The Effect of Informal Caregiving on Labor Market Outcomes in South Korea

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December 2008

Abstract

Embedded in traditional culture perpetuating family-centered elderly care, informal care is still viewed as a family or moral issue rather than a social and policy issue in South Korea. Using newly available microdata from the Korean Longitudinal Study of Aging, this study investigates the effect of informal caregiving on labor market outcomes in South Korea. By doing so, this study provides evidence to inform elderly long-term care policy in South Korea, and also fills a gap in the international literature by providing results from an Asian country. Empirical analyses address various methodological issues by investigating gender differences, by examining both extensive and intensive labor market adjustments with two definitions of labor force participation, by employing different functional forms of care intensity, and by accounting for the potential endogeneity of informal care as well as intergenerational co-residence. Robust findings suggest negative effects of informal caregiving on labor market outcomes among women, but not among men. Compared with otherwise similar non-caregivers, female intensive caregivers who provide at least more than 10 hours of care per week are at an increased risk of being out of the labor force by 15.2 percentage points. When examining the probability of employment in the formal sector only, the effect magnitude is smaller. Among employed women, more intensive caregivers receive lower hourly wages by 1.65K Korean Won than otherwise similar non-caregivers. Informal care is already an important economic issue in South Korea even though aging is still at an early stage.

Key Words: informal care; labor market outcome; population aging; Korea; KLoSA
JEL Classification Codes: I11; I12; J22

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* I would like to thank my advisor, Edward Norton, as well as Sally Stearns, Courtney Van Houtven, Michelle Mayer, and Peggye Dilworth-Anderson for invaluable guidance and advice. Karen Eggleston provided helpful comments and suggestions. I am grateful to the Korea Labor Institute for financial support, the data, and comments on a draft report. Please do not cite or quote without permission from the author.

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1. Introduction

South Korea is experiencing rapid population aging. The aged dependency ratio, defined as the number of persons aged 65 or older divided by the number of persons aged 15-64, 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 suggests that the working-age population in South Korea has an increasing burden of supporting the elderly population and the economy as a whole at the macroeconomic level. At the same time, given current family-centered elderly care in South Korea, decreasing fertility rates suggest that working-age individuals will face a greater likelihood to care for their elderly parents than before. Such double burden on the working-age population raises the question of whether the current elderly long-term care system, which is almost entirely dependent on informal care by family members, has labor market costs. This question is particularly salient because South Korea, one of the East Asian Tigers, will no longer enjoy the so-called demographic dividend that contributed to its economic boom for the past few decades (Bloom *et al*., 2000).

Nevertheless, little attention has been paid to informal care in the policy and research arena in South Korea. Embedded in traditional culture perpetuating family-centered elderly care (Sung, 1990; Chee, 2000), informal care is still viewed as a family or moral issue rather than a social and policy issue in South Korea. Policymakers may even rely on the cultural tradition of filial piety as policy measures to address issues of an aged society (Shin and Shaw, 2003), as exemplified by the legislation of *Promoting and Supporting Filial Piety Act* (Ministry of Health and Welfare, 2007). Moreover, although public long-term care insurance started in South Korea in 2008, most debates to date have focused on implementation issues of financing and provision of formal long-term care services (Sunwoo, 2004; Kwon, 2008). Little discussion has so far been directed at the interface between formal and informal care, let alone the benefits and costs of informal care itself.

This paper examines the effect of informal caregiving on caregivers' labor market outcomes in South Korea. Despite the staggering magnitude and speed of population aging in Asia (Kinsella and Velkoff, 2002; United Nations, 2002a, 2002b), this issue has

rarely been studied in this region, except for recent work from Japan (Shimizutani *et al*., 2008). In a recent systematic review of the literature on informal caregivers' labor supply published in English between 1986 and 2006 (Lilly *et al*., 2007), thirty-five articles included for its final review are all from North America and Europe. This dearth of literature in Asia is even more pronounced with the recent interest in cultural and institutional differences within European countries (Spiess and Schneider, 2003; Crespo, 2006; Bolin *et al.*, 2008). This paper fills the gap in the international literature by using newly available, nationally representative, and internationally comparable data from South Korea.

To compare with previous studies and to provide a more complete understanding of the effect of caregiving on labor market outcomes, this study pays special attention to four methodological issues importantly recognized in the literature (for an overview of key issues in the literature, see Lilly *et al*., 2007). First, considerable gender differences may exist in the effects of informal caregiving on labor market outcomes, because gender affects decisions on living arrangements, caregiving, and labor supply (Finley, 1989; Fredriksen, 1996; Dentinger and Clarkberg, 2002; Carmichael and Charles, 2003). As a traditionally patriarchal society, South Korea may exhibit more pronounced gender differences in the effect than Western cultures. To examine such gender differences explicitly, I estimate all empirical models separately by gender. Second, this study not only examines labor supply adjustments at both extensive and intensive margins but also accounts for the large informal sector in the labor market, particularly among women (Chen *et al*., 1999). To do so, labor force participation differentiates employment in the formal sector from participation in any type of market work, which includes self-employed or unpaid family work as well as employed work. For these two different definitions of labor force participation, I also examine wage rate and hours worked, respectively, to investigate possible adjustments at the intensive margin. Third, to examine for possible non-linearity and threshold effects (Ettner, 1995; Carmichael and Charles, 1998), I employ a categorical specification of informal care intensity as well as a continuous one. Finally, following the more recent literature (Crespo, 2006; Heitmueller, 2007; Bolin *et al.*, 2008), this study accounts for the potential endogeneity between informal care and labor market outcomes. This study also recognizes that living

arrangement decisions are also potentially endogenous to caregiving decisions (Stern, 1995; Pezzin *et al*., 1996; Pezzin and Schone, 1999). Therefore, intergenerational co-residence is another potential endogenous variable in models of labor supply. Given its high prevalence and occurrence before caregiving decisions in South Korea as in many Asian countries, the issue of co-residence merits due attention. Fortunately, cultural and institutional settings of South Korea allow for exploiting potential sources of identification using family-level instrumental variables (IVs).

Robust findings suggest negative effects of informal caregiving on labor market outcomes among women, but not among men. Informal care is already an important economic issue in South Korea even though population aging is still at an early stage. This study also contributes to the literature with interesting findings in the aforementioned four methodological issues.

2. Survey of the Literature and Conceptual Framework

Survey of the Literature

A small but increasing body of literature has examined the effect of informal caregiving on caregivers' labor market outcomes. 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 the 1990s reflects continued demographic changes and their implications for the labor force. As Ettner (1995) points out, economic research had previously been more interested in child care and its effect on female labor supply than in elderly parent care, which plays 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; Crespo, 2006; Heitmueller, 2007; 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 Farley-Short, 1990; Boaz and Muller, 1992), thus limiting the generalizability of study results because of 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; Latif, 2006; Crespo, 2006; Heitmueller, 2007; 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 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*. (2007) 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 earn less even when participating in the labor force, supporting previous findings from another UK study (Carmichael and Charles, 2003).

Release of the SHARE data has 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 the same, however, what co-residence captures in the empirical work.

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.

Conceptual Framework

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 how informal caregiving might affect labor market decisions (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. 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 1 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, as a latent variable, 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 a 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 Farley-Short, 1990; Carmichael and Charles, 1998, 2003; Heitmueller, 2007). 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, 2007). 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 here 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 these 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, 2007). 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 of 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, 2007), 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, 2007). Hence, caring responsibilities may fall on individuals with lower opportunity costs of time, or lower 'ability' (Heitmueller, 2007).

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 the labor market situation can affect caregiving decisions (Heitmueller, 2007). 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 commitment 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 commitment 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 pathways, these reasons all lead to the argument that not controlling for endogeneity may overestimate the potential negative effect of informal caregiving on caregivers' labor market outcomes.

Some further considerations are relevant to the cultural and institutional setting in South Korea. First, the endogeneity of informal caregiving may be weakened. Traditional cultural norms in Korea 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, these factors suggest that, in South Korea, informal caregiving may have been determined largely exogenously at the population level. This exogeneity may not hold in the future and even for current younger generations.

Second, informal caregiving may be correlated with *higher* unobserved ability and employability in Korea. 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 shoulders 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. Therefore, 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 supply, particularly for the daughter-in-law in a multi-generation household. An adult child's decisions on intergenerational living arrangements and on his or her labor supply may not be independent. 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 daughter'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 different methodological challenge that both variables are potentially endogenous.

3. Empirical Methods

Data and Sample Selection

This study uses the first-wave data from the 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 the 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.

The KLoSA was pre-designed to facilitate 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, expectations and life satisfaction. Unlike other comparable studies, the baseline KLoSA had its lower-limit age criterion at 45, not 50, to better capture the increasingly unstable employment status among Korean adults in their mid-40s and their retirement decisions (Boo *et al*., 2006). To focus on the typical working-age population in South Korea, I exclude individuals aged 65 or older (n=4,155). After excluding the few observations with missing values, the final samples have 2,278 men and 3,366 women.

Variables

Dependent variable: Labor market outcomes

I define four labor market outcomes. First, I define a binary variable of *Any employed work* as 1 if an individual is employed and as 0 if not. For the employed, I consider a continuous variable of hourly wage rate, which is calculated using the formula, (monthly income)/(weekly hours worked×4). Next, I define another binary variable of *Any work* to include self-employed and unpaid family workers as well as employed

workers. For those in *Any work*, I consider weekly hours worked as the respective continuous variable of interest. All these variables are based on responses for their current primary job. To account for the right-skewed distribution of the two continuous variables, I take the natural logarithm.

Key independent variable: Informal care

In the KLoSA survey, the respondent was first asked to identify "any family members (spouse, parents, parents of spouse, siblings and/or children) over the age of 10 who are unable to carry out activities of daily living (ADL)" (see Appendix for the questionnaire). ADLs were explained to the respondent as "(referring) to everyday routines such as eating, dressing, bathing or using the toilet, etc." Then, the respondent was asked whom, if any, the respondent provided any help with ADLs during the past 12 months. Following that question, the respondent was asked roughly how many hours per week and subsequently how many weeks he or she provided help during the same period. Using this information, I first calculate the sum of ADL care hours provided to family members. Similar questions were asked for IADL care, which was described as "(help) with other things such as household chores, errands, transportation, grocery shopping, financial management, etc." Another difference in those questions between ADL and IADL care was that IADL care was only asked for family members who were not living with the respondent. In case responses were given in months, KLoSA interviewers were instructed to enter 4 for 1 month, 26 for 6 months, and 52 for 1 year, respectively. I add the number of ADL and IADL care hours for a particular family member at the respondent-observation level. Then I sum up all care hours provided to more than one person at the respondent-observation level. By dividing the number by 52, I obtain averaged weekly hours of care the respondent provided during the past 12 months.

I take the natural logarithm of (1+weekly care hours) to account for the right skewedness in distribution. In addition, I create a set of two dummy variables representing less intensive care and more intensive care with the omitted reference category being no care. I use 10 hours per week as a cutoff commonly used in previous empirical work (Ettner, 1995; Carmichael and Charles, 1998, 2003), and also use 20 as another cutoff for sensitivity analysis.

Other explanatory variables

In addition to these key study variables, statistical models control for individuals' demographic and socioeconomic factors, health status, region of residence, and parental characteristics. Demographic and socioeconomic factors include age, marital status, education level, household assets, and house ownership. 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. For health status, I include disability and poor self-rated health as control variables. I create fourteen dummy variables representing each large administrative area, with the omitted category being Seoul Metropolitan City.

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 in 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.

Instrumental variables (IVs)

Three IVs for informal care 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. These IVs should strongly predict one's probability of providing informal care or intensity of care but should not directly affect one's labor market outcomes. Furthermore, there is hardly any plausible explanation that these IVs may violate the monotonicity condition; that is, each IV must predict the endogenous variable either positively or negatively.

Sample Description

Summary statistics of the study variables are presented in Table 1. Stark gender differences are observed in labor market outcomes. Women are less likely to participate in the labor force than men, for both *Any work* and *Any employed work*. Although those in *Any work* do not reveal any gender difference in weekly hours worked, employed women on average earn only half as much as employed men do. Women provide informal care more often than men do. Furthermore, caregiving women provide more hours of care than caregiving men do. Caregiving women are also more likely to become intensive caregivers.

Compared by informal care intensity, labor market outcomes are generally poorer among more intensive caregivers than among less intensive caregivers or non-caregivers, particularly for women (Table 2). However, some outcomes are even better among less intensive caregivers than among non-caregivers.

Estimation Strategy

I estimate the following model in general form:

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

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 with the reference being no caregiving. 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(s) of main interest are β.

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 can be made jointly with his or her decision on market work. Moreover, co-residing adult children may have different levels of employability to begin with:

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

Fixed effects estimation could exploit within-sibling group variation as identifying information (Norton and Van Houtven, 2006). However, such an estimation strategy still depends on a rather strong assumption that, within each sibling group, caregiving responsibilities fall on one or more siblings in a random fashion. This assumption fails if family members make decisions on who provides care based on their ability or employability, which is not easily observed in empirical data. To address this methodological challenge, this study employs an IV approach. In an IV approach, 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. In this study, family members' functional limitation provides potentially promising IVs because family members' functional limitation will

increase the possibility of one's providing informal care but will not directly affect one's labor market decisions (Ettner, 1995; Bolin *et al*., 2008).

Eq. (1) raises another major challenge for the empirical estimation 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 IVs might be available from family-level (parent-level or sibling-level) characteristics because both informal caregiving and intergenerational co-residence can be different forms of intergenerational relations with elderly parents. However, I do not use an IV approach for the two endogenous explanatory variables for two related reasons. First, in many Korean extended families, the co-residence decision is made long before the decision about informal caregiving. 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 IVs 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 and number of sisters) showed strong predictive power for co-residence but only weak associations for informal caregiving. By contrast, parent-level variables (*e.g.*, parents' ADL and 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. In a preliminary analysis, I use subsamples of KLoSA respondents' adult children to test for the endogeneity of co-residence with regard to labor force participation. For the purpose of comparison by gender/age group, I estimate a bivariate probit model not only for the midlife (aged 45-64) but also younger (aged 25-44) adult child subsamples.

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

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

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 the 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.

In estimating the bivariate probit model, sibling-level variables are a source of 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* is another potential IV in the male subsamples. Tests of exclusion restrictions follow Rashad and Kaestner (2004). The summarized results in Table 3 suggest that the IVs can be validly excluded from the main equation. The likelihood-ratio tests of *rho*=0 suggest different results by age group but not by gender, indicating that exogeneity of co-residence cannot be rejected among midlife adult children. Based on these results, I proceed to estimate the main model with co-residence included as an exogenous control variable.

Source of Identification

The source of identification in this study comes from individuals who had any family member with a functional limitation and thus provided informal care. Bivariate analyses in Table 4 suggest that a family member's functional limitation is highly correlated with informal caregiving but largely not correlated with labor market outcomes.

Results of specification tests for the IVs provide formal tests for the assumptions (Table 5). The test results are consistent regardless of whether informal care intensity is

defined as a continuous variable or as a set of two dummy variables. *F*-statistics for joint significance of the IVs are large, suggesting that the IVs have good explanatory power for informal caregiving. The IVs also pass the test of exclusion restrictions. The results of the exogeneity test suggest that exogeneity cannot be rejected in any of the models.

Supplemental Analysis

Detailed information on respondents' adult children in the KLoSA data allows for constructing comparable samples. A similar approach has been taken for the SHARE data (Crespo, 2006). I construct two subsamples: younger (aged 25-44) and midlife (aged 45-64) adult child subsamples. I use forty-five as the cutoff age to create these two subsamples so that both the midlife adult child sample and the main study sample can have the same age group of 45-64. Using respondents' functional limitations as instruments for adult children's informal caregiving, I find that informal caregiving has a negative effect on caregivers' labor force participation among women across age groups, but not among men. This supplemental analysis also detects endogeneity of caregiving in some models. The full results of the supplemental analysis are not presented here but are available on request.

4. Results

The estimation results show negative effects of informal caregiving on labor market outcomes among women, but not among men (Tables 6-7). For men, most coefficient estimates do not reach statistical significance, except for two positive coefficients in conditional wage models in Table 7. For women, however, providing informal care appears to have negative effects on labor force participation (either *Any work* or *Any employed work*) although statistical significance varies by specification of care intensity. More intensive caregivers show statistically significant and negative coefficients of larger magnitude, while less intensive caregivers have statistically insignificant and positive coefficients of smaller magnitude. These findings suggest that increasing care intensity has threshold effects, because less intensive caregiving does not appear to decrease the probability of labor force participation. Rather, the positive

coefficients suggest that less intensive caregiving may even have beneficial effects on labor force participation, although the coefficients do not reach statistical significance. Related to this finding, the results of conditional hours worked show another interesting finding. That is, less intensive caregivers may be able to combine work and care but, if they do, they work fewer hours and earn less. Taken together, these results suggest that more intensive caregiving and less intensive caregiving may have different effects on labor market outcomes at the extensive/intensive margins. Therefore, I use the preferred dummy-variable specification to present incremental effects of two levels of informal care intensity.

Table 8 shows incremental effects of less intensive and more intensive caregiving on labor market outcomes. Again, the effects of caregiving on labor market outcomes are concentrated among female, more intensive caregivers. For this group, the negative effects on labor market outcomes are found at both extensive and intensive margins. Compared with otherwise similar non-caregivers, female caregivers providing at least 10 hours of care per week are at an increased risk of being out of the labor force by 15.2 percentage points. For employed work, the effect magnitude is smaller (8.2 percentage point reduction). Among employed women, more intensive caregivers appear to receive lower hourly wages by 1.65K Korean Won than otherwise similar non-caregivers.

5. Discussion

This study has produced several interesting methodological findings that contribute to the international literature. First, although previous studies have noted gender differences in labor market effects of caregiving (Carmichael and Charles, 1998, 2003; Heitmueller and Inglis, 2007; Bolin *et al*., 2008), this study shows more striking gender differences from an Asian country. The stark gender differences in caregivers' labor market outcomes found in this study could be explained in several ways: 1) The income effect can be stronger among men than among women, because men are primarily responsible for bringing in household income; 2) The point where the substitution effect dominates the income effect may be higher among men than among women; and 3) Married caregiving men are better able to adjust their care hours to maintain their market

work, in which case their wives may have to relinquish their market work to be the primary caregiver in the home. Two data-related issues could also have contributed to these gender differences. Part of care hours reported by a married man may reflect care provided by his wife, who likely shares the caring responsibility. Furthermore, the number of male caregivers in the study sample may not be large enough to detect statistically significant effects.

Another related point is the importance of accounting for labor market characteristics in a given economy. To some extent, the large magnitude of negative effects of caregiving among women is attributable to the lower quality of their jobs in the labor market. Compared with employment in the formal sector, market work in the informal sector could be replaced more easily with informal elderly care when needed. This study shows that the negative effect of informal caregiving on labor force participation is larger for *Any work* than for *Any employed work*. In future research, the choice of labor market outcomes and operational definition of labor force participation warrants caution in developing countries with a large informal labor sector (Hill, 1983)

Third, by combining various labor market outcomes and different specifications of care intensity, this study provides a fuller picture of caregivers' labor market behavior. The results provide some evidence on the threshold effect that, up to a certain level of care intensity, caregiving does not necessarily deter labor force participation (Ettner, 1995; Carmichael and Charles, 1998). Less intensive caregivers appear to be even more likely to participate in the labor force, although the results are statistically insignificant. Furthermore, among labor force participants, less intensive caregiving can negatively affect hours worked or wage rate. Taken together, these results suggest that informal caregiving could affect labor market outcomes in a more complex way than was posited in the previous empirical work. One relevant research implication here is that a continuous variable of informal care intensity may fail to capture non-monotonic and threshold effects of care intensity.

Fourth, although the main models in this study do not detect endogeneity between caregiving and labor market outcomes, findings from the supplemental analyses imply that accounting for endogeneity is important and will be more so in the future. When subsamples of adult children derived from the KLoSA data were used, endogeneity was

detected with respect to not only caregiving but also intergenerational co-residence in several models of labor force participation. This finding may be in part because the models used fewer control variables and in part because individuals, particularly younger generations, are more likely to make their decisions on parental care or living arrangements in relation to their labor market decisions. By contrast, among current older (midlife) generations, informal caregiving may be more likely to exogenous with the cultural tradition of filial piety, where parental support responsibilities are determined mainly based on birth order and gender.

Several limitations should be acknowledged. First, the cross-sectional nature of the data not only precludes the possibility of examining temporal sequence of caregiving and work transitions but also hinders investigating possible effects of duration-related variables. Although the IV approach may partially address the issue of reverse causality, longitudinal data with long duration would provide more opportunities to enhance the empirical work. The duration of caregiving can also be an important factor affecting labor market outcomes. Furthermore, while the wage differentials may suggest cumulated effects of discrimination and unfavorable work trajectories (Heitmueller and Inglis, 2007; Bolin *et al*., 2008), the data in this study do not allow for further investigation. Second, compared with data from other aging studies, the data include a relatively lower proportion of caregivers because the recent rapid aging may not yet be fully reflected in caregiving at the population level. Third, this study did not explore possible heterogeneous effects by important individual characteristics or the type of informal care. For example, different types of caregiving tasks such as assisting with daily living and providing companionship were not taken into account, although they may have different effects on labor market outcomes.

Future research exploiting longitudinal data from the KLoSA would provide opportunities to improve study designs and to answer other related questions. One particularly interesting and policy-relevant study will be to investigate the effects of South Korea's public long-term care insurance introduced in 2008 on formal and informal care use, living arrangements, and caregivers' labor market 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).

The main policy implication of this study is that informal caregiving is already an important economic issue in South Korea even before the full effects of rapid population aging in the recent decades have appeared. Although family-centered elderly care has often been touted as a great asset to support the welfare state of South Korea, the current elderly care system has its own costs as well, in the form of poorer labor market outcomes of caregivers. These costs may go beyond individuals. 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, these costs may aggravate socioeconomic and gender inequalities in income and may last into late life. Given a certain out-of-pocket price for formal care, substituting formal care is financially more difficult among poor families; thus, they have fewer choices other than providing informal care at the expense of their own employment. Thus, informal caregiving can exacerbate old-age poverty and income inequality (Harrington Meyer, 1996; Viitanen, 2005). Caregiving may put disproportionately more women at the risk of giving up work for caregiving, investing less in training, and consequently settling for a less favored employment trajectory along the life course. These effects collectively may lead to an increased probability of older women's living in poverty (Wakabayashi and Donato, 2005). The projected demographic transition in South Korea foretells that such problems will intensify rapidly. This study identifies female intensive caregivers as a priority group for immediate policy attention, for both elderly long-term care policy and labor policy.

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Table 1. Summary statistics, 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 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 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%

Table 2. Labor market outcomes, by gender and care intensity

	Male			Female		
Panel A: No care vs. any care hour	0	> 0		0	> 0	
Any work (%)	75.1	67.8		35.0	29.7	
Weekly work hours, hours (mean)	49	51		49	46	
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	0	0<hr<10	hr ≥ 10	0	0<hr<10	hr ≥ 10
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 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	0	0<hr<20	≥ 20	0	0<hr<20	≥ 20
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 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: KRW=Korean Won.

Table 3. Tests for bivariate probit models of co-residence and labor force participation

	Adult child aged 25-44		Adult child aged 45-64	
	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				
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, excluding observations with any parental ADL/IADL limitation. IV=instrumental variable, LFP=labor force participation. Other variables included in the model are age, education level, marital status, house ownership, number of children, and parent's marital status, house ownership, assets, and region dummies. * $p<0.05$. ** $p<0.01$.

Table 4. Informal care and labor market outcomes, by gender and family member ADL status

	Male			Female		
[a]*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 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: [a]Family member include any parent, parent-in-law, and sibling or other relatives.

Table 5. Specification tests for instrumental variables for informal care

Sample Extensive margin Intensive margin	Strengths of instruments[a]	Test of exclusion restrictions	Exogeneity test	Conclusion[b]
Panel A: Continuous variable specification of hours of informal care				
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 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 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
Panel B: Dummy-variable specification with cutoff at 10 hours of informal care per week				
	• 1 if 0 < care hours < 10 • 1 if care hours ≥ 10			
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 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 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: [a]The instruments used are (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 have any ADL limitation. [b]Conclusion is based on statistical significance at the 5% level. Other variables included in the models are co-residence, age, marital status, education level, assets, house ownership, disability and poor self-rated health, whether both parents live together, parent's house ownership, parent's education, and fourteen region dummies. † $p<0.10$. *** $p<0.001$.

Table 6. Coefficient estimates in Probit models of Any work and OLS models of conditional logged weekly hours worked

Dependent var. Independent var. of main interest	Male	Female
Panel A: Continuous variable specification of hours of informal care		
Any work		
ln(1+ weekly hours of care)	−0.059	−0.110*
ln(weekly work hours) if any		
ln(1+ weekly hours of care)	−0.005	−0.017
Panel B: Dummy-variable specification with cutoff at 10 hours of informal care per week		
Any work		
No informal care hour (Ref.)	-	-
0 < Informal care hours < 10	0.024	0.167
Informal care hours ≥ 10	−0.304	−0.506**
ln(weekly work hours) if any		
No informal care hour (Ref.)	-	-
0 < Informal care hours < 10	0.102	−0.273*
Informal care hours ≥ 10	−0.029	−0.018
Panel C: Dummy-variable specification with cutoff at 20 hours of informal care per week		
Any work		
No informal care hour (Ref.)	-	-
0 < Informal care hours <20	−0.122	0.068
Informal care hours ≥ 20	−0.166	−0.597**
ln(weekly work hours) if any		
No informal care hour (Ref.)	-	-
0 < Informal care hours < 20	0.117	−0.205†
Informal care hours ≥ 20	−0.138	−0.072

Notes: Other variables included in the models are co-residence, age, marital status, education level, assets, house ownership, disability and poor self-rated health, whether both parents live together, parent's house ownership, parent's education, and fourteen region dummies. † $p<0.10$. * $p<0.05$. ** $p<0.01$.

Table 7. Coefficient estimates in Probit models of Any employed work and OLS models of conditional logged hourly wage rate

Dependent var. Independent var. of main interest	Male	Female
Panel A: Continuous variable specification of hours of informal care		
Any employed work		
ln(1+ weekly hours of care)	−0.022	−0.065
ln(hourly wage rate) if any		
ln(1+ weekly hours of care)	0.060*	−0.037
Panel B: Dummy-variable specification with cutoff at 10 hours of informal care per week		
Any employed work		
No informal care hour (Ref.)	-	-
0 < Informal care hours < 10	−0.140	0.207
Informal care hours ≥ 10	−0.065	−0.437†
ln(hourly wage rate) if any		
No informal care hour (Ref.)	-	-
0 < Informal care hours < 10	0.168†	−0.014
Informal care hours ≥ 10	0.099	−0.151†
Panel C: Dummy-variable specification with cutoff at 20 hours of informal care per week		
Any employed work		
No informal care hour (Ref.)	-	-
0 < Informal care hours <20	−0.157	0.049
Informal care hours ≥ 20	0.011	−0.362
ln(hourly wage rate) if any		
No informal care hour (Ref.)	-	-
0 < Informal care hours < 20	0.123	−0.016
Informal care hours ≥ 20	0.180	−0.176†

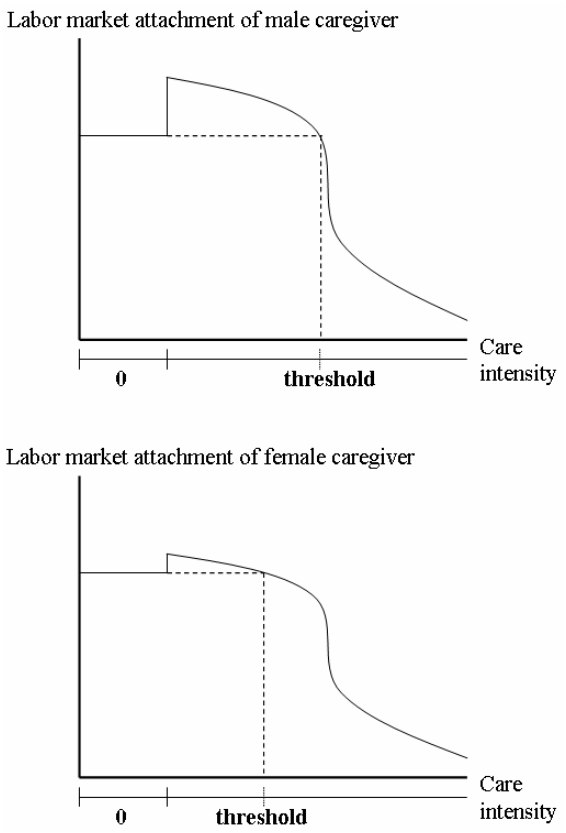
Notes: Other variables included in the model are co-residence, age, marital status, education level, assets, house ownership, disability and poor self-rated health, whether both parents live together, parent's house ownership, parent's education, and fourteen region dummies. † $p<0.10$. * $p<0.05$.

Table 8. Bootstrapped incremental effects of informal care on labor market outcomes

	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 B2: 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: Bias-corrected bootstrapped 95% confidence intervals derived from 1,000 repetitions are shown in brackets. * $p<0.05$.

Figure 1. Hypothesized relation between labor market attachment and care intensity by gender



Appendix. Questions related to informal care in the KLoSA questionnaire

Q1. 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

Q2. Did you provide (names listed in Q1) 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)

Q3. During the past 12 months (not calendar year), roughly how many hours per week did you help out [name chosen from Q2]? _____hours per week

Q4. How many weeks did you provide such care to [name chosen from Q2] during the past 12 months? _____weeks

Q5. 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)

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