The Effects of Catastrophic Health Expenditure on the Labor Supply of Individuals: Focusing on Disease Status of Family Member

By

IM, Hyundo

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF PUBLIC POLICY

2019

The Effects of Catastrophic Health Expenditure on the Labor Supply of Individuals: Focusing on Disease Status of Family Member

By

IM, Hyundo

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF PUBLIC POLICY

2019

Professor SHIN, Jaeun

The Effects of Catastrophic Health Expenditure on the Labor Supply of Individuals: Focusing on Disease Status of Family Member

By

IM, Hyundo

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF PUBLIC POLICY

Committee in charge:

Professor SHIN, Jaeun, Supervisor

Professor YANG, Hee-Seung

Approval as of December, 2019

ABSTRACT

The Effects of Catastrophic Health Expenditure on the Labor Supply of Individuals: Focusing on Disease Status of Family Member

By

Hyundo Im

Among various factors that can affect labor supply, health expenditure also plays an essential role because depends on the size of health expenditure, we can presume the seriousness of the disease and possible side effects of health expenditure on household finance as well. However, forming a direct causal relationship between health expenditure and labor supply is complex, since there are other health factors that can affect the effects of health expenditure on labor choice of individuals. In addition, relatively trivial size of health expenditure may not provide a meaningful intuition about the effect on labor supply. Thus, this study focuses on the effects of catastrophic health expenditure (CHE), the health expenditure that exceeds a certain proportion of the capacity to pay, on the employment status of individuals while controlling for the existence of family member who is experiencing either serious disease or chronic disease. Regression results provide strong statistical evidence that catastrophic health expenditure is strongly associated with decreasing probability of an individual to be in employment status. The effects of having family members with either chronic or serious disease are varying by individual characteristics, especially when the sample is distinguished by gender. Given a family member experiences either chronic or serious disease, women are less likely to diminish their employment when the family member experiences chronic disease. On the other hand, the effect of the disease status of a family member does not statistically influence the employment status of men, but only when the family member experiences both chronic and serious disease. CHE has significant negative effects on the employment of individuals, but the effects of the disease status of the family member on the individual's employment status vary by gender.

Dedicated to Jaeun Shin

ACKNOWLEDGEMENTS

Sincere gratitude to everyone who have given their precious time, advice, and dedicated support to this thesis. First of all, I want to thank my supervisor, professor Jaeun Shin for providing plethora of advice for writing this thesis. I also want to express my gratitude to professor Hee-Seung Yang for providing additional advice to enhance the quality of this thesis.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Introduction

In the discussion of labor supply, various factors are debated whether which factor contributes to the decision of working for each individual, therefore influence the total labor supply of the economy. Among many indicators of labor supply, health is considered important since a certain level of minimum health is required for any individual to participate in labor activities – though varies by occupation and by the individual. However, such indicator of subjective health is difficult to define and therefore lots of studies of labor supply regarding health focus on the health expenditure which provides some implications about the burden on the household budget and seriousness of the disease. Still, health expenditure has wide variance because of the characteristics of Korean public health that public health expenditure covers around 65 percent of health expenditure of individuals and the coverage differs by the type of expenditure and income level of individuals. Mainly, lots of diseases with a small amount of health expenditure in Korea are covered by national health insurance that relatively small payments are hard to distinguish from another. Thus, the certain criterion is necessary to observe the effects of a large amount of health expenditure on labor decision of individuals.

Another debate on household labor supply is whether the labor status of the family member can be the substitution of another. This kind of discussion usually deals with who is in charge of the majority of home production. Depends on income, culture, or specific household characteristic, the different number of family members participate in labor activities. However, measuring such substitution effect is puzzling in many cases since channels of effects are hard to define and lots of omitted variables also play their roles to complicate the interpretation. Despite the complexity to investigate

substitution effects in labor supply, certain variables help us to estimate such as the health status of family member. If one of the household members is experiencing adverse health condition, for example, chronic disease and/or serious disease, it may affect the labor supply of comparatively healthier household member. Under this hypothesis, I attempt to investigate the substitution effects of disease status on household labor supply by controlling chronic disease status and/or serious disease status of household members of sample individuals.

Catastrophic health expenditure (CHE) is the status that the out-of-pocket health expenditure exceeds a certain proportion of income or capacity to pay of a household. CHE has diverse definitions and equations since there is no distinct criterion that defines which level of medical expenditure can be considered as "catastrophic" health expenditure. In this study, I use the definition of CHE from World Health Organization (WHO) that health expenditure divided by capacity to pay – disposable income less food expenditure. For the regression analysis, I use Korean Welfare Panel Study (KWPS), the panel data that begins with the sample size of 7,000 households, outweighed low-income families. Using panel probit model with random effects, I have observed there is a significant negative association between CHE with 10 percent cutoff and employment status controlling the effects of chronic disease status and/or serious disease status of the household member. In addition, using a lagged variable of CHE, the results suggest the possibility of a causal relationship between CHE and the employment choice of next year. Lastly, multinomial probit analysis provides empirical evidence – which is complicated to interpret – that CHE can have a comparatively negative effect on the individual's labor choice with diverse routine. Still, further discussions about possible problems of variable selection and model specification would be needed.

Regression results suggest that the welfare package that provides not only financial support but also indirect support for a household to reduce the opportunity cost of caring their seriously ill family member, therefore individuals would not have to either reducing their labor supply or experiencing possible job mismatch to hastily fulfill their budget constraint.

Literature Review

South Korea is a country with a 2015 GDP per capita of $29,742, and the country spent approximately 7.4 percent of GDP in 2015 for health expenditure (World Bank). Compared to both the OECD average and world average, health expenditure is not comprising a large proportion of Korea's GDP. In addition, in 2015, out-pocket-expenditure is 36.8 percent of health expenditure, which is almost the double of world average (18.1 percent) and close to the triple of the OECD average (13.75 percent). The above information indicates that Korean citizens are spending a substantial amount of out-of-pocket expenditure for their health. However, since the average health expenditure in Korea is approximately $2,012.7 in 2015, compared to the OECD average ($4,519), such comparison may be complicated. In Korea, the major health policy instrument is national health insurance (NHI) system, which provides universal coverage to the whole Korean population. However, since the coverage is not substantial compared to the OECD average, some argue that more improvements are necessary. Some studies intend to observe the relation between subscribing private health insurance and health expenditure in Korea. Kim (2018) discusses the effects of applying for private health insurance on health expenditure and the frequency of using blood pressure related health services. In the study, she does not find enough evidence that presents any significant effects exists between private health insurance and health expenditure and service usage for patients of high blood pressure. This may due to the characteristics of the market of blood pressure usage, but still, this study leaves us the question whether the effects of private health insurance are limited in Korea. However, such discussion is necessary in terms of health expenditure of an individual. On the other hand, some studies alternate their focus on specific types of private health

insurance, therefore they may find a significant relationship with health expenditure in Korea. Focusing on actual expense insurance, Kim and Shin (2017) study the effects of buying new medical insurance for actual expense on personal health expenditure and national health insurance spending. Using difference-in-differences model, they find strong evidence that thr first assignment of private health insurance for actual expense increases the size of medical expense. Still, this may not lead us to the clue that links employment status and health expenditure.

In the discussion of labor supply, a plethora of studies debate which factors constitute labor supply. Many studies of labor supply discuss the relationship between determinants of income and labor supply. Friedberg (2000) insists that net wage, demographic characteristics, and virtual income dominantly affects labor supply decision, while the virtual income comprises nonlabor income and Social Security benefits with the given condition. In addition, Yang (2016) suggests the determinant of income, such as Earned Income Tax Credit (EITC) receipt causes income seasonality that changes labor supply pattern of married women which therefore engender alteration in family labor supply. However, Lambrinos (2001) argues that omitting individual health factors may cause positive bias regarding the relationship between wage rate and labor supply. In addition, Lambrinos suggests that using disability status as an exogenous variable would be problematic in terms of the discussion of labor supply because of reverse causality matter. These aforementioned studies provide the implication that general determinants of labor supply are usually income-related factors, while health indicators can also work as determinants and external factors of labor supply.

Since its effects on labor supply is substantial, health is considered in the series of studies of labor supply. Goryakin and Suhrcke (2017) present that poor health has

the apparent adverse impact on labor supply in the Russian Federation case. They have found that along with poor health, diverse illness conditions have their own impacts on discouraging working status. This implies health and labor supply have a negative association. However, Smith et al. (2016) believe that both health and education have effects on labor supply, while education has an indirect effect on labor supply through the channel of health using Education-enhanced Health Capital path analysis. The study suggests that some rooms of discussion for endogeneity between health and labor supply exists and the solution may be essential to overcome the problem of reverse causality. The effect of health on labor supply may be obscure since health can be simply distinguished into physical health or mental health. Some research has explored the impact of mental health on labor supply. For instance, Schurer (2017) suggests in her study that given a person with a positive personality, the person is less likely to drop out of the labor force despite the health shock occurs. On the other hand, a person with negative personality is more likely to drop out of the labor force and diminishes his working hours after the health shock. Therefore, it can be inferred that the effect of physical health on labor supply may be altered by mental health status. However, we may also assume that adverse physical health condition may also influence mental health condition, thus constructing the direction of the channel may be needed.

In addition, discussing the relationship between labor supply and health, it is necessary to find out the association between health and income factors. It is plausible to debate that adverse health condition has a direct negative influence on income factors. Diverse illness leads to health expenditure and depends on the size of the financial burden by illness, labor supply may vary. Page (2011) describes in his study that in the United States, for part-time workers with low-income, health expenditure subsidy for a kidney transplant may engender drop in labor force after the transplant has occurred.

The study indicates that for low-income part-time workers, health expenditure subsidy will have dominant income effects while full-time workers with low-income are more likely to increase their participation after the transplant. This study hints the reactions of workers towards certain disease may differ by their income levels. However, such caution may be necessary in because of some diseases, workers may react differently compared to, for example, kidney failure.

While some studies focus on the effects of the individual's health conditions on his own, some studies explore the research area that connects the relationship between health and labor activity within the household. These studies usually observe either income effects or substitution effects within the household labor supply, using health as an indicator. One of the studies discusses the effect of a husband's health on wife's labor supply, instrumenting husband's earnings (Siegel, 2006). In this study, husband's adverse health condition has somewhat mixed effects on the wife's labor supply that some diseases increase wife's labor supply while others decrease the labor supply of wife. For instance, the husband's heart disease led increasing wife's labor participation, whereas husband's stroke results in decreasing wife's labor participation. The study indicates that there is either substitution effects or income effects which depends on the opportunity cost engendered by specific disease of a husband. This result is essential for studying the relationship between CHE and labor supply of household member because separating the effects of specific disease type from the relationship between CHE and labor supply may be essential to reveal the actual effect.

The study done by Garcia-Gomez et al. (2011) supports the above points. Using acute hospital admissions data from Dutch, Garcia-Gomez et al. find that sudden illness has the negative effect on not only the labor supply and income of own, but also on the labor supply and income of a spouse. They observe that the effect aggravates for the

bottom of the income distribution, and the negative employment effect is larger for husbands than for wives and in high-income households. This study indicates that there can be heterogeneity in effects of a spouse's health condition on another by gender and income. However, since this study is only focusing on sudden illness, the information may not be sufficient to observe how the effect of chronic disease on the labor supply of spouse differ. Regarding chronic illness of a household member, Comblon and Marazyan (2017) discuss how individuals respond to the chronic illness of their household members. They find that women are more likely to increase their labor supply if a male member of their household experiences chronic illness. Considering the study is done in Africa, where the social norm of male domination in workforce is prevalent, this evidence suggests that culture is not likely to affect the channel between labor supply of individuals and their household members' chronic illness. This study is suggesting a crucial implication that some increases in household labor supply are not "voluntary," which suggests that there can be the failure in job matching due to the urgency in the household's finance.

Diverse studies use CHE with different formulas and cutoff points because variables given in data, culture, and time-context. Studies related to CHE in Korea mainly focus on household finance, especially related to poverty issues. Two studies pioneer the research are of CHE: Wagstaff and Doorslaer (2003) and Xu et al. (2003). Wagstaff and Doorslaer intend to impoverishment effects of CHE using Vietnam data from 1993 to 1998. They find that the proportion of facing CHE in Vietnam diminished over time and the poverty impact of out-of-pocket payments is predominantly due to poor people becoming poorer rather than the opposite. They illustrate that the calculation of CHE is based on two assumptions: health care payments are thought of as involuntary, undeliberate, and non-discretionary and household members would

have enjoyed the higher level of consumption which equals to the level of health care consumption. These two assumptions may seem restrictive, but logically sound that a large proportion of health expenditure occur involuntarily and demands a substantial amount of household income. In addition to Wagstaff and Doorslaer, Xu et al. systematically calculate CHE and conduct cross-country analysis which observes the relationship between incurrence of CHE and characteristics of countries that experiencing a relatively high rate of CHE. They find CHE more likely to occurs in the countries in transition and certain Latin American countries. Moreover, they suggest three preconditions for CHE incurrence: the availability of health services requiring payment, low capacity to pay, and the lack of prepayment (or health insurance).

Extending from the relationship between the financial status of households and CHE, Prasanna et al. (2018) try to estimate any treatment effect of cash transfer program in India, the National Tuberculosis Program. They try to see if the government's financial assistance can reduce the probability of CHE incurrence. They find that the cash treatment has reduced the probability of CHE incurrence, but significant number of households – third of sample – encountered CHE. However, the study faces the limit that this result may be restricted to India and Tuberculosis treatment only. For the broader application, observing the treatment effect of CHE with larger category of the disease may be necessary.

In Korea, several studies focus on the effect of CHE on various household outcomes. For instance, Song and Shin (2015) discuss the importance of comprehensive health expenditure ceiling system in order to prevent possible damage from CHE. They argue that the negative impact of CHE on household finance is grave enough to push the socioeconomic status of households. Kim and Yang (2011) identify the difference in financial characteristics of households with or without CHE adjusting household

characteristics. They show that households with CHE have significantly lower earned, business, and property income and higher transfer and loan incomes than those without catastrophic health expenditure. These studies focus on the relationship between CHE and household finance, but they do not discuss how CHE can affect the source of income, which can directly affect household finance.

Relating to the CHE, Anbari et al. (2014) assert that chronic disease and insufficient household wealth are the highest predictors of CHE using Iran's cross-sectional data. In Iran's case, lack of money was the main factor that also accelerated the probability of CHE that pre-treatment was unavailable to prevent such illness that causes CHE. Furthermore, Choi (2015) explores which chronic disease status engenders the catastrophic health expenditure of the household. However, the study is lacking factors other than health condition that can influence the consequence of catastrophic health expenditure such as living environment, working condition, and family characteristics. Despite the insufficient evidence that Choi has provided, the study supplements intuition that there may be a causal channel of effects from chronic disease to CHE status of the household.

Series of research about CHE usually focus on the financial characteristics and financial effects of CHE. This research differs from previous studies that this study is exploring the possible causal relationship between CHE and employment choice of individuals. This approach may provide the view that how serious health expenditure in the household can affect the labor supply of individuals.

Data

This study uses Korean Welfare Panel Study (KWPS) from 2008 to 2017. One particular characteristic of the study is that it overweighs the proportion of low-income families. Initially, in 2006, KWPS initiates the collection of data with 3,500 general families and 3,500 low-income families, with a total of 7,300 households in the sample. The low-income group is selected based on the criteria that whether the household current income is below 60% that of the median income. As same as other panel data, KWPS also experienced attrition in its samples. Therefore, 1,800 samples were added in 2012. As of in 2017, a total of 6,486 households remains in the sample. Another problem of KWPS would be attrition in low-income families since already low-income families may get out of the poverty line because of their own activity or they become just out of sample. KWPS includes various sets of variables not only household information, but information of household members, children, and handicaps. For the purpose of the study, household information and household members' information has been used.

There are several questionnaires asking about employment-related issues in KWPS survey. These sections are asking which type of job you are currently working on, and I focus on three questionnaires: "Regular Paid Worker", "Temporary Paid Worker", and "Daily Paid Worker". I construct an employment status dummy equals one if an individual says yes to one of these questions. Otherwise, I mark them as zero. This specification may not provide sufficient knowledge about employment status since the employment status dummy is not covering self-employed and employers. However, since self-employed and employers may have diverse substitution options on their labor supply than paid employees, concentrating on paid workers would provide enough

implications in terms of analyzing the effect of massive health expenditure. Therefore, the variable of employment status is displaying currently working employees in the sample of KWPS. In addition, since KWPS is biased towards the low-income group, although the panel experienced attrition and some initially low-income household got out of poverty, the analysis using this data set would enable the estimates to provide interpretations which is less likely to represent richer households. However, since this estimate of employment rate is calculated based on KWPS data, this rate may not represent the whole population of Korea. Categorization of industries where individuals are working is defined by the KWPS.

Since there are myriad types of diseases, it is impossible to control all those disease types. Therefore, in this study, I generate two dummy variables: serious disease and chronic disease status. If an individual is experiencing cancer, heart disease, or rare disease, serious disease status dummy equals one, zero otherwise. Ministry of Health and Welfare of Korea defines cancer, heart disease, rare disease, and brain disease are four most serious diseases in Korea, since they are the four most prevalent disease among various serious diseases. However, since KWPS does not have a clear variable that indicates brain disease, I only use three diseases to generate serious disease dummy. For chronic disease dummy, if an individual ever experienced chronic disease and obtained medical treatment, the dummy equals one and equals zero otherwise. Using these two dummies, I also generate two more dummies, which indicate whether an individual has any household member experiencing serious disease or chronic disease. These two dummies indicating the disease status of the household member of individuals are going to help to estimate possible substitution effects on labor supply of individuals.

Table 1 illustrates the descriptive statistics of the most recent two years of

KWPS. The rest of the descriptive statistics are presented in the appendix (Appendix 1). From Table 1, there are several changes in both individual and household characteristics along 2016 and 2017 panels. One of the most important changes is that the probability of CHE among individuals increased by 1 percent and the increment is statistically significant. This can be resulted not only by increasing medical expenditure but also by increasing the amount of food expenditures which consists denominator of the equation of CHE. However, compared to the change in the occurrence of CHE, employment status, which is the variable of interest, decreased from 2016 to 2017 but not statistically significant. The relationship does not seem direct and significant, but at least there is a piece of evidence that they have a negative correlation among CHE level and employment status from KWPS in 2016 and in 2017.

Nevertheless, since Korea experienced adverse economic condition because of the side effects of the Great Recession in 2008, these significant changes are inevitable. Particularly, possibility of adverse economic effects starting from 2008 may have created adverse conditions for socioeconomic variables of samples. In addition, age, chronic disease status, and employment status have increased since samples in the panel aged and became more experienced. These changes are not avoidable since the data is a panel and it is following the same subject – as best as possible – therefore time-varying effects alter several individuals and household characteristics.

Table 1 - Descriptive Statistics of year 2016 and 2017

Variables	Average		t-stat
	2016	2017	
CHE (>10%)	0.11	0.12	**2.15**
Age	43.11	43.31	1.07
Sex (female=1)	0.52	0.52	0.26
Low-income	0.14	0.14	-0.13
Employment Status	0.70	0.71	0.73
Education	5.61	5.66	**2.08**
Experience in Work	8.37	8.24	-0.74
Religion	0.56	0.56	0.17
Chronic Member	0.63	0.67	**5.64**
Serious Member	0.15	0.16	0.86
Medical Expenditure	17.40	18.84	**3.31**
Disposable Income	5647.01	5801.51	1.50
Working Hours (per week)	44.58	44.71	0.48
Self-rated Health	3.62	3.60	-0.96
Job Satisfaction	3.53	3.52	-1.13
Number of Family	3.35	3.30	**-2.52**
Private Insurance	1.47	1.53	**2.77**
Married	0.63	0.62	-1.07
Observations	7942.00	7667.00	

Table 2 is presenting the summary statistics by the disease status of a household member(s). There are four categorizations of disease status: neither chronic disease status nor serious disease status, no chronic disease status but serious disease, status, chronic disease status but no serious disease status, and both chronic and serious disease status. The table presents distinct differences among clusters by showing significant F-statistics, despite there are some similarities among some clusters. It is observable that the proportion of CHE increases as the gravity of disease status of household member increases from no disease status to both serious and chronic disease status. However, there are distinct differences in the average ages by whether the household member of

the individual is experiencing chronic disease status. While the average age of without chronic disease is below 41, those with chronic disease status show the average age of above 44. In addition to age, there are differences among disease groups such as the proportion of low-income group, education, health expenditure, self-rated health, job satisfaction, the number of family, and married status. Most importantly, the table indicates that the employment status is significantly discouraged by chronic disease status of family member.

Based on the implications from Table 2, there are distinct differences between the sample with and without chronic disease status. Intuitively, households with chronic disease patients are much older, poorer, and less educated. This is similar to the conclusion of Smith et al. (2016) that education has a strong relationship with the income and health status of individuals. In addition, the table is showing that the health expenditure increases as the gravity of household member increases. Another consequential finding, as already discusses above, in this table is that there is a significant difference in employment status between household members with and without chronic disease patient, while the difference in working hours is not significant. The difference is almost 8 percentage point, and the difference is substantial in practical sense. However, since the group with chronic disease patient is older than another, it is hard to ignore the effect of age on this matter.

Table 2 - Summary by disease group in 2017

	Neither chronic nor serious disease		No chronic but serious		Chronic but no serious		Both chronic and serious		F
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
CHE (>10%)	0.03	0.17	0.19	0.39	0.10	0.30	0.37	0.48	**323.5**
Age	40.78	10.41	40.58	11.66	44.62	12.89	44.41	13.00	**55.17**
Sex (female=1)	0.52	0.50	0.54	0.50	0.53	0.50	0.52	0.50	0.133
Low Income	0.07	0.26	0.08	0.27	0.16	0.37	0.16	0.37	**36.07**
Employment Status	0.76	0.43	0.75	0.43	0.68	0.47	0.68	0.47	**15.46**
Education	5.95	1.14	5.84	1.26	5.53	1.30	5.54	1.30	**61.22**
Experience in Work	5.48	6.96	6.11	7.95	6.02	8.77	5.75	8.89	**2.281**
Religion	1.61	0.49	1.54	0.50	1.54	0.50	1.53	0.50	**8.321**
Chronic Member	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	.
Serious Member	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	.
Medical Expenditure	10.79	16.06	24.51	27.62	16.38	19.85	45.11	49.50	**469.7**
Disposable Income	5727.23	3087.56	5884.93	2829.70	5828.98	5073.08	6044.44	4024.34	1.289
Working Hours (per week)	44.67	12.83	43.49	9.87	44.74	12.86	44.90	14.43	0.326
Self-rated Health	3.87	0.70	3.78	0.71	3.52	0.84	3.28	0.94	**147.9**
Job Satisfaction	3.62	0.73	3.63	0.77	3.47	0.82	3.45	0.79	**21.91**
Number of Family	3.24	1.20	3.28	1.04	3.30	1.18	3.50	1.20	**12.02**
Private Insurance	1.60	1.20	1.67	1.12	1.47	1.25	1.64	1.37	**8.843**
Married	0.72	0.45	0.65	0.48	0.58	0.49	0.57	0.49	**43.09**
Observations	2378		574		2227		636		

Catastrophic Health Expenditure

The catastrophic health expenditure has various definitions, which mainly due to either the availability of data or the context of problems. Calculating CHE, there are two main approaches: Wagstaff and Doorslaer (2003) and Xu et al. (2005). Wagstaff and Doorslaer calculate based on capacity to pay equals to total consumption less subsistence expenditure, which is spent on food. WHO asserts that household income and expenditure surveys supplement sound details to assess whether households encounter "catastrophic" health costs. As previously mentioned, Wagstaff and Doorslaer assume, in term of calculating CHE, such health care payments are not voluntary, deliberate, and discretionary – in other words, these payments are not wanted and therefore the choices are due to "shock." However, they agree that CHE may not provide fully satisfying implications in terms of deriving effects of massive health expenditure since it is hard to catch who is contributing the incurrence of CHE and other costs that are not specifically health expenditure but engendered by health problems related to CHE.

Compared to Wagstaff and Doorslaer (2003), Xu et al. (2005) define the capacity to pay as income less food expenditure. The initial definition of CHE may reduce the possible error caused by various indirect costs from health care, but this approach may not be practical. Therefore, whereas some researchers use the definition of Wagstaff and Doorslaer (Aregbeshola and Khan, 2018; Xu et al., 2003; Kim and Kang, 2018; Kang et al., 2018; Kim and Yang, 2011), other use the definition of Xu et al. (Anbari et al., 2014; Prasanna et al., 2018; Song and Shin, 2015; Sweeney et al., 2018). In this study, I use CHE equation of Xu et al. (2005), which uses capacity pay

equals to disposable income less food expenditure. In addition, for the purpose of the study, I use CHE with the cutoff of 10 percent.

$$\mathrm{CHE}_{\{it,>c\}} = \frac{Health\ Expenditure_{\{it\}}}{Disposable\ Inc_{\{it\}} - Total\ Food\ Expenditure_{\{it\}}} > c\%$$

The difference in the calculation of CHE may cause some bias, since the method of Xu et al. (2005) is not specifically focusing on consumption of an individual, but income as a whole for deriving capacity to pay. However, the approach of Wagstaff and Doorsaler (2003) is not flawless that their approach is not containing the effect of saving and indirect health expenditure. Since the purpose of the study is estimating the effect of CHE on employment choice, using disposable income, which is also an important factor of saving, may be better. Because saving is also an important factor that affects the decision of work through the channel of reservation wage, the approach can fit better than the approach of Wagstaff and Doorslaer. Not only the calculation method of CHE, specifying an arbitrary cutoff point may be problematic. However, despite the differences in calculations and cutoff points, Sweeney et al. (2018) qualify in their study that the decision of cutoff point between 10 and 20 percent may not cause a serious difference in terms of the proportion of the population. Moreover, they state that cutoff point should be derived based on the context of the country or time while it may not be plausible to say there is a “golden scale” for deciding CHE.

Research Method

The goal of the study is to investigate whether the occurrence of CHE is significantly affecting the labor status of individuals while controlling for the effects of having a family member who is in chronic disease status and/or serious disease status. Therefore, I focus on four variables: employment status, CHE with arbitrary cutoff, and family member with chronic disease status, and family member with serious disease status. Using these four basic variables, I construct the following regression equations.

Equation (1) presents the effects of CHE on employment status controlling whether the individual has a family member with chronic disease and/or serious disease. In order to account for individual characteristics and household characteristics, the model controls for individual education, disposable income, number of private health insurance, experience, self-rated health, job satisfaction, sex, low-income family, and number of family members. In addition, since time and regional related effects are not ignorable, year fixed and regional fixed effects are implemented on this model as well.

$$\mathbf{Emp}_{it} = \mu_0 + \delta_1 CHE_{it} + \delta_2 Chronic_{it} + \delta_3 Serious_{it} + X'\beta + S_t + R_{it} + \varepsilon_{it} \quad (1)$$

Equation (1) would enable to observe the effects of CHE with different criteria, mainly equal to or above 10 percent, on the employment status of individuals. The employment status can be repeated along each individual's lifetime and diverse factors affect the employment status. It is not only up to the desire of the individual to be employed, but also the decision of an employer who hires the individual. Moreover, since the variable of CHE is under the assumption that the incurrence of CHE is not desirable, δ_1 would provide the inference that how undesirable health expenditure would influence the employment status of an individual. Therefore, there are diverse

unobservable factors to derive the effect of CHE on the employment status clearly. Considering these difficulties of unobservable characteristics, individual random effects are implemented on the model assuming distributions of these idiosyncratic errors. In addition, the probit model is used to avoid the problem of extrapolation and nonlinearity that linear model faces.

Although equation (1) is controlling for the chronic disease and serious disease status of household members, it is possible that some individuals' household members suffer both chronic disease and serious disease which can result in diverse factors such as aging and complication. Therefore, it is essential to generate mutually exclusive dummies to estimate the joint effects of chronic disease and serious disease. For the disease status of family members, I have categorized by chronic and no serious(CNS) disease, no chronic and serious(NCS), and both chronic and serious(CS) disease. By using these dummies, the equation is able to derive the impact of each disease status of individuals and separate the effects from the effect of CHE on employment status. Therefore, I have the equation (2) below:

$$\mathbf{Emp}_{it} = \boldsymbol{\mu_0} + \boldsymbol{\delta_1 CHE_{it}} + \boldsymbol{\delta_2 CNS_{it}} + \boldsymbol{\delta_3 NCS_{it}} + \boldsymbol{\delta_4 CS_{it}} + \boldsymbol{X'\beta} + \boldsymbol{S_t} + \boldsymbol{R_{it}} + \boldsymbol{\varepsilon_{it}} \quad \mathbf{(2)}$$

The equation (2) controls for whether an individual has any family member with the chronic disease, the serious disease, or both. The baseline of comparison is an individual who has any family member without neither disease type. The coefficient of interaction term would provide the impact of having all disease categories mentioned above. The coefficient of CHE would supplement the impact of CHE on the employment status of an individual controlling for different disease status.

As well as many countries around the world, Korea is experiencing an exponential increase in medical expenses. For the last ten years, the medical expenses

had increased more than double from 2008. Figure 1 is presenting this change along the time. In 2008, the medical expenses of Korea were approximately 2.8 trillion Korean Won (approximately 2.5 billion USD) while it increased up to 6.9 trillion Korean Won (approximately 6.16 billion USD) in 2017. There can be versatile reasons why Korea is experiencing this dramatic increase, and one of the reasons may due to shifting in the demography of Korea. As Figure 2 shows, the Korean population is aging that the distribution of population along ages is shifting rightward. Since the majority of Korea population, the population from the generation of baby boomers who were born between 1955 and 1963, the average age of Korea is rising significantly (Kim and Son, 2018; Chae, 2018).

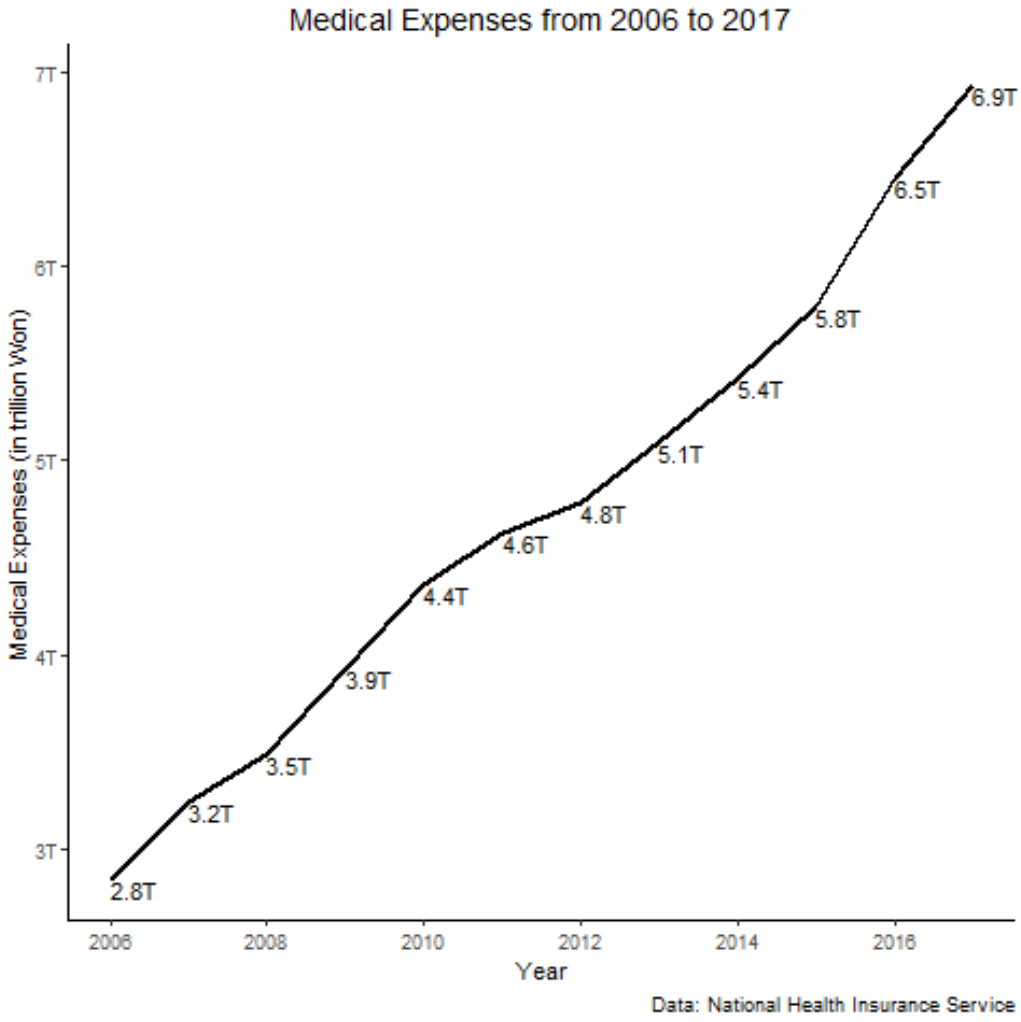

Figure 1 – Medical Expenses from 2006 to 2017

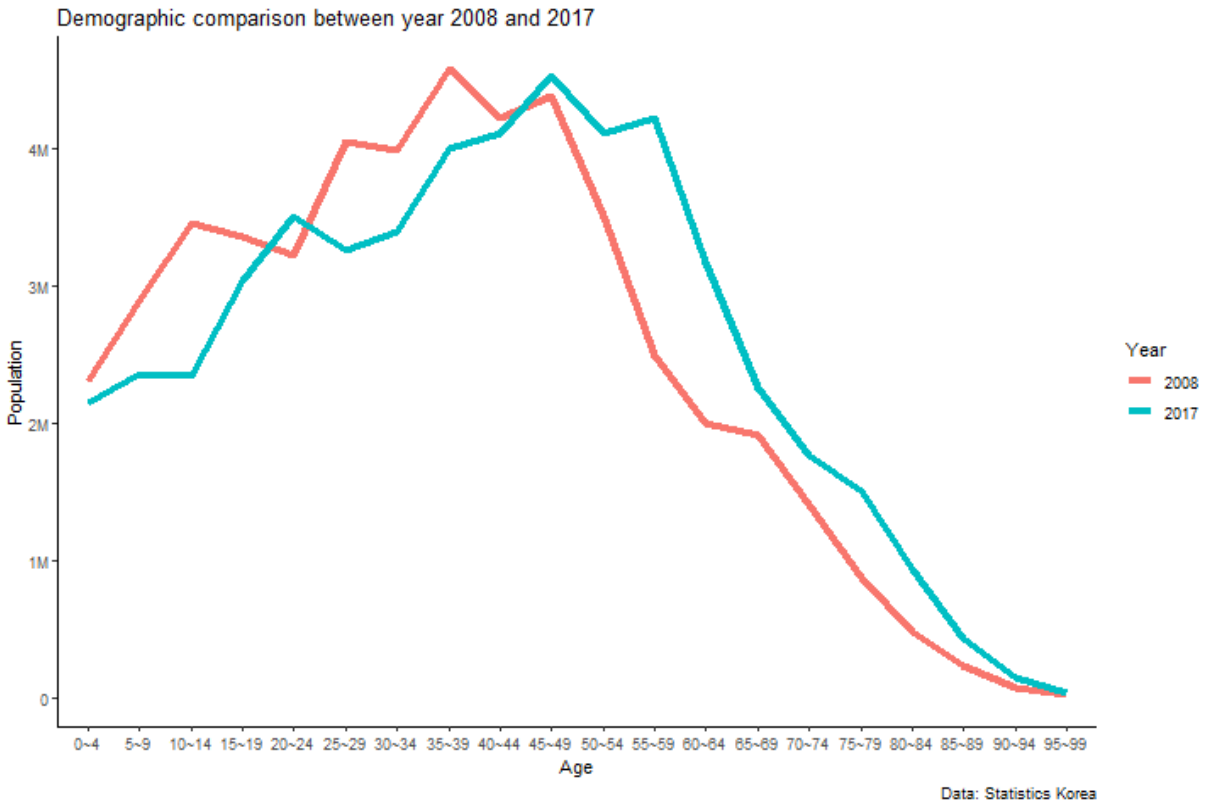

Figure 2 – Demographic comparison between year 2008 and 2017

The loophole of both models would be the implausibility of observing direct causal effects of CHE on the employment status of an individual. There is possible reversal causality between health expenditure and employment status that if such employee's job is physically intensive, the health status of an individual may get worse as much as engender a large amount of health expenditure. Moreover, as most regression models, this model also contains the vulnerability against omitted variable bias, and possibly, against robustness in external validity since the model uses Korean data

Empirical Results

Table 3 presents regression results implementing regression equation (2). All columns use the panel probit model with random effects. Since regional specific effects and time specific effects are not negligible, all models use time fixed effects and region fixed effects by default (Pinidiyapathirage et al. 2017). Column 1 of Table 3 uses the full sample with only four variables of interest: CHE w/ 10% cut off and dummy variables of whether the individual is from the household that has at least one patient with or without chronic disease and serious disease. All omitted values in employment status are removed prior to deriving estimates. From column 1, the result presents that when CHE occurs, the employment status of individuals is expected to diminish by 0.34 standard deviation. Using dummy variable of having household members with no chronic disease and no serious disease as the baseline, having the household member with the chronic disease only or the serious disease only does not influence the employment status of an individual significantly (Schofield 2014). However, when the individual has at least one household member with both chronic disease and serious disease, the individual is more likely to increase his or her probability of being employed. Nevertheless, it can be inferred that the effect can be either over- or underestimated since household members may react differently depends on gender, age, private insurance, or his or her own disease status (Goryakin and Suhrcke 2017; Park et al. 2012; Schofield et al. 2016).

Table 3 - Regression Estimates from Linear Fixed Effects and Probit Fixed Effects

	Full Sample (1)	Full Sample & All Variables (2)	Male Sample (3)	Female Sample (4)
	Dependent variable is employment status			
CHE>10%	-0.34***	-0.18***	-0.20***	-0.16***
	(0.03)	(0.03)	(0.04)	(0.03)
Chronic & No Serious	0.08	0.14**	0.06	0.19***
	(0.06)	(0.06)	(0.11)	(0.07)
No Chronic & Serious	0.01	0.04	-0.00	0.08
	(0.05)	(0.05)	(0.10)	(0.06)
Chronic & Serious	0.17***	0.10***	0.21***	0.01
	(0.03)	(0.03)	(0.05)	(0.04)
Age		0.04***	0.03***	0.03***
		(0.00)	(0.00)	(0.00)
Number of private insurance		0.07***	0.10***	0.05***
		(0.01)	(0.02)	(0.01)
Education		0.01	-0.03	-0.04*
		(0.02)	(0.02)	(0.02)
Sex		-1.26***		
		(0.04)		
Log disposable income		0.66***	0.72***	0.63***
		(0.03)	(0.06)	(0.04)
Low-income Group		-0.21***	-0.44***	-0.04
		(0.04)	(0.06)	(0.05)
Married		0.12**	1.42***	-0.62***
		(0.05)	(0.07)	(0.06)
Number of family members		-0.21***	-0.27***	-0.21***
		(0.02)	(0.02)	(0.02)
Chronic Disease		-0.19***	-0.25***	-0.21***
		(0.03)	(0.04)	(0.03)
Self-rated health		0.00	0.01	0.00
		(0.01)	(0.02)	(0.01)
Job satisfaction		0.15***	0.17***	0.12***
		(0.01)	(0.02)	(0.01)
Region & Time FE	Y	Y	Y	Y
Observations	83,413	79,412	37,078	42,334
Number of PID	13,860	13,610	6,597	7,013

Robust standard errors clustered by individual level in parentheses. Column 1 to 4 is linear models with fixed effects. Due to the multicollinearity issue, the dummy variable of Sex is removed. From column 5 to 8 is probit models with random effects. The variable of experience is removed due to the calculation limitation of likelihood.

*** p<0.01, ** p<0.05, * p<0.1

Column 2 is using more controls to diminish omitted variable bias that column 1 is not controlling. Column 2 controls age, number of family members, education, gender, income, low-income group, self-rated health, and job satisfaction. When additional controls are implemented, there are distinct changes in the coefficients of interest. The magnitude of coefficients of CHE and disease status of both chronic and serious disease diminish while the disease status of chronic disease only increases and becomes statistically significant. This indicates that not only region-variant effects and time-variant effects, other variant effects also influence the impact of CHE and disease status on the employment status of individuals. Considering there has been series of studies about different reactions in labor supply by gender, I focus on the estimate of gender that when the individual is a woman, she is less likely to be in employment status than man (Berger 1983; Garcia-Gomez et al. 2011; Siegel 2006). However, this interpretation based on this estimate may be erroneous. Therefore, I stratified the sample by the gender of individuals from the panel to observe distinct changes in effects by gender. Column 3 uses male sample only, and some changes are observable that the impact of the disease status of having a household member with both chronic disease and serious disease increases statistically significant from column 2. On the other hand, in column 4, which uses female sample only, the impact of the disease status of both chronic disease and serious disease loses its significance while the household member's disease status of chronic disease only becomes significantly positive.

Based on the results from Table 3, it can be inferred that CHE has a significant negative impact on the employment status of individuals even after controlling for disease status of household members. In addition, there are distinct gender differences in disease status of household members. When a man has at least one household member with both serious and chronic disease, he is more likely to increase his employment status by 0.21 standard deviation while other disease statuses have no significant effect. On the other hand, when a woman has

at least one household member with only chronic disease status, she is more likely to increase her employment by 0.19 standard deviation while other disease statuses have no significant effect. There can be several possible reasons why each gender shows these differences, but the coefficient of CHE is significant and consistent.

Although the results from Table 3 provides the significance of CHE on the employment status of individuals, there are still several questions that the results cannot answer. First, the results cannot suggest suspected long-term effects of CHE on employment status. Table 3 only presents what can be the direction of effects of CHE on the employment status of individuals given CHE occurs in the same year. Since there has been a debate that CHE is having long term negative effect on household finance, it may be necessary to explore whether CHE is causing a drop in long-run labor supply (Wagstaff and Doorslaer 2003). It is necessary to learn how long the effects of CHE may last on the labor decision. Second, Table 3 does not provide the implication about how much CHE influence the changes in the employment decision of individuals. For instance, what if an individual was not employed in the prior year, what would he or she decide in the next year? The model from Table 3 does not provide the implication for this problem. Therefore, I present two additional tables in following to answer two questions suggested above.

First, table 4 supplements the semi-long-term effects of CHE on the employment status. Columns 1 to 3 use 1-lagged variable of CHE instead of previous CHE variable in order to observe the effect of the CHE incurrence in the previous year on the employment status. On the other hand, columns 4 to 6 use an additional 2-lagged variable of CHE to observe whether CHE occurrence has the impact on the employment status at least more than one year. Similar to Table 4, CHE does have a significant negative effect on the employment status, but lower in magnitude. In addition, compared to female estimate in Table 3, the 1-lagged CHE variable is marginally significant in Table 4. Though there are some differences in magnitudes of variables,

general directions of the estimates of main variables in column 1 of Table 4 are the same as that of Table 4. Nevertheless, when the 2-lagged variable of CHE is implemented in column 4 to 6, none of the 2-lagged CHE shows significance. Therefore, it can be inferred that although CHE occurrence may have adverse effects on the employment status significantly for one year, such occurrence may not be able to influence the labor decision of individuals at least more than two years. CHE occurrence is serious for the short-term of 1 year, but it may not have serious long-term effects on the labor decision of individuals. The results in Table 4 is not only significant because it is presenting semi-long term effect on labor supply but also suggesting a possible causal relationship between CHE and labor supply that the 1-lagged CHE is less likely to be affected by other variables in present. Still, the results are not presenting how an individual changes labor strategy given the incurrence of CHE.

In order to answer the second question, Table 5 presents the average marginal effects of multinomial logistic regression on changes in employment status from 2016 to 2017: staying not employed, not employed to employed, employed to not employed, and staying employed. In this table, the results indicate given CHE occurs in 2016, how employment status would change from 2016 to 2017. The baseline of the table is the group of staying not employed in both 2016 and 2017 and having no household member with both chronic disease and serious disease. Since interpretation using relative odds ratio is not convenient to observe the expected changes in the probability of changes in employment status, the average marginal effects of models are provided.

Table 4 - Effect of CHE on Employment Status Using Lagged Variable

	1-lag w/ All Samples (1)	1-lag w/ Male Sample (2)	1-lag w/ Female Sample (3)	2-lag w/ All Samples (4)	2-lag w/ Male Sample (5)	2-lag w/ Female Sample (6)
	Dependent variable is employment status					
CHE>10% from 1 year ago	-0.09***	-0.14***	-0.06*	-0.09***	-0.13**	-0.08*
	(0.03)	(0.04)	(0.04)	(0.03)	(0.05)	(0.04)
CHE>10% from 2 years ago				-0.00	-0.06	0.02
				(0.03)	(0.05)	(0.04)
Chronic & No Serious	0.21***	0.17	0.24***	0.19**	0.09	0.23**
	(0.07)	(0.13)	(0.08)	(0.08)	(0.16)	(0.09)
No Chronic & Serious	0.06	0.08	0.07	0.02	-0.05	0.06
	(0.06)	(0.12)	(0.07)	(0.07)	(0.15)	(0.08)
Chronic & Serious	0.18***	0.31***	0.08	0.22***	0.38***	0.10*
	(0.04)	(0.06)	(0.05)	(0.04)	(0.07)	(0.05)
Age	0.03***	0.02***	0.03***	0.03***	0.01*	0.03***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Number of private insurance	0.07***	0.10***	0.05***	0.06***	0.11***	0.03**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
Education	-0.03	-0.08***	-0.07**	-0.05**	-0.12***	-0.07**
	(0.02)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)
Sex	-1.41***			-1.54***		
	(0.04)			(0.05)		
Log disposable income	0.68***	0.66***	0.68***	0.73***	0.70***	0.73***
	(0.04)	(0.06)	(0.05)	(0.04)	(0.07)	(0.05)
Low-income Group	-0.26***	-0.52***	-0.07	-0.27***	-0.56***	-0.08
	(0.04)	(0.07)	(0.06)	(0.05)	(0.08)	(0.06)
Married	0.03	1.30***	-0.70***	-0.02	1.28***	-0.75***
	(0.05)	(0.08)	(0.07)	(0.06)	(0.09)	(0.07)
Number of family members	-0.20***	-0.24***	-0.21***	-0.21***	-0.23***	-0.23***
	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)
Chronic Disease	-0.15***	-0.18***	-0.19***	-0.12***	-0.13**	-0.16***
	(0.03)	(0.05)	(0.04)	(0.03)	(0.05)	(0.04)
Self-rated health	0.07***	0.13***	0.04***	0.09***	0.16***	0.06***
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
Job satisfaction	0.23***	0.32***	0.16***	0.24***	0.34***	0.18***
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
Region & Time FE	Y	Y	Y	Y	Y	Y
Observations	65,722					
Number of PID	11,905					

Standard errors clustered by PID of individuals. Average marginal effects are presented in the Appendix

*** p<0.01, ** p<0.05, * p<0.1

Table 5 - Average Marginal Effects of Multinomial Regression Model

	All Sample			Male Sample			Female Sample		
	NE => E	E => NE	E => E	NE => E	E => NE	E => E	NE => E	E => NE	E => E
CHE>10% in 2016	0.0176*	-0.0165	-0.0230	0.0012	-0.0197	0.0111	0.0354**	-0.0150	-0.0424
	(0.0074)	(0.0103)	(0.0171)	(0.0090)	(0.0130)	(0.0193)	(0.0114)	(0.0156)	(0.0266)
Chronic & No Serious	-0.0060	-0.0268	-0.0451	0.3888	-0.0404	-0.3388	-0.0030	-0.0450	-0.0529
	(0.0257)	(0.0226)	(0.0435)	(26.0333)	(1.8119)	(17.6136)	(0.0338)	(0.0325)	(0.0632)
No Chronic & Serious	0.0177	-0.0137	-0.0340	0.4148	-0.0413	-0.3290	0.0164	-0.0181	-0.0324
	(0.0245)	(0.0206)	(0.0400)	(26.0333)	(1.8118)	(17.6136)	(0.0313)	(0.0292)	(0.0573)
Chronic & Serious	-0.0281**	-0.0234*	0.0394*	-0.0384**	-0.0125	0.0650**	-0.0165	-0.0319*	-0.0222
	(0.0093)	(0.0106)	(0.0194)	(0.0123)	(0.0138)	(0.0227)	(0.0142)	(0.0158)	(0.0299)
Observations	6847			3151			3696		

Average Marginal Effects of Appendix 3 are presented. Standard errors are clustered by PID of individuals. The baseline of dependent variable is not employed in 2016 and not employed in 2017. Model specification is the same as column 2 of Table 4 except CHE variable changed from CHE of the given year but CHE incurrence in 2016

*** p<0.01, ** p<0.05, * p<0.1

All sample results from Table 5 present that compared to baseline, not employed in 2016 and employed in 2017 and having no household member with both chronic disease and serious disease, CHE occurrence in 2016 more likely engenders not employed individuals in 2016 to be employed in 2017. This trend disappears using male sample but male sample's reactions towards the disease status of household members, particularly both chronic disease and serious disease status, are statistically different from the baseline probability. On the other hand, results using female sample present different outcomes that disease status does not show a distinct difference in probability of not employed in both 2016 and 2017 while individuals who are not employed in 2016 are more likely to be employed in 2017 by 3.54 percentage point on average. This may indicate that the substitution effects in household labor are larger for women given their households are suffering from CHE. However, since this table is merely comparing three disease groups to the baseline group, therefore the interpretation may demand some cautions.

In summary, three regression tables suggest the same point: CHE has an adverse effect on the employment status of individuals. Controlling other factors, especially disease status of the rest of household members, the magnitude of the effects of CHE on employment status diminishes but still significantly negative. Furthermore, CHE may have the short-term effect but it may not have long-run effect on the employment status of individuals. This result can indicate that such households with CHE occurrence may not need the long-term assistant but the short-term assistant that reduces the hazardous impact of CHE on households. Table 5 may support this point by showing individuals who are not in employment status is more likely to increase their labor when CHE occurs. The labor choice of these individuals may result in a lack in the budget constraint of the household due to the disorder of household members who were previously in employment status to generate household income.

Conclusion

Korea is currently facing several challenges due to myriad economic and social factors such as the aging population and slow economic growth. Inevitably, these are also threatening the basic social welfare of citizens, therefore it is worth to investigate what can be fixed or improved. Since Korea's public health system highly relies on the income of citizens, which is the function of the labor of each individual, it should be the society's concern to keep the factor of income steady. This study is exploring the relationship between catastrophic health expenditure and labor choice of individuals.

Results from regression models confirm there is a strong relationship between catastrophic health expenditure and employment status of individuals. However, there are several loopholes in terms of providing a convincing policy implication since the empirical model and results presented cannot verify the direct channel of effects from catastrophic health expenditure and employment status of individuals. In order to derive the causal inference, we may need to divide the sample more precisely to see whether the effect of CHE on employment choice alters significantly. Technically, as Anbari et al. (2014) suggest, CHE may have measurement bias since households, especially poor households, may refrain to burden CHE due to their limited budget. This may cause underestimation of the proportion of CHE incurrence. However, Anbari et al. observe the misguided proportion of refrained CHE is not significant, therefore measurement error of CHE may be negligible enough to assume that such error may interrupt the derivation of estimates. Another approach can be finding a convincing instrument which has strong reasoning of exclusion restriction, therefore we can estimate unbiased estimate of CHE on employment. Still, these solutions are challenging.

Nevertheless, the results of this research suggest that CHE may have negative causal effects and the effects of having at least one family member who has the chronic disease and/or

the serious disease differs by men and women. In response, to diminish the impact of CHE on household labor supply, some policy measures may be necessary. Since CHE and disease status mentioned above can decrease the individual labor supply, which can be aggregated to market labor supply, some government supports may be necessary either directly or indirectly. For instance, for household that has chronic disease member, either government can supply nurse service or promote the market to provide nurse service to the household to decrease the likelihood of diminishing labor supply. In addition, considering that women may increase their employment when they have chronic disease member, we may also need to concern whether such increase in labor supply is a desirable decision or decision in response to risk-averse.

The tasks regarding CHE are usually two: how to prevent it or how to deal with it. In many cases, intuitively, prevention of CHE may be challenging since it is physically impossible to control the intensity of disease of every patient. Therefore, dealing with CHE would be more realistic, although it is still a demanding task. With respect to this issue, several researchers provide possible solutions, mostly financial support. However, financial support alone may not be sufficient enough, therefore another safeguard regarding CHE incurrence might be supporting informal care. The reason that supporting informal care as the safeguard is that some statistical pieces of evidence suggest that caregiving does not diminish the labor supply of household with a family member who needs the care (Mern, 2013). Public support on informal care given CHE incurrence may be able to diminish the shock. If the individual can sustain his or her labor supply with public support, then the likelihood of downward shifting in socioeconomic status may diminish to the desirable level. In addition, supporting informal care can be effective in terms of cost-benefit analysis since several studies verify that informal care has some advantages comparing to formal care. As Cecchini (2018) mentions, formal care is costly and informal care is more convenient for many households. Not only it is less costly than formal care, Bremer et al. (2017) assert in their cross-national study that informal

caregiving can diminish public health care spending by reducing formal home care services – the impact may differ by country. However, of course, any change in the employment status of individuals resulted in informal care support will need careful analysis to conclude whether the effect is socially desirable.

Lastly, for further research, it may be necessary to analyze the reactions of individuals by the relation of sick household to the individual. Since series of studies find strong statistical evidence from alternative labor choice of husband or wife given the adverse health condition of his or her spouse, there is a possibility to expand to more dynamic relationships such as adult old parents and adult sons or daughters, if data is available. There are diverse possible relationships to explore. For instance, if a sick family member is the child of the subject, what would the subject do? In other words, if a subject is a parent and his or her child is facing either chronic disease or serious disease, how the parent would react? Not only the position within the household, the size of medical subsidies or institutional support may also have some effects on the relationship between CHE and the employment status of individuals.

APPENDICES

Appendix 1 - Summary statistics by year

2008

	N	mean	sd	min	max
CHE(>10%)	8823	.119	.324	0	1
Age	8823	41.604	11.853	19	63
Sex	8823	.518	.5	0	1
Low-income	8823	.212	.409	0	1
Employment Status	8730	.671	.47	0	1
Education	8823	5.269	1.385	2	9
Experience	5856	7.609	8.964	0	49
Religion	7908	1.527	.705	1	9
Chronic Member	8823	.579	.494	0	1
Serious Member	8823	.142	.349	0	1
Medical Expenditure	8823	12.145	20.728	0	333
Total Food Expenditure	8823	65.154	28.536	0	260
Disposable Income	8823	3829.248	3365.843	-8287.2	74836
Working Hours (per week)	4626	51.599	34.716	0	999
Self-rated Health	8730	3.612	1.525	1	9
Job Satisfaction	8730	3.454	1.58	1	9
Number of Family	8823	3.406	1.178	1	8
Private Insurance	8823	.936	2.088	0	99
Married	8821	.672	.47	0	1

2009

CHE(>10%)	8567	.122	.328	0	1
Age	8567	41.87	11.804	19	63
Sex	8567	.518	.5	0	1
Low-income	8567	.196	.397	0	1
Employment Status	8471	.664	.472	0	1
Education	8567	5.3	1.378	2	9
Experience	5627	7.798	8.948	1	49
Religion	7624	1.529	.507	1	9
Chronic Member	8567	.626	.484	0	1
Serious Member	8567	.159	.366	0	1
Medical Expenditure	8567	13.32	23.625	0	521
Total Food Expenditure	8567	67.633	28.624	6	264
Disposable Income	8567	4068.108	3266.41	-37588	88040
Working Hours (per week)	4653	51.439	37.569	0	999

Self-rated Health	8158	3.423	.982	1	9
Job Satisfaction	8158	3.199	.995	1	9
Number of Family	8567	3.411	1.178	1	8
Private Insurance	8567	1.041	2.382	0	99
Married	8565	.671	.47	0	1
2010					
CHE(>10%)	8217	.112	.316	0	1
Age	8217	42.04	11.862	19	63
Sex	8217	.519	.5	0	1
Low-income	8217	.185	.388	0	1
Employment Status	8128	.692	.462	0	1
Education	8217	5.35	1.368	2	9
Experience	5624	7.869	8.939	1	48
Religion	7299	1.49	.5	1	2
Chronic Member	8215	.574	.494	0	1
Serious Member	8215	.144	.351	0	1
Medical Expenditure	8217	13.369	22.443	0	376
Total Food Expenditure	8217	67.817	27.993	8.2	283
Disposable Income	8217	4365.662	3717.057	-24292	82214
Working Hours (per week)	4522	48.562	32.015	0	999
Self-rated Health	7769	3.575	.919	1	5
Job Satisfaction	7769	3.257	.954	1	5
Number of Family	8217	3.406	1.201	1	8
Private Insurance	8217	1.121	2.198	0	99
Married	8217	.66	.474	0	1
2011					
CHE(>10%)	7611	.109	.312	0	1
Age	7611	42.174	11.851	19	63
Sex	7611	.524	.499	0	1
Low-income	7611	.179	.384	0	1
Employment Status	7545	.704	.457	0	1
Education	7611	5.399	1.352	2	9
Experience	5309	8.07	9.013	1	54
Religion	6724	1.519	.501	1	5
Chronic Member	7611	.59	.492	0	1
Serious Member	7611	.134	.34	0	1
Medical Expenditure	7611	14.463	23.334	0	431
Total Food Expenditure	7611	73.42	30.175	7	240
Disposable	7611	4623.555	5518.289	-16730	288226

Income					
Working Hours (per week)	4280	47.883	14.325	0	126
Self-rated Health	7198	3.603	.897	1	5
Job Satisfaction	7198	3.347	.887	1	5
Number of Family	7611	3.41	1.198	1	8
Private Insurance	7611	1.175	1.162	0	11
Married	7611	.659	.474	0	1
2012					
CHE(>10%)	9439	.126	.332	0	1
Age	9439	42.751	11.929	19	63
Sex	9439	.526	.499	0	1
Low-income	9439	.165	.371	0	1
Employment Status	9354	.692	.462	0	1
Education	9439	5.413	1.362	2	9
Experience	6470	8.16	9	1	51
Religion	8332	1.517	.5	1	2
Chronic Member	9439	.609	.488	0	1
Serious Member	9439	.159	.366	0	1
Medical Expenditure	9439	15.769	26.075	0	1195
Total Food Expenditure	9439	74.336	31.424	5	308
Disposable Income	9439	4625.134	3132.614	-5512	44424
Working Hours (per week)	5149	46.959	13.696	0	126
Self-rated Health	8790	3.546	.909	1	5
Job Satisfaction	8790	3.359	.858	1	5
Number of Family	9439	3.351	1.198	1	9
Private Insurance	9439	1.232	1.181	0	11
Married	9439	.656	.475	0	1
2013					
CHE(>10%)	9059	.133	.339	0	1
Age	9059	42.828	11.988	19	63
Sex	9059	.523	.5	0	1
Low-income	9059	.165	.372	0	1
Employment Status	8971	.702	.458	0	1
Education	9059	5.464	1.342	2	9
Experience	6295	8.024	8.767	0	52
Religion	7964	1.521	.5	1	2
Chronic Member	9059	.627	.484	0	1
Serious Member	9059	.16	.366	0	1
Medical Expenditure	9059	16.94	23.582	0	385

Total Food Expenditure	9059	77.527	33.494	5	422
Disposable Income	9059	4962.073	3498.282	-2658	69441
Working Hours (per week)	5217	46.774	19.165	0	999
Self-rated Health	8460	3.529	.901	1	5
Job Satisfaction	8460	3.38	.876	1	5
Number of Family	9059	3.367	1.202	1	9
Private Insurance	9059	1.283	1.215	0	25
Married	9059	.648	.478	0	1
2014					
CHE(>10%)	8574	.123	.329	0	1
Age	8576	42.936	12.064	19	63
Sex	8576	.52	.5	0	1
Low-income	8576	.154	.361	0	1
Employment Status	8492	.697	.46	0	1
Education	8576	5.512	1.327	2	9
Experience	5917	8.396	8.868	1	54
Religion	7504	1.528	.499	1	2
Chronic Member	8576	.665	.472	0	1
Serious Member	8576	.144	.352	0	1
Medical Expenditure	8574	16.232	22.826	0	259
Total Food Expenditure	8576	78.798	34.43	5	294
Disposable Income	8576	5191.272	4162.391	-20516	108888
Working Hours (per week)	5019	45.101	13.624	0	113
Self-rated Health	8157	3.508	.87	1	5
Job Satisfaction	8157	3.393	.856	1	5
Number of Family	8576	3.361	1.191	1	8
Private Insurance	8576	1.274	1.178	0	19
Married	8576	.641	.48	0	1
2015					
CHE(>10%)	8357	.121	.326	0	1
Age	8357	43.111	12.186	19	63
Sex	8357	.521	.5	0	1
Low-income	8357	.144	.351	0	1
Employment Status	8278	.693	.461	0	1
Education	8357	5.56	1.306	2	9
Experience	5738	8.576	8.975	1	51
Religion	7315	1.548	.498	1	2
Chronic Member	8357	.615	.487	0	1

Serious Member	8357	.15	.357	0	1
Medical Expenditure	8357	16.956	24.101	0	359
Total Food Expenditure	8357	80.542	35.659	5	417
Disposable Income	8357	5351.999	5815.376	-28685	244030
Working Hours (per week)	4891	44.651	13.362	0	120
Self-rated Health	7855	3.634	.829	1	5
Job Satisfaction	7855	3.483	.817	1	5
Number of Family	8357	3.364	1.203	1	8
Private Insurance	8357	1.416	1.247	0	12
Married	8357	.636	.481	0	1
2016					
CHE(>10%)	7942	.106	.308	0	1
Age	7942	43.105	12.193	19	63
Sex	7942	.521	.5	0	1
Low-income	7942	.136	.343	0	1
Employment Status	7865	.7	.458	0	1
Education	7942	5.613	1.289	2	9
Experience	5506	8.37	8.924	1	48
Religion	6925	1.562	.496	1	2
Chronic Member	7942	.628	.483	0	1
Serious Member	7942	.153	.36	0	1
Medical Expenditure	7942	17.401	26.168	0	349
Total Food Expenditure	7942	84.543	35.719	10	341
Disposable Income	7942	5647.011	8011.719	-15659	451181
Working Hours (per week)	4714	44.579	12.899	0	105
Self-rated Health	7415	3.615	.848	1	5
Job Satisfaction	7415	3.531	.822	1	5
Number of Family	7942	3.352	1.203	1	9
Private Insurance	7942	1.472	1.262	0	12
Married	7942	.628	.483	0	1
2017					
CHE(>10%)	7667	.117	.322	0	1
Age	7667	43.315	12.308	19	63
Sex	7667	.523	.5	0	1
Low-income	7667	.135	.342	0	1
Employment Status	7588	.705	.456	0	1
Education	7667	5.656	1.273	2	9

Experience	5353	8.244	8.741	1	47
Religion	6661	1.564	.496	1	2
Chronic Member	7667	.671	.47	0	1
Serious Member	7667	.158	.365	0	1
Medical Expenditure	7667	18.835	27.878	0	480
Total Food Expenditure	7667	86.281	36.086	10	307
Disposable Income	7667	5801.513	4352.043	-11857	124031
Working Hours (per week)	4560	44.709	13.009	0	124
Self-rated Health	7219	3.602	.836	1	5
Job Satisfaction	7219	3.516	.792	1	9
Number of Family	7667	3.304	1.186	1	9
Private Insurance	7667	1.528	1.256	0	11
Married	7667	.62	.486	0	1

Bibliography

Anbarin, Zohreh, Abolfazl Mohammadbeigi, Narges Mohammadsaleh, and Ali Ebrazeh. 2014. "Health Expenditure and Catastrophic Costs for Inpatient- and out-Patient Care in Iran." *International Journal of Preventive Medicine* 5 (8): 1023–28.

Aregbeshola, Bolaji Samson, and Samina Mohsin Khan. 2018. "Out-of-Pocket Payments, Catastrophic Health Expenditure and Poverty Among Households in Nigeria 2010." *International Journal of Health Policy and Management* 7 (9): 798–806.

Berger, Mark C. 1983. "Labor Supply and Spouse's Health: The Effects of Illness, Disability, and Mortality." *Social Science Quarterly* 64 (3): 494–509.

Blau, David M., David K. Guilkey, and Barry M. Popkin. 2006. "Infant Health and the Labor Supply of Mothers." *The Journal of Human Resources* 31 (1): 90–139.

Bremer, Patrick, David Challis, Ingalill Rahm Hallberg, Helena Leino-Kilpi, Kai Saks, Bruno Vellas, Sandra M.G. Zwakhalen, and Dirk Sauerland. 2017. "Informal and Formal Care: Substitutes or Complements in Care for People with Dementia? Empirical Evidence for 8 European Countries." *Health Policy* 121 (6): 613–22.

Burke, Rachel M., Emily R. Smith, Rebecca Moritz Dahl, Paulina A. Rebolledo, Maria Del Carmen Calderón, Beatriz Cañipa, Edgar Chavez, et al.. 2014. "The Economic Burden of Pediatric Gastroenteritis to Bolivian Families: A Cross-Sectional Study of Correlates of Catastrophic Cost and Overall Cost Burden." *BMC Public Health* 14 (1).

Choi, Jae Woo, Tae Hyun Kim, Sung In Jang, Suk Yong Jang, Woo Rim Kim, and Eun Cheol Park. 2016. "Catastrophic Health Expenditure According to Employment Status in South Korea: A Population-Based Panel Study." *BMJ Open* 6 (7): 1–7.

Comblon, Virginie, and Karine Marazyan. 2017. "Labor Supply Responses to Chronic Illness in Senegal."

Fu, Rong, Haruko Noguchi, Akira Kawamura, Hideto Takahashi, and Nanako Tamiya. 2017. "Spillover Effect of Japanese Long-Term Care Insurance as an Employment Promotion Policy for Family Caregivers." *Journal of Health Economics* 56: 103–12.

Garcia-Gomez, Pilar, Hans van Kippersluis, and Eddy van Doorslaer. 2011. "Effects of Health on Own and Spousal Employment and Income Using Acute Hospital Admissions." *Ssrn* 3.

Goryakin, Yevgeniy, and Marc Suhrcke. 2017. "The Impact of Poor Adult Health on Labor

Supply in the Russian Federation." *European Journal of Health Economics* 18 (3): 361–72.

Hassink, Wolter H.J., and Bernard Van den Berg. 2011. "Time-Bound Opportunity Costs of Informal Care: Consequences for Access to Professional Care, Caregiver Support, and Labour Supply Estimates." *Social Science and Medicine* 73 (10): 1508–16.

Kang, Jeong-Hee, and Chul-Woung Kim. 2018. "Article History: Relationship Between Catastrophic Health Expenditures and Income Quintile Decline Osong Public Health and Research Perspectives." *Public Health Res Perspect* 9 (2): 73–80.

Kang, Seung Hyun, Yeong Jun Ju, Hyo Jung Yoon, Sang Ah Lee, Woorim Kim, and Eun Cheol Park. 2018. "The Relationship between Catastrophic Health Expenditure and Health-Related Quality of Life." *International Journal for Equity in Health* 17 (1): 1–9.

Kim, Kwan Ok, and Young Jeon Shin. 2017. "Effects of Buying a Medical Insurance for Actual Expense on Medical Cost." *Journal of Critical Social Policy* 54: 305–34.

Kim, Younhee, and Bongmin Yang. 2011. "Relationship between Catastrophic Health Expenditures and Household Incomes and Expenditure Patterns in South Korea." *Health Policy* 100 (2–3): 239–46.

Kingsolver, Joel G, David W. Gerbing, James C Anderson, Jeffrey R. Edwards, Richard P. Bagozzi, Richard S. Blackburn, Kenneth a Bollen, et al.. 2000. "The Labor Supply Effects of the Social Security Earnings Test." *The Review of Economics and Statistics* 82 (1): 48–63.

Lee, Jae-Eun. n.d. "How Change of Self-Medical Expenses Affect That of Private Health Insurance Changes."

Meng, Annika. 2013. "Informal Home Care and Labor-Force Participation of Household Members." *Empirical Economics* 44 (2): 959–79.

Nguyen, Ha Trong, and Luke Brian Connelly. 2014. "The Effect of Unpaid Caregiving Intensity on Labour Force Participation: Results from a Multinomial Endogenous Treatment Model." *Social Science and Medicine* 100: 115–22.

Okoronkwo, Ijeoma L., Jessie N. Ekpemiro, Edna U. Okwor, Pat U. Okpala, and Florence O. Adeyemo. 2015. "Economic Burden and Catastrophic Cost among People Living with Type2 Diabetes Mellitus Attending a Tertiary Health Institution in South-East Zone, Nigeria Endocrine Disorders." *BMC Research Notes* 8 (1): 1–9.

Organization., World Health. 2016. "China Country Assessment Report on Ageing and Health. ."

Oshio, Takashi, and Emiko Usui. 2017. “Informal Parental Care and Female Labour Supply in Japan.” *Applied Economics Letters* 24 (9): 635–38.

Page, Timothy F. 2011. “Labor Supply Responses to Government Subsidized Health Insurance: Evidence from Kidney Transplant Patients.” *International Journal of Health Care Finance and Economics* 11 (2): 133–44.

Park, Susan, Sung Il Cho, and Soong Nang Jang. 2012. “Health Conditions Sensitive to Retirement and Job Loss among Korean Middle-Aged and Older Adults.” *Journal of Preventive Medicine and Public Health* 45 (3): 188–95.

Pinidiyapathirage, Janani, Megan O’Shannessy, Jane Harte, Susan Brumby, and Scott Kitchener. 2018. “Chronic Disease and Health Risk Behaviors among Rural Agricultural Workforce in Queensland.” *Journal of Agromedicine* 23 (1): 32–39.

Powell, David, and Seth Seabury. 2018. “Medical Care Spending and Labor Market Outcomes: Evidence from Workers’ Compensation Reforms.” *American Economic Review* 108 (10): 2996–3027.

Prasanna, Thirunavukkarasu, Kathiresan Jeyashree, Palanivel Chinnakali, Yogesh Bahurupi, Kavita Vasudevan, and Mrinalini Das. 2018. “Catastrophic Costs of Tuberculosis Care: A Mixed Methods Study from Puducherry, India.” *Global Health Action* 11 (1).

Schmitz, Hendrik, and Matthias Westphal. 2017. “Informal Care and Long-Term Labor Market Outcomes.” *Journal of Health Economics* 56: 1–18.

Schofield, Deborah, Michelle Cunich, Rupendra Shrestha, Megan Passey, Simon Kelly, Robert Tanton, and Lennert Veerman. 2014. “The Impact of Chronic Conditions of Care Recipients on the Labour Force Participation of Informal Carers in Australia: Which Conditions Are Associated with Higher Rates of Non-Participation in the Labour Force?” *BMC Public Health* 14 (1).

Schofield, Deborah, Rupendra N. Shrestha, Michelle M. Cunich, Robert Tanton, Lennert Veerman, Simon J. Kelly, and Megan E. Passey. 2016. “Economic Costs of Chronic Disease through Lost Productive Life Years (PLYs) among Australians Aged 45–64 Years from 2015 to 2030: Results from a Microsimulation Model.” *BMJ Open* 6 (9).

Siegel, Michele J. 2006. “Measuring the Effect of Husband’s Health on Wife’s Labor Supply.” *Health Economics* 15 (6): 579–601.

Smith, William C., Sakiko Ikoma, and David P. Baker. 2016. “Education, Health, and Labor Force Supply: Broadening Human Capital for National Development in Malawi.” *Cogent Education* 3 (1): 1–15.

Song, Eun Cheol, and Young Jeon Shin. 2015. “The Comprehensive Health Expenditure Ceiling System to Prevent Catastrophic Health Expenditure: Focusing on Applicability Using Cost Estimation.” *Health and Social Welfare Review* 35 (2): 429–56.

Sweeney, Sedona, Rachel Mukora, Sophie Candfield, Lorna Guinness, Alison D. Grant, and Anna Vassall. 2018. “Measuring Income for Catastrophic Cost Estimates: Limitations and Policy Implications of Current Approaches.” *Social Science and Medicine* 215 (November 2017): 7–15.

Turpin, Liza J., Carol L. McWilliam, and Catherine Ward-Griffin. 2012. “The Meaning of a Positive Client-Nurse Relationship for Senior Home Care Clients with Chronic Disease.” *Canadian Journal on Aging* 31 (4): 457–69.

Wagstaff, Adam, and Eddy van Doorslaer. 2003. “Catastrophe and Impoverishment in Paying for Health Care: With Applications to Vietnam 1993-1998.” *Health Economics* 12 (11): 921–34.

Xu, K. et al.. 2005. “Household Catastrophic Helath Expenditure: A Multicountry Analysis.” *Lancet* 362 (9378): 111–17.

Yamada, Hiroyuki, and Satoshi Shimizutani. 2015. “Labor Market Outcomes of Informal Care Provision in Japan.” *Journal of the Economics of Ageing* 6: 79–88.

Yang, Tzu-Ting. 2018. “Family Labor Supply and the Timing of Cash Transfers: Evidence from the Earned Income Tax Credit.” *Journal of Human Resources* 53 (2): 445–73.