Informal and formal care for elderly persons: How adult children's characteristics affect the use of formal care in Japan[☆]

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ABSTRACT

Informal care by adult children remains the most common source of caregiving for elderly parents in Japan, even after the introduction of long-term care insurance in 2000. We estimate how the potential supply of child caregivers affects the use of formal care of elderly parents, focusing on the differences across children. We find that the effects of children's presence vary substantially with gender, marital status, and opportunity costs of children. The potential supply of daughters-in-law, as the traditional source of informal care, is less important in providing care than that of unmarried children. The opportunity costs of children make a difference in the use of formal long-term care.

Introduction

The age distribution in all regions of the world has been shifting gradually to older ages, and Japan is expected to be by far the world's oldest at mid-century (Cabinet office, Government of Japan, 2007). Moreover, Japan is expected to attain the world's highest level of the 65+ people dependency ratio (United Nations, 2007). Because of these dramatic changes in demographics, public long-term care insurance was introduced to Japan in 2000. Because the new public long-term care insurance gave more opportunities for elderly persons to use formal long-term care, the overall cost of the insurance system had already doubled between 2000 and 2006. The rapidly aging population combined with the lower availability of child caregivers will continue to bring a substantial increase to the cost of formal care of the next several decades in Japan.

Even after the new long-term care insurance has been implemented, informal care by adult children is still the most common source of care for elderly persons in Japan. Most informal care is provided by daughters: 41% by daughters-in-law and 34% by daughters, compared to 24% by sons and 1% by sons-in-law among all child caregivers (MHLW, 2004). In particular, traditional Japanese social norms put the primary responsibility for care on the daughter-in-law to care for her parents-in-law. Reflecting this traditional background, the prior system of elderly long-term care in Japan has implemented a means-test and formal long-term care is not usually available to elderly persons who have potential family caregivers. Yamamoto and Wallhagen (1998) found that the traditional social norm is still prevalent; thus, daughter caregivers are reluctant to use any formal long-term care for respite purposes.

However, some studies have pointed out that the child caregivers' role has been changing in Japan (Hashizume, 2000; Long & Harris, 2000). There are two major changes. First, the informal caregiver has less often been the

daughter-in-law in recent times. The proportion of children-in-law caregivers living with their frail parents dropped from 30% in 1995 to 20% in 2004. In contrast, the proportion of biological children caretakers living with their parents barely changed from 18% in 1995 to 19% in 2004 (MHLW, 2004). At the same time, more elderly people are now living alone or with a spouse than ever before. On account of the changes in living arrangements and family structure, in the new insurance scheme, anyone aged 65 years or older can get benefits regardless of income and the availability of family support, if they are certified as eligible based on their functional and cognitive status. Benefits are provided in the form of services with no cash payments to the family or other informal caregivers.

Second, son caregivers are gradually becoming more prevalent, accounting for 25% of actual child caregivers in 2004 compared to 20% in 2001 (MHLW, 2001 and 2004). Some studies have documented that the differences in caregivers between sons and daughters reflects the differences in opportunity costs of time (Norton, 2000). McGarry (1998) found that daughters are more likely to provide care for their parents than sons because their opportunity costs of time are less than those of sons. However, recent studies (see, e.g., Carmichael & Charles, 2003) have found that caregiving for the elderly substantially burdens in the form of an opportunity cost not only for sons, but also for daughters because the opportunity costs of time for women has been increasing.

We need to better understand how child caregivers affect formal care use for elderly parents while focusing on the characteristics of children. This understanding will assist in formulating revisions of the long-term care insurance, which are scheduled every five years. To date, some studies have empirically examined how child caregivers affect formal care for their elderly parents. Van Houtven and Norton (2004) found that the effects of actual child caregivers vary by the types of care. Informal care from actual child caregivers is a significant substitute for formal long-term care, but in contrast, it serves as a complement for outpatient surgery. Furthermore, it has been found that the substitution effects on formal long-term care differ by the characteristics of actual child caregivers (Stern, 1995; Van Houtven & Norton, 2008). While existing studies have focused mainly on the USA, there is at least one study of Japan after the new insurance was introduced. Tamiya, Yamaoka, and Yano (2002) found that the effects of informal care vary by types of actual caregivers. This study has limitations, however, because the authors did not control for the endogeneity of actual caregivers in the model of formal long-term care use and used limited data taken from a single city just one month after the new insurance started.

The purpose of this paper is to empirically examine how child caregivers affect formal care for their elderly parents, with a particular emphasis on the differential effects for gender, marital status, and opportunity costs of children. Our study uses a nationally representative sample and investigates the effect of child caregivers on formal care use for elderly parents using an exogenous measure of informal care, the potential supply of child caregivers (not the actual supply of child caregivers). Our results show

that the presence of children with a lower opportunity cost has a significant negative effect on long-term care use for elderly parents than that with a higher opportunity cost. This result supports our prediction that caregiving from children is a substitute for elderly parents' long-term care use.

Conceptual framework

We follow the same conceptual framework as Van Houtven and Norton (2004). They assume that a parent chooses to utilize formal care conditional on whether or not their children supply informal care. The purpose of this paper is to test three questions regarding the relationship between the potential supply of child caregivers and formal care use for elderly parents.

First, how does informal care from children affect formal care in terms of substitutes or complements? The effect of children's presence on formal long-term care is different based on the types of care. Informal care would be a substitute for formal long-term care in the sense that elderly parents can receive assistance (e.g., in eating and taking a bath) from their children. In contrast, informal care would serve as a complement for formal care such as outpatient care requiring professional practice and could not be replaced by family or other informal caregivers. In this case, children give support for the elderly parents in the form of transportation to the hospital and the administration of medicine following the doctor's instructions. We hypothesize that informal care might be a substitute for formal long-term care and a complement for outpatient care. We also hypothesize that the presence of children who live with their parents will be more likely to provide care than that of children who do not live with, because they have lower costs for supporting their parents. Accordingly, we also examine the effects of the sub-group of children who live with their parents.

Second, does the traditional Japanese social norm still matter? It is reasonable to assume that, for the potential supply of informal caregiver, a son is replaced by a daughter-in-law if the son gets married. This assumption implies that the potential supply of child caregivers is divided into four groups: daughters-in-law, unmarried daughters, unmarried sons, and married daughters. For married daughters, it would be possible to provide care for both their own parents and parents-in-law. We hypothesize that the presence of daughters-in-law may have a stronger effect on formal care use for elderly parents than that of other children, if the traditional norm still prevails. Specifically, in a typical case under the traditional norm, a daughter-in-law lives with her parents-in-law. We expect that the effect of having daughters-in-law on formal long-term care is stronger and more significant than that of having other children, using sub-groups of children who live with their parents.

Third, do the opportunity costs of time make a difference among children? As already stated, previous studies have shown that the differences in the opportunity costs of time lead to differences in actual caregiving between sons and daughters (Carmichael & Charles, 2003;

McGarry, 1998). It is hypothesized that children with a lower opportunity cost of time are more likely to provide care for their parents than that of children with a higher opportunity cost. We expect that there may be differential effects between children with a lower opportunity cost of time and that of children with a higher opportunity cost.

Methods

The demand for the use of formal care is estimated by the four types of care: institutional long-term care only, home health care only, any combination of long-term care (institutional long-term care and home health care), and outpatient care. The key independent variables are the number of children, regardless of whether or not children actually provide care, as a proxy of the potential supply of child caregivers. To assess the overall effects of the potential supply of child caregivers on elderly parents' formal care, we estimate the following linear probability model:

$$\Pr(\text{Formal care}_{pj} = 1) = \alpha_{0j} + (\text{IC}_{ps} \mid \text{HS or less})\alpha_{1sj}$$
$$+ (\text{IC}_{ps} \mid \text{more than HS})\alpha_{2sj}$$
$$+ X_p\alpha_{3j} + \epsilon_{pj} \qquad (1)$$

where IC refers to the potential supply of child caregivers, X_p refers to a vector of a parent's characteristics, the αs are estimated parameters, and between is an error term. The subscript p refers to a parent, j ($j = 1,...,4$) refers to the four types of formal care, s ($s = 1,...,4$) refers to the four children groups: daughters-in-law, unmarried daughters, unmarried sons, and married daughters. Educational attainment is used as a proxy for the opportunity costs of children's time, and each children group has been split into two variables depending on whether children have more than a high school education ($\text{IC}_{ps} \mid$ more than HS), or they have a high school education or less ($\text{IC}_{ps} \mid$ HS or less). Accordingly, each of the four formal care models has eight coefficients on four children groups with lower education (α_{1sj}) and four children groups with higher education (α_{2sj}).

First, to see whether the relationship between informal care and formal care varies according the types of formal care, we test all 32 coefficients of children's presence (each of eight parameters for four α_{1sj} and four α_{2sj} in four types of formal care models) for the signs and significance using a *t*-test. If informal care is a substitute for formal care, both the estimates of α_{1sj} and α_{2sj} should have negative signs. Whereas, if informal care is a complement, then α_{1sj} and α_{2sj} should have positive signs. We expect that the coefficients of the number of children have negative signs in the formal long-term care model, while the coefficients have positive signs in the outpatient care model. We also expect the effects to be stronger when we use the subgroups of children who live with their parents.

Second, to test whether the traditional social norm still prevails, we compare the magnitude and significance between daughters-in-law and other children groups by educational attainment. If the traditional norm still has importance, the coefficients of the presence of daughters-in-law are expected to have more negative signs than those of the presence of other children in formal long-term care models. The difference between daughters-in-law and other children are expected to be larger in magnitude if we examine the effects of the sub-groups of children who live with their single elderly parents, because the typical case of the traditional norm is meant to be co-residence of a daughter-in-law and her parents-in-law.

Third, to test whether there are any differential effects in the opportunity cost of children on formal care, we compare the magnitude and significance between less education (α_{1sj}) and more education (α_{2sj}) for each children group and test the null hypothesis that $\alpha_{1sj} = \alpha_{2sj}$ using an *F*-test with (1, 1449) degrees of freedom. Our conceptual framework expects that the effect of the presence of children with a lower opportunity cost would be greater than that of the presence of children with a higher opportunity cost.

In the empirical implementation, when we examine the effects of the sub-groups of children who live with their single elderly parents, the definition of the model has changed slightly in two ways. First, the four children groups with higher education are aggregated into one, because there are fewer children with more than a high school education. Second, those who are not the elderly subject's children but who lived with the elderly subject were included as proxies for potential informal caregivers.

Data

This study used data from the 2001 wave of the Nihon University Japanese Longitudinal Study of Aging (NUJLSOA), which was conducted by the Nihon University Center for Information Networking. The NUJLSOA is a longitudinal survey of a nationally representative sample of the population over age 65 years in Japan and was designed to analyze the use of formal long-term care and the relationship between family structure, living arrangements, and formal long-term care use. Although the first wave in 1999 is also available, we examined our hypotheses using only the 2001 wave. Under the prior system of the new insurance started in 2000, the elderly received formal long-term care based on the availability of family support and income rather than their functional and cognitive status. Therefore, the number of children used as an exogenous measure of child caregivers in this paper could not be treated as exogenous in the 1999 wave, because formal long-term care use was simultaneously determined by the potential supply of child caregivers under the system before 2000. This means that the explanatory variable children's presence has an endogeneity problem in the model when we use the 1999 wave. Accordingly, the first wave of data was not useful and we did not use the 1999 data for comparison.

The entire sample includes 3992 respondents in the 2001 wave. To focus on the effects of children's presence, we restricted the sample to single elderly parents, bringing the number of respondents down to 1698. Because of the eligibility under the new insurance scheme, the sample used was single parents aged 65 years or over. Finally, our sample was limited to the 1450 respondents with valid observations for key adult child-related variables and for Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs) of single elderly parents.

Dependent variable

The main focus of this paper is to analyze the relationship between the potential supply of child caregivers and formal care use for single elderly parents. Our conceptual framework predicted that informal care reduces formal long-term care use and, in contrast, increases outpatient care. The use of long-term care was defined by the response to the survey question, "Are you currently using the following services? Or have you ever used the following services after you received care-needs certification in the public long-term care insurance?". The variable *institutional long-term care use* indicates whether single elderly parents have used or are currently using any residential-type care facility including nursing homes, rehabilitation facilities for the elderly, and units of general hospitals designed for the elderly and covered by public long-term care insurance. The variable also includes elderly people who are currently hospitalized on the date of the interview, because it is the most realistic option for them to receive long-term care by hospitalization due to the absolute shortage of paid home care and nursing home (Ikegami, 1997). Of those who are currently hospitalized, about 90% have been hospitalized more than one month, indicating that the majority of them receive chronic care and long-term care rather than acute care. The variable *home health care use* includes visiting services (home help, visiting nurses, and bathing help), institutional services for the elderly living at home (day care and short stay for respite purposes), and physical goods (home renovation, provision of equipment like beds and wheelchairs). We also created the variable *formal long-term care use*, which combined the above two variables to examine the effects on formal long-term care in general.

The use of outpatient care was defined by the following question, "Are you currently visiting a hospital or clinic to receive medication?" The variable *outpatient care use* equaled one if the respondent visited a doctor regardless of whether receiving medication. If the respondent did not visit a doctor, the variable equaled zero. By this definition, 5.0% of the sample used institutional long-term care, 9.8% of the sample used home health care, 13.2% of the sample used at least one formal long-term care service, and 77.7% of the sample used outpatient care (see Table 1).

Key explanatory variables

We use the number of children as a proxy for the potential supply of child caregivers. Our hypotheses suggest that the magnitude and significance of how informal care affects formal care may differ according to the characteristics of the potential source of child caregiving. The potential supply of child caregivers varies, on average, from 0.02 to 0.87 based on the characteristics of children (see Table 1).

It may be possible that the marital status of children simply reflects the age of their parents: parents of unmarried children might be younger than parents of married children. Table 1, column 2 shows the average age of single elderly parents by children groups. Regardless of educational attainment of children, parents of

Table 1
Descriptive statistics of dependent variables and key explanatory variables

Variable	Mean	Average age of unmarried parents (each number > 0)
Dependent variables		
(1) Institutional long-term care use	0.050	
(2) Home health care use	0.098	
(3) Formal long-term care use ((1) + (2))	0.132	
(4) Outpatient care use	0.777	
Informal care		
Number of children with high school education or less		
Daughters-in-law	0.766	79.88
Unmarried daughters	0.174	80.98
Unmarried sons	0.144	79.01
Married daughters	0.869	79.71
Number of children with more than high school education		
Daughters-in-law	0.099	79.44
Unmarried daughters	0.023	80.59
Unmarried sons	0.046	76.39
Married daughters	0.097	77.79
Number of children with high school education or less living with their parents		
Daughters-in-law	0.293	80.39
Unmarried daughters	0.065	80.69
Unmarried sons	0.073	78.73
Married daughters	0.092	80.07
Number of children with more than high school education living with their parents		
Children (daughters-in-law, unmarried daughters, unmarried sons, and married daughters)	0.109	77.83
Number of others living with the elderly subject	0.116	78.50

unmarried daughters are inclined to be older and parents of unmarried sons are younger.

Other explanatory variable

The econometric model also controlled for parent's age, gender, income, 12 chronic conditions, number of ADL limitations, number of IADL limitations, proxy respondent, 10 regional dummies, and a constant term. The average age of individuals was about 79 years, and about 80% of the sample was female (see Appendix A). Income is measured based on 13 broad income categories. The higher eight income groups have a relatively small number of observations and are combined into one group. We also include an income missing variable to avoid the loss of a large number of observations. Accordingly, we use seven income-related variables.

Results

Taken as a whole, the results show that the potential supply of child caregivers affects formal care use for their elderly parents. The children's presence acts as a substitute for formal long-term care. The marital status of children also affects the magnitude of formal care use. In addition, there is a differential effect between the presence of children with less education and that of children with more education.

Substitutes or complements?

First, we examined the hypothesis that the effects of the potential supply of child caregivers differ by type of formal care use (see Table 2). The overall results are quite weak even though we have some significant results for our hypotheses. The presence of less educated unmarried children is a substitute for formal long-term care. The less educated unmarried daughters had a significantly negative effect on the probability of institutional long-term care and any formal long-term care use. Also, the presence of less educated unmarried sons was associated with a lower probability of having any formal long-term care compared to that of less educated married daughters. In contrast, the presence of married daughters with a higher opportunity cost had a positive effect on the probability of having any formal long-term care, but the coefficient was significant at only 10% level.

The coefficients in the case of outpatient care show that the presence of less educated unmarried daughters had a negative effect, contradicting our prediction (Table 2, column 4). However, this result was less than convincing because the significance level of the coefficient on unmarried daughters was only 10% and most other coefficients were not statistically significant.

The presence of co-resident children appears to more steadily reduce formal long-term care use than that of children not limited to co-residence of parents (see Table 3). The presence of unmarried daughters in general implies a 2.4% point lower probability of institutional long-term care use (Table 2, column 1). In contrast, the presence of unmarried daughters who lived with their parents is associated with a 7.0% point lower probability of having institutional long-term care (Table 3, column 1). In addition, the coefficients on the children's presence

increase in significance in institutional long-term care use, home health care use, and any combination of long-term care use. The estimates might underestimate on formal long-term care use because co-residence represents a choice and thus there is the potential for selection bias to affect these results.

Does the traditional social norm still matter? Daughters-in-law vs other children

We now turn to see whether the potential supply of daughters-in-law still has importance in caring for their parents-in-law. The presence of daughters-in-law does not have a lower probability of formal long-term care use than that of other children. The coefficients of daughters-in-law had no significant effects on formal long-term care for their parents-in-law (Table 2). Furthermore, when children lived with their parents, the coefficients of daughters-in-law were smaller in magnitude than those of unmarried children among less educated children (Table 3).

The difference in opportunity costs of child caregivers

Overall, the presence of children with a lower opportunity cost has greater and more significant substitution effects on formal long-term care than that of children with a higher opportunity cost. We present an empirical test for whether there are any differential effects in opportunity costs between less education and more education for each children group using an *F*-test. It was only for the potential supply of unmarried daughters that a statistically significant difference was found at the 5% level (see the bottom of Table 2). When the presence of children was limited to those living with their single elderly parents, there was a statistically significant difference in opportunity costs for

Table 2
Linear probability model of formal care use as a function of number of children by educational attainment

	(1) Institutional long-term care use	(2) Home health care use	(3) Formal long-term care use ((1)+(2))	(4) Outpatient care use
Number of children with high school education or less				
Daughters-in-law	−0.0082 (0.0058)	0.0018 (0.0087)	−0.0060 (0.008	−0.0075 (0.0121)
Unmarried daughters	−0.0243** (0.0119)	−0.0196 (0.0174)	−0.0395** (0.017)	−0.0444 (0.0244)
Unmarried sons	−0.0114 (0.0104)	−0.0202 (0.0161)	−0.0341** (0.017)	−0.0045 (0.0209)
Married daughters	0.0054 (0.0057)	−0.0076 (0.0081)	−0.0039 (0.0081)	−0.0007 (0.0106)
Number of children with more than high school education				
Daughters-in-law	−0.0015 (0.0094)	−0.0131 (0.0153)	−0.0191 (0.0153)	−0.0021 (0.0285)
Unmarried daughters	0.0866 (0.0528)	0.0452 (0.0612)	0.0700 (0.0508)	0.0337 (0.0641)
Unmarried sons	0.0124 (0.0205)	−0.0225 (0.0239)	−0.0152 (0.0208)	0.0062 (0.0501)
Married daughters	0.0240 (0.0162)	0.0294 (0.0242)	0.0417* (0.0247)	−0.0414 (0.0334)
H_0: children with high school education or less = children with more than high school education				
Daughters-in-law	n.s.	n.s.	n.s.	n.s.
Unmarried daughters	**	n.s.	**	n.s.
Unmarried sons	n.s.	n.s.	n.s.	n.s.
Married daughters	n.s.	n.s.	*	n.s.
R-squared	0.30	0.22	0.38	0.18
Number of observations	1450	1450	1450	1450

Notes: the sample is limited to single parents aged 65 years or older. Each model is estimated using a linear probability model and contains other explanatory variables for age, female, 6 income dummies, 12 chronic diseases, number of ADL limitations, number of IADL limitations, proxy respondent, 10 regional dummies, and a constant term. Robust standard errors are reported in parentheses.
***Significance at the 1% level.
**Significance at the 5% level.
*Significance at the 10% level.

Table 3
Linear probability model of formal care use as a function of number of children living with single parents by educational attainment

	(1) Institutional long-term care use	(2) Home health care use	(3) Formal long-term care use ((1) + (2))	(4) Outpatient care use
Number of children with high school education or less living with their parents				
Daughters-in-law	−0.0245** (0.0123)	−0.0272 (0.0175)	−0.0495*** (0.0173)	0.0169 (0.0251)
Unmarried daughters	−0.0707*** (0.0204)	−0.0441 (0.0288)	−0.0955*** (0.0304)	0.0071 (0.0401)
Unmarried sons	−0.0361** (0.0154)	−0.0447* (0.0265)	−0.0766*** (0.0274)	−0.0056 (0.0355)
Married daughters	0.0012 (0.0208)	−0.0452 (0.0277)	−0.0517* (0.0285)	0.0242 (0.0369)
Number of children with more than high school education living with their parents				
Children (daughters-in-law, unmarried daughters, unmarried sons, and married daughters)	0.0173 (0.0227)	−0.0224 (0.0246)	−0.0358 (0.0224)	0.0175 (0.0445)
Number of others living with the elderly subject	−0.0110 (0.0119)	−0.0351* (0.0136)	−0.0368** (0.0166)	−0.0037 (0.0165)
H_0: children with high school education or less = children with more than high school education				
Daughters-in-law	*	n.s.	n.s.	n.s.
Unmarried daughters	***	n.s.	*	n.s.
Unmarried sons	**	n.s.	n.s.	n.s.
Married daughters	n.s.	n.s.	n.s.	n.s.
R-squared	0.30	0.23	0.39	0.18
Number of observations	1450	1450	1450	1450

Notes: the sample is limited to single parents aged 65 years or older. Each model is estimated using a linear probability model and contains other explanatory variables for age, female, 6 income dummies, 12 chronic diseases, number of ADL limitations, number of IADL limitations, proxy respondent, 10 regional dummies, and a constant term. Robust standard errors are reported in parentheses.
***Significance at the 1% level.
**Significance at the 5% level.
*Significance at the 10% level.

daughters-in-law and unmarried children (see the bottom of Table 3).

Robustness checks

One concern of our estimation may be that a small number of elderly parents having many children can have a substantial effect on formal care use. We reestimated the model in Eq. (1) using variables indicating whether single elderly parents have at least one child rather than the number of children for each children group. We found that the estimation results were similar but the explanatory power of the model was slightly better in the model that used the number of children than in the model that used at least one child.

Another concern is that when the traditional social norm is upheld, the birth order of sons may affect the probability of whether or not daughters-in-law provide care. In order to check this, we reestimated the model focusing on the birth order of married sons. Instead of including the number of daughters-in-law, we included the two dummy variables. One variable is daughters-in-law married to eldest sons and the other is daughters-in-law married to other sons. For other children groups, we used the set of variables indicating whether single parents have at least one child, rather than using the number of children. We found that daughters-in-law married to eldest sons had slightly stronger substitute effects than those married to other sons in most cases. However, the coefficients on daughters-in-law were mostly smaller in magnitude, regardless of the birth order of sons, than those of unmarried children. These results are similar to those reported above and lead us to conclude that our basic results are not sensitive to the birth order of sons.

An alternative concern deals with the potential supply of married sons, which is a potential supply of child caregivers that we have ignored so far. We reestimated by including the presence of married sons instead of including the presence of daughters-in-law. We found that married sons had similar effects to those of daughters-in-law. One limitation is that it is difficult to separate the effects of married sons from those of daughters-in-law because the presence of married sons and daughters-in-law are highly correlated, even if they are split by educational attainment. Under the limitation, however, we found that the effects of married sons' presence on formal long-term care were less negative than for unmarried children's presence among less educated children. We did not examine the effects of sons-in-law because actual sons'-in-law caregivers are extremely rare (MHLW, 2004).

Discussion

In summary, these results indicate some evidence to support our hypotheses. First, the effects of the potential supply of child caregivers are not uniform for single elderly parents' formal long-term care use. The results suggest that gender appears to have quantitatively different, but qualitatively similar negative effects on parent's formal long-term care use among unmarried children. The results also suggest that marital status and the opportunity cost of time play important roles, when children decide whether to provide care or not. Second, the hypothesis under the traditional social norm, i.e., that daughters-in-law take on primary caregiving responsibilities, is not supported even if the birth order of sons is taken into consideration. These results are consistent with studies suggesting that actual

daughters'-in-law caregivers are becoming less important in providing care for elderly parents (Hashizume, 2000; Long & Harris, 2000). Third, the results are consistent with our conceptual framework that the presence of children with a lower opportunity cost of time are more likely to provide care than that of children with a higher opportunity cost of time, resulting in a stronger substitution effect of the former than of the latter.

These results have several policy implications. Informal care by children possibly reduces the cost of formal long-term care by decreasing its use. More importantly, these results suggest that the reduction varies by the characteristics of informal caregivers. Furthermore, the traditional role of daughters as the primary caregiver to their parents is changing, reinforcing the idea that eligibility for public long-term care insurance benefits should be determined solely by health status, rather than the availability of family support as under the prior system.

An important direction for future work is to examine how informal care affects expenditures on long-term care for the elderly in Japan (Van Houtven & Norton, 2008). Our analysis could be extended to assess whether public long-term care insurance should pay cash payments to family caregivers, because it might be more cost-effectiveness. Our results suggest that the characteristics of a source of informal caregiving should be considered when estimating the reduction in formal long-term care expenditures as a result of the substitution effect of informal caregiving. Unfortunately, there is no information available in the survey about who actually provides care and to what extent. If data were available, this would allow us to do a more policy-relevant study using our framework.

Appendix A. Descriptive statistics of other explanatory variables

Variable	Mean
Age	79.18
Female	0.832
Income1	0.109
(–$4, 100, the reference category)	
Income2 ($4100–$8300)	0.212
Income3 ($8300–$12,500)	0.174
Income4 ($12,500–$16,700)	0.142
Income5 ($16,700–$25,000)	0.117
Income6 ($25,000–)	0.071
Income missing	0.174
Heart problems	0.237
Cancer	0.048
Cerebrovascular disease	0.125
High blood pressure	0.446
Diabetes	0.097
Respiratory illness	0.093
Digestive illness	0.214
Renal or urinary tract ailments	0.081

Appendix (*continued*)

Variable	Mean
Ailments of the liver or gallbladder	0.088
Arthritis	0.283
Chronic back pain	0.261
Hip fractures	0.104
Number of ADL limitations (min = 1, max = 7)	0.752
Number of IADL limitations (min = 1, max = 7)	0.981
Proxy respondent	0.148
Region 1	0.043
Region 2	0.096
Region 3	0.220
Region 4	0.068
Region 5	0.062
Region 6	0.088
Region 7	0.146
Region 8	0.077
Region 9	0.041
Region 10	0.090
Region 11	0.070

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