates. If taking on a caregiving role reflects the person's unemployability, correcting for the endogeneity may show less significant and smaller effect magnitudes, as postulated in Heitmueller (2007). Bolin *et al*. (2008) also uses data from the SHARE and employs an IV estimation strategy. In their model specification, the hypothesis of exogeneity of hours of informal care was not rejected in models of employment, conditional hours worked, and conditional hourly wage rate. Latif (2006) uses Canadian data from the General Social Survey and also employs a similar IV approach. Test results indicated that caregiving was not endogenous in the probit model of employment and conditional ordinary least squares (OLS) models of the number of work hours. Caregiving, defined as a binary variable, was found to decrease work hours statistically significantly for employed women, but not for men. Probit estimates of the effect of caregiving were not statistically significant.

Co-residence deserves some additional consideration for empirical work (Lilly *et al*., 2007) particularly for studies in South Korea and many other Asian countries. Intergenerational household formation that well precedes caregiving may involve different implications from co-residence triggered by caregiving. Previous studies have suggested that co-residential caregivers are more likely to be out of the labor force than extra-residential caregivers (Ettner, 1995, 1996; Carmichael and Charles, 2003), while the opposite was also found (White-Means, 1997). It is not very clear, however, what co-residence captures in the empirical work in the literature.

Co-residential care is often used as a proxy for more intensive care than extra-residential care (Ettner, 1995, 1996; Carmichael and Charles, 2003), because co-residence may reflect care recipient's higher care needs and caregiver's higher time commitment to informal care. In White-Means (1997), co-residence concerns the structure of informal care and is included as a control variable in the regression models. However, co-residence itself is potentially endogenous to labor force participation. Several papers examined the issue of endogeneity of co-residence in the context of elderly care. Pezzin *et al*. (1996) recognize that the choice of a certain type of living arrangement may be determined by the mix of formal and informal care, which in turn can be affected by publicly provided formal care. In a later work, Pezzin and Schone (1999) find that both co-residence and informal caregiving are less likely to occur among adult daughters with higher time demands for other activities, such as number of children. Their findings suggest that informal caregiving and intergenerational co-residence are different modes of assistance to elderly parents, and that publicly provided formal care could affect both co-residence and caregiving decisions. Pezzin *et al*. (1996) propose that the total effect of publicly provided formal care on informal care can be decomposed into two components: the direct effect (change in care hours) and the indirect effect (change in the probability of choosing a particular living arrangement). Stern (1995) also acknowledges the potential endogeneity between adult children's informal caregiving and their distance characteristics and labor force participation.

Taken together, this literature suggests that, when estimating the effect of informal caregiving on caregivers' labor force participation, not only adult children's informal caregiving but also co-residence is potentially endogenous to their labor force

participation. Nevertheless, the endogeneity of co-residence preceding parent care has not been carefully examined in the existing empirical work on caregiver's labor force participation.

Effects of informal care on caregivers' health

A large body of multidisciplinary literature has studied the effects of informal caregiving on caregivers' health (for reviews or meta-analysis with different focuses, Schulz *et al*., 1990; Schulz *et al*., 1995; Walker *et al*., 1995; Bookwala *et al*., 2000; Yee and Schulz, 2000; Dilworth-Anderson *et al.*, 2002; Pinquart and Sörensen, 2003; Vitaliano *et al*., 2003; Pinquart and Sörensen, 2006; Pinquart and Sörensen, 2007). The literature examined psychological and physical health outcomes. Psychological outcomes include caregiver burden, psychological distress, strain, stress, general subjective well-being, quality of life, and depressive symptoms (Bookwala *et al*., 2000; Pinquart and Sörensen, 2003; Schulz *et al*., 1995). Physical health outcomes include self-rated health, symptom checklists, and chronic conditions as well as health care utilization (Schulz *et al*., 1995; Bookwala *et al*., 2000; Pinquart and Sörensen, 2003). Studies also examined physiological and clinical outcomes, such as immune functioning, cardiovascular functioning, and blood pressure (Schulz *et al*., 1995; Vitaliano *et al*., 2003). As a natural extension, mortality was also studied (Schulz and Beach, 1999).

Although considerable heterogeneity exists in the literature, meta-analyses and well-designed reviews provide several generalizable and robust findings. First, caregivers experience poorer psychological health such as depressive symptoms than non-caregivers do (Schulz *et al*., 1995; Pinquart and Sörensen, 2003). Second, for physical outcomes, the

risk of caregiving is slightly greater (Pinquart and Sörensen, 2003; Vitaliano *et al*., 2003) or much less conclusive (Schulz *et al*., 1995). Third, studies have noted many important sub-group differences by caregiver's gender and age, particularly by whether the caregiver has dementia-related stressors of the care recipient (Schulz *et al*., 1995; Pinquart and Sörensen, 2007).

Given the aims of the current study, the remaining literature review focuses on three issues: (1) external validity of studies on caregiving health effects and; (2) selection into caregiving; and (3) culture and caregiving health effects.

Lack of external validity has been mentioned as a major limitation of the caregiving literature (Schulz, 1990). Many studies use non-representative samples in specific caregiving settings (Barer and Johnson, 1990; Schulz, 1990; Walker *et al*., 1995; Dilworth-Anderson *et al.*, 2002; Pinquart and Sörensen, 2003). Moreover, studies often lack comparison groups (Vitaliano *et al*., 2003). These issues are often aggravated by inconsistent measurement of health outcomes. Taken together, these problems led to the difficulty in drawing generalizable policy conclusions on caregiving health effects. One alternative is to use data from large, population-based surveys, although this approach raises different issues such as lack of important variables and less detailed information on caregiving contexts (Schulz, 1990). Therefore, it is important to balance and compromise between internal and external validity (Schulz, 1990).

Selection into caregiving is another methodological problem concerning internal validity, compared with external validity. In their critical review of the caregiving literature, Barer and Johnson (1990) point out that self-selected samples are overrepresented in the literature. Schulz (1990) also suggests that health status may

determine who will provide informal care in the family. The selection hypothesis explains why observed health effects of caregiving might be small (Schulz, 1990). While well acknowledged, this methodological challenge has been rarely addressed in the literature. In a recent study on dementia caregivers' drug use, Van Houtven *et al*. (2005) test for the potential endogeneity of care intensity using an instrumental variable method and find no evidence of endogeneity between care intensity and number of drug use among dementia caregivers.

Culture plays an important role in explaining caregiving health effects (Dilworth-Anderson and Gibson, 2002; Dilworth-Anderson *et al*, 2004). Cultural beliefs exert their influence in at least three ways (Dilworth-Anderson *et al*, 1999). First, cultural beliefs "set the stage for caregiving" (Dilworth-Anderson *et al*, 1999). Through collective responses at the family and societal levels, cultural beliefs affect attitudinal and behavioral patterns affecting care. In South Korea, cultural beliefs have influenced intergenerational co-residence, the gendered pattern of care, the stigma associated with institutional care, and even the underdevelopment of a formal long-term care system. Second, cultural beliefs are also internalized at the individual level. A caregiver's view on filial piety and familial obligations is not only an individual characteristic but also a reflection of dominant cultural beliefs. Different views on caregiving responsibilities may lessen or worsen negative health effects of caregiving (Youn *et al*., 1999; Knight *et al*., 2002). In this respect, daughter-in-laws are of special interest in South Korea and other Asian countries (Harris and Long, 1993; Kim and Lee 2003; Kim, 2001; Zhan and Montgomery, 2003; Lee *et al*., 2007), because their view on caregiving to their in-laws can influence caregiver health effects. Third, cultural beliefs may also affect responses to

feelings about caring, such as intrusion and burden (Dilworth-Anderson *et al*., 1999). More generally, culture may modify symptom expression and clinical manifestations of psychiatric and mood disorders (Kirmayer, 1989), as has been elucidated by Kleinman's works on somatization of depression in Chinese culture (Kleinman, 1977; Kleinman, 1982; Kleinman, 2004). Studies also found that Koreans are less likely to report depressive symptoms as "depressed mood" and "thoughts of death," but instead more likely to complain about "low energy" and "concentration difficulty" (Chang *et al.*, 2008), and that they are more likely to somatize emotional distress (Pang, 2000). *Hwabyung*, a Korean culture-bound syndrome (Pang, 1990; Simons and Hughes, 1993), is in fact the most common form of somatization among Koreans (Yong and McCallion, 2003). Due to the elusive nature and diverse symptom expressions of somatization, patients with *hwabyung* often seek medical care for their physical symptoms, such as epigastric pain and palpitation, rather than for emotional problems. Yong and McCallion (2003) examine *hwabyung* in the context of caregiver stress.

This review of the literature indicates that balancing external validity and internal validity, accounting for the possibility of selection into caregiving, and exploring cultural dimension in caregiver health effects may yield fruitful research contributions.

Significance

Although dramatic demographic transitions in Asian countries have been well documented, less is known about the working and caring lives of informal caregivers in the region. Some exceptions come with Japan's introduction of long-term care insurance, including Oural *et al*. (2007), Shimizutani *et al*. (2008), and Hanaoka and Norton (2008).

Using newly available, rich microdata from South Korea, this dissertation fills the gap in the literature. By studying the effects of informal care on caregivers' labor market outcomes and health, this dissertation makes several research contributions.

Study on the effects of informal care on caregivers' labor market outcomes

1. Using data from the KLoSA, this study provides results from a less-studied Asian country, thereby adding to the growing body of international literature.
2. By deriving additional subsamples of adult children from the KLoSA, this study examines gender and age group differences in the effects of informal caregiving on caregivers' labor market outcomes.
3. Accounting for cultural background on intergenerational co-residence and informal caregiving, this study treats both co-residence and informal caregiving as potentially endogenous to labor supply. I test for the endogeneity using bivariate probit models and instrumental variables models. A strong filial bond and lack of substitutable formal long-term care in South Korea allow for using parent's functional limitations as excellent IVs for adult children's informal care.
4. In examining labor supply both at the extensive and intensive margin, this study considers various functional forms of informal care hours, thus allowing for checking for robustness and threshold effects.

Study on the effects of informal care on caregivers' health

1. This study provides results with good external validity on caregiver health effects from an Asian country, by using a nationally-representative sample, exploring multiple health outcomes, and examining various functional forms of informal care.
2. This study tests for the possibility of selection into caregiving using IV methods. Parents-in-law's functional limitations provide conceptually plausible IVs.
3. This study examines a spectrum of psychological and physical health outcomes, including outpatient care use and prescription drug use. This allows for checking for robustness and exploring different patterns by study outcome.

In addition to these research contributions, this dissertation aims to inform current policies on long-term care in South Korea. Although public long-term care insurance was introduced in South Korea in July 2008, surprisingly little research has paid attention to the majority of long-term care workforce. With the implementation of the public long-term insurance program and ongoing data collection through the KLoSA, this dissertation will also serve as a baseline study that will facilitate examining policy effects of the public long-term care insurance in the near future.

CHAPTER 2: CONCEPTUAL FRAMEWORK

Informal Care and Caregivers' Labor Market Outcomes

Economic models of supply of informal care can be modified to explain informal caregivers' decision regarding labor force participation (Norton, 2000). The hallmark of such economic models is that the provision of informal care requires a trade-off with work and leisure. Thus, one important area for empirical work is to examine the effect of informal caregiving on labor force participation, which has been done in the US (for a summary, see Norton, 2000). Recent papers on the empirical question provide a summarized list of the effects of informal caregiving on labor force participation (Carmichael and Charles, 2003; Heitmueller and Inglis, 2007).

The full effects of informal caregiving on labor market outcomes consist of two main effects: substitution effect and income effect (Carmichael and Charles, 2003; Heitmueller and Inglis, 2007). Through the substitution effect, caregivers are less likely to be in the labor force, because the reservation wage increases for the remaining hours after informal care is given. Through the income effect, caregivers are more likely to remain in the labor force, because fewer working hours and greater expenditures due to caregiving will reduce their disposable incomes and induce them to maintain their income source in the labor market (Figure 2.1). Caregivers will choose not to work only when the substitution effect exceeds the income effect. Thus, caregiving may not necessarily deter labor force participation and may even increase the likelihood of being in the labor force,

providing an interesting empirical question. It seems plausible that the relative magnitudes of the substitution and income effects vary depending on the intensity of informal care. More intensive caregivers, for example, who provide 40 hours of care per week, would find it hard to maintain their paid work even with decreased work hours because the substitution effect will dominate the income effect. On the other hand, less intensive caregivers still might be able to combine work and care (Ettner, 1995; Carmichael and Charles, 1998). Less intensive caregivers may have even higher labor market attachment than otherwise similar non-caregivers. Therefore, there may be some threshold for care intensity below which no significant negative effect exists and above which the substitution effect dominates the income effect (Carmichael and Charles, 1998).

Figure 2.2 presents hypothesized relation between care intensity and labor market attachment, which is determined mainly by the combination of the income effect and substitution effect at a given level of care intensity. Labor market attachment is likely to differ by gender. In many societies, including South Korea, the income effect of informal caregiving is likely to be higher among men than among women. Furthermore, compared with women, men may also be affected to the lesser extent by the substitution effect of caregiving. As a result, women are likely to have lower labor market attachment at a given level of caregiving and also a lower threshold level of informal care, above which labor market attachment is low enough for the caregiver to choose to leave the labor force.

While this hypothesized gender difference may be true of independent men and women at a societal level, the division of labor between married men and women serves as an institutional setting that further polarizes the direction of the countervailing effects of informal caregiving on labor market attachment. Once the caring responsibility falls on

a married adult child, specialization may take place within the nuclear family. The woman of the nuclear family, whose time costs are typically lower than her husband's, may then decide to leave the labor force for care of her parent-in-law or parent. For the man, the caring responsibilities may require even higher earnings than before because his wife does not bring income any longer. Therefore, in a household providing parental care, the man may be more likely to stay in the labor force because of the income effect, whereas negative effects of caregiving on labor market attachment will concentrate on the woman. Even though the man shares the responsibility of caring for his mother with his wife, the presence of his wife as the primary caregiver or at least an additional caregiver will considerably lessen the substitution effect of his caregiving.

The burdensome nature of caregiving and its workplace consequences suggest some additional effects. A respite effect exists when caregivers use work to take a break from caregiving (Stone and Short, 1990; Carmichael and Charles, 1998, 2003; Heitmueller, 2006). Furthermore, informal caregivers may experience discrimination in wage or promotion because they may require higher flexibility and show less reliability than other employees (Carmichael and Charles, 1998; Heitmueller and Inglis, 2006; Heitmueller, 2006). Even without obvious and perceived discrimination effects, caregivers themselves might prefer job opportunities with less demanding responsibilities and more flexible work arrangements so that they may continue to combine work and caring (Carmichael and Charles, 1998). Moreover, caregivers may be less likely to invest in career development necessary for better job placements in their future career. Even previous caregiving history may negatively affect labor market opportunities for persons who want to return to the labor force. Labor market decisions are made throughout the

life-course (Henz, 2004). Given such multiple and long-term effects of caregiving, Lilly *et al*. (2007) propose that future research needs to look at labor market adjustments within the caregiving trajectory. One research question is whether caregivers may earn less than their otherwise similar counterparts even when participating in the labor force and working for the same hours.

In addition, caregiving may have negative effects on other critical human capital for the labor market, mainly health. That is, caregiving may also have indirect effects on labor market outcomes through its detrimental health effects such as depression among dementia caregivers (Wilson *et al*., 2007). In this scenario, health status is a mediating variable for the effect of caregiving on labor market outcomes. Therefore, estimates on non-health (direct) effects of caregiving will depend on the extent to which a statistical model accounts for caregiver's health status.

The effects of informal caregiving on labor market outcomes will be estimated as the sum of the counteracting effects. However, estimating the effects in empirical work is not simple. The existing literature provides several reasons why caregiving might be endogenous to labor market outcomes in standard statistical models.

Caring responsibilities may occur disproportionately more in disadvantaged families (Heitmueller, 2006). This argument is closely related to the phenomenon of familial aggregation in disease and disability from the literature on socioeconomic inequalities in health. That is, families with a disabled person are more likely to have individuals with already fewer employment opportunities. In this argument, socioeconomic status is an omitted factor that affects both caregiving and labor market outcomes. If the empirical model does not control adequately for family-level

socioeconomic status, the estimate on the effect of caregiving will overstate the true effect on labor market outcomes. However, even if family-level socioeconomic status is controlled for, one should consider three typical types of potential endogeneity issues for linking caregiving and labor market outcomes.

First, caregiving may be correlated with unobserved 'unemployability' (Heitmueller, 2006), causing the typical source of endogeneity bias due to omitted variables. That is, self-selection into caregiving may be more likely among individuals with poorer prospects for employment. A similar yet not identical argument can also be made. Individuals with high opportunity cost of time are less likely to quit working to provide informal care, because they would prefer to substitute formal care for informal care (Heitmueller, 2006). Hence, caring responsibilities may fall on individuals with lower opportunity costs of time, or lower 'ability' (Heitmueller, 2006).

Second, current employment can be "a sign of revealed preference for market rather than home production" (Ettner, 1995). Family members who are not currently working are more likely to take on the caring role. In a typical cross-sectional study, this issue of reverse causality or simultaneity is hard to address. Reverse causality may also arise because labor market situation can affect caregiving decisions (Heitmueller, 2006). The discrimination effect can also lead to this endogeneity bias. Rather than continue combining work and caring responsibilities, the caregiver experiencing wage penalties may stop working altogether. Such individuals will then show longer caring hours and higher rates of unemployment in the data. Consequently, the negative effect of caregiving will be overstated.

Third, measurement error for the amount of caregiving may also introduce endogeneity bias. Measurement of informal care hours in general presents a great challenge (Van den Berg and Spauwen, 2006), and the metric of hours of informal care does not adequately capture the intensity or quality of informal care (Van Houtven and Norton, 2008). Given that, a caregiver or a care recipient may self-adjust the quality of care and then report informal care hours differently depending on the care quality and possibly on the caregiver's revealed commitment to caregiving. If a caregiver's being in the labor force is perceived as lower commitments to caregiving by the care recipient, then the care recipient may under-report hours of informal care actually received. On the other hand, co-residing caregivers out of the labor force may over-report their actual care hours, not only because it is hard to tease out informal care hours from their living with the disabled care recipient but also because their higher commitments to caregiving may make them believe they are providing more hours of care than they actually provide. This second possibility, non-random measurement error, causes another source of endogeneity bias. If over-reporting of care hours occurs among caregivers out of the labor force, this endogeneity bias from measurement error will overstate the effect of caregiving on labor market outcomes. Despite their different pathway, these reasons all lead to the argument that not controlling for the endogeneity may overestimate the potential negative effect of informal caregiving on caregivers' labor market outcomes.

In addition to this basic framework, some further considerations are relevant to the cultural and institutional setting in South Korea. First, the endogeneity of informal caregiving may be weakened. As described in cultural background, traditional cultural norms dictate who provides parental care in the family based on birth order and gender

— the eldest son and his wife in the co-residential household. Moreover, the lack of culturally acceptable and substitutable formal care does not allow for many strategic decisions regarding informal care between parents and adult children. Together, informal caregiving may be determined largely exogenously at the population level in South Korea. With changing social norms, this exogeneity may not be the case any longer, particularly for younger generations as opposed to older generations.

Second, informal caregiving may be correlated with higher unobserved ability and employability. The previous literature implicitly assumed that adult children maximize one utility function for the extended family. In such a unitary household model, specialization occurs between siblings so that a sibling with lower ability is more likely to assume the caring role to their disabled parent. Such a unitary household model ignores that married adult children also consider the utility of their own nuclear families. Furthermore, family pressure for parent care is on the shoulder of better-off and more able children, who have a spacious house with extra room for the disabled parent. It follows that caregiving may not necessarily be correlated with unemployability, lower ability, or lower opportunity cost of time. In other words, the "marginal caregiver," who is most likely to vary in their decisions on informal care with potential caregiving responsibilities, may be different from what has been typically postulated in the previous literature.

Finally, co-residence needs special consideration. In traditional Korean extended families, decisions on intergenerational co-residence typically precede decisions on parental care. Then, one natural question is whether co-residence to begin with, rather than informal caregiving, is endogenous to labor force participation, particularly for the

daughter-in-law in multi-generation household. An adult child's decisions on intergenerational living arrangements and on his or her labor market outcomes may not be independent (Figure 2.1). Adult children who are less willing to work outside the home or less able to find a market job may decide to co-reside with their parents or parents-in-law. Although co-residence may generally require higher commitments to parents and home, co-residence will not necessarily affect negatively adult children's labor market outcomes. Elderly parents are increasingly an important source of child care in South Korea, supporting their daughter's or daughter-in-law's employment. Women with higher attachments to the labor force may prefer to co-reside because their elderly parents can help her with child care and other household work. This phenomenon is also observed in Japan (Sasaki, 2002). Therefore, co-residence is potentially endogenous to labor market outcomes, particularly for younger generations. If an adult child's co-residence follows her decision on informal caregiving, either by moving in or having her parents move in, co-residence may reflect a structure for caregiving or care intensity, as implicitly postulated in much of the previous literature. In that case, controlling for the endogeneity of informal care would be sufficient. On the other hand, informal caregiving superimposed on intergenerational co-residence raises a methodological challenge that both variables are potentially endogenous.

This conceptual framework provides several testable hypotheses. First, through decreasing labor market attachment, increasing care intensity decreases caregivers' probability of labor force participation as well as participants' labor market outcomes, including hours worked, income, and wage rate Second, the negative effects of informal caregiving have a threshold of care intensity, below which no worse labor market

outcomes are observed. Third, gender differences exist for the negative effects. The conceptual framework also guides the empirical work. The endogeneity between informal caregiving and labor market outcomes must be accounted for. However, the pattern of potential endogeneity bias may be different in South Korea from what has been typically postulated in the literature. Third, co-residence is another potential endogenous variable in empirical studies linking informal care and labor market outcomes.

Informal Care and Caregivers' Health

The conceptual framework of this study builds on several theoretical components in the caregiving literature (Figure 2.3). Schulz *et al*. (1995) suggest that three factors of caregiving may cause negative health effects, which I define broadly as poorer health and increased health care use. First, performing caregiving tasks can exert negative effects on health through increased emotional stress and physical strain. Second, caregiving inevitably involves observing a loved one's decline and anticipatory bereavement, which itself may affect the caregiver's psychological health. Third, the caregiver's psychological well-being can be influenced by the care recipient's affect (the phenomenon of contagion), particularly because functionally disabled care recipients are often depressed (Schulz *et al*., 1995). Caregivers' increased use of health care services such as drugs may reflect poor psychological and physical health effects of caregiving.

Caregiving may, however, have positive health effects (Walker *et al*., 1995; Beach *et al*., 2000; Tarlow *et al*., 2004). Caregiving may also reduce access to health care (Kim *et al.*, 2004; Chaix *et al*., 2006), thus showing lower health care use than otherwise would be expected at least in the short run. Although positive aspects of caregiving

should be acknowledged, intensive caregiving undertaken over a long period of time most likely have greater negative effects rather than positive effects. Compared with more intensive caregiving, less intensive caregiving is less likely to have negative health effects. Therefore, observed health effects of caregiving will be the net effects taking into account these effects with opposing directions.

Caregiver health effects are a complex phenomenon (Beach *et al*., 2000) and may involve a variety of factors, including caregiver, care recipient, relational, and contextual factors. Besides care intensity, the observed health effects of caregiving may vary along several dimensions. In this study, I focus on three dimensions. First, caregiver health effects may vary depending on the nature of an outcome measure under study. Given the phenomenon of contagion or the psychological effect regarding expected bereavement of care recipient, caregivers' psychological health outcomes can be negatively affected by a low level of care intensity (Figure 2.4). By contrast, physical health outcomes, including health care use, are likely to take more care intensity to present their manifestations. Consequently, psychological health effects of caregiving are less likely to have a threshold, compared with psychological health effects.

Second, I hypothesize that the caregiver-recipient relationship may moderate positive and negative health effects. For example, because daughter-in-laws do not have blood-ties to the frail elderly in their married families, daughter-in-law caregivers may experience contagion of affect less than otherwise similar daughter caregivers. Likewise, beneficial effects of caregiving may also be smaller among daughter-in-law caregivers. Depending on the caregiver-recipient relationship, the effects of caregiving on health outcomes may be heterogeneous.

Third, as discussed in the literature review, culture plays an important role in caregiver health effects by affecting institutional settings, by shaping beliefs and attitudes to caregiving, and even by influencing symptom manifestations. Although this study does not aim to be cross-cultural, acknowledging the far-reaching effects of culture on caregiver health effects could provide useful guidance to the empirical research and interpretations of the results.

Figure 2.3 also suggests that informal caregiving and negative health outcomes could be correlated with increased vulnerability, limited resources, and baseline health status. In linking caregiving and negative health outcomes, such potential confounders should be considered as demographic characteristics, education, and assets. One particularly important factor to be controlled for is health status. Health status may affect one's probability of assuming caregiving responsibilities (selection into caregiving) and how much care is provided. However, health status is not easily observed in typical population-based survey data.

Based on this conceptual framework, I test for the main hypothesis that informal caregiving has negative effects on caregivers' health in South Korea. I examine potential differences in caregiver health effects by outcome, care intensity, and caregiver-recipient relationship. In the empirical work, I carefully account for the potential endogeneity between caregiving and negative health outcomes.

Summary of Testable Hypotheses

H1: Informal caregiving has negative effects on caregivers' labor market outcomes.

H1a: Informal caregiving decreases the probability of caregivers' participating in the labor force, with a greater magnitude among women than among men.

H1b: For labor force participants, informal caregiving reduces worked hours, paid income, and wage rate, with a greater magnitude among women than among men.

H1c: Compared with otherwise similar non-caregivers, less intensive caregivers experience no worse labor market outcomes (threshold effect).

H2: Informal caregiving has negative effects on caregivers' health.

H2a: Informal caregiving has negative effects on caregivers' psychological and physical health.

H2b: Informal caregiving increases caregivers' outpatient care use and prescription drug use.

H2c: Compared with otherwise similar non-caregivers, less intensive caregivers experience no worse outcomes (threshold effect).

H2d: The effects of informal caregiving on caregivers' health differ among spousal care, own parental care, and parent-in-law care.

Although I test for these hypotheses in the two separate studies, the conceptual frameworks share several key features, including possible threshold effect of care intensity and the issue of endogeneity. This focus is important because the empirical work primarily aims to provide policy-relevant results by estimating the causal effects of informal care by different levels of care intensity.

Figure 2.1. Conceptual framework for the effects of informal care on labor market outcomes

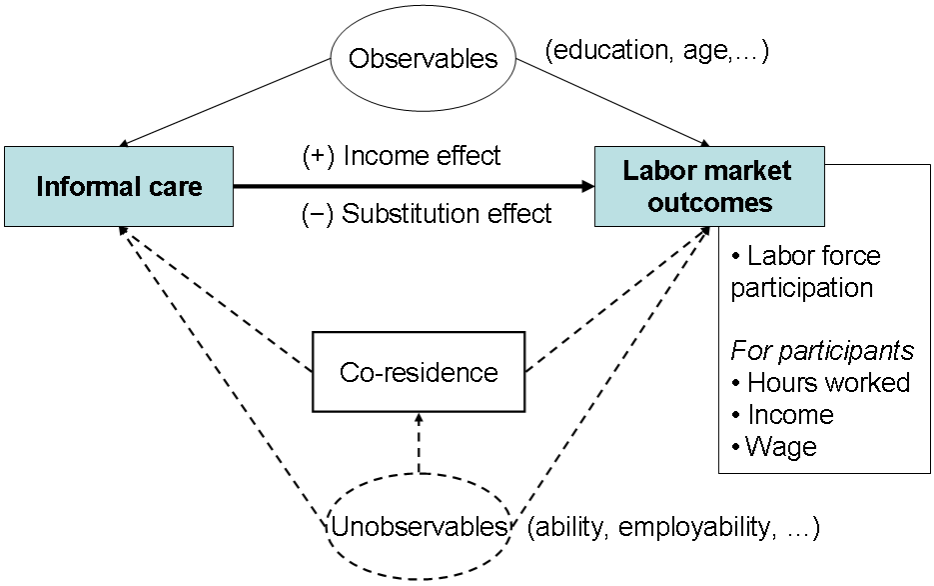


Figure 2.2. Hypothesized relation between labor market attachment and care intensity by gender

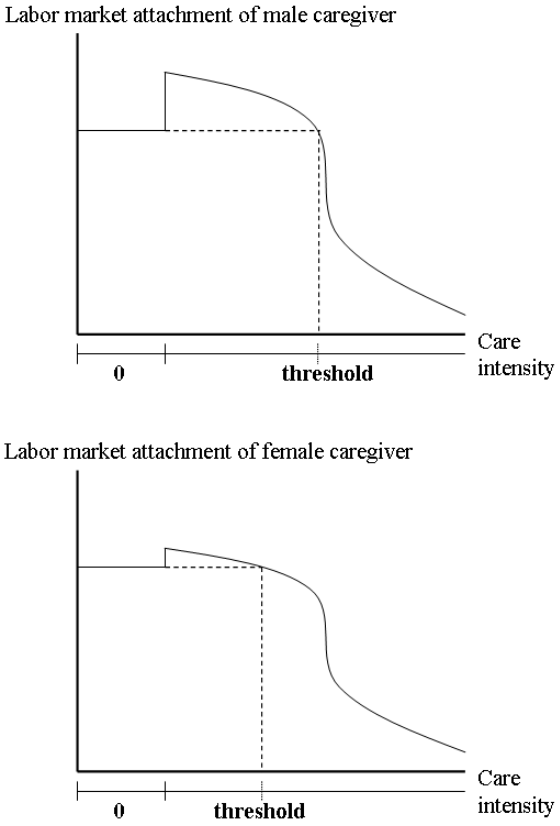


Figure 2.3. Conceptual framework for caregiver health effects

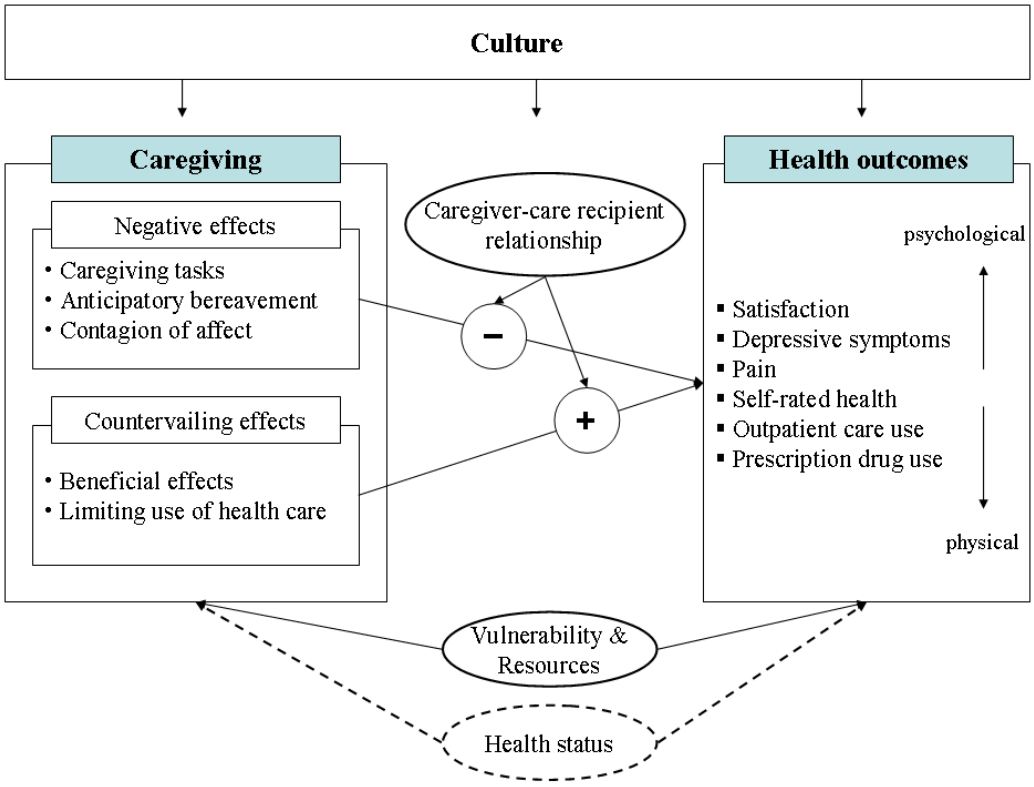
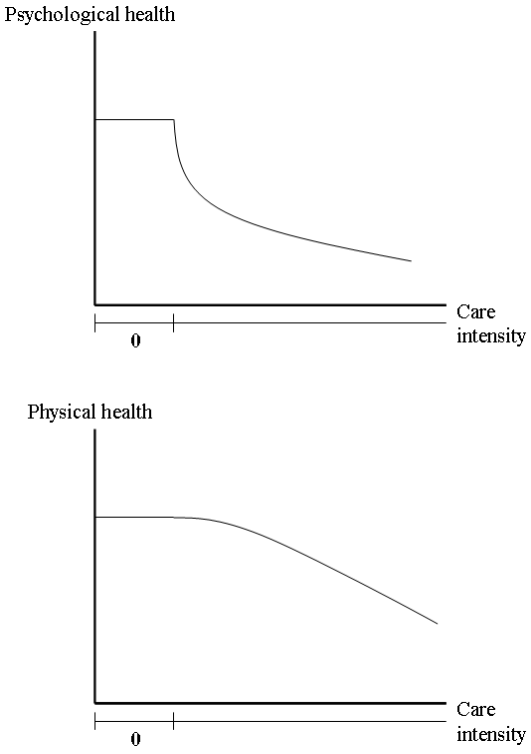


Figure 2.4. Hypothesized relation between caregiver health and care intensity by outcome type



CHAPTER 3: DATA

Korean Longitudinal Study of Aging (KLoSA)

The KLoSA is a nationally representative study of non-institutionalized South Korean adults aged 45 or older in fifteen large administrative areas (Seoul Metropolitan City, six other Metropolitan Cities, and eight Provinces, excluding Jeju Province for the sake of survey convenience). This original study population is followed up every two years, with an Off-Year Survey planned in intervening years. In its first wave survey conducted between July and December 2006, 10,254 individuals in 6,171 households (1.7 per household) were interviewed face-to-face using the Computer-Assisted Personal Interviewing (CAPI) method.

In designing the KLoSA, great efforts were made to exploit the previous experience of existing aging panel studies in other countries. In fact, the KLoSA was pre-designed to improve international comparability with other panel studies on aging, especially with the Health and Retirement Study (HRS) in the US and the SHARE (Smith, 2006; Boo & Chang, 2006). Overall survey themes of the KLoSA are consistent with those of the HRS and SHARE, including questionnaires on demographics, family and family transfers, health, employment, income, assets and debts, expectation and life satisfaction. One major difference between the KLoSA and other comparable studies is that the age criterion for target population of the KLoSA is 45, not 50. This lower age criterion was adopted for the purpose of better capturing increasingly unstable

employment status among Korean adults of mid-40s and its effects on their retirement decisions.

One of the great strengths of the KLoSA for the current study is its detailed information on the survey respondents as well as their children, siblings, and parents. This detailed information allows for a close look at the provision and receipt of informal care within a family. Furthermore, one could easily generate important family-level variables based on the current information, and also construct another study sample, for example, a sample of KLoSA respondents' adult children.

The major limitation of the data is that, despite its name, the KLoSA is not a longitudinal study as of 2008. This limitation precludes opportunities to raise more interesting questions and to better address some of the key methodological issues.

Sample Selection

I exploit the original KLoSA dataset in two ways. First, I view KLoSA respondents as potential care recipients. KLoSA respondents were asked to give information on all their living children, including informal care provided. I use KLoSA respondents' responses to construct the sample of adult children, which I will call the Adult Child sample throughout this paper. Second, I view KLoSA respondents as potential caregivers for their family members. I will call this sample of original KLoSA respondents as the Respondent sample. The study on caregivers' labor market outcomes uses both samples, while the study on caregiver health effects uses only the Respondent sample. Table 3.1 presents an overview of sample selection, and Table 3.2 provides key variables to be used for each study and sample.

Constructing the Adult Child sample serves several purposes for the study on caregivers' labor market outcomes. First, the Adult Child sample and the Respondent sample have different relative advantages, which arise from two different ways of exploiting rich information on KLoSA respondents. When using the Adult Child sample, I can take advantage of rich information on their parents (KLoSA respondents), such as number of functional imitations. There are some disadvantages with using the Adult Child sample. All information is collected indirectly, through responses from their parents. Therefore, only informal care provided to KLoSA respondents can be known, and care provided to other elders is not known. Moreover, variables are composed of easily observable information, such as education level and whether or not the adult child is currently working. On the other hand, the Respondent sample has rich information on potential caregivers themselves but less detailed information on family members. For example, the Respondent sample allows for using variables such as hours of work and paid income, while providing an indicator variable of whether or not each family member has any Activity of Daily Living (ADL) limitation but not number of ADL or Instrumental Activity of Daily Living (IADL) limitations. Therefore, the Adult Child sample and the Respondent sample are complementary. Crespo (2006) takes a similar approach to construct two complementary samples using the SHARE.

Second, the Adult Child sample also allows for examining relatively younger potential caregivers who are not covered in the Respondent sample. This advantage provides an opportunity to examine potential age group differences. Third, because part of the Adult Child sample also covers the same age group (45-64) as the Respondent sample, it allows me to check for robustness of study results.

I apply different exclusion criteria for each study. For the study on caregivers' labor market outcomes, I exclude individuals aged 65 or older (both the Adult Child sample and the Respondent sample) to focus on typical working-age populations in South Korea. In addition, I exclude persons aged less than 25 in the Adult Child sample because many individuals under 25 may be still in college or mandatory military service. I divide the Adult Child sample into two subsamples: Younger Adult Child subsample and Midlife Adult Child subsample. I use forty-five as the cutoff age to create these two subsamples so that both the Midlife Adult Child sample and the Respondent sample can have the same age group of 45-64. For the study on caregiver health effects, I exclude individuals with any ADL limitation because their health status is not representative for potential caregivers in the study sample and because they are very unlikely to be caregivers.

Variables

Dependent variable: Labor market outcomes

The Adult Child sample only provides information on whether or not an individual is "currently working for the purpose of bringing in income" as reported by his or her parents. In the Respondent sample, I take advantage of rich information on labor market outcomes, including the type of work (employed, self-employed, and unpaid family work), work hours, income and wage (Table 3.3).

I use such diverse labor market outcomes for two main reasons. First, by not depending solely on the outcome of labor force participation, this study aims to provide a fuller understanding of the labor market effects of informal caregiving. Caregivers may

leave the labor force (adjustment at the extensive margin), or may reduce their market work (adjustment at the intensive margin) while still being in the labor force. A more complete understanding of the complex labor market effects of informal care is also critical for policy purposes. Second, the structure of labor market in South Korea has a relatively large proportion of self-employed or unpaid family workers outside of employment, particularly among midlife women. To account for this feature, I construct three different outcomes to capture adjustments at the extensive margin. For each of the three variables, I also create an outcome variable capturing adjustments at the intensive margin.

Specifically, I define *Any work* to include self-employed and unpaid family workers in addition to employed workers. I consider weekly hours worked as the outcome of interest for those in *Any work*. The definition of *Any paid work* does not include unpaid family workers. For those in *Any paid work*, I examine monthly income earned. There are 58 self-employed individuals that reported a deficit for their business. I treat their income as 0. Finally, *Any employed work* is defined as 1 if an individual is employed and 0 if not. For the employed, I consider hourly wage rate, which is calculated using the formula, (monthly income)/(weekly hours worked/4). All the variables are based on responses for their current primary job. To account for the right-skewed distribution of the three intensive-margin outcomes, I convert them into logged values by taking the natural logarithm of (1+unit value).

Dependent variable: Caregiver health outcomes

I use multiple caregiver health outcomes available in the KLoSA. This choice of

outcome measures is informed by Schulz (1990) and additional sources (Haley *et al*., 1987; Pang, 2000; Yong and McCallion, 2003) (Table 3.4). In total, I investigate six groups of outcomes. Below I describe how I define dependent variables for each outcome group, starting with outcomes of more psychological nature toward outcomes of physical nature and health care use.

- Satisfaction with quality of life and with health
- Depressive symptomatology
- Pain affecting daily activities
- Self-rated health
- Outpatient care use
- Prescription drug use

Satisfaction with quality of life and with health

Based on the following questions in the KLoSA, I define two continuous variables with possible values from 0 to 100.

> Please answer how much you are satisfied with the followings compared to your contemporaries. 0 means absolutely dissatisfied and 100 means absolutely satisfied. (A visual analogue scale with 10 points interval is shown.)
> - In overall, how satisfied are you with your quality of life (or how happy you feel)?
> - How satisfied are you with your health?

Depressive symptomatology

Given the challenge of detecting depression in the general population using a survey questionnaire, I employ multiple ways of measuring depressive symptoms. One way is to define a person as being depressed if the response to the following question is 1 or 3. This also is one of two ways the KLoSA defines depression in its data.

> - Have you ever had feelings of being sad, blue, or depressed for two weeks or more during the past year?
> ① Yes
> ③ Did not feel depressed because I was taking anti-depressant medication
> ⑤ No

Only those who answered in 1 or 5 to the question above were asked to answer the following questions from the Center for Epidemiologic Studies Depression (CES-D) scale (Andersen *et al.*, 1994). The CES-D scale has been widely used as a screening tool for depression among diverse populations, including Koreans (Cho and Kim, 1998). For each of the ten questions, respondents were asked to choose one of the four items below. There are two ways to use the results. One is to obtain the weighted sum (Andersen *et al.*, 1994). The fifth and eighth questions involve positive symptoms and thus should be reverse-coded. For example, if a person gives ① Very rarely to the eight negative symptoms and ④ Almost always to the two positive symptoms, then the weighted summary score is calculated as 0=0×10, the lowest possible score. The highest possible score is 30=3×10.

In addition to using the weighted sum as a continuous variable, an alternative way is to use a cutoff to create a dichotomous variable. Summary score of 10 or higher has been suggested as a screening tool (Andersen *et al.*, 1994; Irwin *et al.*, 1999; Cheng and Chan, 2005; Jang *et al*., 2005)). Another way is to count the number of responses having non-zero values and to create a dichotomous variable 1 if the number is 4 or higher. This is a second way that the KLoSA provides a variable of being depressed in the general population. Although the CES-D scale has been found to be valid in several previous studies from South Korea, it is not known yet whether the scale can be applied to screen depression in the current KLoSA sample. Given this, I use the three dependent variables to check for the sensitivity of results.

> Next I will ask about how you felt and behaved during the last week. Please think of how often you felt or behaved like followings.

- During the last week, how often did you lose interest in most things?
- During the last week, how often did you have trouble concentrating?
- During the last week, how often did you feel depressed?
- During the last week, how often did you feel tired out or low in energy?
- How was your last week? How often did you feel pretty good?
- During the last week, how often were you afraid of something?
- During the last week, how often did you have trouble falling asleep?
- How often did you feel you were overall satisfied last week?
- How often did you feel alone last week?
- How often have you felt down on yourself, no good or worthless last week?

① Very rarely (less than one day)
② Sometimes (1-2 days)
③ Often (3-4 days)
④ Almost always (5-7 days)

Pain affecting daily activities

Caregiving often involves physical efforts and may produce pains. Moreover, individuals with psychological distress often present with physical symptoms, known as somatization. After KLoSA respondents were asked about pain for various body parts, they were asked to answer the following question. Based on the response, I generate a binary variable of whether a person has pain affecting daily activities.

- Does the pain make it difficult for you to do daily activities?

Self-rated health

Self-rated health is measured using a five-category ordinal scale on the following question.

- Would you say your health is excellent, very good, good, fair, or poor?

To account for differences in response patterns from other countries, KLoSA respondents were also asked to answer an alternative question with a different five-category ordinal scale (very good, good, fair, poor or very poor). I only use responses

from the question above, because there was greater distributional variation than for the alternative question. In addition to using the ordinal variable, I create a binary variable of whether a person reports *fair* to *poor* self-rated health.

Outpatient care use

I generate two variables on outpatient care use. First, I define a binary indicator variable of *Any outpatient care use*=1 if the respondent reported visiting a doctor's office, including emergency room, hospital outpatient office, and an oriental clinic, at least once in the past 12 months. I do not include hospitalization, dental visit, or public health clinic visit for outpatient care use. Second, only for those with *Any outpatient care use*=1, I create a continuous variable of total out-of-pocket spending during the period. For this question, KLoSA respondents were asked not to include the amount covered by private insurance plan or other family members such as children or parents. Because the distribution of out-of-pocket spending showed the typical right-skewed pattern, I take its natural logarithm.

Prescription drug use

For outpatient care use, I create two variables on prescription drug use. The binary indicator variable of *Any prescription drug use* is created using the survey question "In the past 12 months, have you regularly taken prescription medication?" The continuous variable of logged out-of-pocket spending on prescription drug use is based on the question, "About how much have you paid out-of-pocket for these prescriptions last year?"

Key independent variable: Informal care

In the Adult Child sample, I use KLoSA respondents' responses to calculate care hours provided by each adult child in the past month. In the KLoSA survey, respondents were asked to provide up to three persons who most often helps with their ADLs and IADLs, as shown in Q1 below. For each child providing any informal care, I calculate the number of care hours during the last month as the product of Q2 and Q3. In the survey, interviewers were directed to enter 1 for less than an hour of care in Q3. If both parents reported receiving care from one of their children, I sum up the number of care hours for both parents at the child-observation level. This calculation process can be expressed as $\sum_i (Q2_i \times Q3_i)$, where *i* can take on 2 only if both parents appear as KLoSA respondents. Resulting values indicate how many hours of informal care a child provided to his or her parent(s) during the past month. I convert weekly hours of care by using the formula of weekly care hours = monthly care hours/(30.4×7).

> **Q1.** Who most often helps you with (dressing, washing, bathing, eating, getting out of bed, using toilet, controlling urination and defecation, grooming, doing the chores, preparing hot meals, doing laundry, going out, using transportations, shopping, managing money, making phone calls, taking medications)? (Select from the list displayed by CAPI)
> 02 Spouse
> 03 Mother
> 04 Father
> 05 Mother-in-law
> 06 Father-in-law
> 07 ~ 16 Children
> 27 ~ 40 Sibling
> 47 Brother-in-law, sister-in-law
> 48 Spouse of child
> 49 Grandchild
> 50 Other relative
> 55 Helper or other non-relative

> **Q2.** During the last month, on about how many days did [helper's name chosen from Q1] help you? _____days (range: 1~31)
>
> **Q3.** On the days [helper's name chosen from Q2] helps you, about how many hours per day is that? _____ hours (range: 1~24)

For the Respondent sample, I first calculate the sum of ADL care hours provided to spouse, parents, parents-in-law, children, siblings, or other relatives, using responses to Q4 through Q7. For IADL care, respondents were asked Q8 to Q10 (IADL equivalent to Q5 to Q7 for ADL), but were not requested to first identify a family member with IADL limitations as they were for Q4. (Information on IADL limitations of family members is not available in the KLoSA.) In case response to Q7 or Q10 was given in months, KLoSA interviewers were instructed to enter 4 for 1 month, 26 for 6 months, and 52 for 1 year, respectively. The product of Q6 and Q7 (Q9 and Q10) gives the number of hours of ADL (IADL) care provided to a particular person indicated in Q5 (Q8) during the past 12 months. I add the number of ADL and IADL care hours for a family member at the respondent-observation level. I also sum up care hours provided to more than one person at the respondent-observation level. Numerically, this calculation equivalent to $\sum_i (Q6_i \times Q7_i + Q9_i \times Q10_i)$, where *i* takes on the number in Q4. The number tells how many hours of informal care a respondent provided for any family member during the past 12 months. Dividing the number by 52, I obtain averaged weekly hours of care during the past 12 month.

> **Q4.** Are there any members of your family over the age 10 (spouse, parents, parents of spouse, siblings and/or children) who are unable to carry out activities of daily living (ADL)? Activities of daily living refer to everyday routines such as eating, dressing, bathing or using the toilet, etc. Please identify all members of family with ADL difficulties. (Select from the list displayed by CAPI)

02 Spouse
03 Mother
04 Father
05 Mother-in-law
06 Father-in-law
07 ~ 16 Children
27 ~ 40 Sibling
47 Brother/sister-in-law of spouse
48 Son/daughter-in-law
49 Grandchildren
50 Other relatives

Q5. Did you provide (names listed in Q4) any help with activities of daily living during the past 12 months (not calendar year)? If so, who was helped? (Select from the list displayed by CAPI)

Q6. During the past 12 months (not calendar year), roughly how many hours per week did you help out [name chosen from Q5]? _____hours per week

Q7. How many weeks did you provide such care to [name chosen from Q5] during the past 12 months? _____weeks

Q8. Did you help any of your family members (spouse, parents, parents of spouse, siblings and/or children) who are not living with you with other things such as household chores, errands, transportation, grocery shopping, financial management, etc.? If you did, who was helped? Please identify all family members whom you helped out during the past 12 months. (Select from the list displayed by CAPI)

Q9. During the past 12 months (not calendar year), roughly how many hours per week did you help out [name chosen from Q8]? _____hours per week

Q10. How many weeks did you provide such care to [name chosen from Q8] during the past 12 months? _____weeks

In both Adult Child and Respondent samples, I take the natural logarithm of (1+weekly care hours) to account for the right skewedness in distribution. In addition, I create two dummy variables representing less intensive care and more intensive care with the omitted reference category being no care. I consider three cutoffs to less intensive and more intensive care for both samples. Previous studies have used the definition of

intensive care as care of more than 10 to 20 hours per week (Carmichael and Charles, 1998). I use 10, 15, and 20 hours per week for cutoff points in the Respondent sample. For the Adult Child sample, I use lower cutoff points: 5, 7.5, and 10 hours per week considering the distribution of parental care hours.

Instrumental variables

Depending on the endogenous variable and sample used for each study, I consider different sets of instrumental variables (IVs). Rationales for using these IVs will be described in the following method section. Here I focus on how I define the variables. Below I describe three sets of IVs used in the study on caregivers' labor market outcomes, and another one set of IVs for the study on caregiver health outcomes.

IVs for co-residence in the Adult Child sample in the study on labor market outcomes

To predict the probability of co-residence using exogenous determinants, I use three IVs: number of brothers, number of sisters, and whether the child is the eldest son in the family. All these numbers are calculated based on the number of living siblings. To be clear, the eldest son is defined as the oldest son only among sons, not taking into account daughters. For example, if there is only one son and many older daughters, then the son is defied as the eldest son. Therefore, the probability of being the eldest son among men could be greater than 50%.

IVs for informal care in the Adult Child sample in the study on labor market outcomes

For the Adult Child sample, rich information on their parents (KLoSA respondents) allows me to exploit detailed information on their functional limitations. If both parents have functional limitations, I sum up their number of ADL/IADL limitations at the child-observation level. Because ADL and IADL limitations may need quite different nature of informal care, I use them separately. Furthermore, effects of IADL limitations on the demand for informal care are unlikely linear. Thus, I use categorized variables for IADL limitations. If these assumptions are supported by the data, the IVs should have high explanatory power in the first-stage regressions of informal care hours. The results in the method section suggest that these assumptions are indeed reasonable. Based on the assumptions, I use three IVs: 1) number of parent(s)' ADL limitations (0-14), 2) whether parent(s) have 1-4 IADL limitations (binary), and 3) whether parent(s) has 5-20 IADL limitations (binary).

IVs for informal care in the Respondent sample in the study on labor market outcomes

For the Respondent sample, information on functional limitations of family members is less detailed than for the Adult Child sample. As described earlier, only whether each family member has any ADL limitation is available. Three IVs for the Respondent sample are all binary indicator variables: 1) whether parent(s) have any ADL limitation, 2) whether parent(s)-in-law have any ADL limitation, and 3) whether any sibling or relative has any ADL limitation.

IVs for informal care in the study on caregiver health outcomes

Because IVs should predict informal care but should not directly affect psychological and physical health outcomes of the caregiver, more conceptually plausible sources of IVs come from functional limitations of parents-in-law having no blood-tie with the caregiver. Thus, I use a different set of IVs from those in the Respondent sample in the study on caregivers' labor market outcomes. Specifically, I consider 1) whether the father-in-law has any ADL limitation, 2) whether the mother-in-law has any ADL limitation, and 3) whether parent(s) have any ADL limitation.

Other explanatory variables

In addition to these key study variables described so far, statistical models account for individual's demographic and socioeconomic factors, parental characteristics, health status, variables on medical security, and region of residence. Lists of study variables and their summary statistics are presented in Tables 3.15-3.18 by study and sample to be used.

Demographic and socioeconomic factors include age, marital status, number of children, education level, house ownership, and household assets. Household assets are first calculated as the total sum of present values for detailed items of financial and real estate assets. These items include own house; real estate, such as land, rental real estate, a partnership, or money owed to you on a land contract or mortgage except your current home; cash over 500,000 Korean won, bank savings, stocks/trusts/mutual funds, bonds, insurance, private money lending, mutual savings club, etc.; money in installment deposits, certificates of deposits, and other savings accounts; stocks and mutual funds bonds; personal loans to be repaid; saved through traditional private savings club (*Gye*);

vehicles for transportation; any other assets, such as valuables, paintings, antiques, and golf membership. I aggregate the sum of assets at the household level, and categorize all households into quintiles, thus creating four dummy variables on the lowest to the second highest quintiles. These variables are used as parental characteristics for the Adult Child sample.

Variables on parental characteristics include whether both parents live together, parent's house ownership, and parent's education level. For parent's education level, I take any higher education level between father and mother. I include these parental characteristics for two main reasons. First, parental characteristics may affect the amount of informal care provided by children. If both parents live together, their children will be far less likely to provide informal care and, if ever, less amount of care. Parents having a house and higher education levels may capture their socioeconomic status, thereby affecting their health status and care needs. Second, these parental characteristics may also influence children's labor market outcomes. Parent's education level could capture unobserved educational investment to children during childhood, which may persist through adulthood. Therefore, parental characteristics are expected to serve as important control variables in both first- and second-stage regressions in the structural equation models of caregiver's labor market outcomes.

Because health status may affect individual labor market outcomes, I include two indicator variables of poor self-rated health and of disability. For the study on caregiver health effects, comprehensive measures of health constitute study outcomes. Thus, I only consider disability and 13 disease indicators available in the KLoSA (Table 3.18). In the models on health care use, I add variables on medical security. The statutory medical

security system in South Korea consists of the NHI and two types of the *MedicalAid* system for people outside of the NHI. *MedicalAid* beneficiaries pay lower out-of-pocket spending for health care services than their NHI counterparts. Among *MedicalAid* beneficiaries, those on Type I pay less than those on Type 2. I also include an indicator variable of having voluntary private health insurance.

Region of residence can be a potential confounder for labor market outcomes, health and health care use. In the Respondent sample, I use fourteen dummy variables representing each large administrative area with the omitted category being Seoul Metropolitan City. However, because individuals in the Adult Child sample do not necessarily live in their parent's region of residence, I only use three broad dummy variables: Seoul Metropolitan City (omitted category), Non-Seoul Metropolitan City, and Province.

Sample Description

To provide an overview of the study samples, I present several tables and figures for key characteristics of the KLoSA population. Figure 3.1 presents proportion of adults with functional limitations by age group. With aging, the proportion of having functional limitations increase, with the highest observed for the age group 80+. Twenty eight percent of people aged 80 or older have any ADL limitation and 55 percent any ADL/IADL limitations. Figure 3.2 shows that older elderly are more likely to live alone or live with non-spouse family member. When focusing on the elderly with any ADL limitation (Table 3.5), 85.5 percent receive any informal care in the past month. For the 60-69 age group, spouses seem to be the dominant caregiver type. Among the elderly

aged 80 or older, adult children appear to be caregivers for the elderly. In both age groups, the proportion of living with spouse or living with non-spouse family member is over 70 percent.

Next, I present descriptive statistics regarding informal care in a great detail in three ways. First, I provide the overall distribution of weekly care hours in the Adult Child sample (Tables 3.6-3.7) and the Respondent sample (Tables 3.8-3.9, Figures 3.3-3.5). Second, as a suggestive rationale for the validity of IVs, I present bivariate analyses between informal care and IVs (Tables 3.10-3.12). Third, I provide tables of bivariate analyses between informal care and outcomes of interest (Tables 3.12-3.14).

In the Adult Child sample aged 25-44, 448 observations (2.73%) were reported to provide any parental care in the past month (Table 3.6). Of the parental caregivers, the median of weekly care hours is 2.30 (25 percentile: 0.46, 75 percentile: 6.90). Table 3.7 provides distribution of care hours when the parental caregivers are divided into two groups of less intensive caregivers and more intensive caregivers. Three cutoff points are used. Even at the cutoff of 5 hours per week, 311 adult children are classified as less intensive caregivers, while 137 as more intensive caregivers. In the group of less intensive caregivers, the interquartile range suggests that the majority of less intensive caregivers provide very little care. As the cutoff point is raised to 10 hours per week, the interquartile range is 0.46 to 4.6, showing that still relatively little care is provided by the defined group of less intensive caregivers.

In the Respondent sample aged 45-64, 315 observations (3.07%) were found to have any informal care hours. Among these caregivers, the median of weekly hours of informal care is 15.23, with the interquartile range being from 3.23 to 40.38 (Table 3.8).

Because weekly hours of informal care are calculated from average hours of care per week and number of weeks of care in the past 12 months, I also examine the interquartile distribution of each variable (Table 3.8, Figures 3.3-3.5). The median of weekly care hours is 21, while the absolute majority of caregivers reported that they provided care for 52 weeks, the whole 12-month period (Table 3.8, Figure 3.5). Table 3.9 presents the distribution of calculated weekly care hours and original components when caregivers in the Respondent sample are classified into less intensive and more intensive caregivers. Even at the cutoff of 5 hours per week, caregivers classified as most intensive caregivers provide care for the entire year (25 percentile is 52 weeks). These statistics suggest that the main component of more intensive caregiving is not the duration but number of care hours per week.

Tables 3.10-3.11 present bivariate analyses of informal care (and labor market outcomes) and functional limitation of family members, which I consider to be a source of IVs. Ideally, family members' functional limitation should be highly correlated with informal care but should not show high correlation with labor market outcomes. Family members' functional limitation is indeed highly correlated with informal care provision in all the subsamples. The correlation between family members' functional limitation and labor market outcomes are largely statistically insignificant in the Respondent sample, while mostly statistically significant in the Adult Child sample. The bivariate results for the Adult Child sample do not necessarily preclude the use of parental ADL/IADL status as IVs in instrumental variable estimation because the correlation could be controlled for using observable covariates.

Results of bivariate analyses between informal care (and caregiver health outcomes) and parental (including parents-in-law's) ADL status suggest that parental ADL status is highly correlated with informal care provision (Table 3.12). For all the main health outcome measures as well as most of the indicators for health status, the correlation is not statistically significant at the 5% level, which is promising in terms of instrument validity. For variables on other characteristics, the correlation is mostly statistically insignificant with a few exceptions (age, education level, and private health insurance enrollment). Differences in education level and rates of private health insurance enrollment between the two groups could be explained by the difference in mean age.

In bivariate analyses between informal care and labor market outcomes for each subsample (Tables 3.13-3.14), labor market outcomes are generally poorer for more intensive caregivers, particularly among women. However, some labor market outcomes are even better for less intensive caregivers than for non-caregivers. These observed differences could be due to the effect of caregiving as well as observed and unobserved differences between the counterparts. Summary statistics of caregiver health outcomes and other variables by caregiving status are provided in Table 3.18. Although some outcomes appear to be poorer in the caregiver group compared with the other two groups, no consistent pattern is observed across health outcomes.

Tables 3.15-3.17 present summary statistics of study variables for the study on caregivers' labor market outcomes. Between Table 3.14 and Table 3.15, several interesting findings emerge. First, labor force participation rates show considerable gender differences. While men's labor force participation rates are over 80% for both samples (83.2% in the Younger Adult Child sample and 86.3% in the Midlife Adult Child

sample), women's labor force participation rates are 43.6% among the age group of 25-44 and 27.8% in the age group of 45-64. Second, midlife adult children show higher proportions of providing any parental care than younger adult children do, which is not surprising given that parents of midlife adult children have parents with higher proportions of having any ADL/IADL limitation. Third, these two tables also provide a snapshot of striking socio-demographic transitions South Korea has experienced in the past decades. The average number of brothers and sisters dropped, and the number of adult children's own children decreased. The high rates of college education are remarkable in the Adult Child sample versus the Respondent sample, particularly among women. Forty-four percent of women aged 25-44 received any college education, compared with 14.1% in women aged 45-64.

Stark gender differences are observed in labor market outcomes (Table 3.16). Women are less likely to be in any type of work including unpaid work for family business, but they appear to work the same hours once they are in the labor force. Gender differences are even more striking when looking at the figures for paid work. Women are far less likely to be in paid work (28.9%), while most men appear to be in paid jobs. Moreover, women are paid much less than men are, when compared between only paid work samples. However, it should be noted that women of this age group have much lower education levels than men. Women are more likely to provide informal care than men (3.5% vs. 2.2%). Women also provide more hours of care than men. The mean of weekly hours of informal care is 36.6 for women and 20.0 for men. Female caregivers are more likely to be more intensive caregivers than male caregivers are.

For the study on caregiver health effects, summary statistics are presented by potential and actual caregiver status (Table 3.18). Compared with the non-caregiver group having any family ADL limitation, the actual caregiver group shows higher proportions of ADL limitation among spouse and mother-in-law. While the average age is higher in the caregiver group, their health status does not necessarily appear to be worse.

Figures 3.6-3.9 provide distributions of selected health outcomes by caregiver status. In the histograms, compared with the non-caregiver group, the caregiver group has lower bars for satisfaction score (Figure 3.6), higher bars for *poor* self-rated health (Figure 3.7), and higher bars for higher CES-D score (Figure 3.8). Distribution of out-of-pocket spending from prescription drug is less clear (Figure 3.9).

Table 3.1. Overview of sample selection by study

Study	Effects of informal care on caregivers' labor market outcomes			Effects of informal care on caregiver health
Sample name	Adult Child sample		Respondent sample	Respondent sample
	Younger Adult Child sample	Midlife Adult Child sample		
Source data	KLoSA respondents' children (*N*=20,156)		KLoSA respondents (≥ 45) (*N*=10,254)	
Exclusion criteria				
Age (# of dropped obs.)	If under 25 or unknown (3,088)	If 65 or older or unknown (221)	If 65 or older (4,155)	(Not applied)
Functional limitation (# of dropped obs.)	(Not applied)	(Not applied)	(Not applied)	If any ADL limitation (488)
Missing values for other study variables (# of dropped obs.)	(65)		(5)	(12)
Study sample used	25 ≤ Age < 44 Total: 11,146 Male: 5,776 Female: 5,370	45 ≤ Age < 65 Total: 5,636 Male: 2,910 Female: 2,726	45 ≤ Age < 65 Total: 6,094 Male: 2,728 Female: 3,366	45 ≤ Age Total: 9,754

Note: Korean Longitudinal Study of Aging (2006)

Table 3.2. Overview of key variables by study

Study	Effects of informal care on caregivers' labor market outcomes			Effects of informal care on caregiver health
Sample name	Younger Adult Child sample	Midlife Adult Child sample	Respondent sample	Respondent sample
Dependent variable	Labor force participation (LFP)		Six labor market outcomes	Six groups of caregiver health outcomes
Key independent variable	Continuous variable of logged weekly informal care hours Dummy variables: Less intensive care & More intensive care (ref. No care)			
Source of identifying instrumental variables	ADL/IADL limitations of parents		ADL limitations of family members	

Table 3.3. Dependent variables in the study of labor market outcomes

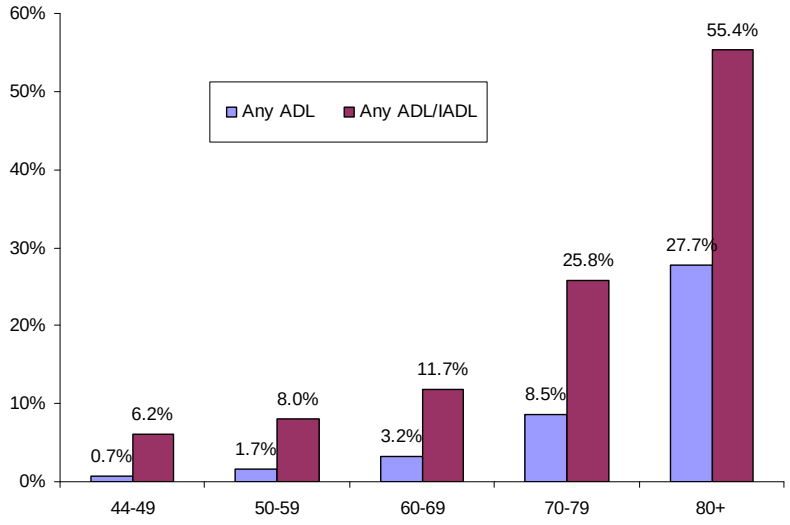
Adjustments	Adult Child sample	Respondent sample		
Extensive margin (y=1 if yes, =0 if no)	**Labor force participation**	**Any work**	**Any paid work**	**Any employed work**
Definition	Working for the purpose of bringing in income	Employed	Employed	Employed
		Self-employed	Self-employed	-
		Unpaid family worker	-	-
Intensive margin (ln(y),conditional)	Not available	**Weekly hours worked**	**Monthly income earned**	**Hourly wage rate**

Table 3.4. Health outcomes in the study of caregiver health effects

Outcomes studied in the literature	Caregiver health outcomes available in the KLoSA (2006)	Variable type
Enduring outcomes (Schultz, 1990)		
Symptom reports		
Depression	Depressive symptoms (CES-D)	10-item list
Anxiety	N/A	
Anger	N/A	
Fatigue	N/A	
Poor health	Self-rated health	5-scale ordinal
Pre-clinical disease		
Hypertension	(Available, but not used)	
Blood Measures	N/A	
Clinical chemistries		
Lipids		
Atherosclerosis	N/A	
Pulmonary function	N/A	
Compromised immune function	N/A	
Clinical disease		
Depression	Feeling depressed for two weeks or more during the past year or being on anti-depressant medication	Binary
Infectious disease	N/A	
Heart disease	(Available, but not used)	
Health Care Utilization		
Drugs	Regular prescription drug use	
	Any use	Binary
	Out-of-pocket costs if any	Continuous
Health care services	Outpatient care use (including oriental clinic use)	
	Any use	Binary
	Out-of-pocket costs if any	Continuous
Life satisfaction (Haley *et al*., 1987)		
Life satisfaction	Satisfaction with quality of life	Continuous
	Satisfaction with health	Continuous
Somatization (Pang, 2000; Yong and McCallion, 2003)		
Body pain	Pain affecting daily activities	Binary

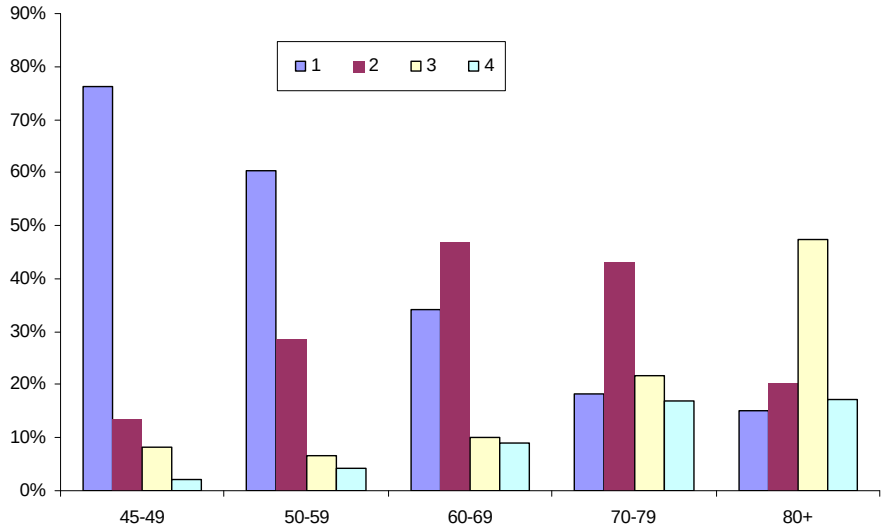
Note: N/A=not available in the KLoSA, thus not used in the present study

Figure 3.1. Proportion of adults with functional limitations by age group



Data: KLoSA (2006) respondents, weighted.

Figure 3.2. Distribution of marital and co-residential status by age group



Data: KLoSA (2006) respondents, weighted. (% within age group)
1: Married and co-residing with any other household member; 2: Living with spouse;
3: Living with at least one non-spouse family member; 4: Single-person household

Table 3.5. Marital/co-residential status and informal care for elderly with any ADL limitation

Age group	60-69	70-79	80+	Total
Living with spouse	79.3%	61.2%	34.6%	57.1%
Living with non-spouse family member	44.5%	52.8%	73.0%	57.7%
Received any informal care in the past month	76.8%	85.4%	89.0%	85.5%

Notes: KLoSA (2006) respondents aged 60 or older, weighted. Responses are not mutually exclusive.

Table 3.6. Quartile distribution of calculated weekly care hours among parental caregivers in the Adult Child sample

	25 percentile	Median	75 percentile
Calculated weekly care hours	0.46	2.30	6.90

Notes: KLoSA (2006) respondents' adult children aged 25-44 who were reported to provide any parental care in the past month (*n*=448, 2.73% of 16,399), unweighted.

Table 3.7. Categorization of care intensity among parental caregivers using different cutoff points in the Adult Child sample

	Less intensive care	More intensive care
Panel A: cutoff at 5 hours per week	***Less than 5 hours***	***5 hours or more***
Number of observations	311	137
Calculated weekly care hours	[0.23, 0.92, 2.30]	[6.9, 13.8, 27.6]
Panel B: cutoff at 7.5 hours per week	***Less than 7.5 hours***	***7.5 hours or more***
Number of observations	354	94
Calculated weekly care hours	[0.46, 1.2, 3.5]	[13.8, 20.7, 35.7]
Panel C: cutoff at 10 hours per week	***Less than 10 hours***	***10 hours or more***
Number of observations	366	82
Calculated weekly care hours	[0.46, 1.3, 4.6]	[13.8, 20.7, 46.1]

Notes: KLoSA (2006) respondents' adult children aged 25-44 who were reported to provide any parental care in the past month (*n*=448, 2.73% of 16,399), unweighted. Brackets contain 25 percentile, median, and 75 percentile within each category.

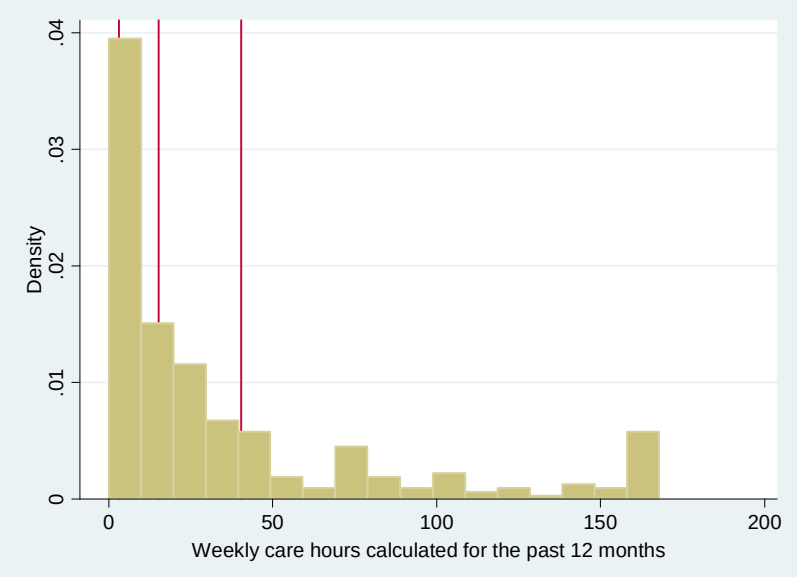
Table 3.8. Quartile distribution of calculated weekly care hours and elements among caregivers in the Respondent sample

	25 percentile	Median	75 percentile
Calculated weekly care hours	3.23	15.23	40.38
Reported care hours per week	10	21	70
Reported number of weeks in past 12 months	20	52	52

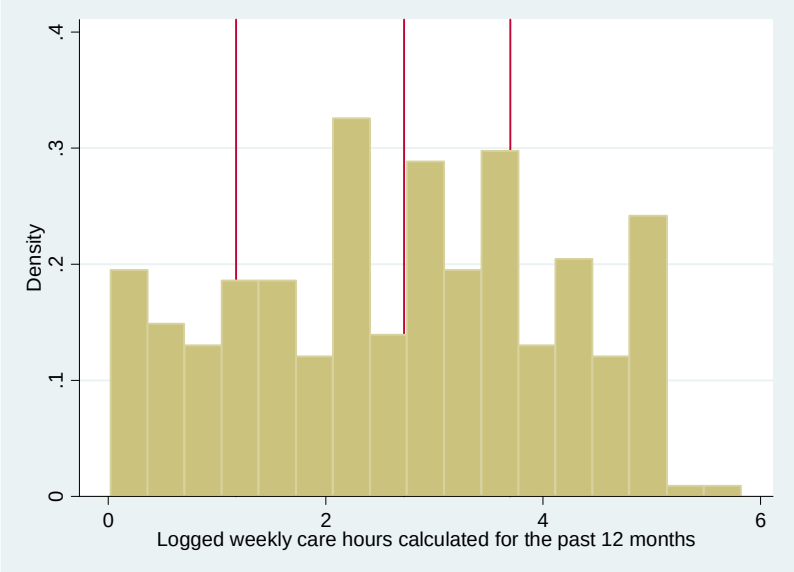
Notes: KLoSA (2006) respondents who reported providing any informal care in the past 12 months (*n*=315, 3.07% of the total KLoSA sample), unweighted.

Figure 3.3. Histogram of weekly care hours calculated for the past 12 months

(a) Unlogged hours of informal care

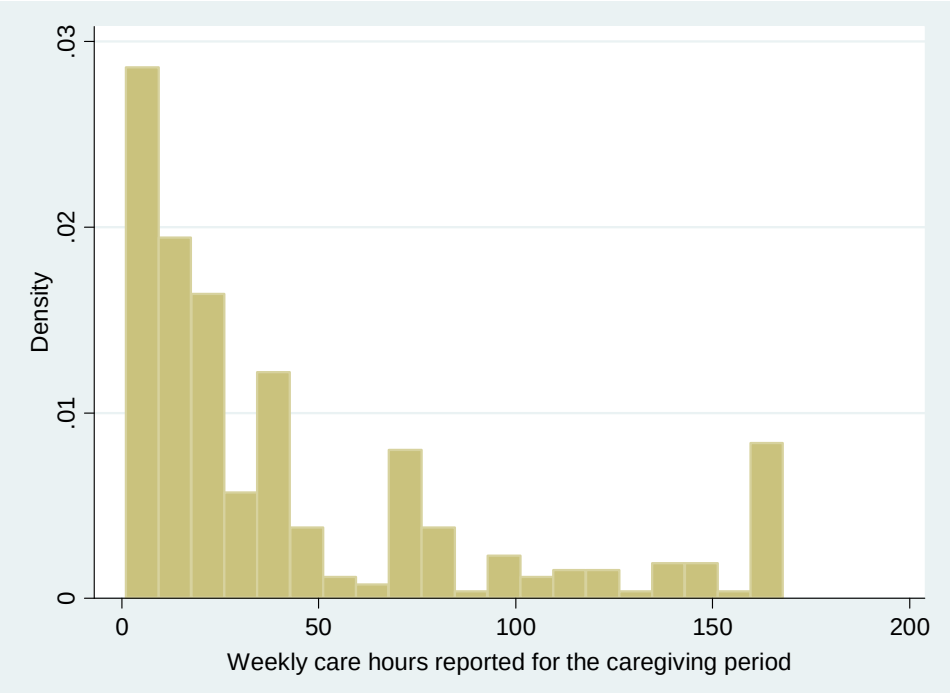


(b) Logged hours of informal care



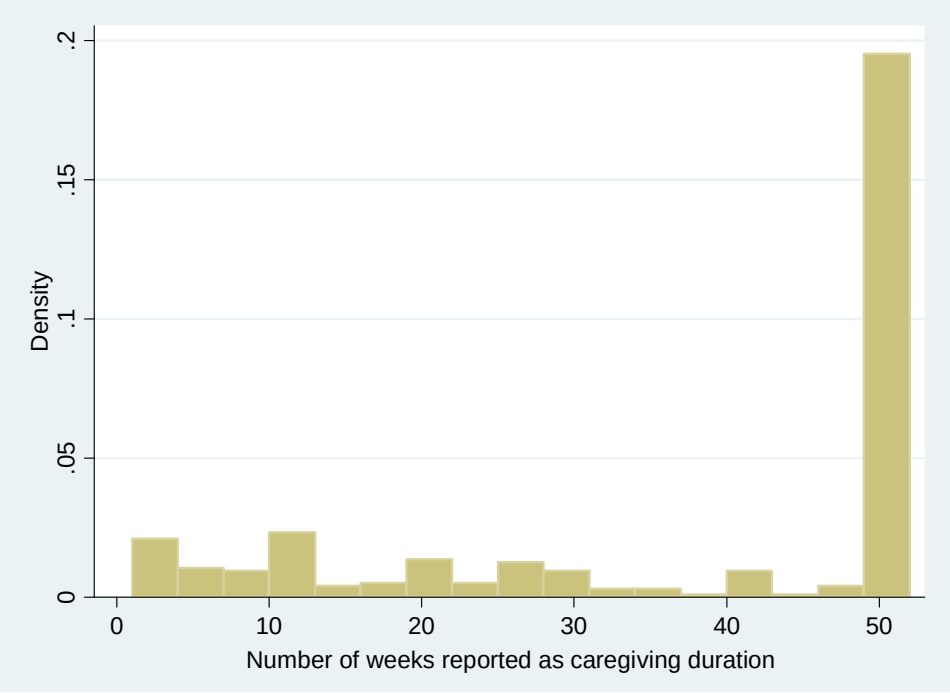
Notes: KLoSA (2006) respondents who reported providing any informal care in the past 12 months (*n*=315, 3.07% of the total KLoSA sample). Three lines show 25 percentile, median, and 75 percentile.

Figure 3.4. Histogram of weekly care hours reported for the caregiving period



Note: KLoSA (2006) respondents who reported providing any informal care in the past 12 months (*n*=315, 3.07% of the total KLoSA sample).

Figure 3.5. Histogram of number of weeks reported as caregiving duration



Note: KLoSA (2006) respondents who reported providing any informal care in the past 12 months (*n*=315, 3.07% of the total KLoSA sample).

Table 3.9. Categorization of care intensity among caregivers using different cutoff points

	Less intensive care	More intensive care
Panel A: cutoff at 5 hours per week	***Less than 5 hours***	***5 hours or more***
Number of observations	93	222
Calculated weekly care hours (hours)	[0.6, 1.5, 2.9]	[14, 28, 70]
Reported weekly hours cared (hours)	[2, 5, 10]	[20, 35, 84]
Reported number of weeks cared (weeks)	[4, 12, 26]	[52, 52, 52]
Cared for more than one person (%)	8.60	13.96
Panel B: cutoff at 10 hours per week	***Less than 10 hours***	***10 hours or more***
Number of observations	123	192
Calculated weekly care hours (hours)	[0.8, 2.2, 4.8]	[20, 35, 76.7]
Reported weekly hours cared (hours)	[3, 7, 13]	[20.5, 40, 90.5]
Reported number of weeks cared (weeks)	[7, 16, 42]	[52, 52, 52]
Cared for more than one person (%)	12.20	12.50
Panel C: cutoff at 15 hours per week	***Less than 15 hours***	***15 hours or more***
Number of observations	154	161
Calculated weekly care hours (hours)	[1.1, 3.1, 7.7]	[22.2, 40, 92.3]
Reported weekly hours cared (hours)	[4, 10, 14]	[30, 60, 102]
Reported number of weeks cared (weeks)	[10, 24, 52]	[52, 52, 52]
Cared for more than one person (%)	11.69	13.04
Panel D: cutoff at 20 hours per week	***Less than 20 hours***	***20 hours or more***
Number of observations	170	145
Calculated weekly care hours (hours)	[1.3, 3.9, 10]	[30, 48.5, 100]
Reported weekly hours cared (hours)	[4, 10, 18]	[35, 70, 114]
Reported number of weeks cared (weeks)	[10, 25, 52]	[52, 52, 52]
Cared for more than one person (%)	11.18	13.79

Notes: KLoSA (2006) respondents who reported providing any informal care in the past 12 months (n=315, 3.07% of the total Respondent sample). Brackets contain 25 percentile, median, and 75 percentile within each category.

Table 3.10. Informal care and labor force participation rates in the Adult Child sample, by gender and parental ADL/IADL status

	Male			Female		
Any ADL/IADL limitation of parents?	No	Yes	*p* value	No	Yes	*p* value
Panel A: Younger Adult Child sample (aged 25-44)						
Number of observations	4,760	1,038		4,382	1,008	
Parental informal care						
Provided any parental care (%)	0.0	9.8	**<0.001**	0.0	10.3	**<0.001**
Categorization of care intensity						
No parental care (%)	100.0	90.2		100.0	89.7	
Less than 5 hours per week (%)	0.0	7.9	**<0.001**	0.0	7.2	**<0.001**
More than 5 hours per week (%)	0.0	1.9		0.0	3.1	
Labor force participation rate (%)	82.7	85.3	**0.044**	45.1	37.1	**<0.001**
Panel B: Midlife Adult Child sample (aged 45-64)						
Number of observations	1,821	1,098		1,672	1,068	
Parental informal care						
Provided any parental care (%)	0.0	14.3	**<0.001**	0.0	8.0	**<0.001**
Categorization of care intensity						
No parental care (%)	100.0	85.7		100.0	92.0	
Less than 5 hours per week (%)	0.0	9.6	**<0.001**	0.0	4.8	**<0.001**
More than 5 hours per week (%)	0.0	4.7		0.0	3.2	
Labor force participation rate (%)	86.1	86.7	0.667	30.9	23.1	**<0.001**

Notes: KLoSA (2006) respondents' adult children aged 25-64, unweighted.

Table 3.11. Informal care and labor market outcomes in the Respondent sample, by gender and family member ADL status

	Male			Female		
Any ADL limitation of family member?	No	Yes	*p* value	No	Yes	*p* value
Number of observations	2,559	171	-	3,150	219	-
Informal care						
Provided any informal care (%)	0.4	28.1	**<0.001**	1.6	31.1	**<0.001**
Categorization of care intensity						
No informal care (%)	99.6	71.9		98.4	68.9	
Less than 10 hours per week (%)	0.2	16.4	**<0.001**	0.4	17.4	**<0.001**
More than 10 hours per week (%)	0.2	11.7		1.2	13.7	
Labor market outcomes						
Any work (%)	74.8	77.8	0.377	34.4	40.2	0.085
Weekly work hours (hours)	48.7	49.0	0.841	48.9	46.1	0.202
Any paid work (%)	73.9	76.6	0.440	28.5	34.2	0.072
Monthly income (10K KRW)	222.2	200.7	0.419	108.4	96.9	0.268
Any employed work (%)	40.1	37.4	0.497	17.5	20.5	0.247
Hourly wage rate (10K KRW)	1.26	1.54	**0.026**	0.61	0.57	0.680

Notes: KLoSA (2006) respondents aged 45-64, unweighted.

Table 3.12. Informal care, health outcomes and other characteristics, by parental ADL status

Any ADL limitation of parent-in-law or parent?	No (n=9,473)	Yes (n=291)	*p* value
Informal care			
Provided no informal care	98.1%	60.8%	
Provide care less than 10 hrs week (1=yes, 0=no)	0.6%	19.6%	**<0.001**
Provide care 10 hrs or more per week (1=yes, 0=no)	1.3%	19.6%	
Outcome measures			
Satisfaction with health and quality of life			
Score of satisfaction with QOL (0-100)	62.2	62.6	0.605
Score of satisfaction with health (0-100)	57.1	59.5	0.407
Depressive symptomatology			
Feeling depressed for two weeks or more during the past year or being on anti-depressant medication (1=yes, 0=no)	11.1%	13.1%	0.284
[a]CES-D score (0-30)	7.2	7.0	0.298
[a]CES-D number of items checked ≥ 4 (1=yes, 0=no)	37.8%	36.3%	0.610
[a]CES-D score ≥ 10 (1=yes, 0=no)	20.8%	19.0%	0.455
Body pain			
Having pain affecting daily activities (1=yes, 0=no)	25.0%	22.7%	0.372
Self-rated health			
Ordered categories			
1 *Excellent*	2.1%	2.8%	
2 *Very good*	11.1%	12.7%	
3 *Good*	35.7%	35.4%	0.837
4 *Fair*	27.8%	26.1%	
5 *Poor*	23.3%	23.0%	
Fair to *poor* (1=yes, 0=no)	51.0%	49.1%	0.528
Outpatient care use			
Any outpatient care use in the past 12 months (1=yes, 0=no)	62.3%	66.7%	0.133
Total out-of-pocket costs for outpatient care if any	24.4	24.0	0.983
Prescription drug use			
Any regular prescription drug use in the past 12 months (1=yes, 0=no)	41.0%	35.7%	0.074
Total out-of-pocket costs for drugs use if any	33.0	33.9	0.932
Other explanatory variable			
Female (1=yes, 0=no)	56.4%	55.3%	0.718
Age (year)	61.2	55.1	**<0.001**
Currently married (1=yes, 0=no)	78.6%	83.8%	**0.032**
Education			
Elementary school (1=yes, 0=no)	46.1%	30.6%	
Middle school (1=yes, 0=no)	16.5%	18.2%	**<0.001**
High school (1=yes, 0=no)	27.0%	35.4%	
College or higher (1=yes, 0=no)	10.4%	15.8%	
Total assets quintile (1: lowest, 5: highest)			
Quintile 1 (1=yes, 0=no)	19.5%	18.6%	
Quintile 2 (1=yes, 0=no)	20.1%	21.3%	
Quintile 3 (1=yes, 0=no)	20.3%	16.2%	0.205
Quintile 4 (1=yes, 0=no)	20.1%	19.2%	
Quintile 5 (1=yes, 0=no)	20.0%	24.7%	

Owns a house (1=yes, 0=no)	77.1%	74.2%	0.252
Medical security			
Statutory			
National Health Insurance (1=yes, 0=no)	94.4%	94.9%	
MedicalAid Type 1 (1=yes, 0=no)	3.4%	2.4%	0.542
MedicalAid Type 2 (1=yes, 0=no)	2.2%	2.7%	
Voluntary private health insurance (1=yes, 0=no)	33.1%	49.5%	**<0.001**
Disability and health condition indicator			
Disability diagnosed	5.3%	7.2%	0.155
Hypertension diagnosed	26.8%	24.1%	0.290
Diabetes diagnosed	11.7%	8.2%	0.072
Cancer diagnosed	2.3%	2.7%	0.599
Chronic lung disease diagnosed	2.2%	1.0%	0.187
Liver disease diagnosed	1.5%	3.4%	**0.011**
Heart disease diagnosed	4.6%	4.8%	0.881
Stroke diagnosed	2.4%	2.7%	0.699
Psychiatric problem diagnosed	2.0%	2.1%	0.905
Arthritis diagnosed	16.1%	12.0%	0.063
Injured due to traffic accident	9.3%	12.0%	0.116
Fall in the last two years	3.7%	5.5%	0.106
Prostate disease diagnosed	2.6%	2.7%	0.863
Urinary incontinence experienced	8.5%	10.3%	0.279

Notes: KLoSA (2006) respondents, excluding persons with any ADL limitation, unweighted. [a]The number of observations used is fewer because these questions excluded people who chose "Did not feel depressed because I was taking anti-depressant medication" in the first question on depressive symptomatology.

Table 3.13. Labor force participation rates in the Adult Child sample, by gender and care intensity

	Male			Female		
Panel A: No care vs. any care hour	*None*	*Any*		*None*	*Any*	
Younger Adult Children, LFP rate (%)	83.2	82.4		43.6	41.3	
Midlife Adult Children, LFP rate (%)	86.6	82.2		27.8	31.8	
Panel B: cutoff at 5 hours per week	*None*	*Less*	*More*	*None*	*Less*	*More*
Younger Adult Children, LFP rate (%)	83.2	85.4	70.0	43.6	46.6	29.0
Midlife Adult Children, LFP rate (%)	86.6	83.8	78.8	27.8	29.4	35.3
Panel D: cutoff at 10 hours per week	*None*	*Less*	*More*	*None*	*Less*	*More*
Younger Adult Children, LFP rate (%)	83.2	85.7	54.5	43.6	44.7	26.3
Midlife Adult Children, LFP rate (%)	86.6	85.6	64.0	27.8	32.8	29.6

Notes: KLoSA (2006) respondents' adult children aged 25-64, unweighted.

Table 3.14. Labor market outcomes in the Respondent sample, by gender and care intensity

	Male			Female		
Panel A: No care vs. any care hour	*None*	*Any*		*None*	*Any*	
Any work (%)	75.1	67.8		35.0	29.7	
Weekly work hours, hours (mean)	49	51		49	46	
Any paid work (%)	74.3	66.1		28.9	27.1	
Monthly income, 10K KRW (mean)	221	226		109	73	
(median)	200	170		90	58	
Any employed work (%)	40.0	33.9		17.8	15.3	
Hourly wage rate, 10K KRW (mean)	1.26	1.81		0.61	0.45	
(median)	1.00	1.76		0.45	0.38	
Panel B: cutoff at 10 hours per week	*None*	*Less*	*More*	*None*	*Less*	*More*
Any work (%)	75.1	78.8	53.8	35.0	42.0	20.6
Weekly work hours, hours (mean)	49	53	47	49	44	50
Any paid work (%)	74.3	78.8	50.0	28.9	40.0	17.6
Monthly income, 10K KRW (mean)	221	244	190	109	68	82
(median)	200	200	150	90	58	62
Any employed work (%)	40.0	36.4	30.8	17.8	24.0	8.8
Hourly wage rate, 10K KRW (mean)	1.26	1.98	1.55	0.61	0.47	0.41
(median)	1.00	2.14	1.37	0.45	0.36	0.39
Panel C: cutoff at 20 hours per week	*None*	*Less*	*More*	*None*	*Less*	*More*
Any work (%)	75.1	73.2	55.6	35.0	38.2	18.0
Weekly work hours, hours (mean)	49	53	45	49	46	47
Any paid work (%)	74.3	73.2	50.0	28.9	33.8	18.0
Monthly income, 10K KRW (mean)	221	233	202	109	69	84
(median)	200	200	100	90	55	70
Any employed work (%)	40.0	34.1	33.3	17.8	19.1	10.0
Hourly wage rate, 10K KRW (mean)	1.26	1.89	1.61	0.61	0.46	0.42
(median)	1.00	1.76	1.54	0.45	0.35	0.44

Notes: KLoSA (2006) respondents aged 45-64, weighted. KRW is Korean Won.

Table 3.15. Summary statistics of the Younger Adult Child sample, by gender

Variables	Male (*N*=5,776)		Female (*N*=5,370)	
	Mean/Freq, SD/%		Mean/Freq, SD/%	
Labor force participation (1=yes, 0=no)	4,805	83.2%	2,344	43.6%
Informal care (provided to own parents)				
Any informal care (1=yes, 0=no)	102	1.8%	104	1.9%
Weekly care hours if any	7.4	25.0	10.8	29.9
Parent(s)' functional limitations				
Any ADL/IADL limitation (1=yes, 0=no)	1,030	17.8%	1,007	18.8%
ADL limitations sum (number:0-14)	0.2	1.0	0.2	1.0
Any ADL limitation (1=yes, 0=no)	302	5.2%	305	5.7%
IADL limitations: 0 (1=yes, 0=no)	1,008	17.5%	979	18.2%
IADL limitations: 1-4 (1=yes, 0=no)	716	12.4%	699	13.0%
IADL limitations: 5-20 (1=yes, 0=no)	292	5.1%	280	5.2%
Co-residence with parent(s) (1=yes, 0=no)	1,586	27.5%	895	16.7%
Sibling characteristics				
Number of brothers	1.2	1.0	1.4	0.9
Number of sisters	1.3	1.2	1.5	1.3
Being eldest son in family (1=yes, 0=no)	2,963	51.3%	-	-
Other child characteristics				
Age (year)	35.2	5.5	35.1	5.6
Education				
Less than middle school (1=yes, 0=no)	79	1.4%	158	2.9%
Any middle school (1=yes, 0=no)	246	4.3%	309	5.8%
Any high school (1=yes, 0=no)	2,024	35.0%	2,405	44.8%
Any college (1=yes, 0=no)	3,219	55.7%	2,377	44.3%
Any graduate school (1=yes, 0=no)	208	3.6%	121	2.3%
Marital status				
Currently married (1=yes, 0=no)	3,372	58.4%	3,934	73.3%
Widow/separated/divorced (1=yes, 0=no)	141	2.4%	108	2.0%
Never married (1=yes, 0=no)	2,263	39.2%	1,328	24.7%
Owns a house (1=yes, 0=no)	1,635	28.3%	798	14.9%
Number of own children	1.0	1.0	1.3	1.0
Other parental characteristics				
Currently married (1=yes, 0=no)	4,064	70.4%	3,764	70.1%
At least middle school (1=yes, 0=no)	2,940	50.9%	2,774	51.7%
Owns a house (1=yes, 0=no)	4,576	79.2%	4,268	79.5%
Total assets quintile (1: lowest, 5: highest)				
Quintile 1 (1=yes, 0=no)	1,152	19.9%	1,056	19.7%
Quintile 2 (1=yes, 0=no)	1,500	26.0%	1,361	25.3%
Quintile 3 (1=yes, 0=no)	1,235	21.4%	1,114	20.7%
Quintile 4 (1=yes, 0=no)	976	16.9%	963	17.9%
Quintile 5 (1=yes, 0=no)	913	15.8%	876	16.3%
Region				
Seoul Metropolitan City (1=yes, 0=no)	873	15.1%	802	14.9%
Non-Seoul Metropolitan (1=yes, 0=no)	1,644	28.5%	1,478	27.5%
Provincial (1=yes, 0=no)	3,259	56.4%	3,090	57.5%

Note: KLoSA (2006) respondents' adult children aged 25-44, unweighted.

Table 3.16. Summary statistics of the Midlife Adult Child sample, by gender

Variables	Male (*N*=2,910)		Female (*N*=2,726)	
	Mean/Freq, SD/%		Mean/Freq, SD/%	
Labor force participation (1=yes, 0=no)	2,512	86.3%	757	27.8%
Informal care (provided to own parents)				
Any informal care (1=yes, 0=no)	157	5.4%	84	3.1%
Weekly care hours if any	7.7	14.00	14.5	32.8
Parent(s)' functional limitations				
Any ADL/IADL limitation (1=yes, 0=no)	1,098	37.7%	1,064	39.0%
ADL limitations sum (number: 0-14)	0.7	1.9	0.7	1.8
Any ADL limitation (1=yes, 0=no)	464	15.9%	464	17.0%
IADL limitations: 0 (1=yes, 0=no)	1,088	37.4%	1,046	38.4%
IADL limitations: 1-4 (1=yes, 0=no)	532	18.3%	499	18.3%
IADL limitations: 5-20 (1=yes, 0=no)	556	19.1%	547	20.1%
Co-residence with parent(s) (1=yes, 0=no)	611	21.0%	122	4.5%
Sibling characteristics				
Number of brothers	1.8	1.2	2.0	1.1
Number of sisters	1.8	1.3	2.1	1.5
Being eldest son in family (1=yes, 0=no)	1,612	55.4%	-	-
Other child characteristics				
Age (year)	51.0	4.9	50.8	4.8
Education				
Less than middle school (1=yes, 0=no)	360	12.4%	646	23.7%
Any middle school (1=yes, 0=no)	399	13.7%	541	19.8%
Any high school (1=yes, 0=no)	1,214	41.7%	1,141	41.9%
Any college (1=yes, 0=no)	865	29.7%	385	14.1%
Any graduate school (1=yes, 0=no)	72	2.5%	13	0.5%
Marital status				
Currently married (1=yes, 0=no)	2,659	91.4%	2,499	91.7%
Widow/separated/divorced (1=yes, 0=no)	148	5.1%	162	5.9%
Never married (1=yes, 0=no)	103	3.5%	65	2.4%
Owns a house (1=yes, 0=no)	1,930	66.3%	785	28.8%
Number of own children	2.0	0.9	2.1	0.9
Other parental characteristics				
Currently married (1=yes, 0=no)	1,105	38.0%	1,048	38.4%
At least middle school (1=yes, 0=no)	631	21.7%	576	21.1%
Owns a house (1=yes, 0=no)	2,237	76.9%	2,025	74.3%
Total assets quintile (1: lowest, 5: highest)				
Quintile 1 (1=yes, 0=no)	685	23.5%	742	27.2%
Quintile 2 (1=yes, 0=no)	749	25.7%	700	25.7%
Quintile 3 (1=yes, 0=no)	500	17.2%	453	16.6%
Quintile 4 (1=yes, 0=no)	462	15.9%	399	14.6%
Quintile 5 (1=yes, 0=no)	514	17.7%	432	15.8%
Region				
Seoul Metropolitan City (1=yes, 0=no)	452	15.5%	406	14.9%
Non-Seoul Metropolitan (1=yes, 0=no)	753	25.9%	714	26.2%
Provincial (1=yes, 0=no)	1,705	58.6%	1,606	58.9%

Note: KLoSA (2006) respondents' adult children aged 45-64, unweighted.

Table 3.17. Summary statistics of the Respondent sample, by gender

Variables	Male (*N*=2,728)		Female (*N*=3,366)	
	Mean/Freq, SD/%		Mean/Freq, SD/%	
Labor market outcomes				
Any work (1=yes, 0=no)	2,035	74.9%	1,169	34.8%
Weekly hours worked if any	48.7	16.8	48.7	19.6
Any paid work (1=yes, 0=no)	1,950	74.1%	951	28.9%
Monthly income (10K Korean Won) if any	220.8	291.4	107.4	85.6
Any employed work (1=yes, 0=no)	1,044	38.3%	582	17.3%
Hourly wage rate (10K Korean Won) if any	1.27	1.00	0.61	0.56
Informal care				
Any informal care (1=yes, 0=no)	59	2.2%	118	3.5%
Informal care hours per week if any	20.0	33.3	36.6	49.3
Provide care less than 10 hrs week (1=yes, 0=no)	33	55.9%	50	42.4%
Provide care 10 hrs or more per week (1=yes, 0=no)	26	44.1%	68	57.6%
Provide care less than 15 hrs week (1=yes, 0=no)	38	64.4%	62	52.5%
Provide care 15 hrs or more per week (1=yes, 0=no)	21	35.6%	56	47.5%
Provide care less than 20 hrs week (1=yes, 0=no)	41	69.5%	68	57.6%
Provide care 20 hrs or more per week (1=yes, 0=no)	18	30.5%	50	42.4%
Parent(s)' functional limitations				
Parent(s)'s ADL limitation (1=yes, 0=no)	96	3.5%	97	2.9%
Parent(s)-in-law's ADL limitation (1=yes, 0=no)	17	0.6%	42	1.2%
Sibling or relatives' ADL limitation (1=yes, 0=no)	60	2.2%	83	2.5%
Co-residence with parent(s) (1=yes, 0=no)	470	17.2%	368	10.9%
Other own characteristics				
Age (year)	54.1	5.8	53.9	5.9
Currently married (1=yes, 0=no)	2,531	92.8%	2,837	84.3%
Education				
Elementary school (1=yes, 0=no)	505	18.5%	1,299	38.6%
Middle school (1=yes, 0=no)	510	18.7%	739	22.0%
High school (1=yes, 0=no)	1,127	41.3%	1,079	32.1%
College (1=yes, 0=no)	586	21.5%	249	7.4%
Total assets quintile (1: lowest, 5: highest)				
Quintile 1 (1=yes, 0=no)	455	16.7%	617	18.3%
Quintile 2 (1=yes, 0=no)	438	16.1%	606	18.0%
Quintile 3 (1=yes, 0=no)	570	20.9%	692	20.6%
Quintile 4 (1=yes, 0=no)	648	23.8%	731	21.7%
Quintile 5 (1=yes, 0=no)	617	22.6%	720	21.4%
Owns a house (1=yes, 0=no)	2,108	77.3%	2,572	76.4%
Disability (1=yes, 0=no)	207	7.6%	121	3.6%
Poor self-rated health (1=yes, 0=no)	409	15.0%	781	23.2%
Other parental characteristics				
Both parents live together (1=yes, 0=no)	266	9.8%	388	11.5%
Parent(s) owns a house (1=yes, 0=no)	466	17.1%	593	17.6%
Parent(s) no formal education (1=yes, 0=no)	1,317	48.3%	1,658	49.3%

Notes: KLoSA (2006) respondents aged 45-64, unweighted.

Table 3.18. Summary statistics of the Respondent sample, by potential/actual caregiver status

Potential/actual caregiver status	Non-caregiver without family ADL limitation (n=8,983)	Non-caregiver with any family ADL limitation (n=474)	Caregiver (n=297)
Outcome variable			
Satisfaction with health and quality of life			
Score of satisfaction with QOL (0-100)	62.58	59.87	56.33
Score of satisfaction with health (0-100)	57.55	53.67	52.49
Depressive symptomatology			
Feeling depressed for two weeks or more during the past year or being on anti-depressant medication (1=yes, 0=no)	10.6%	17.3%	16.5%
[a]CES-D score (0-30)	7.16	7.70	8.34
[a]CES-D number of items checked ≥ 4 (1=yes, 0=no)	37.1%	42.1%	52.2%
[a]CES-D score ≥ 10 (1=yes, 0=no)	20.2%	25.8%	30.6%
Body pain			
Having pain affecting daily activities (1=yes, 0=no)	24.0%	34.6%	35.7%
Self-rated health			
Ordered categories			
1 *Excellent*	2.2%	1.1%	2.7%
2 *Very good*	11.4%	8.2%	10.1%
3 *Good*	36.5%	26.0%	28.3%
4 *Fair*	27.6%	29.3%	27.3%
5 *Poor*	22.3%	35.4%	31.7%
Fair to *poor* (1=yes, 0=no)	50.0%	64.8%	58.9%
Outpatient care use			
Any outpatient care use in the past 12 months (1=yes, 0=no)	62.0%	67.3%	67.7%
Total out-of-pocket costs for outpatient care if any	24.83	18.93	20.18
Prescription drug use			
Any regular prescription drug use in the past 12 months (1=yes, 0=no)	40.3%	47.0%	45.8%
Total out-of-pocket costs for drugs use if any	33.35	27.10	33.55
Informal care (Explanatory variable of main interest)			
Weekly hours of informal care	-	-	35.37
Provide care less than 10 hrs week (1=yes, 0=no)	-	-	38.7%
Provide care 10 hrs or more per week (1=yes, 0=no)	-	-	61.3%
Provide care less than 15 hrs week (1=yes, 0=no)	-	-	48.1%
Provide care 15 hrs or more per week (1=yes, 0=no)	-	-	51.9%
Provide care less than 20 hrs week (1=yes, 0=no)	-	-	53.5%
Provide care 20 hrs or more per week (1=yes, 0=no)	-	-	46.5%
ADL limitation of family member			
Spouse ADL limitation (1=yes, 0=no)	-	6.3%	38.0%
Father ADL (1=yes, 0=no)	-	8.2%	6.7%
Mother ADL (1=yes, 0=no)	-	22.6%	21.5%
Father-in-law ADL (1=yes, 0=no)	-	3.0%	3.4%
Mother-in-law ADL (1=yes, 0=no)	-	4.6%	10.4%
Sibling or other relative ADL (1=yes, 0=no)	-	47.0%	10.4%
Child's ADL limitation (1=yes, 0=no)	-	11.4%	11.8%
Other explanatory variable			
Female (1=yes, 0=no)	56.0%	59.3%	64.0%
Age (year)	61.1	60.3	62.0
Currently married (1=yes, 0=no)	78.6%	78.9%	84.2%

Education			
Elementary school (1=yes, 0=no)	45.5%	48.3%	47.1%
Middle school (1=yes, 0=no)	16.4%	17.9%	18.2%
High school (1=yes, 0=no)	27.5%	24.1%	24.2%
College or higher (1=yes, 0=no)	10.6%	9.7%	10.4%
Total assets quintile (1: lowest, 5: highest)			
Quintile 1 (1=yes, 0=no)	19.2%	21.1%	23.6%
Quintile 2 (1=yes, 0=no)	20.0%	22.8%	20.5%
Quintile 3 (1=yes, 0=no)	20.3%	18.1%	19.9%
Quintile 4 (1=yes, 0=no)	20.3%	19.0%	16.5%
Quintile 5 (1=yes, 0=no)	20.3%	19.0%	19.5%
Owns a house (1=yes, 0=no)	77.3%	74.5%	72.7%
Medical security			
Statutory			
National Health Insurance (1=yes, 0=no)	94.8%	92.1%	87.9%
MedicalAid Type 1 (1=yes, 0=no)	3.1%	4.9%	8.4%
MedicalAid Type 2 (1=yes, 0=no)	2.1%	3.0%	3.7%
Voluntary private health insurance (1=yes, 0=no)	33.4%	36.7%	33.7%
Disability and health condition indicator			
Disability diagnosed	5.3%	7.0%	6.1%
Hypertension diagnosed	26.5%	31.4%	27.3%
Diabetes diagnosed	11.6%	11.0%	10.4%
Cancer diagnosed	2.2%	2.5%	3.7%
Chronic lung disease diagnosed	2.1%	2.1%	2.0%
Liver disease diagnosed	1.5%	2.1%	3.0%
Heart disease diagnosed	4.5%	7.2%	6.1%
Stroke diagnosed	2.4%	3.2%	2.7%
Psychiatric problem diagnosed	1.9%	1.7%	3.4%
Arthritis diagnosed	15.5%	22.4%	18.9%
Injured due to traffic accident	9.0%	13.9%	12.5%
Fall in the last two years	3.5%	7.8%	5.7%
Prostate disease diagnosed	2.5%	3.6%	3.7%
Urinary incontinence experienced	8.2%	11.6%	14.8%

Notes: KLoSA (2006) respondents, excluding persons with any ADL limitation, unweighted. [a]The number of observations used is fewer because these questions excluded people who chose "Did not feel depressed because I was taking anti-depressant medication" in the first question on depressive symptomatology.

Figure 3.6. Distribution of score of satisfaction with quality-of-life by caregiver status

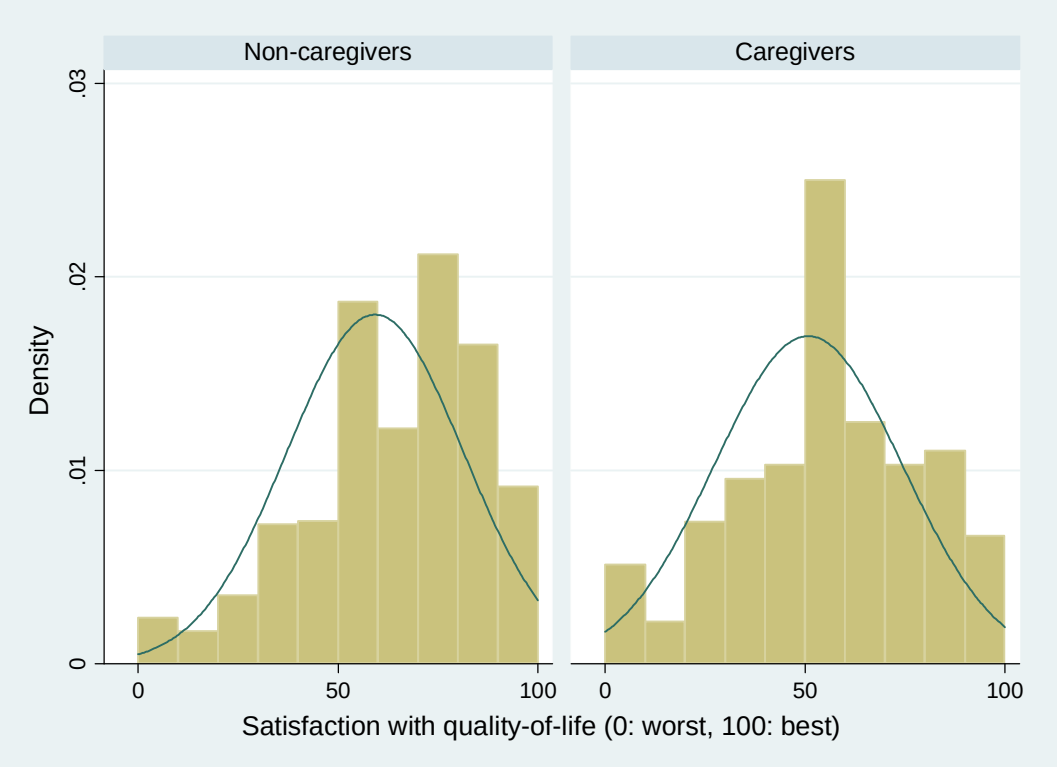


Figure 3.7. Distribution of self-rated health by caregiver status

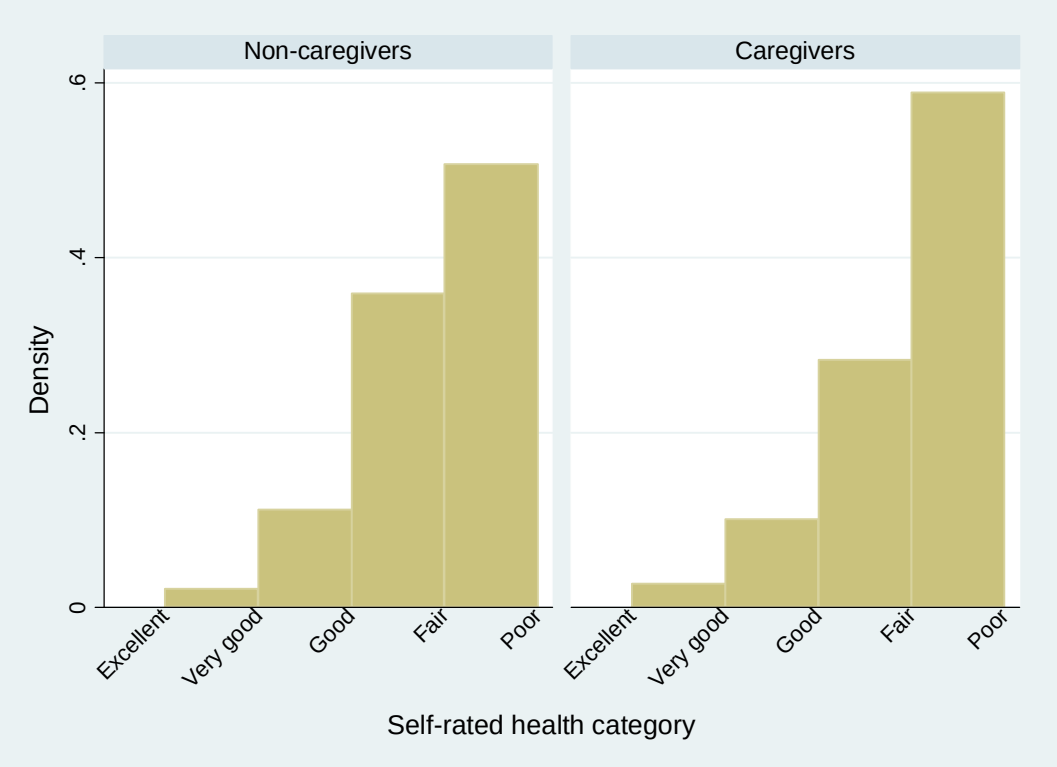


Figure 3.8. Distribution of CES-D score by caregiver status

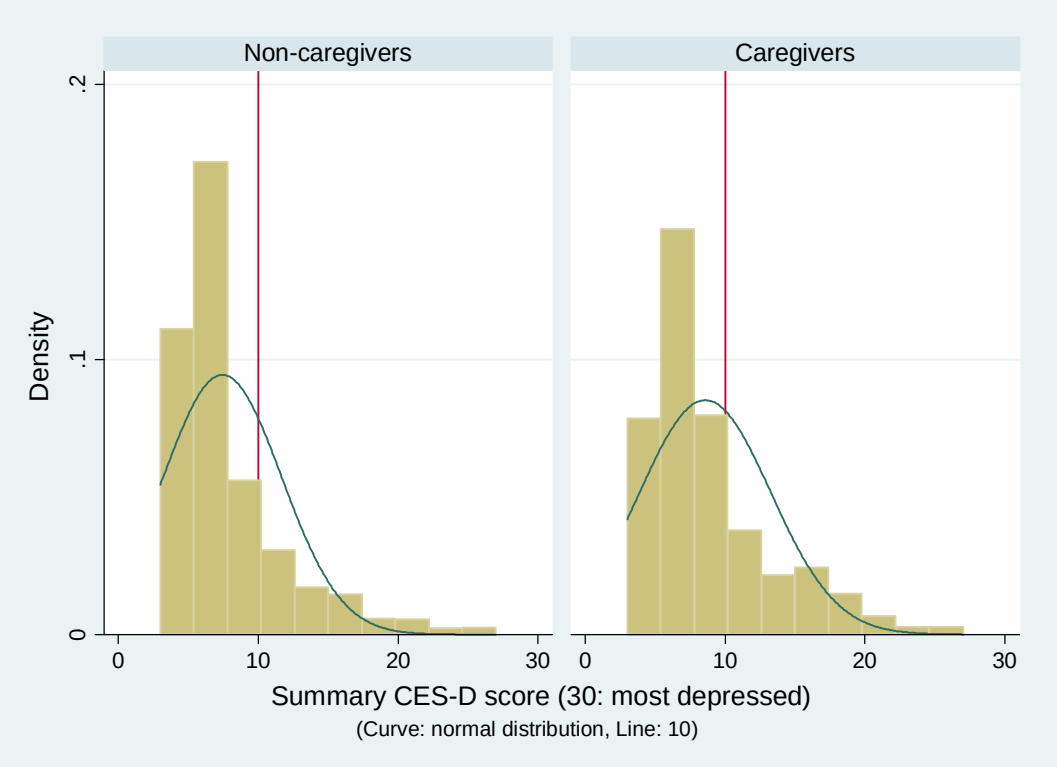
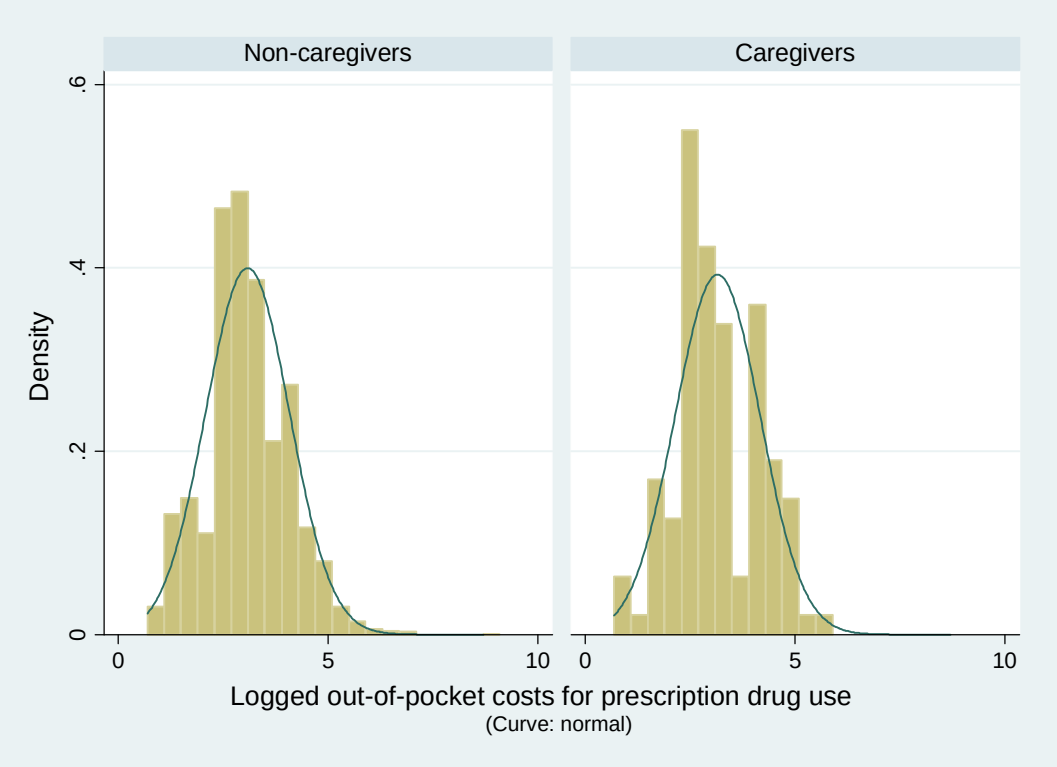


Figure 3.9. Distribution of log of out-of-pocket costs for prescription drug use if any



CHAPTER 4: RESEARCH DESIGN AND METHODS

Methods to Estimate Effects on Caregivers' Labor Market Outcomes

How to test the hypothesis

To test the hypothesis, I estimate the following model in general form by gender.

$$LMO_{si} = \beta IC_{si} + \gamma CORESIDE_{si} + \delta X_{si} + \mu_s + \varepsilon_{si} \qquad \text{Eq. (1)}$$

where subscript s denotes sibling group, subscript i individual, LMO_{si} labor market outcomes of individual i from a sibling group s, IC_{si} informal care, and $CORESIDE_{si}$ a binary variable of whether the adult child co-resides with his or her parent(s). IC_{si} may take on logged weekly hours of informal care or a set of two dummy variables for less intensive and more intensive care. X_{si} is a vector of other explanatory variables, μ_i sibling-group fixed effects, and ε_{si} the error term. This model estimates β, γ, and δ for respective variable(s). The coefficient of main interest is β. I test the hypothesis by checking the statistical significance of estimated coefficient(s) β.

Overview of the estimation strategy

The conceptual framework indicates that this statistical model may suffer from the identification problem for the following reasons. First, informal caregiving occurs more often among socially disadvantaged families, whose adult children have lower prospects for employment and thus are more likely to provide care. If the statistical

model cannot control for important family characteristics using a given set of control variables, informal caregiving is correlated with unobserved family characteristics.

$$Corr\,(IC_{si},\ \mu_s) \neq 0$$

Second, informal caregiving may be correlated with unobserved ability or employability at the individual level.

$$Corr\,(IC_{si}, \varepsilon_{si}) \neq 0$$

Third, an adult child's decision on co-residence is made jointly with his or her decision on work. Moreover, co-residing adult children may have different levels of employability to begin with.

$$Corr\,(CORESIDE_{si}, \varepsilon_{si}) \neq 0$$

I address these statistical issues in the following order. I first estimate a sibling-level fixed effects model of labor force participation. Because the Adult Child sample consists of siblings nested within each family that has the same parent(s), fixed effects estimation can exploit within-sibling group variation as identifying information (Norton and Van Houtven, 2006). However, this estimation depends on a rather strong assumption that, within each sibling group, caregiving responsibilities fall on one or more siblings in a random fashion. In other words, in a given family, informal care should be decided exogenously.

$$Corr\,(IC_{si}, \varepsilon_{si} \mid \mu_s) = 0$$

This assumption fails if family members make decisions on who provides care based on their ability or employability, which is not observable in the data. (This assumption still might be valid if parental caregiving responsibilities fall entirely on the eldest son and daughter-in-law.) To overcome this limitation, I made an attempt to

estimate an instrumental variable-fixed effects (IV-FE) model. For this estimation to be successful, identifying information must be available that predicts informal caregiving within each family. Unfortunately, family-level variables cannot be used in this way because such variables do not have any variation within families (thus, sibling groups). Moreover, most individual characteristics are likely correlated with unobserved ability or employability. Therefore, it is difficult to find valid IVs, particularly given that the Adult Child sample provides less detailed information for the individuals. One plausible possibility is to use geographic proximity between extra-residential daughters and their parents (Latif, 2006; Bolin *et al*., 2008). However, it should be acknowledged that geographic proximity may also be an endogenous child characteristic (Stern, 1995). Although it is less likely than in other societies for married daughters in South Korea to choose their location based on their work or parental care, it is still possible. Moreover, variables of geographic proximity were found to have very low explanatory power, precluding the use of IV-FE model. Therefore, I estimate the standard fixed effects model. In addition to the fixed effects logit model, I also estimate a linear probability model. Again, the results should be interpreted only tentatively depending on the assumption mentioned above.

The statistical model in Eq. (1) raises another major challenge for the empirical analysis because not only *IC* but also *CORESIDE* are potentially endogenous to *LMO*. The statistical model could be estimated validly if appropriate instruments were available that predict both *IC* and *CORESIDE* but do not directly affect *LMO*. Theoretically, such instrumental variables might be available from family-level (parent-level or sibling-level) characteristics because both informal caregiving and intergenerational co-residence are

just different forms of intergenerational relations to elderly parents. However, I do not estimate the model using an IV method for two endogenous explanatory variables for the following reasons. First, in many Korean extended families, co-residence may have long continued when informal caregiving occurs. In such cases, decisions on informal caregiving are made in the given living arrangement of intergenerational co-residence. Therefore, it would not make much sense to treat co-residence and informal caregiving as decisions that necessarily happen at the same time horizon in a given cross-sectional dataset. Second, this conceptual issue also leads to the difficulty of implementing an IV approach practically, because it is hard to find instrumental variables that have strong predictive power for *both* co-residence and informal caregiving. In fact, when both sibling-level and parent-level variables were included in the first-stage models of co-residence and informal caregiving, sibling-level variables (*e.g*., number of brothers, number of sisters, and being the eldest son in the family) showed strong predictive power for co-residence but only weak associations for informal caregiving. By contrast, parent-level variables (*e.g.*, parents' ADL or IADL limitations) were found to be strong predictors for informal caregiving but not for co-residence.

As an alternative approach, I follow a staged analysis plan (Figure 4.1). As postulated in the conceptual framework, the endogeneity between co-residence and labor force participation matters only when co-residence precedes the decision on informal caregiving. Thus, I test for the endogeneity of co-residence with regard to labor force participation by gender and age group. Based on the results, I proceed to estimate the model using the standard IV approach. Specifically, if the sample of a specific gender/age group shows that decision on co-residence is made jointly with decision on labor force

participation, I estimate the model separately for co-residential and extra-residential subsamples. For some gender/age group, co-residence may be found to be exogenous to labor force participation, which is probably more likely among older generations as described in the cultural background. In that gender/age group, I include co-residence as another exogenous control variable in the model, assuming that co-residence might have only additive effects to the main effect of informal caregiving on labor force participation.

For the Adult Child sample, the dependent variable is a binary variable of whether or not the adult child is currently working. I conduct probit regression analyses as well as IV probit estimation. The data in the Respondent sample allow for additionally examining adjustments in the intensive margin. Considering the labor market structure in South Korea, I examine possible adjustments in the intensive margin in three ways. First, given any work, does informal caregiving affect weekly hours worked? Second, given any paid work, excluding the group involved in unpaid help for family business, does informal caregiving affect his or her monthly income? Third, given any employed work, further excluding the self-employed group, does informal caregiving affect hourly wage rate? For these three analyses, I employ the two-part model framework, where the second-part model uses observations with any positive outcomes. Because these dependent variables are continuous variables, I estimate IV two-stage least square (IV-2SLS) models to correct for the potential endogeneity of informal caregiving hours. Unlike many labor economics applications, I use the two-part model (Bolin *et al.*, 2008), mainly because the main interest here lies in actual labor market outcomes among labor force participants rather than potential outcomes.

Testing for endogeneity between co-residence and labor force participation

To test for the endogeneity of co-residence by gender and age group, I use four subsamples derived from the Adult Child sample, excluding observations whose parent(s) have any ADL/IADL limitation. For each subsample, I estimate a bivariate probit model.

$$LFP^* = \gamma CORESIDE + \delta_2 X + \varepsilon_2 \quad \text{Eq. (2)}$$

$$CORESIDE^* = \delta_1 X + \phi IV + \varepsilon_3 \quad \text{Eq. (3)}$$

where *LFP** and *CORESIDE** are latent variables for the indicator variable of *LFP* (1 if *LFP**>0, otherwise 0) and for the indicator variable of *CORESIDE* (1 if *CORESIDE**>0, otherwise 0). *X* denotes the same variables as in Eq. (1), and *IV* is instrumental variables used for the *CORESIDE* equation. If the two decisions on co-residence and on labor force participation are independent, the two probit equations can be estimated separately. If the two decisions are not independent, estimating Eq. (2) alone will produce inconsistent coefficient estimates. In that case, consistent estimates can be obtained by estimating the two equations jointly in a bivariate probit model. A formal test on whether the two decisions are independent or not can be conducted by examining a likelihood-ratio test of whether *rho*, the correlation coefficient between ε_2, and ε_3, is statistically different from zero or not.

To estimate the bivariate probit model efficiently, IVs are needed. Two basic conditions for such IVs are similar to those required for IVs in the usual IV approach. Applied to the current bivariate probit model, first, IVs should have good predictive power for *CORESIDE*, and second, IVs should not be directly correlated with *LFP*. Sibling-level variables are a source of potentially promising IVs. Because of the diffusion

of responsibilities (Schulz, 1990), *number of brothers* and *number of sisters* will have the effect of decreasing one's probability of co-residing with his or her parents, but these variables are unlikely to directly affect one's probability of participating in the labor force. For the same reason, *being the eldest son in the family* (for men only) is another potential IV. Based on these rationales, I use *number of brothers* and *number of sisters* for female subsamples and all three IVs for male subsamples.

Because these analyses are pre-analyses conducted before the main analyses, I present the results in this section. The results presented in Tables 4.1-4.3 show that the IVs indeed meet the two requirements. In the first and fourth columns of Table 4.1 and Table 4.2, estimated coefficients of the IVs and their standard errors show that IVs are all individually statistically significant, except for the *number of sisters* in the Respondent sample. Moreover, Wald tests in Table 4.3 show that the IVs are jointly statistically significant. Interestingly, it is among older males (the Respondent sample), who are probably more influenced by traditional cultural norms, that *being the eldest son in the family* shows a large positive coefficient but *number of sisters* is not statistically significant. Tests of exclusion restrictions follow Rashad and Kaestner (2004). The results in Table 4.3 suggest that the IVs can be validly excluded from the main equation. Finally, the likelihood-ratio tests of *rho*=0 indicate that the endogeneity of co-residence varies by age group, but not by gender. For both male and females in the Younger Adult Child sample, the test on *rho* suggests that co-residence is endogenous to labor force participation, while the same test for the Midlife Adult Child sample does not. Again, this difference may reflect the current transition in cultural norms that take place between older and younger generations in South Korea. In current older generations, co-residence

tended to be pre-determined exogenously, that is, regardless of their decisions on work or other opportunities. By contrast, for younger generations, their decision on co-residence is made in conjunction with their work decisions. Because the estimated coefficients for *CORESIDE* are not of main interest for the current study, I describe the estimation results only briefly. Co-residence decreases the probability of labor force participation among both males and females in the Younger Adult Child sample (−0.767 in 3rd and −0.738 in 6th columns of Table 4.1). By contrast, co-residence increases the probability of labor force participation among women in the Midlife Child sample (see 0.648 in 5th column of Table 4.2).

From these results, I follow a decision rule for proceeding to the main analysis (Figures 4.1-4.2). Because co-residence appears to be endogenous among younger generations, I conduct separate analyses of the Younger Adult Child sample by co-residence status. The exogeneity of co-residence is not rejected for the Midlife Adult Child sample. Based on this finding, I do not conduct separate analyses by co-residence status for older generation samples (the Midlife Child sample and also the Respondent sample), but add to the model another control variable of whether the person co-resides with his or her parent or not.

Instrumental variable estimation

Although the sibling-level fixed effects estimation may deal with one source of endogeneity, the conceptual framework indicates that informal care still is potentially endogenous to caregivers' labor market outcomes because of unobserved heterogeneity at the individual level. Therefore, conventional multiple regression analyses may not fully

control for the potential omitted variable bias in making causal inference on the effects of informal care on labor market outcomes.

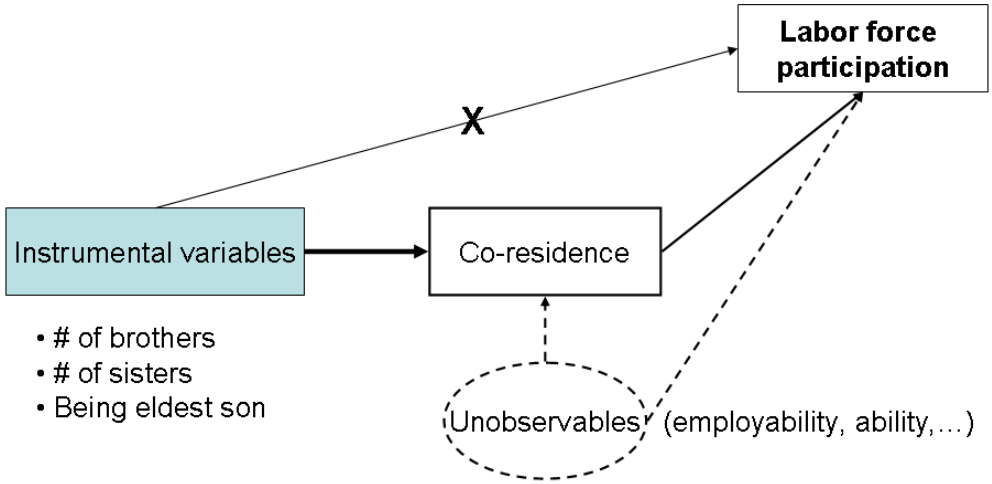
To address this methodological challenge, this study employs an IV approach. To do so, it is critical to find good instruments, variables that have strong explanatory power for the endogenous explanatory variable in the first-stage equation and that can also be validly excluded from the main equation. These two conditions can be checked formally using respective statistical tests.

In this study, family members' functional limitation provides potentially promising IVs because family members' functional limitation will increase the possibility of providing informal care but will not directly affect adult children's decisions on labor force participation (Ettner, 1995; Bolin *et al*., 2008). Because the KLoSA data provide variables on functional limitations of family members, I do not rely on other proxies to predict parental care needs or parental ability to substitute formal care, such as parental education (Ettner, 1995).

Tables 4.4-4.10 show the results of first-stage regressions and specification tests of IVs for selected subsamples. I present results of specification tests for two different ways of defining the intensity of informal care: 1) a continuous variable of ln(1+weekly care hours) (Tables 4.4-4.6, Tables 4.8-4.9) and 2) a set of two dummy variables representing less intensive care and more intensive care (Tables 4.5-4.7, Table 4.10). Overall, IVs meet the requirements of good explanatory power and exclusion restrictions. Interestingly, *F*-statistics for joint significance of the IVs are very large, all exceeding 40. This is not surprising from the high correlations between family members' functional limitation and informal care in bivariate analyses.

Figure 4.1. Diagram for estimation strategy for the Adult Child sample

A. As a pre-analysis, examine the endogeneity of co-residence by gender and age group using bivariate probit models exploiting sibling characteristics as instruments.



B. Apply a decision rule for each gender/age group
   1. If co-residence is found to be endogenous to labor force participation, conduct stratified analysis by co-/extra-residential status.
   2. If the exogeneity of co-residence is not rejected, consider co-residence as another observable control variable.

C. For the main analysis, employ the instrumental variable approach using functional limitations of family members as identifying instruments.

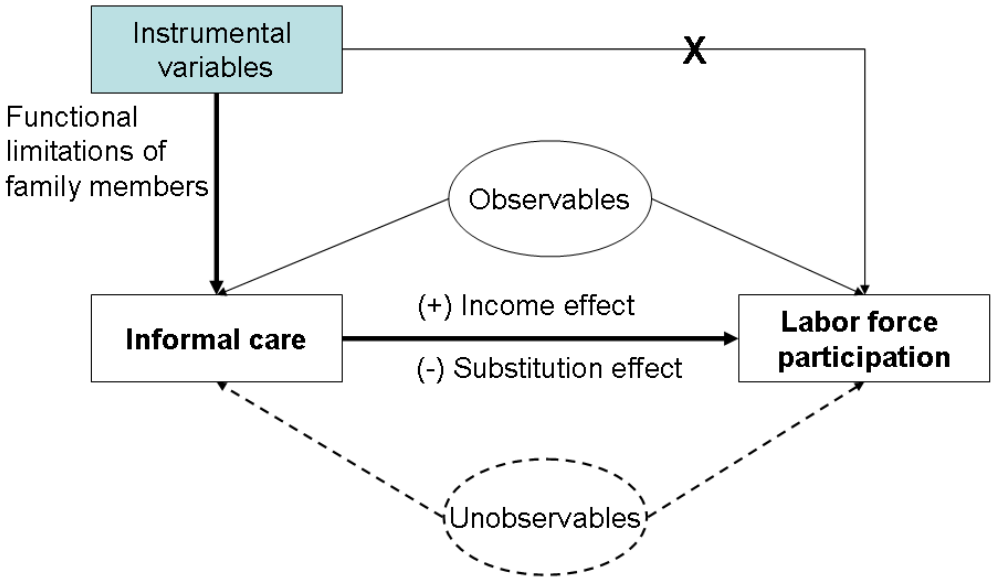


Table 4.1. Probit and bivariate probit regression of LFP in the Younger Adult Child sample, by gender

	Male			Female		
	Co-reside Probit	LFP Probit	**LFP BVP**	Co-reside Probit	LFP Probit	**LFP BVP**
Co-reside with parent(s)		−0.210	−0.767		0.094	−0.738
		(0.055)**	(0.230)**		(0.069)	(0.216)**
Child's characteristics						
Age (year)	−0.198	0.559	0.500	−0.143	0.041	−0.009
	(0.053)**	(0.056)**	(0.063)**	(0.072)*	(0.051)	(0.052)
Age-squared/100	0.003	−0.008	−0.007	0.002	−0.001	0.000
	(0.001)**	(0.001)**	(0.001)**	(0.001)	(0.001)	(0.001)
Education (ref. Any graduate)						
Less than middle school	0.476	0.012	0.058	−0.133	−0.262	−0.235
	(0.238)*	(0.232)	(0.229)	(0.343)	(0.184)	(0.183)
Any middle school	0.248	−0.164	−0.123	0.110	−0.028	0.010
	(0.178)	(0.164)	(0.162)	(0.251)	(0.152)	(0.151)
Any high school	0.479	0.333	0.391	0.312	−0.076	−0.022
	(0.130)**	(0.127)**	(0.126)**	(0.172)	(0.127)	(0.125)
Any college	0.435	0.270	0.325	0.262	0.28	0.318
	(0.125)**	(0.120)*	(0.120)**	(0.165)	(0.124)*	(0.122)**
Marital status (ref. Married)						
Widow/separat/divorced	1.224	−0.491	−0.288	1.745	0.635	0.890
	(0.134)**	(0.146)**	(0.165)	(0.157)**	(0.140)**	(0.148)**
Never married	1.326	−0.572	−0.35	2.081	0.819	1.186
	(0.075)**	(0.082)**	(0.120)**	(0.106)**	(0.077)**	(0.110)**
Owns a house	−0.023	0.593	0.580	0.195	0.484	0.490
	(0.063)	(0.077)**	(0.076)**	(0.103)	(0.056)**	(0.056)**
Number of own children	0.016	−0.032	−0.026	0.086	−0.094	−0.082
	(0.036)	(0.038)	(0.038)	(0.049)	(0.028)**	(0.028)**
Parents' characteristics						
Currently married	−0.380	−0.017	−0.070	−0.241	−0.105	−0.126
	(0.055)**	(0.061)	(0.063)	(0.079)**	(0.049)*	(0.049)*
At least middle school	−0.115	0.000	−0.008	0.014	−0.052	−0.035
	(0.054)*	(0.057)	(0.056)	(0.075)	(0.049)	(0.048)
Owns a house	−0.138	0.008	−0.013	0.145	−0.107	−0.100
	(0.098)	(0.099)	(0.098)	(0.142)	(0.086)	(0.085)
Total assets quintile (ref. 5)						
Quintile 1 (lowest)	−0.488	−0.055	−0.126	−0.156	−0.199	−0.236
	(0.120)**	(0.125)	(0.125)	(0.167)	(0.105)	(0.104)*
Quintile 2	−0.413	0.056	−0.009	−0.272	−0.018	−0.062
	(0.078)**	(0.086)	(0.088)	(0.105)**	(0.071)	(0.071)
Quintile 3	−0.149	0.005	−0.018	−0.218	−0.026	−0.060
	(0.074)*	(0.081)	(0.080)	(0.098)*	(0.068)	(0.068)
Quintile 4	−0.010	0.042	0.038	−0.125	−0.091	−0.115
	(0.075)	(0.083)	(0.082)	(0.094)	(0.069)	(0.068)
Region (ref. Seoul)						
Non-Seoul Metropolitan	−0.187	−0.061	−0.094	−0.198	0.08	0.032
	(0.070)**	(0.079)	(0.079)	(0.090)*	(0.068)	(0.068)

Provincial	−0.409	−0.095	−0.170	−0.478	0.048	−0.040
	(0.066)**	(0.074)	(0.079)*	(0.086)**	(0.063)	(0.067)
Instrumental variables (IVs) for co-residence						
Number of brothers	−0.117			−0.215		
	(0.032)**			(0.043)**		
Number of sisters	−0.051			−0.197		
	(0.020)*			(0.029)**		
Being eldest son in family	0.164			–		
	(0.055)**					
Constant	2.860	−8.768	−7.556	1.323	−0.912	0.074
	(0.933)**	(0.984)**	(1.139)**	(1.228)	(0.913)	(0.935)
rho (ρ)	–	–	0.336	–	–	0.492
Likelihood-ratio test of *rho*=0	–	–	chi2(1) = 3.86*	–	–	chi2(1) =12.59**
N	4,746	4,746	4,746	4,363	4,363	4,363

Notes: KLoSA (2006) respondents' adult children aged 25-44, excluding observations with any parental ADL/IADL limitation. BVP=bivariate probit, LFP=labor force participation Standard errors in parentheses. * $p<0.05$. ** $p<0.01$.

Table 4.2. Probit and bivariate probit regression of LFP in the Midlife Adult Child sample, by gender

	Male			Female		
	Co-reside Probit	**LFP Probit**	LFP BVP	**Co-reside Probit**	**LFP Probit**	LFP BVP
Co-reside with parent(s)		−0.063	0.140		0.648	0.827
		(0.104)	(0.433)		(0.178)**	(0.524)
Child's characteristics						
Age (year)	−0.128	0.452	0.463	0.371	0.400	0.396
	(0.165)	(0.173)**	(0.173)**	(0.320)	(0.176)*	(0.177)*
Age-squared/100	0.001	−0.005	−0.005	−0.004	−0.004	−0.004
	(0.002)	(0.002)**	(0.002)**	(0.003)	(0.002)*	(0.002)*
Education (ref. Any graduate)						
Less than middle school	−0.141	−1.133	−1.121	−0.01	−0.797	−0.789
	(0.254)	(0.503)*	(0.504)*	(0.637)	(0.456)	(0.456)
Any middle school	−0.055	−0.867	−0.865	−0.456	−0.917	−0.905
	(0.247)	(0.502)	(0.502)	(0.642)	(0.455)*	(0.456)*
Any high school	0.042	−0.86	−0.861	−0.026	−0.911	−0.903
	(0.226)	(0.493)	(0.493)	(0.608)	(0.449)*	(0.449)*
Any college	−0.079	−0.771	−0.765	−0.181	−0.575	−0.565
	(0.225)	(0.493)	(0.493)	(0.609)	(0.451)	(0.451)
Marital status (ref. Married)						
Widow/separat/divorced	0.871	−0.893	−0.943	1.319	0.25	0.214
	(0.153)**	(0.152)**	(0.182)**	(0.184)**	(0.151)	(0.181)
Never married	1.159	−1.052	−1.117	1.837	0.235	0.165
	(0.198)**	(0.204)**	(0.241)**	(0.279)**	(0.232)	(0.303)
Owns a house	−0.129	0.66	0.664	0.092	0.713	0.712
	(0.089)	(0.092)**	(0.092)**	(0.156)	(0.074)**	(0.074)**
Number of own children	0.093	−0.036	−0.041	−0.059	−0.068	−0.066
	(0.047)*	(0.051)	(0.053)	(0.088)	(0.045)	(0.045)
Parents' characteristics						
Currently married	−0.392	−0.08	−0.060	−0.621	−0.068	−0.062
	(0.091)**	(0.098)	(0.106)	(0.191)**	(0.080)	(0.081)
At least middle school	−0.432	−0.048	−0.029	0.194	−0.195	−0.197
	(0.109)**	(0.117)	(0.125)	(0.191)	(0.096)*	(0.097)*
Owns a house	−0.473	0.086	0.107	−0.324	−0.506	−0.503
	(0.147)**	(0.151)	(0.157)	(0.261)	(0.127)**	(0.128)**
Total assets quintile (ref. 5)						
Quintile 1 (lowest)	−1.385	−0.025	0.043	−0.678	−0.452	−0.445
	(0.177)**	(0.184)	(0.234)	(0.305)*	(0.154)**	(0.155)**
Quintile 2	−1.033	0.266	0.315	−0.659	−0.059	−0.053
	(0.125)**	(0.144)	(0.177)	(0.233)**	(0.117)	(0.118)
Quintile 3	−0.458	0.085	0.108	−0.209	−0.174	−0.172
	(0.121)**	(0.147)	(0.155)	(0.222)	(0.128)	(0.128)
Quintile 4	−0.085	0.004	0.006	−0.008	−0.028	−0.029
	(0.120)	(0.149)	(0.149)	(0.220)	(0.128)	(0.128)
Region (ref. Seoul)						
Non-Seoul Metropolitan	−0.108	−0.320	−0.307	0.002	0.440	0.443
	(0.120)	(0.146)*	(0.149)*	(0.202)	(0.129)**	(0.129)**

Provincial	−0.135	−0.384	−0.37	−0.144	0.431	0.435
	(0.110)	(0.135)**	(0.139)**	(0.186)	(0.122)**	(0.122)**
Instrumental variables (IVs) for co-residence						
Number of brothers	−0.137			−0.176		
	(0.038)**			(0.066)**		
Number of sisters	−0.053			−0.144		
	(0.030)			(0.055)**		
Being eldest son in family	0.451			–		
	(0.087)**					
Constant	3.244	−8.409	−8.753	−10.009	−8.562	−8.486
	(4.333)	(4.576)	(4.612)	(8.366)	(4.558)	(4.562)
rho (ρ)	–	–	−0.1227	–	–	−0.0933
Likelihood-ratio test of *rho*=0	–	–	chi2(1) = 0.23	–	–	chi2(1) =0.13
N	1,812	1,812	1,812	1,662	1,662	1,662

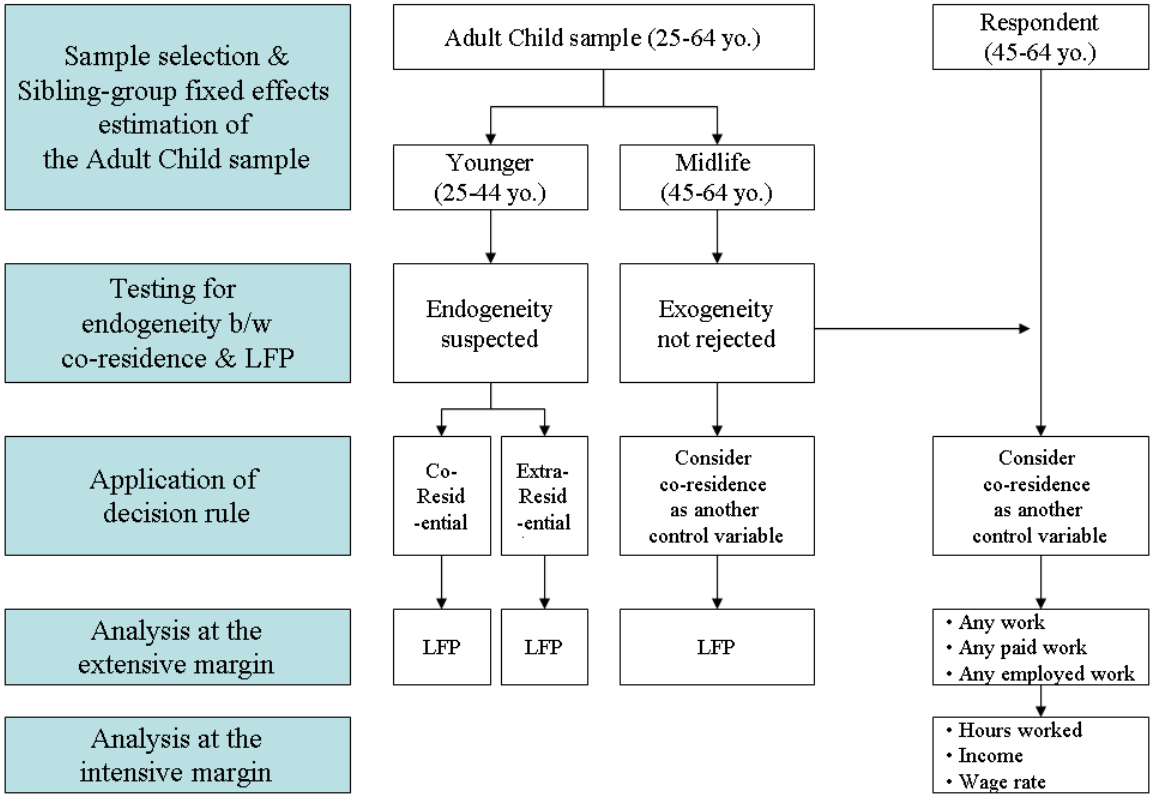
Notes: KLoSA (2006) respondents' adult children aged 45-64, excluding observations with any parental ADL/IADL limitation. BVP=bivariate probit, LFP=labor force participation Standard errors in parentheses. * $p<0.05$. ** $p<0.01$.

Table 4.3. Tests of instrumental variable strength and exclusion restrictions for bivariate probit

	Younger Adult Child sample		Midlife Adult Child sample	
	Male	Female	Male	Female
Wald test of IV strength	chi2(3)=49.77**	chi2(2)=57.09**	chi2(3)=60.43**	chi2(2)=12.35**
Test of exclusion restrictions[a]				
Number of brothers	chi2(1)=0.40	chi2(1)=1.40	chi2(1)=0.97	chi2(1)=0.00
Number of sisters	chi2(1)=1.38	chi2(1)=3.32	chi2(1)=0.00	chi2(1)=1.40
Being eldest son in family	chi2(1)=0.18	-	chi2(1)=0.06	-
Good IVs?	Yes	Yes	Yes	Yes
LR test of *rho*=0	chi2(1)=3.86*	chi2(1)=12.59**	chi2(1)=0.23	chi2(1)=0.13
Conclusion: Co-residence is endogenous to LFP?	Yes	Yes	No	No

Notes: KLoSA (2006) respondents' adult children aged 25-44 (the Younger Adult Child sample) and adult children aged 45-64 (the Midlife Adult Child sample), excluding observations with any parental ADL/IADL limitation. IV is instrumental variable. * $p<0.05$. ** $p<0.01$. [a]Method follows Rashad and Kaestner (2004).

Figure 4.2. Overview of the empirical analysis on caregivers' labor market outcomes



Notes: LFP=labor force participation, All analyses are conducted separately by gender.

Table 4.4. First-stage regression (OLS) of logged weekly care hours in the Younger Adult Child sample, by gender and living arrangement

Independent variables	Male		Female	
	Extra-residential	Co-residential	Extra-residential	Co-residential
Identifying instruments				
Parent(s)' ADL limitations sum (0−14)	0.001	0.047	−0.009	0.005
	(0.002)	(0.013)**	(0.003)**	(0.024)
Parent(s)' IADL limitations: 1−4	0.031	0.179	0.036	0.322
(ref. None)	(0.004)**	(0.026)**	(0.007)**	(0.045)**
Parent(s)' IADL limitations: 5−20	0.034	0.697	0.167	1.310
	(0.008)**	(0.060)**	(0.014)**	(0.148)**
Demographics and socioeconomics				
Age (year)	−0.004	−0.022	0.001	−0.036
	(0.003)	(0.019)	(0.006)	(0.037)
Age-squared/100	0.006	0.038	−0.002	0.055
	(0.004)	(0.029)	(0.009)	(0.057)
Education (ref. Any graduate school)				
Less than middle school	−0.017	−0.037	0.000	0.510
	(0.012)	(0.091)	(0.020)	(0.183)**
Any middle school	−0.012	0.103	0.004	−0.036
	(0.008)	(0.071)	(0.018)	(0.143)
Any high school	0.001	0.026	0.004	0.072
	(0.006)	(0.054)	(0.016)	(0.085)
Any college	0.002	0.016	0.006	0.068
	(0.006)	(0.052)	(0.016)	(0.081)
Marital status (ref. Married)				
Widow/separated/divorced	0.003	−0.008	−0.010	−0.059
	(0.009)	(0.046)	(0.018)	(0.087)
Never married	−0.001	0.070	0.000	−0.274
	(0.004)	(0.035)*	(0.009)	(0.071)**
Owns a house	−0.005	0.047	0.012	0.045
	(0.003)	(0.028)	(0.006)*	(0.067)
Number of own children	0.003	−0.010	−0.004	−0.040
	(0.002)	(0.017)	(0.003)	(0.028)
Parents' characteristics				
Currently married	−0.008	−0.083	0.000	−0.190
	(0.003)**	(0.021)**	(0.005)	(0.042)**
At least middle school	−0.002	0.005	0.000	0.056
	(0.003)	(0.020)	(0.005)	(0.038)
Owns a house	−0.001	−0.036	0.012	−0.103
	(0.005)	(0.041)	(0.009)	(0.073)
Constant	0.088	0.332	−0.033	0.984
	(0.058)	(0.336)	(0.111)	(0.619)
Adj. *R*-squared	0.029	0.247	0.045	0.305
N	4,190	1,586	4,475	895

Notes: KLoSA (2006) respondents' adult children aged 25-44. Standard errors in parentheses. * $p<0.05$. ** $p<0.01$. Parental total assets dummies and regional dummies are included but not shown.

Table 4.5. First-stage regression of care intensity in the Midlife Adult Child sample, female

Specification of dependent variable	Continuous: OLS	A set of two dummy variables: LPM	
Dependent variable	*y*: ln(1+weekly hours of parental care)	*y*: 1 if 0 < weekly hours of care < 5 *(vs*. 0 if none)	*y*: 1 if weekly hours of care ≥ 5 *(vs*. 0 if none)
Independent variables			
Identifying instruments			
Parent(s)' ADL limitations sum (0−14)	0.017	0.006	0.003
	(0.005)**	(0.002)**	(0.001)
Parent(s)' IADL limitations: 1−4	0.084	0.048	0.018
(ref. None)	(0.018)**	(0.007)**	(0.005)**
Parent(s)' IADL limitations: 5−20	0.122	0.032	0.030
	(0.023)**	(0.009)**	(0.007)**
Co-reside with parent(s)	0.602	0.033	0.177
	(0.035)**	(0.013)*	(0.010)**
Demographics and socioeconomics			
Age (year)	−0.022	0.009	−0.010
	(0.028)	(0.011)	(0.008)
Age-squared/100	0.023	−0.009	0.011
	(0.027)	(0.010)	(0.008)
Education (ref. Any graduate school)			
Less than middle school	0.012	0.004	0.001
	(0.099)	(0.038)	(0.029)
Any middle school	0.008	0.013	−0.003
	(0.098)	(0.038)	(0.029)
Any high school	0.016	0.009	0.001
	(0.097)	(0.037)	(0.029)
Any college	0.062	0.009	0.017
	(0.098)	(0.037)	(0.029)
Marital status (ref. Married)			
Widow/separated/divorced	0.027	0.002	0.014
	(0.029)	(0.011)	(0.009)
Never married	−0.230	−0.027	−0.067
	(0.048)**	(0.018)	(0.014)**
Owns a house	0.031	0.016	0.004
	(0.015)*	(0.006)**	(0.004)
Number of own children	−0.011	−0.001	−0.003
	(0.008)	(0.003)	(0.002)
Parents' characteristics			
Currently married	−0.041	−0.015	−0.008
	(0.015)**	(0.006)**	(0.005)
At least middle school	−0.006	0.008	−0.005
	(0.019)	(0.007)	(0.006)
Owns a house	−0.032	−0.012	−0.008
	(0.023)	(0.009)	(0.007)
Constant	0.545	−0.242	0.255
	(0.744)	(0.285)	(0.223)
Adj. *R*-squared	0.161	0.037	0.141
N	2,726	2,726	2,726

Notes: KLoSA (2006) respondents' adult children aged 45-64. Standard errors in parentheses. * $p<0.05$. ** $p<0.01$. Parental total assets dummies and region dummies are included but not shown.

Table 4.6. Specification tests for instrumental variables for logged weekly care hours in the Adult Child sample

Sample and model	Strengths of instruments	Test of exclusion restrictions	Exogeneity test	Conclusion[a]
Younger Adult Child sample (aged 25-44)				
Extra-residential				
Male (*n*=4,190)	F(3, 4167) = 39.78***	chi2(2) = 3.025	chi2(1) = 0.08	Good IVs Probit
Female (*n*=4,475)	F(3, 4452) = 72.05***	chi2(2) = 2.660	chi2(1) = 1.30	Good IVs Probit
Co-residential				
Male (*n*=1,586)	F(3, 1563) = 159.26***	chi2(2) = 0.448	chi2(1) = 2.99	Good IVs Probit
Female (*n*=895)	F(3, 2000) = 98.02***	chi2(2) = 3.371	chi2(1) = 0.69	Good IVs Probit
Midlife Adult Child sample (aged 45-64)				
Male (*N* =2,910)	F(3, 2886) = 71.04**	chi2(2) = 0.213	chi2(1) = 7.24**	Good IVs IV probit
Female (*N* =2,726)	F(3, 2702) = 38.75**	chi2(2) = 1.800	chi2(1) = 5.56*	Good IVs IV probit

Notes: KLoSA (2006) respondents' adult children. * $p<0.05$. ** $p<0.01$. *** $p<0.001$. [a]Decisions are based on statistical significance of $p<0.05$. The instruments used were (1) Sum of parent(s)' ADL limitations; (2) Having parents' IADL limitations between 1 and 4 (yes=1, no=0); and (3) Having parents' IADL limitations between 5 and 20 (yes=1, no=0).

Table 4.7. Specification tests for instrumental variables for two dummy variables of care intensity in the Adult Child sample

Sample and model	Strengths of instruments • 1 if 0 < care hours < 5 • 1 if care hours ≥ 5	Test of exclusion restrictions	Exogeneity test	Conclusion[a]
Younger Adult Child sample (aged 25-44)				
Male (*N*=5,776)	• $F(3, 5752)= 150.41$*** • $F(3, 5752)= 71.27$***	chi2(1) = 1.536	chi2(2) = 1.09	Good IVs Probit
Female (*N*=5,370)	• $F(3, 5346)= 132.23$*** • $F(3, 5346)= 78.96$***	chi2(1) = 1.378	chi2(2) = 0.79	Good IVs Probit
Midlife Adult Child sample (aged 45-64)				
Male (*N*=2,910)	• $F(3, 2886)= 61.96$*** • $F(3, 2886)= 42.38$***	chi2(1) = 0.043	chi2(2) = 6.92**	Good IVs IV probit
Female (*N*=2,726)	• $F(3, 2702)= 31.34$*** • $F(3, 2702)= 20.78$***	chi2(1) = 1.056	chi2(2) = 6.30*	Good IVs IV probit

Notes: KLoSA (2006) respondents' adult children. * $p<0.05$. ** $p<0.01$. *** $p<0.001$. [a]Decisions are based on statistical significance of $p<0.05$. The instruments used were (1) Sum of parent(s)' ADL limitations; (2) Having parents' IADL limitations between 1 and 4 (yes=1, no=0); and (3) Having parents' IADL limitations between 5 and 20 (yes=1, no=0).

Table 4.8. First-stage regression of logged weekly care hours in the Respondent sample, by gender and dependent variable

Independent variables	Male		Female	
	Any work	Hours if work	Any work	Hours if work
Identifying instruments				
Any ADL limitation of parents	0.798	0.588	0.596	0.695
	(0.035)**	(0.034)**	(0.056)**	(0.062)**
Any ADL limitation of parent-in-laws	0.621	0.399	1.349	0.977
	(0.081)**	(0.073)**	(0.085)**	(0.102)**
Any ADL limitation of sibling/relative	0.173	0.144	0.215	0.093
	(0.044)**	(0.044)**	(0.060)**	(0.070)
Demographics and socioeconomics				
Co-reside with parent(s)	0.078	0.058	0.097	0.108
	(0.018)**	(0.018)**	(0.031)**	(0.034)**
Age (year)	0.018	0.013	−0.050	0.022
	(0.024)	(0.024)	(0.034)	(0.043)
Age-squared/100	−0.014	−0.010	0.049	−0.018
	(0.022)	(0.022)	(0.031)	(0.040)
Currently married	−0.010	0.020	0.025	−0.016
	(0.026)	(0.030)	(0.027)	(0.033)
Education (ref. College)				
Elementary school	0.001	0.000	0.038	−0.013
	(0.024)	(0.025)	(0.043)	(0.052)
Middle school	−0.015	−0.004	0.035	0.028
	(0.022)	(0.022)	(0.042)	(0.050)
High school	−0.004	−0.011	−0.001	−0.028
	(0.018)	(0.017)	(0.038)	(0.046)
Total assets quintile (ref. Quintile 5)				
Quintile 1	0.047	0.004	0.074	0.018
	(0.035)	(0.034)	(0.050)	(0.062)
Quintile 2	0.026	−0.011	0.040	−0.013
	(0.024)	(0.023)	(0.034)	(0.043)
Quintile 3	0.025	0.008	0.024	0.007
	(0.021)	(0.020)	(0.030)	(0.039)
Quintile 4	−0.007	−0.030	0.010	−0.012
	(0.019)	(0.019)	(0.029)	(0.038)
Owns a house	0.047	0.024	0.016	0.037
	(0.027)	(0.026)	(0.039)	(0.047)
Disability	0.000	−0.055	0.073	0.033
	(0.026)	(0.033)	(0.050)	(0.076)
Poor self-rated health	0.026	0.004	0.023	0.004
	(0.020)	(0.024)	(0.024)	(0.031)
Constant	−0.564	−0.430	1.283	−0.653
	(0.643)	(0.641)	(0.910)	(1.146)
Adj. *R*-squared	0.19	0.16	0.11	0.18
N	2,728	2,035	3,366	1,169

Notes: KLoSA (2006) respondents aged 45-64. Standard errors in parentheses. * $p<0.05$. ** $p<0.01$. *** $p<0.001$. Whether both parents live together, whether parent(s) owns a house, whether parent(s) no formal education, and region dummies are included but not shown.

Table 4.9. Specification tests for instrumental variables for logged weekly care hours in the Respondent sample

Sample and model	Strengths of instruments	Test of exclusion restrictions	Exogeneity test	Conclusion[a]
Male (N =2,728)				
Any work	*F*(3, 2693) = 196.26***	chi2(2) = 0.029	chi2(1) = 2.14	Good IVs Probit
ln(weekly work hours) if any	*F*(3, 2000) = 114.88***	chi2(2) = 1.826	*F*(1, 2001) = 0.39	Good IVs OLS
Any paid work	*F*(3, 2693) = 196.26***	chi2(2) = 0.536	chi2(1) = 2.10	Good IVs Probit
ln(monthly income) if any	*F*(3, 1915) = 115.49***	chi2(2) = 2.944	*F*(1, 1916) = 0.39	Good IVs OLS
Any employed work	*F*(3, 2693) = 196.26***	chi2(2) = 0.489	chi2(1) = 0.26	Good IVs Probit
ln(hourly wage rate) if any	*F*(3, 1009) = 59.34***	chi2(2) = 2.087	*F*(1, 1010) = 0.20	Good IVs OLS
Female (N =3,366)				
Any work	*F*(3, 3331) = 128.63***	chi2(2) = 4.156	chi2(1) = 2.23	Good IVs Probit
ln(weekly work hours) if any	*F*(3, 2234) = 74.51***	chi2(2) = 0.803	*F*(1, 1135) = 1.87	Good IVs OLS
Any paid work	*F*(3, 3331) = 128.63***	chi2(2) = 2.671	chi2(1) = 2.14	Good IVs Probit
ln(monthly income) if any	*F*(3, 916) = 61.92***	chi2(2) = 2.095	*F*(1, 917) = 0.39	Good IVs OLS
Any employed work	*F*(3, 3331) = 128.63***	chi2(2) = 4.133	chi2(1) = 0.14	Good IVs Probit
ln(hourly wage rate) if any	*F*(3, 547) = 40.65***	chi2(2) = 2.382	*F*(1, 548) = 0.25	Good IVs OLS

Notes: KLoSA (2006) respondents aged 45-64. *** $p<0.001$. [a]Decisions are based on statistical significance of $p<0.05$. The instruments used were (1) whether parent(s) have ADL limitation; (2) whether parent(s)-in-law have any ADL limitation; and (3) whether any sibling or other relatives any ADL limitation.

Table 4.10. Specification tests for instrumental variables for two dummy variables of care intensity in the Respondent sample

Sample and model	Strengths of instruments • 1 if 0 < care hours < 10 • 1 if care hours ≥ 10	Test of exclusion restrictions	Exogeneity test	Conclusion[a]
Male (N =2,728)				
Any work	• $F(3, 2693)= 130.38$*** • $F(3, 2693)= 113.05$***	chi2(1) = 0.005	chi2(2) = 2.38	Good IVs Probit
ln(weekly work hours) if any	• $F(3, 2000)= 122.23$*** • $F(3, 2000)= 45.74$***	chi2(1) = 0.276	$F(2, 1999)$ = 0.48	Good IVs OLS
Any paid work	• $F(3, 2693)= 130.38$*** • $F(3, 2693)= 113.05$***	chi2(1) = 0.314	chi2(2) = 2.30	Good IVs Probit
ln(monthly income) if any	• $F(3, 1915)= 121.76$*** • $F(3, 1915)= 45.62$***	chi2(1) = 2.154	$F(2, 1914)$ = 0.66	Good IVs OLS
Any employed work	• $F(3, 2693)= 130.38$*** • $F(3, 2693)= 113.05$***	chi2(1) = 0.029	chi2(2) = 0.52	Good IVs Probit
ln(hourly wage rate) if any	• $F(3, 1009)= 56.71$*** • $F(3, 1009)= 30.83$***	chi2(1) = 0.329	$F(2, 1008)$ = 0.56	Good IVs OLS
Female (N =3,366)				
Any work	• $F(3, 3331)= 168.28$*** • $F(3, 3331)= 90.08$***	chi2(1) = 0.223	chi2(2) = 5.07†	Good IVs Probit
ln(weekly work hours) if any	• $F(3, 1134)= 64.62$*** • $F(3, 1134)= 45.56$***	chi2(1) = 0.606	$F(2, 1133)$ = 0.29	Good IVs OLS
Any paid work	• $F(3, 3331)= 168.28$*** • $F(3, 3331)= 90.08$***	chi2(1) = 0.357	chi2(2) = 3.02	Good IVs Probit
ln(monthly income) if any	• $F(3, 916)= 59.25$*** • $F(3, 916)= 34.70$***	chi2(1) = 0.682	$F(2, 915)$ = 0.51	Good IVs OLS
Any employed work	• $F(3, 3331)= 168.28$*** • $F(3, 3331)= 90.08$***	chi2(1) = 0.245	chi2(2) = 2.13	Good IVs Probit
ln(hourly wage rate) if any	• $F(3, 547)= 66.91$*** • $F(3, 547)= 10.97$***	chi2(1) = 0.396	$F(2, 546)$ = 0.57	Good IVs OLS

Notes: KLoSA (2006) respondents aged 45-64. [a]Decisions are based on statistical significance of † p <0.1. *** p<0.001. The instruments used were (1) whether parent(s) have ADL limitation; (2) whether parent(s)-in-law have any ADL limitation; and (3) whether any sibling or other relatives any ADL limitation.

Methods to Estimate Effects on Caregivers' Health

How to test the hypothesis

This study estimates the following model in its general specification

$$Health\_Outcomes = \beta IC + \delta X + \varepsilon \qquad \text{Eq. (4)}$$

where *Health_Outcomes* takes an outcome from the six groups of outcome variables. *IC* may take on 1) logged weekly hours of informal care, 2) a set of two dummy variables for less intensive care and more intensive care, or 3) a set of three variables for spouse care, parent care, and parent-in-law care. *X* is a vector of other explanatory variables. The coefficient β is of main interest.

To test the hypotheses H2a to H2c, I check the sign and statistical significance of estimated coefficient(s) β. For favorable health outcomes, I expect β to have negative signs. For unfavorable outcomes, I expect statistically significant and positive coefficient estimates of β. To test the hypothesis H2d, I run an *F*-test of whether the three coefficient estimates are statistically different from each other.

Overview of the estimation strategy

Depending on the nature of an outcome measure, I employ different estimation methods, including ordinary least squares, probit, and ordered probit estimation. I also use the two-part model framework for two expenditures variables: logged out-of-pocket costs for outpatient care use and logged out-of-pocket costs for prescription drug use. Again, I test for potential endogeneity between informal care and caregiver health outcomes. One exception is the ordered probit model of self-rated health, for which a canned statistical program is not available.

Testing for and controlling for selection into caregiving

To address the potential endogeneity issue, I use the IV method as in the study on caregivers' labor market outcomes. In this study, good instruments should predict the main explanatory variable(s) on informal care, but should not directly affect a health outcome measure being studied. This second condition requires exercising great caution in using functional limitations of blood-tie family members as IVs, compared with the study on caregivers' labor market outcomes. This is because blood-tie family members' functional limitations may affect the caregiver's psychological and physical health outcomes. Suppose, for example, a daughter whose diabetic mother had cerebral stroke and is now bedridden due to post-stroke disability. Given the genetic nature of diabetes, the daughter may be more likely to report poorer self-rated health, suffer more depressive symptoms and take more prescription drugs. Moreover, having a disabled mother around might directly affect the daughter's emotional well-being. Therefore, I begin with only two instrumental variables, any ADL limitation of father-in-law and any ADL limitation of mother-in-law, which are less likely to suffer from such issues of instrument validity. The basic assumption here is that parents-in-law's ADL limitation will not directly affect the caregiver's health other than through the daughter-in-law's informal caregiving.

While acknowledging the aforementioned conceptual issue with using functional limitations of blood-tie family members as IVs, I include another instrumental variable, any ADL limitation of parent(s), for the following reasons. First, parents' ADL limitation may be only poorly indicative of the current health status of adult children that are likely more than 20 years younger than their parents. In fact, the set of the three IVs passed

overidentification tests in all statistical models used. Second, there must be at least three IVs to be able to conduct the overidentification test when the functional form of informal caregiving takes on two dummy variables (less intensive, more intensive). Third, using more IVs creates more variation in the predicted values for the endogenous variable, thus allowing for increasing the efficiency of the IV estimation. Table 4.11 presents results of two selected first-stage regression models, and Table 4.12 provides a summary of the results of specification tests. As expected, IVs have high statistical significance individually (Table 4.11) and jointly (2^{nd} column of Table 4.12). Furthermore, tests of exclusion restrictions show that IVs are valid in all models (3^{rd} column of Table 4.12). Endogeneity is detected in only two conditional regression models of health care use (4^{th} column of Table 4.12).

Other methodological issues

Because this study uses cross-sectional data, it is not possible to tell whether the thirteen common diseases in the data preceded informal caregiving or arose during the course of caregiving. In the first case, omitting the disease indicators will lead to omitted variable bias. On the other hand, if one or more of the thirteen diseases occurred after caregiving was initiated, including all common disease indicators in the model might lead to underestimate the total effect of informal caregiving, only by capturing the direct effects not mediated by the disease indicators. This concern is particularly salient when disease conditions such as heart diseases are included in the model. In that case, the estimated coefficient on informal caregiving will not be able to capture the possible negative effects of caregiving on heart diseases. Weighing the relative merits of each

option, I conduct all statistical analyses both with and without the thirteen disease indicators.

Of the control variables included in the health care use models, voluntary private health insurance raises another concern for potential endogeneity issue. While in general health insurance status is endogenous in models of health care use, the current institutional setting around health insurance in South Korea lowers the possibility of endogeneity. The majority of private health insurance plans purchased are of supplemental type, which compensates enrollees for part of large out-of-pocket expenditures not paid by the National Health Insurance (NHI). Insurance coverage is mostly designed for critical illnesses and inpatient care. Furthermore, most outpatient care use and regular prescription drug use are covered relatively well by the NHI. People are unlikely to buy private health insurance based on expected outpatient or prescription drug use. Thus, I treat voluntary health insurance as an exogenous explanatory variable in the models of health care use.

Table 4.11. First-stage regressions of logged weekly hours of informal care

Independent var.	(1)	(2)
Identifying instruments		
Any ADL limitation of father-in-law	0.389	1.163
	(0.105)**	(0.256)**
Any ADL limitation of mother-in-law	1.478	1.598
	(0.071)**	(0.129)**
Any ADL limitation of parent(s)	0.736	0.719
	(0.034)**	(0.063)**
Demographics		
Female	0.051	0.066
	(0.012)**	(0.023)**
Age (year)	0.000	0.006
	(0.005)	(0.011)
Age-squared/100	0.002	-0.002
	(0.004)	(0.008)
Currently married	0.072	0.088
	(0.015)**	(0.023)**
Education (ref. College)		
Elementary school	-0.005	-0.002
	(0.021)	(0.040)
Middle school	0.009	0.017
	(0.021)	(0.042)
High school	-0.011	-0.007
	(0.019)	(0.040)
Total assets quintile (ref. Quintile 5)		
Quintile 1	0.059	0.060
	(0.026)*	(0.047)
Quintile 2	0.042	0.080
	(0.018)*	(0.032)*
Quintile 3	0.032	0.028
	(0.017)	(0.031)
Quintile 4	0.020	0.060
	(0.016)	(0.030)*
Owns a house	0.011	-0.030
	(0.021)	(0.039)
Disability diagnosed	-0.008	-0.017
	(0.023)	(0.034)
Adj. *R*-squared	0.095	0.088
N	9,732	3,898

Notes: KLoSA (2006) respondents, excluding persons with any ADL limitation. (1) First-stage regression for the main regression model of any regular prescription drug use, (2) First-stage regression for the main regression model of logged total out-of-pocket costs if any regular prescription drug use. Both models were estimated including 13 disease indicators variables and 14 regional dummy variables (not shown in the table).

Table 4.12. Specification tests for instrumental variables for logged weekly care hours

Model	Strengths of instruments	Test of exclusion restrictions	Exogeneity test	Conclusion[a]
Satisfaction				
Satisfaction with QOL	$F(3, 9709) = 323.27$***	chi2(2) = 1.557	$F(1, 9710) = 2.04$	Good IVs OLS
Satisfaction with health	$F(3, 9709) = 323.27$***	chi2(2) = 0.300	$F(1, 9710) = 0.54$	Good IVs OLS
Depressive symptomatology				
Feeling depressed for two weeks or more during the past year or being on anti-depressant medication	$F(3, 9723) = 326.20$***	chi2(2) = 0.973	chi2(1) = 0.22	Good IVs Probit
CES-D score	$F(3, 9666) = 332.28$***	chi2(2) = 1.957	$F(1, 9667) = 0.68$	Good IVs OLS
CES-D number of items checked ≥ 4	$F(3, 9666) = 332.28$***	chi2(2) = 2.204	chi2(1) = 0.02	Good IVs Probit
CES-D score ≥ 10	$F(3, 9666) = 332.28$***	chi2(2) = 0.899	chi2(1) = 0.03	Good IVs Probit
Body pain				
Having pain affecting daily activities	$F(3, 9709) = 323.27$***	chi2(2) = 3.168	chi2(1) = 0.01	Good IVs Probit
Self-rated health				
Fair to *poor*	$F(3, 9709) = 323.27$***	chi2(2) = 2.235	chi2(1) = 1.31	Good IVs Probit
Outpatient care use				
Any outpatient care use	$F(3, 9684) = 323.14$***	chi2(2) = 2.210	chi2(1) = 1.79	Good IVs Probit
ln(out-of-pocket costs) if any	$F(3, 6032) = 200.57$***	chi2(2) = 0.694	$F(1, 6033) = 8.48$***	Good IVs IV-2SLS
Prescription drug use				
Any prescription drug use	$F(3, 9684) = 323.14$***	chi2(2) = 0.127	chi2(1) = 0.08	Good IVs Probit
ln(out-of-pocket costs if any	$F(3, 3851) = 112.66$***	chi2(2) = 0.029	$F(1, 3852) = 4.22$**	Good IVs IV-2SLS

Notes: KLoSA (2006) respondents, excluding persons with any ADL limitation. ** Statistically significant at the 5% level *** Statistically significant at the 1% level. [a]Decisions are based on statistical significance of $p<0.05$. The instruments used were (1) whether father-in-law has any ADL limitation; (2) whether mother-in-law has any ADL limitation; and (3) whether parent(s) have any ADL limitation.

CHAPTER 5: RESULTS

Effects of Informal Care on Caregivers' Labor Market Outcomes

Fixed effects estimation

Hausman specification test comparing estimation results between random-effects LPM and fixed-effects LPM suggested that the fixed-effects estimates are preferred. I also present estimation results of fixed-effects logit model. In both estimated models, providing more hours of parental informal care is found to decrease caregiver's labor force participation (Tables 5.1-5.2). More intensive caregivers have lower probabilities of participating in the labor force, regardless of which cutoff point was used (Table 5.2). Interestingly, less intensive caregivers show no lower likelihood of labor force participation than non-caregivers. If informal caregiving were purely correlated with unobserved lower employability shared within sibling-groups, then fixed-effects estimates would be insignificant. The results suggest that, even after controlling for sibling-group effects, parental informal caregiving has negative effects on caregiving child's labor force participation.

Instrumental variables estimation

For men, the effects of informal caregiving on labor market outcomes are statistically insignificant at the 5% level in most analyses (Tables 5.3-5.17), except for two models (Table 5.6, Table 5.14). For women, providing informal care appears to have

negative effects on caregivers' labor market outcomes, but statistical significance varies by subsample and specification of care intensity. In the Adult Child sample, all four regression models using the specification of ln(1+ weekly hours of parental care) produce statistically significant Probit or IV Probit estimates (Tables 5.3-5.6). When the amount of informal care takes the functional form of two dummy variables (Tables 5.7-5.8), caregiving intensity does not have statistically significant effects on labor force participation among female caregivers.

In the Respondent sample, however, models using the specification of ln(1+ weekly hours of informal care) mostly produce statistically insignificant results at the 5% level (Tables 5.10-5.14), with one exception (Table 5.9). Results using the dummy variable specification show statistically significant estimates at the 5% level among female caregivers (Tables 5.15-5.17). The three tables show coefficient estimates for the two dummy-variable specification with different cutoffs for more intensive caregiving. These results suggest that more intensive caregiving and less intensive caregiving may have different effects in the extensive/intensive margin adjustments for labor market outcomes. For example, in Panel C of Table 5.15 and Table 5.16, more intensive caregivers, defined as caregivers providing informal care at least 20 hours per week, are less likely to be participate in *Any work* (coefficient: −0.597, $p<0.01$) or *Any paid work* (coefficient: −0.373, $p<0.1$), while less intensive caregivers do not show such effects at the extensive margin. However, among those participating in *Any work* or *Any paid work*, less intensive caregivers also experience a diminish in weekly hours worked and income. For those currently in *Any work*, being a less intensive caregiver decreases her weekly work hours by about 20.5% (coefficient: −0.205, $p<0.1$). Less intensive caregivers in *Any*

paid work earn less by about 56.7% (coefficient: −0.567, $p<0.05$). Taken together, more intensive caregivers are less likely to be in the labor force altogether. Less intensive caregivers may still participate in the labor force but experience a penalty in labor market outcomes. Table 5.17 presents results of *Any employed work* and conditional hourly wage rate for employed workers. More intensive female caregivers appear to have wage penalty even when they are employed, but these effects are statistically significant only at the 10% level.

These results from the Respondent sample suggest that threshold effects exist for care intensity. Based on these findings, I present summarized results using the dummy variable specification. Table 5.18 shows bootstrapped incremental effects of providing less intensive and more intensive care on labor market outcomes. Again, the results suggest that the effects of caregiving on labor market outcomes are concentrated among more intensive caregivers. Caregivers providing care more than 20 hours per week are less likely to participate in *Any work* by 17.4% points. Moreover, even when participating in employed work, they earn much less than otherwise similar non-caregivers.

Table 5.1. Fixed-effects LPM and logit model of LFP in the Adult Child sample, extra-residential

Independent var.	FE LPM	FE Logit
ln(1+ weekly hours of parental care)	−0.062	−0.502
	(0.025)*	(0.255)*
Demographics and socioeconomics		
Female	−0.474	−2.685
	(0.010)**	(0.078)**
Age (year)	0.022	0.224
	(0.007)**	(0.048)**
Age-squared/100	−0.028	−0.282
	(0.007)**	(0.053)**
Education (ref. Any graduate)		
Less than middle school	−0.177	−1.282
	(0.041)**	(0.347)**
Any middle school	−0.130	−0.927
	(0.038)**	(0.328)**
Any high school	−0.087	−0.587
	(0.034)*	(0.302)
Any college	0.015	0.082
	(0.033)	(0.292)
Marital status (ref. Married)		
Widow/separated/divorced	0.017	−0.070
	(0.031)	(0.180)
Never married	0.048	0.268
	(0.020)*	(0.140)
Owns a house	0.150	1.098
	(0.012)**	(0.097)**
Number of own children	−0.015	−0.111
	(0.006)*	(0.044)*
Constant	0.485	-
	(0.154)**	
Number of observations	13,568	8,837
(number of sibling-groups)	(4,597)	(2,332)

Notes: KLoSA (2006) respondents' adult children aged 25-64 who do not co-reside with their parent(s). * $p<0.05$. ** $p<0.01$. LPM is linear probability model.

Table 5.2. Estimated coefficients on dummy variables of informal care in fixed-effects LPM and logit model of LFP in the Adult Child sample, extra-residential

Independent var.	FE LPM	FE Logit
Any care (vs. No care hour)	−0.035	−0.155
	(0.038)	(0.301)
Dummy variables (ref. No care hour)		
Care < 5 hours/week	0.000	0.081
	(0.040)	(0.318)
Care ≥ 5 hours/week	−0.276	−2.139
	(0.084)**	(0.933)*
Dummy variables (ref. No care hour)		
Care < 7.5 hours/week	−0.009	−0.001
	(0.040)	(0.311)
Care ≥ 7.5 hours/week	−0.253	−1.995
	(0.089)**	(0.994)*
Dummy variables (ref. No care hour)		
Care < 10 hours/week	−0.013	−0.004
	(0.039)	(0.311)
Care ≥ 10 hours/week	−0.301	−2.556
	(0.105)**	(1.302)*

Notes: KLoSA (2006) respondents' adult children aged 25-64 who do not co-reside with their parent(s). *p<0.05. ** p<0.01. Covariates included are the same as in each corresponding model above.

Table 5.3. Probit and IV Probit of LFP in the Younger Adult Child sample (extra-residential subsample), by gender

Independent variables	Male		Female	
	Probit	IV Probit	**Probit**	IV Probit
ln(1+ weekly hours of parental care)	−0.022	0.439	−0.436	−1.120
	(0.345)	(2.158)	(0.185)*	(0.632)
Demographics and socioeconomics				
Age (year)	0.465	0.467	−0.012	−0.010
	(0.067)**	(0.068)**	(0.056)	(0.056)
Age-squared/100	−0.645	−0.648	0.022	0.021
	(0.096)**	(0.097)**	(0.078)	(0.078)
Education (ref. Any graduate)				
Less than middle school	0.176	0.179	−0.467	−0.465
	(0.234)	(0.235)	(0.180)**	(0.181)*
Any middle school	−0.056	−0.054	−0.206	−0.201
	(0.169)	(0.169)	(0.158)	(0.158)
Any high school	0.414	0.411	−0.270	−0.263
	(0.137)**	(0.137)**	(0.137)*	(0.138)
Any college	0.370	0.368	0.075	0.083
	(0.130)**	(0.131)**	(0.135)	(0.135)
Marital status (ref. Married)				
Widow/separated/divorced	−0.747	−0.749	0.597	0.588
	(0.157)**	(0.158)**	(0.153)**	(0.153)**
Never married	−0.646	−0.645	0.951	0.951
	(0.085)**	(0.085)**	(0.078)**	(0.078)**
Owns a house	0.592	0.594	0.516	0.521
	(0.080)**	(0.081)**	(0.053)**	(0.054)**
Number of own children	−0.052	−0.053	−0.107	−0.110
	(0.039)	(0.039)	(0.027)**	(0.027)**
Parents' characteristics				
Currently married	−0.093	−0.092	−0.153	−0.147
	(0.069)	(0.069)	(0.048)**	(0.048)**
At least middle school	0.034	0.036	−0.021	−0.023
	(0.065)	(0.065)	(0.048)	(0.048)
Owns a house	−0.063	−0.063	−0.107	−0.103
	(0.108)	(0.108)	(0.083)	(0.084)
Constant	−7.010	−7.050	0.067	0.032
	(1.188)**	(1.203)**	(0.997)	(1.002)
N	4,190		4,475	

Notes: KLoSA (2006) respondents' adult children aged 25-44, extra-residential subsample only. Standard errors in parentheses. * $p<0.05$. ** $p<0.01$. Parental total assets dummies and regional dummies are included but not shown.

Table 5.4. Probit and IV Probit of LFP in the Younger Adult Child sample (co-residential subsample), by gender

Independent variables	Male		Female	
	Probit	IV Probit	**Probit**	IV Probit
ln(1+ weekly hours of parental care)	−0.074	0.271	−0.204	−0.071
	(0.096)	(0.225)	(0.094)*	(0.189)
Demographics and socioeconomics				
Age (year)	0.559	0.561	0.239	0.243
	(0.087)**	(0.087)**	(0.117)*	(0.118)*
Age-squared/100	−0.770	−0.776	−0.368	−0.377
	(0.130)**	(0.130)**	(0.178)*	(0.179)*
Education (ref. Any graduate)				
Less than middle school	−0.954	−0.966	0.442	0.339
	(0.380)*	(0.381)*	(0.558)	(0.578)
Any middle school	−0.699	−0.747	−0.180	−0.188
	(0.306)*	(0.311)*	(0.423)	(0.425)
Any high school	−0.076	−0.090	0.394	0.385
	(0.239)	(0.240)	(0.251)	(0.252)
Any college	−0.079	−0.090	0.815	0.804
	(0.231)	(0.233)	(0.239)**	(0.240)**
Marital status (ref. Married)				
Widow/separated/divorced	−0.336	−0.344	0.389	0.413
	(0.218)	(0.219)	(0.267)	(0.269)
Never married	−0.387	−0.421	0.185	0.224
	(0.185)*	(0.187)*	(0.222)	(0.231)
Owns a house	0.463	0.452	0.150	0.145
	(0.147)**	(0.148)**	(0.209)	(0.210)
Number of own children	0.168	0.167	0.007	0.013
	(0.099)	(0.100)	(0.090)	(0.093)
Parents' characteristics				
Currently married	0.000	0.013	0.065	0.078
	(0.096)	(0.097)	(0.129)	(0.131)
At least middle school	−0.044	−0.041	0.050	0.040
	(0.089)	(0.089)	(0.120)	(0.121)
Owns a house	0.130	0.130	0.154	0.175
	(0.177)	(0.178)	(0.221)	(0.222)
Constant	−8.908	−8.887	−4.048	−4.157
	(1.489)**	(1.497)**	(1.943)*	(1.956)*
N	1,586		895	

Notes: KLoSA (2006) respondents' adult children aged 25-44, co-residential subsample only. Standard errors in parentheses. * $p<0.05$. ** $p<0.01$. Parental total assets dummies and regional dummies are included but not shown.

Table 5.5. Probit and IV Probit of LFP in the Younger Adult Child sample (both co- and extra-residential), by gender

Independent variables	Male		Female	
	Probit	IV Probit	**Probit**	IV Probit
ln(1+ weekly hours of parental care)	−0.088	0.377	−0.206	−0.409
	(0.089)	(0.433)	(0.080)**	(0.290)
Co-reside with parent(s)	−0.196	−0.220	0.148	0.173
	(0.051)**	(0.055)**	(0.064)*	(0.073)*
Demographics and socioeconomics				
Age (year)	0.508	0.504	0.024	0.027
	(0.051)**	(0.051)**	(0.047)	(0.047)
Age-squared/100	−0.702	−0.697	−0.031	−0.035
	(0.074)**	(0.074)**	(0.066)	(0.067)
Education (ref. Any graduate)				
Less than middle school	−0.153	−0.155	−0.310	−0.301
	(0.195)	(0.196)	(0.165)	(0.165)
Any middle school	−0.208	−0.217	−0.087	−0.084
	(0.147)	(0.148)	(0.141)	(0.141)
Any high school	0.296	0.293	−0.118	−0.114
	(0.119)*	(0.119)*	(0.119)	(0.120)
Any college	0.268	0.265	0.242	0.246
	(0.114)*	(0.114)*	(0.117)*	(0.117)*
Marital status (ref. Married)				
Widow/separated/divorced	−0.553	−0.556	0.679	0.681
	(0.124)**	(0.124)**	(0.128)**	(0.128)**
Never married	−0.600	−0.609	0.849	0.840
	(0.075)**	(0.075)**	(0.071)**	(0.072)**
Owns a house	0.561	0.558	0.505	0.508
	(0.070)**	(0.070)**	(0.051)**	(0.052)**
Number of own children	−0.016	−0.016	−0.093	−0.095
	(0.035)	(0.035)	(0.025)**	(0.026)**
Parents' characteristics				
Currently married	−0.055	−0.050	−0.126	−0.128
	(0.055)	(0.056)	(0.045)**	(0.045)**
At least middle school	0.006	0.008	−0.023	−0.022
	(0.052)	(0.052)	(0.044)	(0.044)
Owns a house	−0.028	−0.028	−0.070	−0.073
	(0.091)	(0.091)	(0.078)	(0.078)
Constant	−7.767	−7.673	−0.672	−0.733
	(0.895)**	(0.902)**	(0.838)	(0.843)
N	5,776		5,370	

Notes: KLoSA (2006) respondents' adult children aged 45-64. Preferred models are in bold. Standard errors in parentheses. * $p<0.05$. ** $p<0.01$. Parental total assets dummies and regional dummies are included but not shown.

Table 5.6. Probit and IV Probit of LFP in the Midlife Adult Child sample (1), by gender

Independent variables	Male		Female	
	Probit	**IV Probit**	Probit	**IV Probit**
ln(1+ weekly hours of parental care)	−0.015	0.802	−0.087	−0.983
	(0.071)	(0.319)*	(0.079)	(0.398)*
Co-reside with parent(s)	−0.110	−0.327	0.551	1.107
	(0.082)	(0.118)**	(0.139)**	(0.282)**
Demographics and socioeconomics				
Age (year)	0.577	0.647	0.352	0.326
	(0.127)**	(0.133)**	(0.129)**	(0.132)*
Age-squared/100	−0.587	−0.661	−0.389	−0.361
	(0.119)**	(0.126)**	(0.124)**	(0.127)**
Education (ref. Any graduate)				
Less than middle school	−1.044	−0.993	−1.129	−1.089
	(0.352)**	(0.353)**	(0.427)**	(0.438)*
Any middle school	−0.727	−0.682	−1.247	−1.208
	(0.352)*	(0.352)	(0.427)**	(0.437)**
Any high school	−0.671	−0.626	−1.256	−1.216
	(0.345)	(0.345)	(0.423)**	(0.433)**
Any college	−0.621	−0.585	−0.893	−0.809
	(0.346)	(0.346)	(0.425)*	(0.436)
Marital status (ref. Married)				
Widow/separated/divorced	−0.791	−0.828	0.403	0.427
	(0.119)**	(0.124)**	(0.113)**	(0.117)**
Never married	−0.684	−0.704	0.198	−0.006
	(0.162)**	(0.167)**	(0.184)	(0.210)
Owns a house	0.655	0.656	0.637	0.659
	(0.073)**	(0.074)**	(0.059)**	(0.061)**
Number of own children	0.019	0.017	−0.068	−0.077
	(0.042)	(0.043)	(0.035)	(0.036)*
Parents' characteristics				
Currently married	−0.104	−0.127	−0.082	−0.097
	(0.073)	(0.075)	(0.062)	(0.064)
At least middle school	−0.033	−0.025	−0.187	−0.211
	(0.093)	(0.095)	(0.078)*	(0.081)**
Owns a house	0.064	0.045	−0.212	−0.261
	(0.118)	(0.120)	(0.094)*	(0.099)**
Constant	−12.273	−13.973	−7.327	−6.696
	(3.391)**	(3.532)**	(3.364)*	(3.452)
N	2,910		2,726	

Notes: KLoSA (2006) respondents' adult children aged 45-64. Standard errors in parentheses. * $p<0.05$. ** $p<0.01$. *** $p<0.001$. Parental total assets dummies and regional dummies are included but not shown.

Table 5.7. Probit and IV Probit of LFP in the Midlife Adult Child sample (2), by gender

Independent variables	Male		Female	
	Probit	**IV Probit**	Probit	**IV Probit**
Dummy for care intensity (ref. none)				
0 < Weekly hours of parental care < 5	−0.103	0.408	−0.185	−1.956
	(0.165)	(0.935)	(0.202)	(2.948)
Weekly hours of parental care ≥ 5	0.170	2.698	−0.150	−1.739
	(0.231)	(1.619)	(0.266)	(4.672)
Co-reside with parent(s)	−0.117	−0.326	0.533	0.886
	(0.082)	(0.117)**	(0.140)**	(0.756)
Demographics and socioeconomics				
Age (year)	0.586	0.671	0.353	0.349
	(0.127)**	(0.143)**	(0.129)**	(0.151)*
Age-squared/100	−0.596	−0.684	−0.390	−0.384
	(0.120)**	(0.136)**	(0.124)**	(0.148)**
Education (ref. Any graduate)				
Less than middle school	−1.054	−1.033	−1.130	−1.095
	(0.354)**	(0.355)**	(0.428)**	(0.436)*
Any middle school	−0.737	−0.732	−1.247	−1.196
	(0.353)*	(0.356)*	(0.427)**	(0.438)**
Any high school	−0.681	−0.680	−1.256	−1.215
	(0.346)*	(0.350)	(0.423)**	(0.432)**
Any college	−0.628	−0.621	−0.894	−0.826
	(0.347)	(0.348)	(0.425)*	(0.438)
Marital status (ref. Married)				
Widow/separated/divorced	−0.793	−0.829	0.404	0.433
	(0.119)**	(0.124)**	(0.113)**	(0.130)**
Never married	−0.689	−0.708	0.202	0.049
	(0.162)**	(0.173)**	(0.184)	(0.307)
Owns a house	0.658	0.658	0.638	0.668
	(0.073)**	(0.076)**	(0.059)**	(0.069)**
Number of own children	0.019	0.018	−0.068	−0.072
	(0.042)	(0.043)	(0.035)	(0.038)
Parents' characteristics				
Currently married	−0.105	−0.131	−0.083	−0.102
	(0.073)	(0.075)	(0.062)	(0.064)
At least middle school	−0.036	−0.033	−0.187	−0.197
	(0.093)	(0.097)	(0.078)*	(0.095)*
Owns a house	0.060	0.025	−0.212	−0.264
	(0.118)	(0.122)	(0.094)*	(0.100)**
Constant	−12.476	−14.522	−7.351	−7.279
	(3.394)**	(3.755)**	(3.364)*	(3.940)
N	2,910		2,726	

Notes: KLoSA (2006) respondents' adult children aged 45-64. Standard errors in parentheses. * $p<0.05$. ** $p<0.01$. *** $p<0.001$. Parental total assets dummies and regional dummies are included but not shown.

Table 5.8. Coefficient estimates in Probit/IV Probit of LFP in the Midlife Adult Child sample

Dependent var. & Key explanatory dummy var.	Male (*N*=2, 910)		Female (*N*=2, 726)	
	Coefficient	Std. Error	Coefficient	Std. Error
Panel A: cutoff at 5 hours per week				
Probit of LFP				
0 < Weekly hours of parental care < 5	0.103	(0.165)	−0.185	(0.202)
Weekly hours of parental care ≥ 5	0.170	(0.268)	−0.150	(0.266)
IV Probit of LFP				
0 < Weekly hours of parental care < 5	**0.408**	**(0.935)**	**−1.956**	**(2.948)**
Weekly hours of parental care ≥ 5	**2.698**	**(1.619)**	**−1.739**	**(4.672)**
Panel B: cutoff at 7.5 hours per week				
Probit of LFP				
0 < Weekly hours of parental care <7.5	0.075	(0.158)	−0.170	(0.196)
Weekly hours of parental care ≥ 7.5	−0.318	(0.275)	−0.179	(0.278)
IV Probit of LFP				
0 < Weekly hours of parental care < 7.5	**0.305**	**(1.000)**	**−3.666**	**(2.740)**
Weekly hours of parental care ≥ 7.5	**4.827**	**(3.513)**	**1.348**	**(4.792)**
Panel C: cutoff at 10 hours per week				
Probit of LFP				
0 < Weekly hours of parental care < 10	0.060	(0.154)	−0.119	(0.190)
Weekly hours of parental care ≥ 10	−0.338	(0.301)	−0.308	(0.297)
IV Probit of LFP				
0 < Weekly hours of parental care < 10	**0.332**	**(0.987)**	**−3.159**	**(2.043)**
Weekly hours of parental care ≥ 10	**5.936**	**(4.600)**	**0.708**	**(3.896)**

Notes: KLoSA (2006) respondents aged 45-64. Preferred estimates are in bold, but none are statistically significant at the 10% level.

Table 5.9. Probit and IV Probit of Any work in the Respondent sample, by gender

Independent variables	Male		Female	
	Probit	IV Probit	**Probit**	IV Probit
ln(1+ weekly hours of informal care)	−0.059	0.212	−0.110	0.062
	(0.072)	(0.200)	(0.046)*	(0.124)
Demographics and socioeconomics				
Co-reside with parent(s)	−0.137	−0.174	0.280	0.244
	(0.081)	(0.085)*	(0.075)**	(0.078)**
Age (year)	−0.023	−0.029	−0.036	−0.034
	(0.113)	(0.114)	(0.085)	(0.085)
Age-squared/100	−0.052	−0.047	−0.013	−0.016
	(0.103)	(0.103)	(0.078)	(0.078)
Currently married	0.591	0.594	−0.246	−0.252
	(0.111)**	(0.112)**	(0.068)**	(0.069)**
Education (ref. College)				
Elementary school	−0.051	−0.051	0.043	0.036
	(0.107)	(0.107)	(0.107)	(0.107)
Middle school	0.085	0.088	0.024	0.015
	(0.102)	(0.102)	(0.103)	(0.104)
High school	0.054	0.055	−0.063	−0.067
	(0.086)	(0.086)	(0.094)	(0.095)
Total assets quintile (ref. Quintile 5)				
Quintile 1	−0.402	−0.410	0.189	0.175
	(0.166)*	(0.166)*	(0.125)	(0.126)
Quintile 2	−0.177	−0.180	0.258	0.249
	(0.109)	(0.109)	(0.085)**	(0.086)**
Quintile 3	−0.075	−0.079	0.225	0.220
	(0.095)	(0.096)	(0.076)**	(0.077)**
Quintile 4	−0.141	−0.136	0.132	0.129
	(0.088)	(0.088)	(0.073)	(0.073)
Owns a house	−0.131	−0.140	−0.036	−0.037
	(0.136)	(0.136)	(0.098)	(0.098)
Disability	−0.617	−0.620	−0.367	−0.378
	(0.107)**	(0.108)**	(0.137)**	(0.138)**
Poor self-rated health	−0.790	−0.799	−0.269	−0.275
	(0.080)**	(0.081)**	(0.061)**	(0.062)**
Other parental characteristics				
Both parents live together	0.313	0.304	0.027	0.024
	(0.142)*	(0.143)*	(0.085)	(0.086)
Parent(s) owns a house	−0.086	−0.097	−0.150	−0.150
	(0.097)	(0.098)	(0.073)*	(0.073)*
Parent(s) no formal education	−0.061	−0.064	0.062	0.063
	(0.065)	(0.065)	(0.053)	(0.053)
Constant	3.407	3.607	1.933	1.870
	(3.102)	(3.115)	(2.290)	(2.300)
N	2,728		3,366	

Notes: KLoSA (2006) respondents aged 45-64. Standard errors in parentheses. * $p<0.05$. ** $p<0.01$.

Table 5.10. OLS and IV-2SLS models for logged weekly hours worked in the Respondent sample, by gender

Independent variables	Male		Female	
	OLS	IV-2SLS	**OLS**	IV-2SLS
ln(1+ weekly hours of informal care)	−0.005	0.043	−0.017	−0.133
	(0.032)	(0.085)	(0.037)	(0.092)
Demographics and socioeconomics				
Co-reside with parent(s)	0.060	0.056	−0.047	−0.027
	(0.027)*	(0.028)*	(0.046)	(0.049)
Age (year)	0.038	0.037	0.062	0.069
	(0.038)	(0.038)	(0.059)	(0.059)
Age-squared/100	−0.041	−0.040	−0.066	−0.072
	(0.035)	(0.035)	(0.054)	(0.055)
Currently married	0.013	0.011	0.003	0.002
	(0.048)	(0.048)	(0.045)	(0.045)
Education (ref. College)				
Elementary school	−0.029	−0.029	0.163	0.161
	(0.039)	(0.039)	(0.071)*	(0.071)*
Middle school	0.040	0.040	0.209	0.214
	(0.034)	(0.034)	(0.068)**	(0.069)**
High school	0.060	0.061	0.186	0.185
	(0.026)*	(0.026)*	(0.063)**	(0.063)**
Total assets quintile (ref. Quintile 5)				
Quintile 1	0.009	0.009	0.025	0.024
	(0.054)	(0.054)	(0.086)	(0.086)
Quintile 2	0.053	0.053	0.013	0.012
	(0.037)	(0.037)	(0.059)	(0.060)
Quintile 3	0.043	0.043	0.062	0.061
	(0.031)	(0.031)	(0.054)	(0.054)
Quintile 4	0.053	0.055	0.049	0.048
	(0.029)	(0.029)	(0.052)	(0.052)
Owns a house	0.015	0.014	−0.014	−0.015
	(0.041)	(0.042)	(0.065)	(0.065)
Disability	−0.110	−0.109	−0.230	−0.227
	(0.051)*	(0.051)*	(0.105)*	(0.105)*
Poor self-rated health	0.013	0.012	0.066	0.069
	(0.038)	(0.038)	(0.043)	(0.043)
Other parental characteristics				
Both parents live together	0.065	0.064	0.034	0.040
	(0.037)	(0.037)	(0.056)	(0.056)
Parent(s) owns a house	−0.048	−0.049	0.006	0.004
	(0.030)	(0.030)	(0.049)	(0.049)
Parent(s) no formal education	0.044	0.043	0.014	0.018
	(0.022)*	(0.022)*	(0.036)	(0.037)
Constant	2.886	2.917	2.191	1.983
	(1.007)**	(1.009)**	(1.574)	(1.588)
N	2,035		1,169	

Notes: KLoSA (2006) respondents aged 45-64, Any work subsample only. Standard errors in parentheses. * $p<0.05$. ** $p<0.01$.

Table 5.11. Probit and IV Probit of Any paid work in the Respondent sample, by gender

Independent variables	Male		Female	
	Probit	IV Probit	**Probit**	IV Probit
ln(1+ weekly hours of informal care)	−0.085	0.177	−0.064	0.110
	(0.073)	(0.197)	(0.046)	(0.127)
Demographics				
Co-reside with parent(s)	−0.147	−0.183	0.134	0.099
	(0.080)	(0.085)*	(0.077)	(0.081)
Age (year)	−0.070	−0.076	0.029	0.031
	(0.113)	(0.113)	(0.088)	(0.088)
Age-squared/100	−0.010	−0.005	−0.079	−0.081
	(0.102)	(0.102)	(0.081)	(0.082)
Currently married	0.584	0.586	−0.422	−0.428
	(0.111)**	(0.112)**	(0.069)**	(0.069)**
Education (ref. College)				
Elementary school	−0.040	−0.039	−0.054	−0.061
	(0.106)	(0.106)	(0.108)	(0.109)
Middle school	0.065	0.068	−0.096	−0.105
	(0.101)	(0.101)	(0.105)	(0.105)
High school	0.040	0.041	−0.148	−0.152
	(0.086)	(0.086)	(0.096)	(0.096)
Total assets quintile (ref. Quintile 5)				
Quintile 1	−0.460	−0.468	0.214	0.199
	(0.165)**	(0.166)**	(0.128)	(0.129)
Quintile 2	−0.180	−0.184	0.271	0.262
	(0.108)	(0.108)	(0.088)**	(0.089)**
Quintile 3	−0.087	−0.091	0.247	0.241
	(0.095)	(0.095)	(0.079)**	(0.079)**
Quintile 4	−0.153	−0.148	0.110	0.107
	(0.087)	(0.088)	(0.076)	(0.076)
Owns a house	−0.159	−0.167	−0.047	−0.049
	(0.136)	(0.136)	(0.100)	(0.100)
Disability	−0.603	−0.606	−0.264	−0.275
	(0.107)**	(0.108)**	(0.140)	(0.140)
Poor self-rated health	−0.789	−0.797	−0.224	−0.230
	(0.080)**	(0.081)**	(0.063)**	(0.064)**
Other parental characteristics				
Both parents live together	0.304	0.296	−0.048	−0.051
	(0.141)*	(0.142)*	(0.087)	(0.087)
Parent(s) owns a house	−0.079	−0.089	−0.098	−0.099
	(0.097)	(0.097)	(0.075)	(0.075)
Parent(s) no formal education	−0.072	−0.075	0.012	0.013
	(0.065)	(0.065)	(0.055)	(0.055)
Constant	4.763	4.948	0.487	0.439
	(3.087)	(3.100)	(2.372)	(2.380)
N	2,728		3,366	

Notes: KLoSA (2006) respondents aged 45-64. Standard errors in parentheses. $p<0.05$. ** $p<0.01$.

Table 5.12. OLS and IV-2SLS models for logged monthly income in the Respondent sample, by gender

Independent variables	Male		Female	
	OLS	IV-2SLS	**OLS**	IV-2SLS
ln(1+ weekly hours of informal care)	−0.050	−0.147	−0.111	−0.212
	(0.084)	(0.216)	(0.083)	(0.203)
Demographics				
Co-reside with parent(s)	−0.067	−0.058	0.107	0.127
	(0.074)	(0.076)	(0.115)	(0.121)
Age (year)	0.147	0.149	0.241	0.247
	(0.100)	(0.100)	(0.143)	(0.144)
Age-squared/100	−0.172	−0.174	−0.252	−0.257
	(0.093)	(0.093)	(0.133)	(0.134)
Currently married	0.166	0.169	−0.040	−0.041
	(0.128)	(0.128)	(0.101)	(0.101)
Education (ref. College)				
Elementary school	−0.475	−0.476	−0.338	−0.337
	(0.103)**	(0.103)**	(0.167)*	(0.167)*
Middle school	−0.286	−0.288	−0.343	−0.337
	(0.090)**	(0.090)**	(0.160)*	(0.161)*
High school	−0.284	−0.286	−0.144	−0.145
	(0.071)**	(0.071)**	(0.147)	(0.147)
Total assets quintile (ref. Quintile 5)				
Quintile 1	−0.808	−0.807	−0.520	−0.524
	(0.143)**	(0.143)**	(0.199)**	(0.199)**
Quintile 2	−0.501	−0.502	−0.282	−0.284
	(0.098)**	(0.098)**	(0.143)*	(0.143)*
Quintile 3	−0.277	−0.277	−0.298	−0.300
	(0.082)**	(0.082)**	(0.129)*	(0.129)*
Quintile 4	−0.251	−0.255	−0.114	−0.115
	(0.078)**	(0.078)**	(0.127)	(0.127)
Owns a house	−0.136	−0.134	−0.275	−0.276
	(0.109)	(0.110)	(0.149)	(0.149)
Disability	−0.093	−0.097	−0.183	−0.181
	(0.134)	(0.135)	(0.235)	(0.235)
Poor self-rated health	−0.300	−0.299	−0.123	−0.121
	(0.101)**	(0.101)**	(0.103)	(0.103)
Other parental characteristics				
Both parents live together	0.043	0.046	0.037	0.045
	(0.098)	(0.099)	(0.132)	(0.132)
Parent(s) owns a house	0.201	0.203	0.196	0.194
	(0.080)*	(0.080)*	(0.113)	(0.113)
Parent(s) no formal education	−0.018	−0.016	−0.065	−0.062
	(0.058)	(0.058)	(0.086)	(0.086)
Constant	2.600	2.537	−0.603	−0.762
	(2.689)	(2.693)	(3.819)	(3.833)
N	1,950		951	

Notes: KLoSA (2006) respondents aged 45-64, Any paid work subsample only. Standard errors in parentheses. $p<0.05$. ** $p<0.01$.

Table 5.13. Probit and IV Probit of Any employed work in the Respondent sample, by gender

Independent variables	Male		Female	
	Probit	IV Probit	**Probit**	IV Probit
ln(1+ weekly hours of informal care)	−0.022	−0.097	−0.065	0.003
	(0.073)	(0.164)	(0.052)	(0.149)
Demographics				
Co-reside with parent(s)	−0.074	−0.064	0.130	0.119
	(0.071)	(0.074)	(0.084)	(0.088)
Age (year)	0.123	0.125	−0.033	−0.031
	(0.095)	(0.095)	(0.099)	(0.099)
Age-squared/100	−0.149	−0.151	−0.022	−0.023
	(0.087)	(0.087)	(0.091)	(0.091)
Currently married	0.163	0.163	−0.190	−0.192
	(0.108)	(0.108)	(0.076)*	(0.076)*
Education (ref. College)				
Elementary school	−0.171	−0.171	−0.012	−0.015
	(0.095)	(0.095)	(0.119)	(0.119)
Middle school	−0.222	−0.224	−0.037	−0.041
	(0.086)*	(0.086)**	(0.114)	(0.115)
High school	−0.258	−0.258	−0.196	−0.196
	(0.069)**	(0.069)**	(0.105)	(0.105)
Total assets quintile (ref. Quintile 5)				
Quintile 1	0.168	0.170	0.487	0.483
	(0.138)	(0.138)	(0.143)**	(0.143)**
Quintile 2	0.053	0.054	0.429	0.425
	(0.094)	(0.095)	(0.100)**	(0.100)**
Quintile 3	0.176	0.177	0.374	0.371
	(0.081)*	(0.081)*	(0.090)**	(0.090)**
Quintile 4	−0.015	−0.016	0.202	0.200
	(0.076)	(0.076)	(0.087)*	(0.087)*
Owns a house	0.131	0.134	0.065	0.066
	(0.108)	(0.108)	(0.110)	(0.110)
Disability	−0.359	−0.357	−0.268	−0.273
	(0.113)**	(0.113)**	(0.160)	(0.160)
Poor self-rated health	−0.552	−0.550	−0.188	−0.190
	(0.085)**	(0.085)**	(0.071)**	(0.072)**
Other parental characteristics				
Both parents live together	0.140	0.143	−0.007	−0.008
	(0.099)	(0.100)	(0.094)	(0.094)
Parent(s) owns a house	0.017	0.018	−0.085	−0.086
	(0.079)	(0.079)	(0.082)	(0.082)
Parent(s) no formal education	0.066	0.067	−0.031	−0.030
	(0.056)	(0.056)	(0.061)	(0.061)
Constant	−2.525	−2.576	1.375	1.334
	(2.563)	(2.566)	(2.646)	(2.649)
N	2,728		3,366	

Notes: KLoSA (2006) respondents aged 45-64. Standard errors in parentheses. $p<0.05$. ** $p<0.01$.

Table 5.14. OLS and IV-2SLS models for logged hourly wage rate in the Respondent sample, by gender

Independent variables	Male		Female	
	OLS	IV-2SLS	**OLS**	IV-2SLS
ln(1+ weekly hours of informal care)	0.060	0.030	−0.037	−0.016
	(0.028)*	(0.071)	(0.020)	(0.046)
Demographics				
Co-reside with parent(s)	−0.015	−0.012	0.030	0.026
	(0.026)	(0.027)	(0.027)	(0.028)
Age (year)	0.086	0.086	0.023	0.022
	(0.034)*	(0.034)*	(0.034)	(0.034)
Age-squared/100	−0.089	−0.089	−0.023	−0.022
	(0.032)**	(0.032)**	(0.032)	(0.032)
Currently married	0.100	0.101	−0.035	−0.035
	(0.042)*	(0.042)*	(0.024)	(0.024)
Education (ref. College)				
Elementary school	−0.329	−0.331	−0.360	−0.359
	(0.035)**	(0.036)**	(0.039)**	(0.040)**
Middle school	−0.331	−0.333	−0.364	−0.365
	(0.033)**	(0.033)**	(0.037)**	(0.037)**
High school	−0.272	−0.274	−0.300	−0.298
	(0.025)**	(0.025)**	(0.035)**	(0.035)**
Total assets quintile (ref. Quintile 5)				
Quintile 1	−0.258	−0.257	−0.165	−0.165
	(0.050)**	(0.050)**	(0.047)**	(0.047)**
Quintile 2	−0.177	−0.177	−0.094	−0.094
	(0.035)**	(0.035)**	(0.035)**	(0.035)**
Quintile 3	−0.143	−0.142	−0.036	−0.037
	(0.029)**	(0.029)**	(0.032)	(0.032)
Quintile 4	−0.086	−0.087	−0.060	−0.062
	(0.028)**	(0.028)**	(0.031)	(0.032)
Owns a house	−0.027	−0.027	−0.037	−0.036
	(0.038)	(0.038)	(0.035)	(0.035)
Disability	0.036	0.035	−0.056	−0.057
	(0.048)	(0.049)	(0.056)	(0.057)
Poor self-rated health	−0.093	−0.092	−0.041	−0.042
	(0.036)**	(0.036)*	(0.024)	(0.024)
Other parental characteristics				
Both parents live together	−0.034	−0.033	−0.005	−0.008
	(0.033)	(0.033)	(0.030)	(0.030)
Parent(s) owns a house	0.073	0.074	0.018	0.019
	(0.027)**	(0.028)**	(0.026)	(0.026)
Parent(s) no formal education	−0.037	−0.036	−0.024	−0.024
	(0.020)	(0.020)	(0.020)	(0.020)
Constant	−1.072	−1.087	0.356	0.374
	(0.922)	(0.923)	(0.904)	(0.906)
N	1,044		582	

Notes: KLoSA (2006) respondents aged 45-64, Any employed work subsample only. Standard errors in parentheses. $p<0.05$. ** $p<0.01$.

Table 5.15. Coefficient estimates in Probit models of Any work and OLS models of conditional logged weekly hours worked in the Respondent sample

Dependent var. & Key explanatory dummy var.	Male		Female	
	Coefficient	Std. Error	Coefficient	Std. Error
Panel A: cutoff at 10 hours per week				
Any work				
0 < Informal care hours < 10	0.024	(0.267)	0.167	(0.184)
Informal care hours ≥ 10	−0.304	(0.268)	−0.506	(0.184)**
ln(weekly work hours) if any work				
0 < Informal care hours < 10	0.102	(0.088)	−0.273	(0.119)*
Informal care hours ≥ 10	−0.029	(0.124)	−0.018	(0.144)
Panel B: cutoff at 15 hours per week				
Any work				
0 < Informal care hours < 15	−0.044	(0.243)	0.118	(0.168)
Informal care hours ≥ 15	−0.279	(0.298)	−0.597	(0.207)**
ln(weekly work hours) if any work				
0 < Informal care hours < 15	0.107	(0.083)	−0.175	(0.110)
Informal care hours ≥ 15	−0.081	(0.141)	−0.158	(0.169)
Panel C: cutoff at 20 hours per week				
Any work				
0 < Informal care hours <20	−0.122	(0.229)	0.068	(0.162)
Informal care hours ≥ 20	−0.166	(0.326)	−0.597	(0.218)**
ln(weekly work hours) if any work				
0 < Informal care hours < 20	0.117	(0.082)	−0.205	(0.108)†
Informal care hours ≥ 20	−0.138	(0.149)	−0.072	(0.179)

Notes: KLoSA (2006) respondents aged 45-64. Conditional hours models used Any work subsample only.
† Statistically significant at the 10% level. $p<0.05$. ** $p<0.01$.

Table 5.16. Coefficient estimates in Probit models of Any paid work and OLS models of conditional logged monthly income in the Respondent sample

Dependent var. & Key explanatory dummy var.	Male		Female	
	Coefficient	Std. Error	Coefficient	Std. Error
Panel A: cutoff at 10 hours per week				
Any paid work				
0 < Informal care hours < 10	0.064	(0.267)	0.309	(0.185)†
Informal care hours ≥ 10	−0.411	(0.272)	−0.375	(0.187)*
ln(monthly income) if any paid work				
0 < Informal care hours < 10	0.048	(0.229)	−0.411	(0.265)
Informal care hours ≥ 10	−0.272	(0.322)	−0.400	(0.333)
Panel B: cutoff at 15 hours per week				
Any paid work				
0 < Informal care hours < 15	−0.010	(0.243)	0.202	(0.169)
Informal care hours ≥ 15	−0.412	(0.304)	−0.381	(0.206)†
ln(monthly income) if any paid work				
0 < Informal care hours < 15	0.034	(0.217)	−0.548	(0.253)**
Informal care hours ≥ 15	−0.327	(0.367)	−0.110	(0.363)
Panel C: cutoff at 20 hours per week				
Any paid work				
0 < Informal care hours < 20	−0.084	(0.229)	0.156	(0.163)
Informal care hours ≥ 20	−0.333	(0.331)	−0.373	(0.216)†
ln(monthly income) if any paid work				
0 < Informal care hours < 20	0.010	(0.214)	−0.567	(0.246)*
Informal care hours ≥ 20	−0.286	(0.387)	−0.009	(0.384)

Notes: KLoSA (2006) respondents aged 45-64. Conditional income models used Any paid work subsample only. † $p<0.10$ * $p<0.05$ ** $p<0.01$

Table 5.17. Coefficient estimates in Probit models of Any employed work and OLS models of conditional logged hourly wage rate in the Respondent sample

Dependent var. & Key explanatory dummy var.	Male		Female	
	Coefficient	Std. Error	Coefficient	Std. Error
Panel A: cutoff at 10 hours per week				
Any employed work				
0 < Informal care hours < 10	−0.140	(0.233)	0.207	(0.201)
Informal care hours ≥ 10	−0.065	(0.272)	−0.437	(0.226)†
ln(hourly wage rate) if employed				
0 < Informal care hours < 10	0.168	(0.086)†	−0.014	(0.062)
Informal care hours ≥ 10	0.099	(0.105)	−0.151	(0.085)†
Panel B: cutoff at 15 hours per week				
Any employed work				
0 < Informal care hours < 15	−0.095	(0.217)	0.064	(0.191)
Informal care hours ≥ 15	−0.136	(0.308)	−0.336	(0.235)
ln(hourly wage rate) if employed				
0 < Informal care hours < 15	0.123	(0.080)	−0.014	(0.062)
Informal care hours ≥ 15	0.180	(0.120)	−0.151	(0.085)†
Panel C: cutoff at 20 hours per week				
Any employed work				
0 < Informal care hours < 20	−0.157	(0.211)	0.049	(0.184)
Informal care hours ≥ 20	0.011	(0.325)	−0.362	(0.251)
ln(hourly wage rate) if employed				
0 < Informal care hours < 20	0.123	(0.080)	−0.016	(0.060)
Informal care hours ≥ 20	0.180	(0.120)	−0.176	(0.094)†

Notes: KLoSA (2006) respondents aged 45-64. Conditional income models used Any paid work subsample only. † $p<0.10$

Table 5.18. Bootstrapped incremental effects of informal care on labor market outcomes in the Respondent sample

	Male	[95% C.I.]	Female	[95% C.I.]
***Panel A1:* 0 < Weekly care hours < 10**				
Pr(Any work)	0.010	[−0.163, 0.149]	0.060	[−0.075, 0.206]
E(weekly hours worked | hours > 0)	5.458	[−3.390, 15.34]	−12.23	[−27.21, 3.598]
E(weekly hours worked)	4.551	[−5.936, 14.00]	−1.645	[−11.91, 6.203]
Pr(Any employed work)	−0.025	[−0.184, 0.148]	0.060	[−0.041, 0.194]
E(hourly wage rate | wage > 0)	0.415	[−0.147, 1.300]	−0.034	[−0.202, 0.182]
E(hourly wage rate)	0.127	[−0.206, 0.439]	0.029	[−0.040, 0.109]
***Panel A2:* Weekly care hours ≥ 10**				
Pr(Any work)	−0.117	[−0.307, 0.036]	−0.152*	[−0.238, −0.050]
E(weekly hours worked | hours > 0)	−1.437	[−16.89, 12.66]	−0.833	[−14.82, 20.67]
E(weekly hours worked)	−6.671	[−20.83, 3.786]	−7.660	[−15.58, 0.284]
Pr(Any employed work)	0.004	[−0.181, 0.188]	−0.082*	[−0.142, −0.007]
E(hourly wage rate | wage > 0)	0.367	[−0.237, 1.243]	−0.165*	[−0.265, −0.066]
E(hourly wage rate)	0.144	[−0.306, 0.506]	−0.077*	[−0.127, −0.033]
***Panel B1:* 0 < Weekly care hours < 20**				
Pr(Any work)	−0.028	[−0.175, 0.094]	0.025	[−0.084, 0.154]
E(weekly hours worked | hours > 0)	6.312	[−2.965, 13.95]	−10.38	[−22.82, 4.813]
E(weekly hours worked)	3.406	[−6.897, 11.34]	−2.368	[−10.29, 4.508]
Pr(Any employed work)	−0.031	[−0.185, 0.121]	0.016	[−0.065, 0.118]
E(hourly wage rate | wage > 0)	0.317	[−0.167, 0.914]	−0.035	[−0.179, 0.152]
E(hourly wage rate)	0.082	[−0.222, 0.346]	0.004	[−0.063, 0.067]
***Panel B1:* Weekly care hours ≥ 20**				
Pr(Any work)	−0.093	[−0.286, 0.080]	−0.174*	[−0.266, −0.041]
E(weekly hours worked | hours > 0)	−6.312	[−22.24, 11.01]	−3.363	[−19.02, 19.93]
E(weekly hours worked)	−9.294	[−29.65, 2.687]	−9.638*	[−18.66, −0.985]
Pr(Any employed work)	0.032	[−0.183, 0.248]	−0.069	[−0.149, 0.031]
E(hourly wage rate | wage > 0)	0.591	[−0.246, 1.789]	−0.187*	[−0.292, −0.079]
E(hourly wage rate)	0.262	[−0.296, 0.654]	−0.073*	[−0.120, −0.010]

Notes: KLoSA (2006) respondents aged 45-64. Conditional models only used observations with positive outcome values. Reference category is no informal care for all estimations. Bias-corrected bootstrapped 95% confidence intervals derived from 1,000 repetitions are shown in brackets. * Incremental effects are statistically significant at the 5% level.

Effects of Informal Care on Caregivers' Health

Overall, the results show that providing more informal care leads to poorer health outcomes, regardless of type of outcomes, functional forms of informal care and whether or not the models include the thirteen health condition indicators. Below I will describe key findings for each of the six outcome groups. For each outcome group, I present the results in two tables. The first table for each outcome group presents estimation results when the main explanatory variable is specified as the natural logarithm of (1+weekly hours of informal care). The second table for each outcome group has a summary of estimated coefficients for four different specifications of care intensity. All the four specification involves one or two dummy variables with the reference category being No care hour (non-caregiver). Because endogeneity was detected only for the conditional models of out-of-pocket costs of outpatient care use and out-of-pocket costs of prescription drug use, I do not repeat the endogeneity issue for other outcomes.

Satisfaction with health and satisfaction with quality of life decrease by informal caregiving (Tables 5.19-5.20). These results can be interpreted directly and more intuitively than results in other models because the two dependent variables are continuous on a scale of 0 to 100. For example, a 100% increase in weekly hours of informal care (*e.g.*, 4 to 8 hours or 10 to 20 hours) leads to a decease in the score of satisfaction with quality of life by 1.994 (first column) and a decease in the score of satisfaction with health by 1.039 (third column). Much greater impact on these outcomes is observed when caregiver groups are compared with non-caregiver groups (Table 5.20). Compared between the two outcomes of satisfaction, satisfaction of quality of life appears to respond more sensitively than satisfaction with health for any given amount of

informal caregiving. Although providing any care shows statistically significant effects (first row, Table 5.20), other results of the three two-dummy specifications suggest that the effects for overall caregivers arise mainly from intensive caregiving. Most of the coefficient estimates for less intensive caregivers are statistically insignificant, and their effect magnitudes are also relatively small (second to last rows, Table 5.20). The negative effect of intensive caregiving is substantial, compared with other coefficient estimates. For example, being an intensive caregiver providing 20 or more hours of care per week has a greater negative effect on satisfaction with quality of life (−7.362, last row and third column, Table 5.20) than having disability or any of the 13 disease indicators (third column, Table 5.20). (Other coefficient estimates remained virtually the same between Table 5.19 and Table 5.20.) Moreover, this reduction in satisfaction with quality of life is comparable to the effect of being placed in the second lowest quintile of total assets (−7.728, compared with the highest quintile), or the effect of having had only middle school education (−6.292, compared with college education).

Caregiving also appears to increase depressive symptoms among caregivers. Longer hours of informal care lead to higher CES-D scores, and higher probabilities of being depressed for the three different definitions in the study sample (Table 5.21). Such findings do not change qualitatively after changing the functional form of informal care from logged hours of informal care to different sets of dummy variables (Table 5.22). Consistent with these findings, more intensive caregivers experience more severe depressive symptoms as shown by their larger coefficient estimates than those of less intensive caregivers (second to last rows, Table 5.22), with only one exception.

Furthermore, even providing any informal care is found to affect caregiver's depressive symptoms (first row, Table 5.22).

Pain affecting daily activities is more likely to be reported as the amount of informal care provided increases (Tables 5.23-5.24). The coefficient estimates of informal care change little depending on whether or not the model includes the thirteen disease indicators, although the estimates in the full model are consistently smaller than the reduced model.

Self-rated health is poorer as caregiving intensity increases. In the ordered probit model of self-rated health measured in a five-category scale, an increase in informal care hours is found to increase the probability of being placed in less favorable self-rated health categories (first and second columns, Table 5.25). When the dependent variable is defined as a binary variable, the results show that more caregiving hours will increase the probability of rating one's health as *Fair* to *Poor* (third and fourth columns, Table 5.25). However, when caregiving is specified as a set of two dummy variables with the reference being non-caregiver, less intensive caregivers do not appear to have statistically significant negative effects for their self-rated health (Table 5.26). More intensive caregiving has negative and statistically significant effects on their self-rated health.

Informal caregiving does not appear to increase the probability of using any outpatient care in the past 12 months (Tables 5.27-5.28), while increasing out-of-pocket costs from outpatient care use among those who used any outpatient care (Table 5.29). A 10% increase in weekly hours of informal care leads to a 2.7 to 3.18 percentage increase in out-of-pocket costs (second and fourth columns, Table 5.29). Because endogeneity was detected in the conditional regressions, the preferred models are IV-2SLS models

presented in the second and fourth columns of Table 5.29. When dummy variable specifications are used, none of the coefficient estimates in the preferred models is statistically significant, although they all have a positive sign with a relatively large magnitude (Table 5.30).

Prescription drug use shows similar patterns to outpatient care use. Informal caregiving does not have statistically significant effects on any regular prescription drug use (Tables 5.31-5.32). However, out-of-pocket costs related to prescription drug use increase with caregiving intensity (Table 5.33). A 10% increase in weekly hours of informal care leads to a 1.99 to 2.30 percentage increase in out-of-pocket costs from prescription drug use (second and fourth columns, Table 5.33).

Lastly, I present estimation results when informal care hours are split into three variables depending on care recipient's relation to the caregiver (Table 5.35). The most prominent is from the coefficient estimates on care for parent-in-law (third row in each panel, Table 5.35). While caregiving for in-laws may result in a higher average score of satisfaction with quality of life, the estimation results for other outcome measures suggest that they have poorer self-rated health (third and fourth columns, Panel A), an increased probability of being depressed (third column, Panel B), and a higher propensity of regular prescription drug use and related out-of-pocket costs (third and fourth columns, Panel D). Among people who reported any regular prescription drug use in the past 12 months, a 10% increase in weekly hours of parent-in-law care leads to a 1.65% increase in out-of-pocket costs from prescription drug use (coefficient: 0.165, $p<0.01$). Results for other two types of informal caregiving are less conclusive. Providing spousal care increases the probability of being depressed for one definition of depression based on CES-D score

(coefficient: 0.582, $p<0.05$) but not for other outcome measures of depressive symptomatology. Care for one's own parent appears to have some effects on depressive symptomatology, but the results are inconsistent depending on how to define depression (third and fourth columns, Panel B, Table 5.35).

Table 5.19. OLS regression analyses of satisfaction with quality of life and satisfaction with health

Dependent var. / Independent var.	Satisfaction with quality of life (0-100)		Satisfaction with health (0-100)	
ln(1+ weekly hours of informal care)	−1.994	−2.087	−1.039	−1.285
	(0.432)**	(0.426)**	(0.430)*	(0.448)**
Demographics				
Female	1.944	1.294	−2.757	−4.158
	(0.437)**	(0.417)**	(0.493)**	(0.491)**
Age (year)	−0.130	−0.380	0.082	−0.861
	(0.203)	(0.201)	(0.230)	(0.234)**
Age-squared/100	0.118	0.291	−0.169	0.465
	(0.161)	(0.160)	(0.182)	(0.186)*
Currently married	4.659	4.830	1.485	2.127
	(0.608)**	(0.610)**	(0.664)*	(0.683)**
Education (ref. College)				
Elementary school	−9.796	−10.348	−9.714	−10.961
	(0.740)**	(0.741)**	(0.829)**	(0.859)**
Middle school	−6.292	−6.559	−6.101	−6.688
	(0.744)**	(0.748)**	(0.822)**	(0.854)**
High school	−3.644	−3.691	−3.542	−3.638
	(0.653)**	(0.654)**	(0.710)**	(0.732)**
Total assets quintile (ref. Quintile 5)				
Quintile 1	−17.695	−17.870	−15.334	−15.980
	(1.014)**	(1.023)**	(1.103)**	(1.154)**
Quintile 2	−7.728	−7.837	−7.551	−7.889
	(0.661)**	(0.661)**	(0.742)**	(0.768)**
Quintile 3	−4.555	−4.699	−3.685	−4.116
	(0.567)**	(0.567)**	(0.662)**	(0.685)**
Quintile 4	−3.352	−3.434	−2.277	−2.528
	(0.543)**	(0.544)**	(0.628)**	(0.655)**
Owns a house	0.163	0.397	−2.792	−2.192
	(0.836)	(0.847)	(0.880)**	(0.931)*
Disability and health condition indicator				
Disability diagnosed	−4.745	−5.883	−10.509	−13.403
	(1.007)**	(0.993)**	(1.138)**	(1.138)**
Hypertension	0.763		−2.496	
	(0.466)		(0.522)**	
Diabetes	−2.418		−7.619	
	(0.645)**		(0.717)**	
Cancer	−5.309		−13.068	
	(1.489)**		(1.759)**	
Chronic lung disease	−2.811		−10.403	
	(1.437)		(1.555)**	
Liver disease	−0.537		−7.591	
	(1.544)		(1.835)**	
Heart disease	−2.677		−8.069	
	(1.003)**		(1.089)**	
Stroke	−3.560		−9.448	

	(1.251)**		(1.463)**	
Psychiatric problem	−4.901		−8.805	
	(1.529)**		(1.601)**	
Arthritis	−3.412		−7.996	
	(0.605)**		(0.665)**	
Injury due to traffic accident	−1.603		−1.849	
	(0.720)*		(0.798)*	
Fall in the last two years	0.617		−3.203	
	(1.139)		(1.243)**	
Prostate disease	−0.294		−2.856	
	(1.294)		(1.314)*	
Urinary incontinence	−2.159		−3.696	
	(0.762)**		(0.835)**	
N	9,753	9,753	9,753	9,753

Notes: KLoSA (2006) respondents, excluding persons with any ADL limitation. Robust standard errors in parentheses. * $p<0.05$. ** $p<0.01$. Fourteen regional dummies for 15 large administrative areas were included in the regression analyses but are not shown here.

Table 5.20. Estimated coefficients on dummy variables of informal care in OLS regression analyses of satisfaction with quality of life and satisfaction with health

Dependent var.	Satisfaction with quality of life (0-100)		Satisfaction with health (0-100)	
Key independent var.	(1)	(2)	(1)	(2)
Any care (vs. No care hour)	−4.834	−5.143	−2.647	−3.348
	(1.235)**	(1.229)**	(1.288)*	(1.367)*
Dummy variables (ref. No care hour)				
Care < 10 hrs/week	−0.571	−0.950	−1.261	−1.866
	(1.645)	(1.641)	(2.044)	(2.149)
Care ≥ 10 hrs/week	−7.532	−7.797	−3.524	−4.286
	(1.680)**	(1.673)**	(1.638)*	(1.753)*
Dummy variables (ref. No care hour)				
Care < 15 hrs/week	−0.941	−1.263	−1.600	−2.183
	(1.517)	(1.514)	(1.870)	(1.982)
Care ≥ 15 hrs/week	−8.452	−8.754	−3.620	−4.433
	(1.853)**	(1.844)**	(1.746)*	(1.862)*
Dummy variables (ref. No care hour)				
Care < 20 hrs/week	−2.641	−3.034	−1.874	−2.589
	(1.516)†	(1.511)*	(1.741)	(1.855)
Care ≥ 20 hrs/week	−7.362	−7.578	−3.537	−4.225
	(1.958)**	(1.950)**	(1.881)†	(1.995)*

Notes: Robust standard errors in parentheses. † $p<0.1$ * $p<0.05$. ** $p<0.01$. Covariates included are the same as in each corresponding model above. (1) Thirteen disease indicator dummies were included; (2) Thirteen disease indicator dummies were not included.

Table 5.21. Probit and OLS regression analyses of depressive symptomatology

Model estimation	Probit	OLS	Probit	Probit
Dependent var.	(1)	CES-D score	(2)	(3)
Independent var.				
ln(1+ weekly hours of informal care)	0.076	0.389	0.137	0.110
	(0.029)**	(0.086)**	(0.026)**	(0.026)**
Demographics				
Female	0.267	0.398	0.161	0.141
	(0.041)**	(0.080)**	(0.030)**	(0.035)**
Age (year)	0.014	−0.006	0.013	0.024
	(0.018)	(0.042)	(0.014)	(0.016)
Age-squared/100	−0.013	0.035	−0.001	−0.009
	(0.014)	(0.034)	(0.011)	(0.012)
Currently married	−0.295	−1.266	−0.246	−0.344
	(0.046)**	(0.130)**	(0.038)**	(0.040)**
Education (ref. College)				
Elementary school	0.291	1.082	0.487	0.561
	(0.079)**	(0.126)**	(0.057)**	(0.071)**
Middle school	0.116	0.481	0.344	0.349
	(0.081)	(0.122)**	(0.058)**	(0.073)**
High school	−0.080	0.184	0.117	0.14
	(0.077)	(0.100)	(0.054)*	(0.070)*
Total assets quintile (ref. Quintile 5)				
Quintile 1	0.332	1.847	0.569	0.576
	(0.086)**	(0.198)**	(0.069)**	(0.078)**
Quintile 2	0.23	0.863	0.342	0.401
	(0.064)**	(0.130)**	(0.049)**	(0.057)**
Quintile 3	−0.017	0.321	0.219	0.202
	(0.064)	(0.105)**	(0.046)**	(0.056)**
Quintile 4	0.019	0.180	0.193	0.195
	(0.063)	(0.097)	(0.045)**	(0.055)**
Owns a house	−0.058	0.042	−0.029	−0.035
	(0.069)	(0.162)	(0.057)	(0.063)
Disability diagnosed	0.377	1.303	0.348	0.377
	(0.068)**	(0.210)**	(0.059)**	(0.062)**
Constant	−1.761	5.838	−1.626	−2.426
	(0.575)**	(1.268)**	(0.452)**	(0.503)**
N	9,754	9,697	9,697	9,697

Notes: KLoSA (2006) respondents, excluding persons with any ADL limitation. Robust standard errors in parentheses. † $p<0.1$. * $p<0.05$. ** $p<0.01$. Fourteen regional dummies for 15 large administrative areas were included in the regression analyses but are not shown here. CES-D=Center for Epidemiologic Study Depression scale.

(1): Feeling depressed for two weeks or more during the past year or being on anti-depressant medication (1=yes, 0=no)

(2): CES-D number of items ≥ 4 (1=yes, 0=no)

(3): CES-D score ≥ 10 (1=yes, 0=no)

Table 5.22. Estimated coefficients on dummy variables of informal care in OLS and probit regression analyses of depressive symptomatology

Model estimation	Probit	OLS	Probit	Probit
Dependent var.	(1)	CES-D score	(2)	(3)
Key independent var.				
Any care (vs. No care hour)	0.244	1.084	0.392	0.330
	(0.093)**	(0.243)**	(0.077)**	(0.082)**
Dummy variables (ref. No care hour)				
Care < 10 hrs/week	0.179	0.641	0.250	0.266
	(0.155)	(0.329)†	(0.122)*	(0.136)†
Care ≥ 10 hrs/week	0.281	1.370	0.482	0.368
	(0.115)*	(0.334)**	(0.100)**	(0.101)**
Dummy variables (ref. No care hour)				
Care < 15 hrs/week	0.227	0.655	0.207	0.218
	(0.137)†	(0.288)*	(0.108)†	(0.122)†
Care ≥ 15 hrs/week	0.259	1.494	0.563	0.422
	(0.125)*	(0.380)**	(0.111)**	(0.110)**
Dummy variables (ref. No care hour)				
Care < 20 hrs/week	0.313	0.815	0.293	0.270
	(0.123)*	(0.285)**	(0.104)**	(0.116)*
Care ≥ 20 hrs/week	0.169	1.392	0.503	0.390
	(0.138)	(0.400)**	(0.115)**	(0.114)**

Notes: KLoSA (2006) respondents, excluding persons with any ADL limitation. Robust standard errors in parentheses. † $p<0.1$. * $p<0.05$. ** $p<0.01$. Covariates included are the same as in each corresponding model above.

(1): Feeling depressed for two weeks or more during the past year or being on anti-depressant medication (1=yes, 0=no)

(2): CES-D number of items checked ≥ 4 (1=yes, 0=no)

(3): CES-D score ≥ 10 (1=yes, 0=no)

Table 5.23. Probit regression analyses of having pain affecting daily activities

Independent var.	(1)	(2)
ln(1+ weekly hours of informal care)	0.067	0.073
	(0.027)*	(0.026)**
Demographics		
Female	0.369	0.533
	(0.039)**	(0.036)**
Age (year)	0.014	0.078
	(0.017)	(0.016)**
Age-squared/100	0.005	−0.040
	(0.013)	(0.012)**
Currently married	0.013	−0.023
	(0.042)	(0.040)
Education (ref. College)		
Elementary school	0.631	0.711
	(0.078)**	(0.075)**
Middle school	0.357	0.416
	(0.081)**	(0.078)**
High school	0.123	0.145
	(0.079)	(0.076)
Total assets quintile (ref. Quintile 5)		
Quintile 1	0.451	0.483
	(0.081)**	(0.078)**
Quintile 2	0.299	0.306
	(0.057)**	(0.055)**
Quintile 3	0.112	0.126
	(0.055)*	(0.053)*
Quintile 4	0.038	0.049
	(0.056)	(0.054)
Owns a house	0.120	0.103
	(0.067)	(0.065)
Disability and health condition indicator		
Disability diagnosed	0.568	0.706
	(0.064)**	(0.061)**
Hypertension	0.135	
	(0.036)**	
Diabetes	0.170	
	(0.048)**	
Cancer	0.345	
	(0.096)**	
Chronic lung disease	0.392	
	(0.099)**	
Liver disease	0.392	
	(0.117)**	
Heart disease	0.121	
	(0.069)	
Stroke	0.439	
	(0.093)**	

Psychiatric problem	0.156	
	(0.104)	
Arthritis	0.809	
	(0.041)**	
Injury due to traffic accident	0.377	
	(0.051)**	
Fall in the last two years	0.460	
	(0.074)**	
Prostate disease	0.167	
	(0.098)	
Urinary incontinence	0.351	
	(0.053)**	
N	9,731	9,731

Notes: KLoSA (2006) respondents, excluding persons with any ADL limitation. Robust standard errors in parentheses. * $p<0.05$. ** $p<0.01$. Fourteen regional dummies for 15 large administrative areas were included in the regression analyses but are not shown here. Thirteen disease indicator dummies were included (1), and not included (2).

Table 5.24. Estimated coefficients on dummy variables of informal care in probit regression analyses of having pain affecting daily activities

Key independent var.	(1)	(2)
Any care (vs. No care hour)	0.249	0.280
	(0.083)**	(0.082)**
Dummy variables (ref. No care hour)		
Care < 10 hrs/week	0.264	0.305
	(0.143)†	(0.132)*
Care ≥ 10 hrs/week	0.241	0.265
	(0.101)*	(0.102)**
Dummy variables (ref. No care hour)		
Care < 15 hrs/week	0.305	0.358
	(0.125)*	(0.120)**
Care ≥ 15 hrs/week	0.202	0.214
	(0.109)†	(0.108)*
Dummy variables (ref. No care hour)		
Care < 20 hrs/week	0.261	0.324
	(0.118)*	(0.114)**
Care ≥ 20 hrs/week	0.237	0.234
	(0.115)*	(0.114)*

Notes: KLoSA (2006) respondents, excluding persons with any ADL limitation. Robust standard errors in parentheses. † $p<0.1$. * $p<0.05$. ** $p<0.01$. Covariates included are the same as in each corresponding model above. Thirteen disease indicator dummies were included (1), and not included (2).

Table 5.25. Ordered probit and probit regression analyses of self-rated health

Model estimation	Ordered probit		Probit	
Dependent var.	Self-rated health: *1 Excellent; 2 Very good; 3 Good; 4 Fair; 5 Poor*		Self-rated health: being *Fair* to *Poor* (y=1)	
Independent var.				
ln(1+ weekly hours of informal care)	0.053	0.068	0.061	0.078
	(0.022)*	(0.021)**	(0.028)*	(0.027)**
Demographics				
Female	0.205	0.270	0.228	0.285
	(0.026)**	(0.024)**	(0.034)**	(0.030)**
Age (year)	0.023	0.086	0.019	0.090
	(0.012)	(0.012)**	(0.015)	(0.015)**
Age-squared/100	−0.003	−0.045	0.002	−0.047
	(0.009)	(0.009)**	(0.012)	(0.012)**
Currently married	0.041	−0.012	0.022	−0.035
	(0.034)	(0.033)	(0.041)	(0.039)
Education (ref. College)				
Elementary school	0.527	0.562	0.611	0.64
	(0.044)**	(0.044)**	(0.058)**	(0.055)**
Middle school	0.280	0.302	0.382	0.405
	(0.044)**	(0.044)**	(0.059)**	(0.057)**
High school	0.111	0.113	0.19	0.189
	(0.039)**	(0.039)**	(0.055)**	(0.052)**
Total assets quintile (ref. Quintile 5)				
Quintile 1	0.419	0.432	0.416	0.428
	(0.061)**	(0.060)**	(0.074)**	(0.071)**
Quintile 2	0.224	0.229	0.267	0.268
	(0.040)**	(0.039)**	(0.051)**	(0.049)**
Quintile 3	0.116	0.135	0.162	0.180
	(0.036)**	(0.035)**	(0.047)**	(0.045)**
Quintile 4	0.049	0.062	−0.002	0.016
	(0.034)	(0.034)	(0.046)	(0.044)
Owns a house	0.049	0.012	0.041	0.006
	(0.050)	(0.049)	(0.060)	(0.058)
Disability and health condition indicator				
Disability diagnosed	0.652	0.800	0.684	0.849
	(0.060)**	(0.056)**	(0.073)**	(0.069)**
Hypertension	0.266		0.301	
	(0.028)**		(0.035)**	
Diabetes	0.510		0.524	
	(0.041)**		(0.049)**	
Cancer	1.084		1.056	
	(0.113)**		(0.111)**	
Chronic lung disease	0.937		0.986	
	(0.092)**		(0.130)**	
Liver disease	0.703		0.788	
	(0.101)**		(0.129)**	
Heart disease	0.687		0.663	
	(0.066)**		(0.081)**	

Stroke	0.815		0.801	
	(0.091)**		(0.119)**	
Psychiatric problem	0.705		0.944	
	(0.107)**		(0.144)**	
Arthritis	0.553		0.577	
	(0.037)**		(0.045)**	
Injury due to traffic accident	0.204		0.248	
	(0.042)**		(0.051)**	
Fall in the last two years	0.403		0.432	
	(0.068)**		(0.086)**	
Prostate disease	0.32		0.381	
	(0.073)**		(0.096)**	
Urinary incontinence	0.297		0.253	
	(0.046)**		(0.056)**	
/cut1	0.013	1.956		
/cut2	1.044	2.962		
/cut3	2.400	4.237		
/cut4	3.426	5.144		
N	9,731	9,731	9,731	9,731

Notes: KLoSA (2006) respondents, excluding persons with any ADL limitation. Robust standard errors in parentheses. * $p<0.05$. ** $p<0.01$. Fourteen regional dummies for 15 large administrative areas were included in the regression analyses but are not shown here.

Table 5.26. Estimated coefficients on dummy variables of informal care in ordered probit and probit regression analyses of self-rated health

Model estimation	Ordered probit		Probit	
Dependent var.	*1 Excellent; 2 Very good; 3 Good; 4 Fair; 5 Poor*		Self-rated health being *Fair* to *Poor* (y=1 vs. 0)	
Key independent var.	(1)	(2)	(1)	(2)
Any care (vs. No care hour)	0.059	0.107	0.102	0.146
	(0.069)	(0.069)	(0.085)	(0.081)†
Dummy variables (ref. No care hour)				
Care < 10 hrs/week	−0.099	−0.048	−0.040	−0.002
	(0.118)	(0.119)	(0.120)	(0.120)
Care ≥ 10 hrs/week	0.160	0.207	0.186	0.238
	(0.082)†	(0.081)*	(0.107)†	(0.101)*
Dummy variables (ref. No care hour)				
Care < 15 hrs/week	−0.107	−0.052	−0.046	0.007
	(0.101)	(0.102)	(0.109)	(0.107)
Care ≥ 15 hrs/week	0.219	0.260	0.236	0.275
	(0.091)*	(0.090)**	(0.119)*	(0.113)*
Dummy variables (ref. No care hour)				
Care < 20 hrs/week	−0.091	−0.030	−0.058	0.004
	(0.094)	(0.096)	(0.103)	(0.101)
Care ≥ 20 hrs/week	0.237	0.269	0.280	0.312
	(0.098)*	(0.095)**	(0.129)*	(0.122)*

Notes: KLoSA (2006) respondents, excluding persons with any ADL limitation. Robust standard errors in parentheses. † $p<0.1$. * $p<0.05$. ** $p<0.01$. Covariates included are the same as in each corresponding model above. Thirteen disease indicator dummies were included (1), and not included (2).

Table 5.27. Probit and IV probit regression analyses of Any outpatient care use

Independent var.	**Probit**	IVP	**Probit**	IVP
ln(1+ weekly hours of informal care)	0.023	0.132	0.028	0.160
	(0.026)	(0.086)	(0.026)	(0.085)
Demographics				
Female	0.299	0.294	0.323	0.316
	(0.031)**	(0.032)**	(0.029)**	(0.030)**
Age (year)	0.054	0.054	0.090	0.090
	(0.014)**	(0.014)**	(0.014)**	(0.014)**
Age-squared/100	−0.037	−0.037	−0.061	−0.061
	(0.011)**	(0.011)**	(0.011)**	(0.011)**
Currently married	0.069	0.061	0.043	0.033
	(0.038)	(0.039)	(0.038)	(0.039)
Education (ref. College)				
Elementary school	0.101	0.102	0.131	0.133
	(0.053)	(0.053)	(0.053)*	(0.052)*
Middle school	0.133	0.133	0.151	0.151
	(0.054)*	(0.054)*	(0.054)**	(0.053)**
High school	0.062	0.064	0.067	0.068
	(0.048)	(0.048)	(0.048)	(0.048)
Total assets quintile (ref. Quintile 5)				
Quintile 1	−0.259	−0.263	−0.239	−0.243
	(0.069)**	(0.069)**	(0.069)**	(0.069)**
Quintile 2	−0.120	−0.124	−0.110	−0.115
	(0.048)*	(0.048)**	(0.047)*	(0.047)*
Quintile 3	−0.082	−0.084	−0.067	−0.070
	(0.044)	(0.044)	(0.044)	(0.044)
Quintile 4	−0.088	−0.090	−0.079	−0.081
	(0.043)*	(0.043)*	(0.043)	(0.043)
Owns a house	−0.110	−0.111	−0.122	−0.123
	(0.057)	(0.056)*	(0.056)*	(0.056)*
Medical Security				
Statutory (ref. National Health Insurance)				
MedicalAid Type 1	0.044	0.023	0.116	0.090
	(0.079)	(0.082)	(0.078)	(0.080)
MedicalAid Type 2	−0.072	−0.080	−0.041	−0.050
	(0.094)	(0.092)	(0.092)	(0.090)
Voluntary private health insurance	0.182	0.181	0.173	0.171
	(0.034)**	(0.033)**	(0.033)**	(0.033)**
Disability and health condition indicator				
Disability diagnosed	0.08	0.082	0.171	0.172
	(0.062)	(0.063)	(0.060)**	(0.061)**
Hypertension	0.257	0.257		
	(0.033)**	(0.033)**		
Diabetes	0.310	0.311		
	(0.046)**	(0.046)**		
Cancer	0.073	0.066		
	(0.091)	(0.091)		

Chronic lung disease	0.254	0.255		
	(0.099)*	(0.098)**		
Liver disease	0.556	0.549		
	(0.121)**	(0.120)**		
Heart disease	0.194	0.191		
	(0.072)**	(0.068)**		
Stroke	0.202	0.204		
	(0.098)*	(0.095)*		
Psychiatric problem	0.407	0.404		
	(0.116)**	(0.112)**		
Arthritis	0.236	0.237		
	(0.041)**	(0.041)**		
Injury due to traffic accident	0.085	0.081		
	(0.048)	(0.048)		
Fall in the last two years	0.098	0.095		
	(0.076)	(0.074)		
Prostate disease	0.281	0.278		
	(0.090)**	(0.090)**		
Urinary incontinence	0.097	0.092		
	(0.053)	(0.053)		
N	9,731	9,731	9,731	9,731

Notes: KLoSA (2006) respondents, excluding persons with any ADL limitation. Robust standard errors in parentheses. * $p<0.05$. ** $p<0.01$. Fourteen regional dummies were included but are not shown here.

Table 5.28. Estimated coefficients on dummy variables of informal care in probit and IV probit regression analyses of Any outpatient care use

Key independent var.	Probit (1)	IV Regress[a] (1)	Probit (2)	IV Regress[a] (2)
Any care (vs. No care hour)	**0.092**	0.250	**0.107**	0.301
	(0.080)	(0.185)	**(0.079)**	(0.184)
Dummy variables (ref. No care hour)				
Care < 10 hrs/week	**0.049**	0.594	**0.057**	0.569
	(0.044)	(0.379)	**(0.044)**	(0.374)
Care ≥ 10 hrs/week	**0.022**	−0.317	**0.028**	−0.238
	(0.034)	(0.366)	**(0.035)**	(0.360)
Dummy variables (ref. No care hour)				
Care < 15 hrs/week	**0.053**	0.485	**0.062**	0.476
	(0.039)	(0.299)	**(0.039)**	(0.297)
Care ≥ 15 hrs/week	**0.014**	−0.462	**0.018**	−0.374
	(0.037)	(0.494)	**(0.038)**	(0.487)
Dummy variables (ref. No care hour)				
Care < 20 hrs/week	**0.056**	0.451	**0.063**	0.449
	(0.037)	(0.277)	**(0.037)**†	(0.276)
Care ≥ 20 hrs/week	**0.006**	−0.432	**0.011**	−0.354
	(0.039)	(0.475)	**(0.040)**	(0.471)

Notes: KLoSA (2006) respondents, excluding persons with any ADL limitation. Robust standard errors in parentheses. † $p<0.1$. * $p<0.05$. ** $p<0.01$. Covariates included are the same as in each corresponding model above. Thirteen disease indicator dummies were included (1), and not included (2). [a]Linear IV regression was used because IV probit did not converge.

Table 5.29. OLS and IV-2SLS regression analyses of logged out-of-pocket costs from outpatient care use if Any

Independent var.	OLS	**IV-2SLS**	OLS	**IV-2SLS**
ln(1+ weekly hours of informal care)	0.000	0.273	0.009	0.318
	(0.028)	(0.104)**	(0.029)	(0.106)**
Demographics				
Female	0.183	0.165	0.227	0.207
	(0.037)**	(0.038)**	(0.036)**	(0.037)**
Age (year)	0.110	0.111	0.152	0.153
	(0.017)**	(0.017)**	(0.017)**	(0.017)**
Age-squared/100	−0.091	−0.092	−0.119	−0.120
	(0.013)**	(0.014)**	(0.013)**	(0.013)**
Currently married	0.084	0.061	0.052	0.027
	(0.046)	(0.047)	(0.047)	(0.048)
Education (ref. College)				
Elementary school	−0.163	−0.155	−0.131	−0.123
	(0.067)*	(0.067)*	(0.067)	(0.068)
Middle school	−0.137	−0.135	−0.12	−0.119
	(0.067)*	(0.067)*	(0.068)	(0.068)
High school	−0.148	−0.145	−0.146	−0.144
	(0.061)*	(0.062)*	(0.062)*	(0.063)*
Total assets quintile (ref. Quintile 5)				
Quintile 1	−0.087	−0.098	−0.057	−0.070
	(0.088)	(0.088)	(0.089)	(0.089)
Quintile 2	−0.107	−0.120	−0.097	−0.113
	(0.057)	(0.058)*	(0.058)	(0.059)
Quintile 3	−0.115	−0.120	−0.103	−0.109
	(0.052)*	(0.052)*	(0.053)	(0.053)*
Quintile 4	−0.093	−0.099	−0.089	−0.097
	(0.051)	(0.051)	(0.052)	(0.053)
Owns a house	0.072	0.071	0.058	0.058
	(0.072)	(0.072)	(0.072)	(0.072)
Medical Security				
Statutory (ref. National Health Insurance)				
MedicalAid Type 1	−1.091	−1.148	−0.990	−1.055
	(0.098)**	(0.102)**	(0.093)**	(0.098)**
MedicalAid Type 2	−0.363	−0.377	−0.32	−0.336
	(0.108)**	(0.108)**	(0.111)**	(0.111)**
Voluntary private health insurance	0.053	0.048	0.025	0.019
	(0.038)	(0.038)	(0.039)	(0.039)
Disability and health condition indicator				
Disability diagnosed	0.139	0.148	0.252	0.258
	(0.078)	(0.078)	(0.079)**	(0.080)**
Hypertension	0.288	0.292		
	(0.038)**	(0.038)**		
Diabetes	0.219	0.223		
	(0.051)**	(0.051)**		
Cancer	0.300	0.290		

	(0.128)*	(0.128)*		
Chronic lung disease	0.289	0.293		
	(0.121)*	(0.121)*		
Liver disease	0.278	0.249		
	(0.128)*	(0.131)		
Heart disease	0.26	0.251		
	(0.075)**	(0.075)**		
Stroke	0.319	0.319		
	(0.111)**	(0.111)**		
Psychiatric problem	0.294	0.287		
	(0.112)**	(0.113)*		
Arthritis	0.325	0.328		
	(0.047)**	(0.047)**		
Injury due to traffic accident	0.053	0.031		
	(0.055)	(0.056)		
Fall in the last two years	0.158	0.146		
	(0.091)	(0.092)		
Prostate disease	0.354	0.336		
	(0.105)**	(0.105)**		
Urinary incontinence	0.142	0.126		
	(0.059)*	(0.059)*		
N	6,079	6,079	6,079	6,079

Notes: KLoSA (2006) respondents, excluding persons with any ADL limitation. Robust standard errors in parentheses. * $p<0.05$. ** $p<0.01$. Fourteen regional dummies for 15 large administrative areas were included in the regression analyses but are not shown here.

Table 5.30. Estimated coefficients on dummy variables of informal care in OLS and IV-2SLS regression analyses of logged out-of-pocket costs from outpatient care use if Any

	OLS	IV-2SLS	OLS	IV-2SLS
Key independent var.	(1)	(1)	(2)	(2)
Any care (vs. No care hour)	**0.033**	0.122	**0.039**	0.150
	(0.027)	(0.069)†	**(0.028)**	(0.071)*
Dummy variables (ref. No care hour)				
Care < 10 hrs/week	0.304	**0.247**	0.312	**0.122**
	(0.136)*	**(0.830)**	(0.136)*	**(0.892)**
Care ≥ 10 hrs/week	−0.035	**1.044**	−0.004	**1.338**
	(0.109)	**(0.724)**	(0.114)	**(0.763)**†
Dummy variables (ref. No care hour)				
Care < 15 hrs/week	0.257	**0.377**	0.276	**0.317**
	(0.121)*	**(0.614)**	(0.122)*	**(0.649)**
Care ≥ 15 hrs/week	−0.056	**1.130**	−0.031	**1.479**
	(0.120)	**(0.912)**	(0.125)	**(0.965)**
Dummy variables (ref. No care hour)				
Care < 20 hrs/week	0.238	**0.418**	0.259	**0.369**
	(0.114)*	**(0.595)**	(0.116)*	**(0.631)**
Care ≥ 20 hrs/week	−0.071	**1.079**	−0.048	**1.416**
	(0.127)	**(0.900)**	(0.133)	**(0.952)**

Notes: Robust standard errors in parentheses. † $p<0.1$. * $p<0.05$. ** $p<0.01$. Thirteen disease indicator dummies were included (1), and not included (2).

Table 5.31. Probit and IV probit regression analyses of Any regular prescription drug use

Independent var.	**Probit**	IVP	**Probit**	IVP
ln(weekly hours of informal care)	0.014	−0.015	0.025	0.106
	(0.032)	(0.109)	(0.025)	(0.086)
Demographics				
Female	0.201	0.203	0.187	0.182
	(0.040)**	(0.042)**	(0.030)**	(0.031)**
Age (year)	0.104	0.104	0.227	0.226
	(0.018)**	(0.018)**	(0.015)**	(0.015)**
Age-squared/100	−0.069	−0.069	−0.153	−0.153
	(0.014)**	(0.014)**	(0.011)**	(0.011)**
Currently married	−0.018	−0.016	−0.090	−0.096
	(0.050)	(0.049)	(0.038)*	(0.038)*
Education (ref. College)				
Elementary school	0.111	0.111	0.111	0.112
	(0.068)	(0.072)	(0.054)*	(0.055)*
Middle school	0.043	0.044	0.084	0.084
	(0.069)	(0.074)	(0.056)	(0.057)
High school	0.02	0.019	0.007	0.008
	(0.063)	(0.068)	(0.052)	(0.053)
Total assets quintile (ref. Quintile 5)				
Quintile 1	−0.056	−0.055	0.014	0.011
	(0.090)	(0.088)	(0.070)	(0.070)
Quintile 2	−0.071	−0.070	−0.028	−0.031
	(0.062)	(0.061)	(0.048)	(0.048)
Quintile 3	−0.075	−0.075	0.011	0.009
	(0.057)	(0.058)	(0.045)	(0.045)
Quintile 4	−0.058	−0.058	−0.014	−0.015
	(0.054)	(0.056)	(0.044)	(0.044)
Owns a house	0.008	0.008	−0.020	−0.021
	(0.071)	(0.072)	(0.057)	(0.057)
Medical Security				
Statutory (ref. National Health Insurance)				
MedicalAid Type 1	0.392	0.398	0.405	0.389
	(0.111)**	(0.102)**	(0.081)**	(0.080)**
MedicalAid Type 2	0.328	0.331	0.288	0.282
	(0.133)*	(0.113)**	(0.093)**	(0.092)**
Voluntary private health insurance	−0.062	−0.061	−0.081	−0.082
	(0.043)	(0.043)	(0.034)*	(0.034)*
Disability and health condition indicator				
Disability diagnosed	0.290	0.289	0.383	0.384
	(0.084)**	(0.076)**	(0.062)**	(0.060)**
Hypertension	2.120	2.120		
	(0.055)**	(0.044)**		
Diabetes	1.738	1.738		
	(0.093)**	(0.065)**		
Cancer	0.889	0.891		
	(0.132)**	(0.102)**		

Chronic lung disease	0.604	0.604		
	(0.162)**	(0.109)**		
Liver disease	0.773	0.776		
	(0.189)**	(0.132)**		
Heart disease	1.030	1.032		
	(0.136)**	(0.092)**		
Stroke	0.689	0.689		
	(0.182)**	(0.127)**		
Psychiatric problem	1.129	1.131		
	(0.183)**	(0.129)**		
Arthritis	0.759	0.759		
	(0.058)**	(0.049)**		
Injury due to traffic accident	0.042	0.043		
	(0.064)	(0.059)		
Fall in the last two years	0.012	0.013		
	(0.104)	(0.089)		
Prostate disease	0.880	0.881		
	(0.126)**	(0.110)**		
Urinary incontinence	0.056	0.057		
	(0.067)	(0.064)		
N	9,731	9,731	9,731	9,731

Notes: Robust standard errors in parentheses. * $p<0.05$. ** $p<0.01$. Fourteen regional dummies for 15 large administrative areas were included in the regression analyses but are not shown here.

Table 5.32. Estimated coefficients on dummy variables of informal care in probit and IV probit regression analyses of Any regular prescription drug use

Key independent var.	Probit (1)	IVP (1)	Probit (2)	IVP (2)
Any care (vs. No care hour)	**0.072**	−0.056	**0.054**	0.186
	(0.097)	(0.253)	**(0.077)**	(0.191)
Dummy variables (ref. No care hour)				
Care < 10 hrs/week	**0.022**	−0.02	**0.016**	−0.113
	(0.032)	(0.217)	**(0.042)**	(0.291)
Care ≥ 10 hrs/week	**0.018**	0.032	**0.022**	0.256
	(0.028)	(0.205)	**(0.035)**	(0.274)
Dummy variables (ref. No care hour)				
Care < 15 hrs/week	**0.043**	−0.004	**0.039**	−0.044
	(0.029)	(0.174)	**(0.038)**	(0.242)
Care ≥ 15 hrs/week	**−0.003**	0.024	**0.002**	0.274
	(0.031)	(0.276)	**(0.038)**	(0.387)
Dummy variables (ref. No care hour)				
Care < 20 hrs/week	**0.045†**	0.007	**0.034**	−0.009
	(0.027)	(0.164)	**(0.036)**	(0.228)
Care ≥ 20 hrs/week	**−0.010**	0.007	**0.003**	0.225
	(0.033)	(0.270)	**(0.041)**	(0.375)

Notes: Robust standard errors in parentheses. † $p<0.1$. * $p<0.05$. ** $p<0.01$. Covariates included are the same as in each corresponding model above. (1) Thirteen disease indicator dummies were included; (2) Thirteen disease indicator dummies were not included.

Table 5.33. OLS and IV-2SLS regression analyses of logged out-of-pocket costs from prescription drug use if Any

Independent var.	OLS	**IV-2SLS**	OLS	**IV-2SLS**
ln(1+ weekly hours of informal care)	0.020	0.199	0.022	0.230
	(0.034)	(0.090)*	(0.034)	(0.094)*
Demographics				
Female	−0.070	−0.084	−0.040	−0.055
	(0.049)	(0.050)	(0.046)	(0.047)
Age (year)	0.066	0.065	0.096	0.096
	(0.024)**	(0.024)**	(0.024)**	(0.024)**
Age-squared/100	−0.06	−0.060	−0.083	−0.082
	(0.019)**	(0.019)**	(0.019)**	(0.019)**
Currently married	0.155	0.138	0.142	0.123
	(0.054)**	(0.055)*	(0.055)**	(0.056)*
Education (ref. College)				
Elementary school	−0.181	−0.177	−0.121	−0.117
	(0.090)*	(0.090)*	(0.091)	(0.091)
Middle school	−0.138	−0.140	−0.098	−0.102
	(0.094)	(0.094)	(0.095)	(0.095)
High school	−0.142	−0.138	−0.129	−0.126
	(0.088)	(0.088)	(0.089)	(0.089)
Total assets quintile (ref. Quintile 5)				
Quintile 1	0.153	0.146	0.155	0.148
	(0.110)	(0.110)	(0.112)	(0.111)
Quintile 2	0.015	0.003	0.023	0.009
	(0.073)	(0.073)	(0.075)	(0.075)
Quintile 3	0.052	0.051	0.070	0.068
	(0.067)	(0.067)	(0.069)	(0.068)
Quintile 4	−0.028	−0.036	−0.01	−0.018
	(0.069)	(0.068)	(0.070)	(0.070)
Owns a house	0.252	0.255	0.209	0.214
	(0.091)**	(0.091)**	(0.092)*	(0.092)*
Medical Security				
Statutory (ref. National Health Insurance)				
MedicalAid Type 1	−1.879	−1.906	−1.835	−1.866
	(0.109)**	(0.110)**	(0.106)**	(0.108)**
MedicalAid Type 2	−0.816	−0.835	−0.804	−0.826
	(0.130)**	(0.131)**	(0.128)**	(0.130)**
Voluntary private health insurance	0.020	0.017	0.001	−0.002
	(0.050)	(0.050)	(0.051)	(0.051)
Disability and health condition indicator				
Disability diagnosed	0.061	0.067	0.122	0.126
	(0.091)	(0.091)	(0.090)	(0.090)
Hypertension	0.038	0.040		
	(0.043)	(0.043)		
Diabetes	0.306	0.310		
	(0.047)**	(0.047)**		
Cancer	0.407	0.397		

	(0.132)**	(0.131)**		
Chronic lung disease	0.104	0.111		
	(0.122)	(0.121)		
Liver disease	0.261	0.244		
	(0.148)	(0.149)		
Heart disease	0.386	0.384		
	(0.073)**	(0.073)**		
Stroke	0.305	0.308		
	(0.101)**	(0.100)**		
Psychiatric problem	0.240	0.231		
	(0.114)*	(0.114)*		
Arthritis	0.270	0.276		
	(0.049)**	(0.049)**		
Injury due to traffic accident	0.001	−0.007		
	(0.069)	(0.069)		
Fall in the last two years	0.152	0.151		
	(0.104)	(0.104)		
Prostate disease	0.137	0.125		
	(0.113)	(0.112)		
Urinary incontinence	0.080	0.071		
	(0.067)	(0.068)		
N	3,898	3,898	3,898	3,898

Notes: Robust standard errors in parentheses. * $p<0.05$. ** $p<0.01$. Fourteen regional dummies for 15 large administrative areas were included in the regression analyses but are not shown here.

Table 5.34. Estimated coefficients on dummy variables of informal care in OLS and IV-2SLS regression analyses of logged out-of-pocket costs from prescription drug use if Any

Key independent var.	OLS (1)	IV-2SLS (1)	OLS (2)	IV-2SLS (2)
Any care (vs. No care hour)	**0.187**	0.533	**0.202**	0.619
	(0.103)†	(0.248)*	**(0.104)**†	(0.260)*
Dummy variables (ref. No care hour)				
Care < 10 hrs/week	**0.417**	0.373	**0.453**	0.542
	(0.169)*	(0.967)	**(0.164)****	(1.025)
Care ≥ 10 hrs/week	**0.063**	0.621	**0.068**	0.661
	(0.126)	(0.529)	**(0.130)**	(0.559)
Dummy variables (ref. No care hour)				
Care < 15 hrs/week	**0.349**	0.463	**0.373**	0.601
	(0.140)*	(0.767)	**(0.140)****	(0.814)
Care ≥ 15 hrs/week	**0.047**	0.629	**0.054**	0.643
	(0.144)	(0.981)	**(0.147)**	(1.032)
Dummy variables (ref. No care hour)				
Care < 20 hrs/week	**0.392**	0.462	**0.409**	0.595
	(0.134)**	(0.672)	**(0.133)****	(0.714)
Care ≥ 20 hrs/week	**−0.030**	0.638	**−0.019**	0.654
	(0.150)	(0.893)	**(0.154)**	(0.946)

Notes: Robust standard errors in parentheses. † $p<0.1$. * $p<0.05$. ** $p<0.01$. Covariates included are the same as in each corresponding model above. (1) Thirteen disease indicator dummies were included; (2) Thirteen disease indicator dummies were not included.

Table 5.35. Estimated coefficients on variables of informal care for spouse/own parent/parent-in-law in regression analyses

Panel A: Satisfaction	Satisfaction	
Model estimation	OLS	OLS
Dependent var.	QOL (0-100)	Health (0-100)
Key independent var.		
ln(1+weekly hours of care for spouse)	−2.676	1.361
	(2.469)	(2.230)
ln(1+weekly hours of care for own parent)	1.655	0.598
	(1.777)	(1.810)
ln(1+weekly hours of care for parent-in-law)	2.501	1.474
	(1.238)*	(1.112)

Panel B: Depressive symptomatology				
Model estimation	Probit	OLS	Probit	Probit
Dependent var.	(1)	CES-D score	(2)	(3)
Key independent var.				
ln(1+weekly hours of care for spouse)	−0.205	0.087	−0.116	0.582
	(0.246)	(0.321)	(0.180)	(0.257)*
ln(1+weekly hours of care for own parent)	0.176	0.013	0.256	−0.397
	(0.197)	(0.148)	(0.143)†	(0.229)†
ln(1+weekly hours of care for parent-in-law)	−0.052	0.236	0.209	0.162
	(0.151)	(0.248)	(0.093)*	(0.111)

Panel C: Body pain and Self-rated health	Body pain	Self-rated health	
Model estimation	Probit	Ordered probit	Probit
Dependent var.	1=yes, 0=no	*1 Exc.~5 Poor*	*Fair* to *Poor* (1=yes, 0=no)
Key independent var.			
ln(1+weekly hours of care for spouse)	−0.025	−0.010	0.180
	(0.153)	(0.145)	(0.227)
ln(1+weekly hours of care for own parent)	0.077	0.023	−0.112
	(0.129)	(0.110)	(0.198)
ln(1+weekly hours of care for parent-in-law)	0.089	0.152	0.167
	(0.100)	(0.057)**	(0.101)†

Panel D: Health care use	Outpatient care use		Prescription drug use	
Model estimation	Probit	OLS	Probit	OLS
Dependent var.	Any use=1	ln(OOP) if Any	Any use=1	ln(OOP) if Any
Key independent var.				
ln(1+weekly hours of care for spouse)	0.038	−0.071	−0.176	−0.018
	(0.174)	(0.220)	(0.224)	(0.208)
ln(1+weekly hours of care for own parent)	−0.084	0.154	0.285	0.204
	(0.143)	(0.196)	(0.192)	(0.172)
ln(1+weekly hours of care for parent-in-law)	0.156	0.130	0.248	0.165
	(0.119)	(0.092)	(0.119)*	(0.052)**

Notes: Covariates are the same as in each corresponding model in previous analyses with 13 disease indicators dummies. Robust standard errors in parentheses. † $p<0.1$. * $p<0.05$. ** $p<0.01$. (1): Feeling depressed for two weeks or more during the past year or being on anti-depressant medication (1=yes, 0=no), (2): CES-D number of items ≥ 4 (1=yes, 0=no), (3): CES-D score ≥ 10 (1=yes, 0=no).

CHAPTER 6: DISCUSSION

The results support the first main hypothesis that informal caregiving has negative effects on caregivers' labor market outcomes, but only among women. Furthermore, the negative effects among female caregivers are found only for more intensive caregivers providing at least 10 hours of care per week. The negative effects on labor market outcomes are found at both extensive and intensive margins (Table 6.1). Compared with otherwise similar non-caregivers, female caregivers providing at least 10 hours of informal care per week are at an increased risk of being out of the labor force by 15.2 percent points. For employed work, the effect magnitude is rather small (8.2 percent point reduction), partly because of the relatively lower employment rate among midlife women in South Korea. Among employed workers, more intensive caregivers appear to receive lower wage by 1.65K KRW (≈ 1.65 USD) than otherwise similar non-caregivers.

For less intensive caregivers providing less than 10 hours per week, the estimated effects vary by model. In some models, the effects show opposite directions between extensive and intensive margins. That is, less intensive caregivers appear to be more likely to be in the labor force, while those remaining in the labor force may reduce work hours and experience lower wage rates. Such a finding has also been reported in Carmichael and Charles (1998). The negative effects of informal care hours on female caregivers' labor force participation are largely consistent across different age groups of adult child samples, lending support to the robustness of the results. For men, negative

effects of informal caregiving on labor market outcomes do not reach statistical significance.

These gender differences can be explained in several ways. First, the income effect of caregiving will be stronger among men than among women, because men are primarily responsible for bringing in household income. Second, the point where the substitution effect dominates the income effect may be higher among men than among women. Third, married caregiving men will be able to adjust their care hours to maintain their jobs, in which case their wives might have to give up their market work to be the primary caregiver in the home. Fourth, larger magnitudes of the negative effects of caregiving among women are also attributable to the lower quality of their jobs in the labor market. Many women participate in the *informal* sector of the labor market, such as unpaid family work, as studied earlier in the Japanese context (Hill, 1983). Work in the informal sector could be more easily replaced with informal family care when needed, compared with employed work the formal sector. The negative effects of informal caregiving on labor force participation are much more pronounced for *Any work* than for *Any employed work* (Table 6.1). Finally, in the Adult Child sample, there is a measurement issue of informal care hours. When KLoSA respondents provide their responses on which child provides how many hours of informal care to them, it is quite possible that a son's care hours come partly or almost entirely from the son's wife (the respondent's daughter-in-law). This is all the more likely because sons come before daughters-in-law in the order of possible responses in KLoSA survey. To the extent this is the case, sons' care hours reported by their parents will have less negative impacts on the sons' employment.

The results also provide some evidence for the threshold effect of care hours discussed in the previous literature (Ettner, 1995; Carmichael and Charles, 1998). Only more intensive caregivers are more likely to be out of the labor force, while less intensive caregivers may still be able to combine work and care. Up to a certain point of care hours, caregivers may even be more likely to be in the labor force than otherwise similar non-caregivers because the income effect dominates the substitution effect. One relevant research implication here is that caution should be made about using a continuous variable of informal care hours, which implicitly assumes the monotonicity of the effects. This study shows that, when the continuous variable of logged care hours is used, most coefficient estimates fail to capture statistically significant effects that emerge in models using the dummy variable specification of more intensive and less intensive care.

Compared with recent studies from other regions, the main results of this study produce interesting findings. First, gender differences in caregivers' labor market outcomes are much more pronounced in South Korea than in other regions (Carmichael and Charles, 2003; Bolin *et al*., 2008). Second, female caregivers experience wage penalty even when participating in the labor force. This finding is consistent with findings in Carmichael and Charles (1998) and Heitmueller and Inglis (2007) but not findings in Bolin *et al*. (2008) Third, the endogeneity between informal caregiving and labor market outcomes is weak, varying by statistical model.

This study attempts to control for multiple sources of endogeneity. Before estimating the main models, this study tested for the endogeneity between intergenerational co-residence and labor force participation by gender and age group. The endogeneity of co-residence and labor force participation has important policy

implications, particularly for cultures such as South Korea. Many intergenerational households are formed with the co-residence of the eldest son and his wife (parent's daughter-in-law) on their marriage. For example, suppose a new daughter-in-law who decided to co-reside with her parents-in-law taking into account her lower attachments to the labor force. She may be more likely to take on the role of caregiving. In such a case, supporting formal long-term care would achieve little success in increasing her likelihood of labor force participation. The degree of substitution between informal and formal long-term care might be small due to the relative stability of living arrangements. Furthermore, even if the substitution were elastic, it would be less likely that the co-residential caregiver develops increased attachments to the labor force just because of the reduction in their care hours. The results of the bivariate probit model estimation suggest that current younger generations in South Korea make their decisions on co-residence jointly with decisions on labor force participation, whereas older generations did not. Intergenerational co-residence is increasingly becoming a matter of choice rather than a family obligation.

To control for the endogeneity between informal care and labor market outcomes, this study employed two approaches. Results of the sibling group fixed-effects estimation using the Adult Child sample indicate that more intensive caregiving is associated with a lower likelihood of labor force participation. Interestingly, fixed-effects estimators have a larger effect magnitude than OLS and random-effects estimators. This finding contradicts the assumption that informal caregiving occurs predominantly among disadvantaged families. Rather, it supports that the marginal caregiver in South Korea may be better-off children with higher employability. Again, this fixed-effects estimation only controls for

one source of endogeneity bias that might arise from the correlation between unobserved sibling group factors and labor force participation.

In IV estimation results, endogeneity of informal care hours is detected for both men and women in the Midlife Adult Child sample aged 45-64. Interestingly, the two IV probit estimates are opposite in direction. Among men, the IV probit estimate on informal care hours has a positive sign, whereas a negative sign among women. Both are statistically significant. The standard probit estimates are statistically insignificant and their effect magnitudes are also small. Thus, the probit estimate has downward bias for men and upward bias for women. This finding is particularly interesting because the marginal caregiver might differ by gender in South Korea. Among men, caregivers are more likely to come from people with lower employability. Once men take on the parental caregiving role, they are more likely to work due to the income effect. This is probably because male caregivers may be poorer, and they are more likely to be unmarried. In contrast, women caring for their parents are more likely to have higher employability. The results show that not correcting for this endogeneity bias underestimates the negative effect of caregiving on female labor force participation. The same pattern is observed for the Younger Adult Child sample, although the endogeneity is not supported by statistical tests.

The study on caregiver health effects has confirmed negative effects of caregiving across four different health outcomes: satisfaction with quality of life and with health, depressive symptomatology, pain affecting daily activities, and self-rated health (H2a). Results also support the hypothesis (H2b) that informal caregiving increases caregivers'

outpatient care use and regular prescription drug use in the previous 12 months, although only the estimates in the models of conditional out-of-pocket spending reaches statistical significance at the 5% level. I summarize the effects of informal care on caregivers' health based on the results using the specification of the main independent variable as logged weekly care hours (Table 6.2).

No coefficient estimates on less intensive caregivers support the dominance of beneficial effects of caregiving over negative caregiver health effects. However, some evidence suggests the threshold effects (H2c). When examining coefficient estimates on less intensive care, many estimates in the models of satisfaction, depressive symptoms, and pain are statistically significant and have effect magnitude smaller than their corresponding coefficients on more intensive caregivers. By contrast, many coefficient estimates in the models of self-rated health, outpatient care use, and prescription drug use do not reach statistical significance and have very small magnitudes. These empirical findings may suggest that negative health effects of less intensive caregiving are more pronounced for psychological outcomes than for physical health outcomes. For physical health outcomes, results are suggestive of threshold effects. One plausible explanation for this difference is that psychological health outcomes may reflect the effects of anticipatory bereavement and emotional contagion more directly than physical health outcomes do. The effects of anticipatory bereavement and emotional contagion may occur even at relatively low care hours once upon being a caregiver, whereas the effects of providing daily care on physical health outcomes may take a certain level of commitment to caregiving.

The results provide some evidence that negative effects of caregiving differ among spousal care, own parental care, and parent-in-law care (H2d). Splitting informal care hours into three variables in the models may have reduced their statistical power considerably. Many coefficient estimates do not reach statistical significance even at the 10% level, so *F*-tests do not work well to test for the potential heterogeneous treatment effects. Nevertheless, some interesting findings emerge. Daughter-in-law caregivers report even higher satisfaction with quality of life and health, while at the same time showing an increased risk of being depressed and using more prescription drugs. This study cannot examine further these puzzling results, but several possible explanations are: first, their higher satisfaction has to do with the issue of social desirability in surveys; second, somatization of their poorer psychological health due to constantly repressed symptom expressions may lead to higher prescription drug use; and third, endogeneity may exist that inherently happier daughters-in-law provide informal care to their parents-in-law. Future research could investigate these issues.

One methodological contribution of this study is to test for selection into caregiving. Endogeneity was not detected in most statistical models. In only two models (conditional out-of-pocket spending for outpatient care use and prescription drug use), informal care hours is found to be endogenous. The IV estimation results in the two conditional outcome models indicate upward bias in the respective standard OLS models. These findings suggest that, in the general population, the issue of selection into caregiving based on health status is not significant. However, when focused only on a certain group, such as users of outpatient care and regular prescription drugs, health status may affect their decisions on taking on caregiving roles. As posited in the

conceptual framework, poor health status can represent revealed ineligibility for informal caregiving. Among individuals using outpatient care and prescription drugs regularly, less healthy individuals could be exempt from the role of caregiving, and healthier individuals may be more likely to take on the caregiving role. However, this selection is unlikely to occur at the general population level, particularly for subjective health outcomes. In other words, it is unlikely that people will choose whether or not to take on caregiving responsibilities based on their expected subjective health outcomes.

Two major limitations should be noted. First, limitations of using cross-sectional data preclude the possibility of accounting for temporal sequence of key events or effects of duration-related variables. For example, the temporal precedence of caregiving over changes in labor market outcomes cannot be known from the data. Moreover, such information as the duration of caregiving and previous history of caregiving is not available from the data. Likewise, information on baseline health status prior to caregiving does not exist in the current data. The IV methods employed can address part of these issues regarding reverse causality. For every model of the caregiver health outcomes, sensitivity was checked as to whether inclusion of common disease indicators changes estimation results considerably. Nevertheless, using longitudinal data with long duration would provide better opportunities to enhance the two studies.

Second, both studies include fewer context-specific variables in the statistical models, in part because such information is not available from the data and in part because the studies focus more on external validity. For example, the study on caregiver health effects does not take into account whether or not the care recipient had Alzheimer

dementia, and whether the care recipient showed problem behavior, although these are known to greatly affect caregiver's stress. Different types of caregiving tasks, such as assisting with daily living and providing companionship (Van Houtven *et al.,* 2005), are not taken into account in the two studies of this dissertation, although different types of tasks may have different effects on caregiver's health and even labor market outcomes. One attempt I made about accounting for context-specific factors is to examine possible heterogeneous effects on caregiver health outcomes depending on caregiver-recipient dyad (spousal care, own parental care, and parent-in-law care). There may be a great deal of heterogeneity arising from not accounting for such context-specific factors. Both studies use care hours as the basic metric of informal care. While the metric may capture much of the graveness of caregiving responsibilities, the advantage of using the generalizable metric should be weighed against the disadvantage of failing to reflect different contexts of caregiving. It is not clear, however, to what extent these factors might affect the overall picture of the results both studies present in this dissertation. Future studies might be able to exploit more context-specific information to examine subgroup differences and to improve overall analysis.

Despite these limitations, the two studies in this dissertation have several major strengths. First, the study on caregivers' labor market outcomes has produced an in-depth analysis of the impact of informal caregiving on labor market outcomes in South Korea. I account for gender differences as well as age group differences explicitly, by constructing relevant samples. Furthermore, for each gender/age group, multiple statistical models were run by combining different functional forms of informal care with labor market

outcomes at both extensive and intensive margin. By doing so, the study revealed a number of interesting findings showing a complex interplay between gender, intensity of care, and different patterns of adjustments, as discussed above. Second, using a variety of caregiver health outcomes allows for not only checking for the robustness of negative health effects but also examining interesting differences in the effects by study outcome. Most notably, psychological health outcomes are found to worsen even at a low level, where physical health outcomes may show some threshold effects. Third, I conduct a careful examination of the issue of endogeneity in both studies. Cultural and institutional settings of informal caregiving in South Korea allow for exploiting strong and valid family-level IVs. IV estimation has played a critical role in revealing gender differences in the marginal caregiver and hence in the effects of informal caregiving on labor market outcomes. In the caregiver health effects study, IV estimation results shed light on what kind of health outcomes may suffer most from the issue of selection into caregiving.

I propose two directions for future research. First, longitudinal data would provide more opportunities for improved study designs as well as allow for examining long-term effects of caregiving on labor market outcomes and health outcomes. One particularly interesting and policy-relevant area of research is to investigate the effects of South Korea's new public long-term care insurance on such outcomes as living arrangements, formal and informal care use, labor market outcomes, and caregiver health outcomes. Such studies will add to the literature produced from Japan's recent experience with transition in elderly long-term care (Oura *et al*., 2007; Shimizutani *et al*., 2008; Hanaoka and Norton, 2008).

Second, comparative studies, either cross-national or cross-cultural, would make meaningful contributions to the literature. The importance of cross-national research on aging has been increasingly emphasized, because international comparison may often provide interesting insights to individual behaviors concerning informal care and related family decisions (National Research Council, 2001). Moreover, developing countries experiencing rapid population aging need to better exploit the potential of cross-cultural research (Zimmer and Martin, 2007). Such comparative studies could exploit accumulating data from internationally comparable studies, such as HRS, SHARE, and KLoSA. Although a north-south gradient in Europe has recently received attention from the field of aging and long-term care (Viitanen, 2005; Crespo, 2006; Bolin *et al*., 2007; Bolin *et al*., 2008), such empirical comparative studies are scant outside of Europe. One immediate possibility is to conduct comparative studies between Japan and South Korea focusing on their experience with long-term care insurance. Some outcomes of interest could include living arrangements, formal and informal care use, labor market outcomes, and caregiver health outcomes. Further, cross-cultural studies would provide much broader ranges of interesting research questions. How do informal caregiving interact with economic behaviors, such as intergenerational transfers and lifetime savings (Norton, 2000)? How are caregiver health effects different by culture? What contributes to negative health effects of caregiving, among lack of support from formal care, cultural settings for care, and cultural differences in symptom expressions?

The main policy implication of this dissertation is that informal caregiving is already an important economic and public health issue in South Korea even before the

full effects of rapid population aging in the recent decades appear. Embedded in traditional culture, family-centered elderly care has often been touted as a great asset to support the welfare state of South Korea. However, the results of this study suggest that the current elderly care system has its own costs as well. Caregivers are less likely to participate in the labor force. Even though they may remain in the labor force, they reduce work hours and earn less than non-caregivers. Furthermore, because of the increasing prevalence of caregiving and its negative effects on health, caregiving should now be viewed as a public health issue.

The projected demographic transition in South Korea foretells that these costs of informal care will grow rapidly. These costs may go beyond individuals, in such forms as reduced income tax revenues or increased health care expenditures. Moreover, these costs may aggravate socioeconomic and gender inequalities in income and last into later life. Public policies on elderly care should take into account the costs of informal care. While South Korea introduced public long-term care insurance in 2008, informal care will serve as the mainstay of elderly long-term care in the foreseeable future, according to experiences in advanced countries. Thus, the role of public policy should be to pursue the optimal mix of formal and informal care. In this context, the study identifies a priority group for policy attention: female caregivers providing at least more than 10 hours per week. They are most likely to experience negative labor market outcomes and health consequences of caregiving. Potential policy measures might span multiple policy areas, including formal long-term care, financial incentives, and labor market policy.

Public long-term care insurance, if well implemented, may potentially improve labor market and health outcomes among caregiver populations. Recent studies from

other countries provide some evidence. Publicly provided long-term care is found to increase female labor force participation in Japan (Shimizutani *et al*., 2008) and Canada (Stabile *et al*., 2006). However, dementia caregivers' depression has little improved with the introduction of Japanese public long-term care insurance (Oura *et al*., 2007). Through the substitution between formal care and informal care among more intensive caregivers, labor market outcomes may improve among women. Caregivers' health, particularly psychological health outcomes, may not show marked improvements, because caregiving involves more than performing daily tasks. Policy measures should take a more comprehensive approach to caregiving than implementing public long-term care insurance alone.

Table 6.1. Summary of the effects of providing informal care of 10 hours per week or more on female labor market outcomes

Effect on labor market outcomes	Magnitude
Probability of labor force participation in any work	15.2% point reduction
Probability of labor force participation in employed work	8.2% point reduction
Hourly wage rate among employed women	1.65K KRW reduction
Unconditional hourly wage rate among women	0.77K KRW reduction

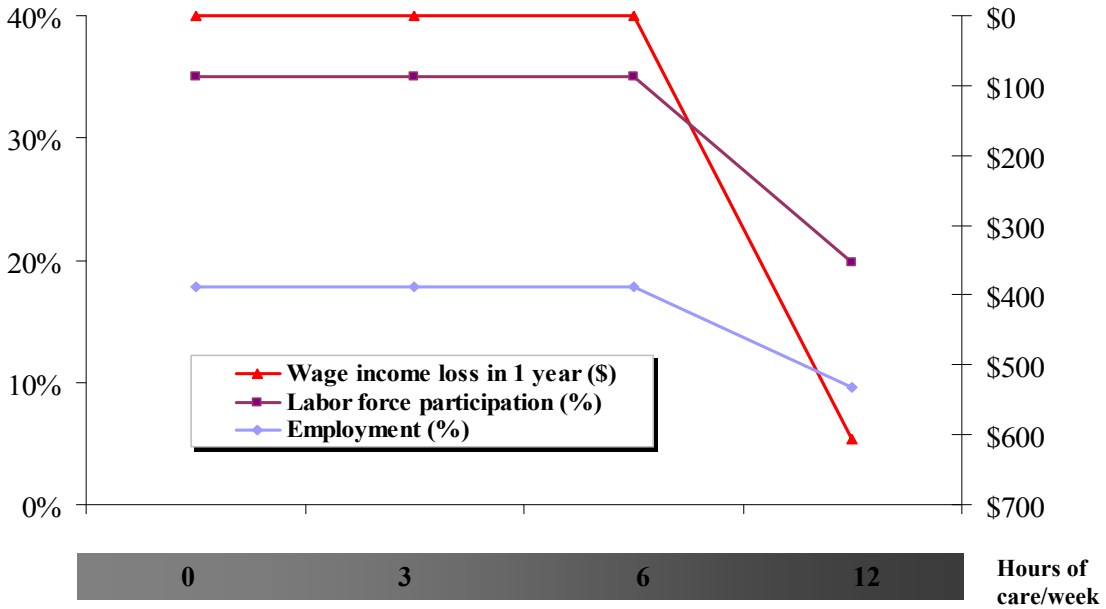
Table 6.2. Summary of estimated coefficients and marginal effects in caregiver health effects

	Coefficient	(S.E.)	Marginal effect of a 100% increase in care hours
Satisfaction			
Satisfaction with quality of life (0-100)	−1.994	(0.432)**	−1.994
Satisfaction with health (0-100)	−1.039	(0.430)**	−1.039
Depressive symptomatology			
(1) Depression	0.076	(0.029)**	1.04% points[a]
CES-D summary score	0.389	(0.086)**	0.389
(2) Depression	0.137	(0.026)**	4.28% points[a]
(3) Depression	0.110	(0.026)**	2.50% points[a]
Body pain			
Pr(Pain affecting daily activities)	0.067	(0.027)*	1.54% points[a]
Self-rated health			
Pr(Self-rated health being *Fair* to *Poor*)	0.061	(0.028)*	1.82% points[a]
Outpatient care use			
Pr(Outpatient care use)	0.023	(0.026)	Statistically insignificant
E(out-of-pocket costs) if any use	0.273	(0.104)**	27.3%
Prescription drug use			
Pr(Prescription drug use)	0.014	(0.032)	Statistically insignificant
E(out-of-pocket costs) if any use	0.199	(0.090)**	19.9%

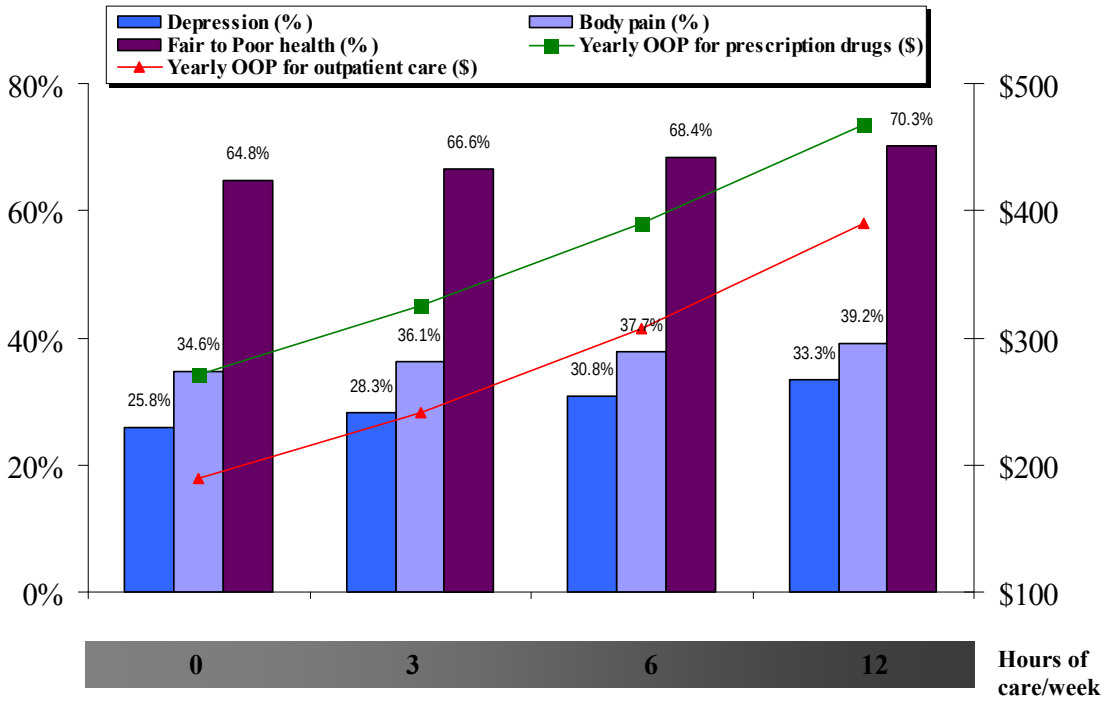
Notes: * $p<0.05$. ** $p<0.01$. (1): Feeling depressed for two weeks or more during the past year or being on anti-depressant medication (1=yes, 0=no), (2): CES-D number of items ≥ 4 (1=yes, 0=no), (3): CES-D score ≥ 10 (1=yes, 0=no). [a]Mean of the probabilities method

Figure 6.1. Effects of informal care on caregivers' labor market outcomes and health

(a) Labor market outcomes (midlife female)



(b) Health outcomes



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