Insurance Coverage, Long-Term Care Utilization, and Health Outcomes *

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Abstract

How does the generosity of social insurance coverage affect demand for healthcare and health outcomes of elderly people? This paper presents an examination of the effects of insurance coverage on long-term care (LTC) utilization and its health consequences using administrative data of the public long-term care insurance (LTCI) system in Japan. In LTCI, a recipient 's health score determines their insurance coverage limit, and thresholds of the score generate discontinuous changes in the level of coverage limits. I implement a regression discontinuity design and find that coverage expansion increases recipients ' LTC utilization considerably irrespective of their health status. When more generous insurance coverage is available, recipients with low care-needs increase day care and rehabilitation services, whereas those with high care-needs increase home care services. Moreover, using more LTC has little effect on health outcomes such as the health score and the entry into nursing homes. Together, these results suggest that generous LTCI coverage can induce excessive LTC utilization without having health benefits.

Keywords: Social insurance, insurance coverage, long-term care, health outcomes

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1 Introduction

As the elderly population increases worldwide, providing accessible and cost-efficient healthcare is becoming increasingly important. Social insurance systems in many countries play central roles in providing affordable healthcare for elderly people. Furthermore, in terms of designing insurance benefits, controlling the generosity of insurance coverage is a key policy tool affecting healthcare demand. Recipients can obtain subsidies for healthcare up to a level of coverage, but they face payment of the full price for care otherwise. Because of price changes, recipients must invariably use healthcare considering a given level of coverage. Understanding the effects of insurance coverage on demand for healthcare and its health consequences is therefore crucially important for developing an optimal social insurance system design.

This paper examines how insurance coverage generosity affects demand for health-related services and health outcomes in the context of a large social insurance program: the long-term care insurance (LTCI) system in Japan. The introduction of LTCI in 2000 was arguably the most radical change in the Japanese healthcare system in decades [5, 19]. LTCI allows eligible recipients to choose long-term care (LTC) services from among various alternatives and to use them with a moderate out-of-pocket payment according to specific coverage. Because of rapid aging of the population, spending on LTCI has increased rapidly. It has come to account for a substantial fraction of Japanese national finances. The total cost of LTCI, which was 3.6 trillion JPY (36 billion USD,[1] 0.7% of Japanese GDP) in 2000, amounted to 10.8 trillion JPY (108 billion USD, 2.0% of Japanese GDP) in 2017.[2] The cost is expected to continue increasing in the years and decades to come [19]. Because of rapid increases in elderly populations worldwide, controlling public spending on LTC has become an urgent policy issue in many countries [16].

In Japan, LTCI coverage is characterized by a monthly coverage limit that sets the monthly maximum spending on home-based LTC services that can be covered by insurance. A unique feature of LTCI is that the coverage limit for recipients who use home-based care is determined by a single health index (standardized care time), which reflects how much LTC the recipient needs. Every LTCI recipient must take a nationally standardized health survey that determines their own standardized care time and the coverage limit they will receive. Recipients must regularly retake the survey; they receive a newly designated coverage limit each time.

Using newly available administrative data on LTCI, this study implements a regression disconti-

[1] For simplicity, the exchange rate of 100 JPY = 1USD is used throughout this paper.

[2] Ministry of Finance. URL: https://www5.cao.go.jp/keizai-shimon/kaigi/special/reform/wg1/291108/shiryou1-8.pdf (Japanese)

nuity (RD) design to estimate the effects of insurance coverage generosity (monthly coverage limit) on LTC utilization. I specifically use five thresholds of standardized care time, which create discontinuous variation in coverage limits for home-based care. The RD estimates explicitly show that generous insurance coverage engenders an increase in LTC utilization. When more generous insurance coverage is available, recipients with low care-needs increase day care and rehabilitation services; recipients with high care-needs increase home care services.

The welfare implications of insurance coverage depend crucially on the health consequences. To elucidate the influences of home-based LTC on health outcomes, the thresholds generating discontinuous changes in insurance coverage are used as instruments for service utilization. A recipient's standardized care time and service usage during the next certification term are used as health outcome proxies because this information is expected to reflect recipients' needs for LTC. The RD estimates show that, for both preventive and usual care, using more LTC affects health outcomes only slightly. This result suggests that generous insurance coverage can induce excessive utilization of LTC from the perspective of recipients' health.

The main contribution of this study is to analyze both economic and health effects of LTCI coverage. Because insurance coverage is an important policy tool, how health insurance coverage affects healthcare utilization has been well studied [1, 10, 11, 12, 22]. For example, Abaluck, Gruber, and Swanson [1] analyze the nonlinear price schedule of Medicare Part D and demonstrate that recipients respond to changes in insurance coverage generosity by changing their purchase behavior of medicine. However, despite its importance, economic and health consequences of insurance coverage for LTCI have rarely been studied. The lack of empirical evidence for LTCI coverage makes policy decisions on LTC difficult because the effects of insurance coverage can be markedly different between LTCI and other health insurance [14, 16, 27, 31]. Fu and Noguchi [16] reported that the LTCI price elasticity is less than one for health insurance in the U.S. My analysis fills this gap and provide empirical evidence showing how LTCI coverage affects recipients' LTC utilization and health outcomes.

Since LTCI have been introduced in various countries, recent studies analyzed its policy consequences. For example, Lei et al. [24] examines the impact of China's public LTCI pilots on the well-being of older adults and their families. They found that the implementation of LTCI has reduced the likelihood of older adults reporting that they were not receiving LTC they needed. Also, Feng et al. [13] exploits the introduction of public LTCI in Shanghai, China, and examines the effect of LTCI on hospital utilization and expenditures. Costa-Font et al. [9] analyzed the introduction of LTC allowance on hospital admissions in Spain. However, these studies have not examined how LTCI coverage should be designed.

Additionally, this study contributes to the literature elucidating the health effects of LTC. Although the effects of nursing home quality on health outcomes have been studied extensively in the health economics literature [15, 21, 25, 18, 26], home-based care has not attracted much attention despite its growing importance [3, 7, 8]. Gill *et al*. [17] report an experiment that assigns elderly people randomly to a home-based intervention program to examine the health consequences of the program. They find that people who are assigned to the program exhibit less functional decline over time. Although the literature have mainly examined effects of the extensive margin of home-based care, this study sheds light on the intensive margin of home-based LTC for recipients with various health conditions. I find that using more LTC has little effect on health outcomes in the short run, irrespective of the health condition of recipients.

The remainder of the paper is presented as follows. Section 2 presents the institutional background and discusses the expected effects of insurance coverage on LTC utilization. Section 3 describes LTCI administrative data and presents summary statistics. Section 4 explains empirical strategies applying RD design. Section 5 reports estimation results for the effect of insurance coverage on LTC utilization and its health consequences. Section 6 concludes this paper.

2 Institutional Background

Public Long-Term Care Insurance in Japan

The public long-term care insurance in Japan (LTCI) is a mandatory social insurance system in which people of a particular age group must participate. People aged 65 and older are classified as "first-insured," with those of ages 40–64 designated as "second-insured." They must pay premiums set by their municipal government, but second-insured individuals must present with designated diseases to receive insurance benefits.[3] Second-insured people are younger, with additional eligibility requirements. Therefore, most LTCI recipients are first-insured.[4]

Care-Needs Certification

Several steps are necessary before one receives long-term care (LTC) services under LTCI. Figure 1 depicts the LTCI utilization process. The first step is to apply to a municipal government for "care-

[3]Designated diseases include terminal cancer, rheumatoid arthritis, ALS, ossification of posterior longitudinal ligament, osteoporosis, dementia, Parkinson's disease, spinocerebellar degeneration, spinal canal stenosis, progeria syndrome, multiple system atrophy, diabetes, cerebrovascular disease, arteriosclerosis obliterans, chronic obstructive lung disease, and osteoarthritis.

[4]In 2017, first-insured recipients account for 96.4% of all recipients. URL: https://www.mhlw.go.jp/topics/kaigo/osirase/jigyo/m17/1712.html (Japanese)

needs certification," which is a health survey to assess applicant need for LTC [33]. [5] The main purpose of care-needs certification is to classify applicants into specific "care-needs levels" that determine the available services and insurance coverage. Care-needs certification is based on a nationally standardized face-to-face survey conducted by a trained examiner at an applicants' home (or at a hospital if applicants are hospitalized). The examiner first checks 79 items related to the applicant's physical and mental condition. Based on the checkup results, a special formula generates hypothetical care times for eight categories of assistance. Table 1 presents the possible time ranges for each category. The sum of these care times is the "standardized care time," which reflects how much LTC the applicant needs. The longer the standardized care time is, the more an applicant is regarded as needing LTC. This indicator serves a key role in determining the insurance coverage for each applicant.

Next, based on the standardized care time, applicants are assigned tentatively to a corresponding care-needs level. Table 2 presents a range of standardized care time and a corresponding care-needs level. After the tentative assignment, the Certification Committee of Needed Long-Term Care (hereinafter, the Certification Committee), which comprises of physicians, nurses, and other health and social service experts, assesses whether the standardized care time appropriately reflects the applicant's need for LTC. If the care time is regarded as appropriate, then the applicant is assigned to the relevant care-needs level; if not, then the Certification Committee reassigns the applicant to the proper care-needs level.

Available Services and Coverage Limits

Care-needs levels are divisible into two broad categories, which are "Care level" and "Support level." These broad categories designate the LTC services available to recipients. Those who are classified as Care level are deemed to need LTC to conduct their daily lives. These recipients are allowed to use widely diverse LTC services. In contrast, people classified as Support level are regarded as able to perform normal daily activities on their own. Consequently, the available services under the Support level are aimed at preventing recipients from having an increased need for care in the future.[6] The prices of LTC services are fixed by the government in both categories and are adjusted every three years.

A distinct feature of LTCI is that insurance coverage for recipients who select home-based care is determined by the recipient's assessed care-needs level. Recipients are therefore unable to choose

[5] A family member or guardian can also apply for the care-needs certification on behalf of the recipients.

[6] Long-term care under the Support level is designed to help recipients accomplish everyday activities independently. For example, if a recipient has a lack of hand mobility, then the caretaker's role is to design a method for housework that the recipient can perform independently.

their coverage on their own based on their preferences. The insurance coverage of LTCI is characterized by monthly coverage limits. For LTC up to the monthly coverage limit, recipients pay 10 or 20 percent of the total expenditure (depending on income), after which the recipient pays the full price.[7] Table 2 presents the coverage limit for each care-needs level expressed as a total unit value for LTC services. Although the unit value varies slightly across services and municipalities, a reasonable approximation of the unit value is 10 JPY or about 0.1 USD. Table 2 also shows that recipients who belong to the higher care-needs level (i.e. those who have a severe condition) are entitled to more generous coverage. They are classified into either Support level 2 or Care level 1 if the applicants' standardized care time is between 35 and 49.9 min. This allocation procedure draws on specific items of standardized care time representing the applicants' cognitive ability and vulnerability in health status.[8] As described herein, the terms "insurance coverage" and "coverage limit" are used interchangeably.

Long-Term Care Utilization

After available services and insurance coverage are determined, recipients who select home-based care create a monthly plan ("care plan") indicating what services are to be provided. In most cases, recipients produce a detailed care plan assisted by specialist, called a care manager.[9] Another important matter to note is that no unused portion of the monthly coverage limit can be carried over to the next month. In other words, recipients cannot expand future coverage by underuse of current services. To accommodate changes in LTC needs, recipients must take care-needs certification regularly. Recipients must retake the care-needs certification before the "certification term" expires to continue using LTC services under LTCI.[10]

Relationship between Insurance Coverage, LTC Utilization, and Health Outcome

The generosity of insurance coverage can affect LTC utilization through several mechanisms. First, the basic concept of moral hazard in health insurance predicts that insurance coverage affects LTC

[7]The 20 percent coinsurance, introduced into 2015, applies to individuals with total annual income of more than 1.6 million JPY (16K USD); that of first-insured family members is greater than 3.46 million JPY (34.6K USD), or 2.8 million JPY (28K USD) for a single-person household).

[8]Recipients are classified into Care level 1 if both of the following requirements are satisfied: (1) It is difficult for the recipient to understand how to use care prevention services appropriately because of mental disability. (2) The physical and mental condition of the recipient is likely to worsen in a short period.

[9]According to the Long-Term Insurance Act, a care manager is defined as an expert who has specialized knowledge about LTC who helps recipients draw up the best care plan based on their needs, in coordination with LTC providers and the municipal government.

[10]Recipients are reclassified into different care-needs levels if necessary. In principle, the first care-needs certification is valid for a half year. The following certification is valid for one year.

utilization through price. Recipients can use LTC services with low price up to a level of coverage, but they face payment of the full price outside the coverage. Because of the price changes, recipients have an incentive to use LTC services considering a given level of coverage. Therefore, if the insurance coverage expands, recipients who had been discouraged from using LTC services due to the level of coverage may increase their service utilization.

Second, some behavioral economics concepts suggest that individuals who do not face effective price changes might still respond to changes in insurance coverage. The coverage limit of LTCI may serve as a salient "starting point," or anchor, which frames a person's thinking about their demand for long term care services. It might also give an official "stamp of approval" to use services to the extent the coverage limit allows. Their LTC utilization might be influenced by changes in insurance coverage even when they do not face effective price changes if the decision-making of recipients is driven by these psychological biases.

Utilizing more home-based LTC can be either positive or negative for recipient's health. Home care can reduce the risk of recipients having a household accident and prevent their health from worsening. Also, day care encourages recipients to take exercise and to communicate with other people, and these activities might help to improve their health as well. However, it is also possible that relatively healthy recipients who rely too heavily on home care for their daily activities may eventually lose the ability to manage activities that they once could. It is unclear whether positive or negative effects dominate, and the direction could depend on a recipient's current health status. Because preventing the deterioration of recipients' health is beneficial for both recipients' quality of life and reducing the public cost of LTCI, the health consequences of long-term care is an important empirical question.

3 Data

LTCI Administrative Data

I use two sets of LTCI administrative data obtained from a local metropolitan government near Tokyo. The first set is LTCI claims data, which include monthly information related to eligibility, LTC utilization, and demographic characteristics for all LTCI recipients in the city. The available sample period of these data extends from June 2012 through March 2018. Eligibility information includes the care-needs level, start and end dates of each certification term, coinsurance rate, and public subsidy eligibility. For service utilization, claims data provide information related to how much each recipient uses and spends on a monthly basis for each type of LTC service. For this study, home-based

care is grouped into five categories: home care, day care, home nursing, rehabilitation, and others. The claims data include limited information related to the demographic characteristics of recipients, providing age and gender, but no information related to income and family structure.

The second dataset is newly available LTCI administrative data on care-needs certification. The most important information in this dataset is the assessed standardized care time, which is used for assigning recipients to a care-needs level. These data, which are available for each certification term, include a breakdown of how the final standardized care time was calculated (that is, it provides a hypothetical care time for each category of assistance) as well as other information related to care-needs certification such as the start and end dates of each certification term. The sample period of LTCI certification data is the same as that for LTCI claims data.

The analysis sample was created by linking the LTCI certification data and claims data via a unique ID number. This dataset allows association of recipients' LTC utilization and their standardized care time. From this preliminary dataset, recipients of several types were excluded from the baseline analysis sample. First, nursing home resident recipients were omitted from analysis because the coverage limit is applied only to home-based care users.[11] Second, recipients receiving public subsidies for LTCI are omitted because they face a different incentive scheme than those of usual recipients. The remaining recipients constitute the baseline sample.

Summary Statistics

Table 3 presents summary statistics for the baseline sample and the respective care-needs levels. Panel A presents demographic information of LTCI recipients.[12] The age of the baseline sample is around 81.2 years old, with recipients in high care-needs levels tending to be slightly older than those of low care-needs levels. Regarding all care-needs levels, more than half of the recipients are women. Approximately 13% of recipients face a higher coinsurance rate (20%) because of high income. This rate is uniform across different care-needs levels. Change of care-needs level represents a fraction of recipients whose care-needs level is changed according to an assessment of the Certification Committee. In the baseline sample, only 5% of all recipients receive different coverage limits from those which the standardized care time indicates: the standardized care time determines the coverage limit in most cases.

Panel B presents the information related to the standardized care time calculated during care-needs

[11] We omit all nursing home resident recipients including those who use institutional care such as community care in the facility.

[12] Because some recipients were allocated into different care-needs levels for several care-needs certifications, the sum of recipients for each care-needs level is not equal to the number of total recipients in the first column.

certification and a breakdown of the hypothetical care time for each assistance category. With higher care-needs levels, assistance burdens related to eating, transferring, toileting and hygiene increase sharply, but other assistance categories are roughly constant across care-needs levels.

Panel C presents information related to LTC utilization. The fraction of coverage limits used shows that the average total expenditure accounts for 40-75% of coverage limits. Day care is the most used LTC services, followed by home care. Home care and home nursing utilization monotonically increase as the care-needs level becomes higher. Demand for day care and rehabilitation decrease at higher care-needs levels. The rate of exceeding the coverage limit also varies among care-needs levels. In the baseline sample, 9% of recipients exceed the monthly coverage limit. The figure is higher for recipients with high care-needs. Only 3-5% of recipients at the Support level exceed the monthly coverage limit. By contrast, for recipients in Care levels 4-5, around 20% of recipients exhaust the monthly coverage limit. One reason not exhausting coverage limits might be the out-of-pocket payment within coverage limits. These statistics suggest that the level of coverage limits is so generous that most recipients do not need to exhaust their coverage limit.

The variation of the rate of exceeding the coverage limit suggests that the effects of insurance coverage on LTC utilization can vary among people with different care-needs levels. In general, people who have exhausted their coverage limit are more likely to increase LTC utilization when the coverage becomes more generous because their utilization may be constrained by the current coverage limit. Therefore, because more recipients have exhausted coverage limit at high care-needs levels, these recipients are expected to be more likely to respond to changes in the coverage limit than those in low care-needs levels.

4 Empirical Strategy

4.1 Utilization Effects of Insurance Coverage

Generous insurance coverage can increase recipients' LTC utilization because it increases the volume of LTC services available to recipients at a lower cost. To estimate recipients' responses to various degrees of insurance coverage generosity, I implement an RD design exploiting the thresholds of the standardized care time that generates discontinuous changes in the monthly coverage limits [2, 20, 23]. Figure 2 presents the relation between standardized care time and coverage limits. Five thresholds exist at 32, 50, 70, 90, and 110 min; these thresholds respectively change the coverage limit by $5,470$ ($+109.3\%$), $2,924$ ($+17.5\%$), $7,315$ ($+37.3\%$), $3,875$ ($+14.4\%$), and $5,259$ ($+17.1\%$) units. The relation between the standardized care time and the coverage limit is not deterministic because the

recipients' care-needs level might be altered by the Certification Committee. Consequently, these thresholds are used as instruments for the generosity of insurance coverage.

Given a particular threshold, I only use recipients whose standardized care time is in one of the two neighboring care-needs levels separated by the threshold. The effects of insurance coverage on LTC utilization at each of the five thresholds is expressed as:

$$Utilization_{it} = \alpha^c + \beta^c Coverage_{it} + f^c(SCT_{it}) + X_{it}\gamma^c + \varepsilon_{it}, \tag{1}$$

where $Utilization_{it}$ stands for the LTC utilization of recipient i in year-month t measured by monthly total units.[13] $Coverage_{it}$ denotes the generosity of insurance coverage (coverage limit). SCT_{it} expresses a standardized care time, which is a running variable. The covariates in X_{it} include age, gender, coinsurance rate, and the hypothetical care times of each category of assistance, which are used collectively to calculate the standardized care time. In addition, $f^c(\cdot)$ signifies a set of functions of standardized care time specified below. The parameter of interest is β^c, denoting the effects of a one-unit increase in insurance coverage on LTC utilization. All parameters are indexed by a threshold c because they are estimated for each threshold.

The first-stage regression is

$$Coverage_{it} = \alpha_0^c + \beta_0^c \mathbb{1}\{SCT_{it} \geq Cutoff\} + f_0^c(SCT_{it}) + X_{it}\gamma_0^c + \varepsilon_{it}, \tag{2}$$

where $Cutoff$ denotes one cutoff values of standardized care time which separates neighboring care-needs level; that is, $Cutoff \in \{32, 50, 70, 90, 110\}$ depending on the threshold exploited for estimation. A dummy variable, $\mathbb{1}\{SCT_{it} \geq Cutoff\}$, takes a value of 1 if the standardized care time is greater than or equal to a given cutoff value. In addition, $f_0^c(\cdot)$ (and $f^c(\cdot)$ in equation 1) is a set of functions of a running variable: its parameters are free to vary on either side of a given threshold. The function is specified as a linear, quadratic, or cubic function for parametric estimation.[14] A nonparametric local polynomial regression with robust confidence intervals proposed by Calonico, Cattaneo, and Titiunik [4] is also estimated. Standard errors are clustered at the recipient level in equations 1 and 2.

[13] An adjustment must be made to reflect service utilization accurately because the number of units of day care service might be higher at upper care-needs levels because of the higher price of these services. To address this point, day care service units are normalized using a price of Care level 1 as a baseline. Hereinafter, the measure of LTC utilization refers to these adjusted data. Effects of day care price changes on LTC utilization are assumed to be negligible because price changes across care-needs levels are fairly small (approx. 10%).

[14] Both sides of the threshold use the same parametric specification.

4.2 Estimation of Long-Term Care Health Consequences

Using recipients' responses to insurance coverage, I estimate the effect of LTC utilization on their health outcomes through two-stage least square (2SLS) estimation. Recipients at the Support level can only use preventive LTC, whereas those at the Care level use usual LTC services. The causal relation of interest can be expressed as shown below.

$$Health_{is+1} = \alpha^c + \beta^c Utilization_{is} + f^c(SCT_{is}) + X_{is,s+1}\gamma^c + \varepsilon_{is}. \tag{3}$$

In this estimation, $Health_{is+1}$ expresses a measure of the health status of recipient i at certification term $s+1$. I use three variables as recipient health measures: (i) standardized care time calculated at the beginning of term $s+1$, (ii) LTC utilization during term $s+1$, and (iii) whether recipients end up entering a nursing home during $s+1$. $Utilization_{is}$ in equation 3 stands for the mean monthly LTC utilization of recipient i during term s. Also, $f^c(\cdot)$ represents a function of the standardized care time. $X_{is,s+1}$ includes the length of time of term s as well as the recipient's characteristics including the hypothetical care time of each category of assistance, as in the regressions discussed above. If utilization information is used as outcomes, then the standardized care time at $s+1$ is included in $X_{is,s+1}$ because the LTC utilization is affected by insurance coverage (care-needs level). The parameter of interest is β^c, which stands for the health effects of LTC utilization.

Long-term care utilization is an endogenous variable. Therefore, each threshold generating discontinuous variation in a coverage limit is used as an instrument for it. The first-stage of 2SLS is estimated using the following regression equation at each of the five thresholds.

$$Utilization_{is} = \alpha_0^c + \beta_0^c \mathbb{1}\{SCT_{is} \geq Cutoff\} + f_0^c(SCT_{is}) + X_{is,s+1}\gamma_0^c + \varepsilon_{is}. \tag{4}$$

The notation is the same as those used for the regressions introduced earlier: $\mathbb{1}\{SCT_{is} \geq Cutoff\}$ is an instrument for LTC utilization. The functional specification of $f_0^c(\cdot)$ in the first stage is same as $f^c(\cdot)$ in the second stage.

It is noteworthy that the estimates represent the short-run health effects of LTC utilization. The 2SLS estimation above uses LTC utilization only during the first term, $s = 1$, to examine direct effect of LTC utilization specifically rather than the cumulative effect from past utilization. The average length of the first term is 6.8 months. Therefore, the estimated health effect is of different LTC utilization for half a year.

4.3 Validity Tests for the RD Design

Distribution of the Running Variable and Density Tests

This section describes validation of local randomness around thresholds. To test the smoothness of the distribution of running variable (standardized care time) statistically, I apply the local polynomial density test proposed by Cattaneo, Jansson, and Ma [6] at each threshold.

Appendix Table A1 presents estimates of the test with the baseline sample and those who take the first care-needs certification. In the case of the baseline sample, the density of standardized care time is smooth around the thresholds for Support levels 1-2, Care levels 3-4 and 4-5. However, the density has a discontinuity at the thresholds for Care levels 1-2 and 2-3, which suggests a potential manipulation problem. Therefore, the former three cases (Support levels 1-2, Care levels 3-4 and 4-5) are used mainly for estimating the utilization effects of insurance coverage. In the case of first certification, the density is smooth around thresholds, except for Care levels 1-2.

Covariates Balance Test

Furthermore, I examine whether predetermined recipient characteristics are balanced around the thresholds. For these analyses, the following parametric equation is estimated as

$$Y_{is} = \alpha^c + \beta^c \mathbb{1}\{SCT_{is} \geq Cutoff\} + f^c(SCT_{is}) + \varepsilon_{is}, \tag{5}$$

where Y_{is} is the covariate of recipient i during certification term s. The linear specifications are used for $f^c(\cdot)$.

Appendix Table A2 presents β^c for all recipients in the baseline sample and those who take the first care-needs certification. As with the density test results, the variations of covariates around thresholds are not significant for Support levels 1-2, Care levels 3-4 and 4-5. Estimates for the first certification are not significant except for those of Care levels 1-2.

In summary, the RD design is reasonably valid at thresholds for Support levels 1-2, and for Care levels 3-4 and 4-5 in the baseline sample. Therefore, these three cases are mainly used to estimate the utilization effects of insurance coverage. Similarly, I use thresholds except for Care levels 1-2 as main empirical results for health effects of LTC utilization.

5 Results

5.1 Effects of Insurance Coverage on LTC Utilization

This section presents estimation results for utilization effects of insurance coverage. As discussed in the section above, I use thresholds in Support levels 1-2, Care levels 3-4 and 4-5 for main empirical analysis. However, results from other thresholds are also presented for reference. Figure 3 presents the relation between standardized care time, monthly coverage limits, and monthly LTC utilization using the baseline sample. The standardized care time is divided into 1-min-wide intervals (bin); hollow circles and triangles respectively represent local average of coverage limits within bins for the Care level and the Support level. Filled circles and triangles represent the local averages of the monthly LTC utilization within a bin. A quadratic prediction is fitted on the plots for each care-needs level. It is noteworthy that coverage limits increase discontinuously at all thresholds, indicating that the thresholds are valid instruments for the insurance coverage generosity. In addition, LTC utilization also increases at all thresholds. This finding strongly suggests that insurance coverage significantly affects LTC utilization.

Table 4 presents the first-stage estimates (β_0 in equation 2) and the second-stage estimates (β in equation 1) for the utilization effect of insurance coverage at each threshold. Each column presents results for a specific polynomial order and nonparametric estimates. The first-stage estimates are positive and significant at all thresholds, irrespective of specifications, which confirms the validity of the instruments. Variation in first-stage estimates by threshold strongly reflects the "mechanical" relation between the standardized care time and coverage limits, as shown in Figure 2. This results indicate that insurance coverage is determined mostly by the standardized care time.

The second-stage estimate represents the effects on LTC utilization of having one unit more generous insurance coverage. The estimates are positive and statistically significant at almost all thresholds and specifications. These estimates demonstrate unambiguously that generous insurance coverage increases LTC utilization. Importantly, although only a small fraction of recipients exhaust their insurance coverage at the Support level, more generous insurance coverage engenders higher LTC utilization. This result suggests that recipients respond to changes in insurance coverage even when they have not exhausted insurance coverage.

The estimates presented above demonstrate the important existence of marked heterogeneity among recipients with different care-needs levels. First, Support level recipients are less sensitive to insurance coverage than those of the Care level. A one unit increase in the coverage limit for the Support level increases utilization by around 0.2 units, whereas that for the Care level increases utilization

by 0.5-0.8 units. This difference might be attributable to the fact that few recipients of the Support level exhaust their insurance coverage. Second, even among Care level recipients, the effects of insurance coverage tend to grow as the care-needs levels increase. The summary statistics indicate that recipients who belong to higher care-needs levels are more likely to exhaust their insurance coverage. Therefore, the trend supports the prediction that the utilization effect of insurance coverage will increase as more recipients exhaust their insurance coverage.

5.2 Utilization Effects by Service Categories

To examine the effect of insurance coverage on LTC utilization further, I also estimate how insurance coverage affects recipients' utilization of different LTC service categories: home care, day care, home nursing, and rehabilitation. With home care services, helpers visit the recipient's home and provide various services to help the recipient in their daily life. Day care services allow recipients to travel to the facility on day trips and to receive services such as exercises, meals, and bathing. Home nursing and rehabilitation provide recipients with medical-related services.

Table 5 presents estimates for utilization effects of insurance coverage by service category. The local polynomial regression proposed by Calonico, Cattaneo, and Titiunik [4] is used for estimation. In this estimation, recipients in different care-needs levels are found to respond differently to insurance coverage. Recipients of Support levels 1-2 increase the use of rehabilitation and day care services when more generous insurance coverage is available, although they do not change home care and home nursing. The general health condition of Support levels 1-2 is described as "a condition in which the recipient is able to perform basic daily on her own, but requires some assistance to prevent the decline of physical functions."[15] As described in Section 2, the available services under the Support level are aimed at preventing recipients from having an increased need for care in the future. The increase in rehabilitation care due to more generous coverage indicates that the coverage expansion induce the use of preventive care among those with high preventive effectiveness. The coverage expansion also increase the use of day care services. A possible explanation is that recipients of Support levels 1-2 may have incentives to increase day care for recreation because these recipients are healthy among the overall LTCI recipients. However, as suggested by the insignificance of the impact on home care, these recipients might have less incentive to increase home care or home nursing because of their good health.

Recipients in Care levels 3-4 and 4-5 change LTC services differently from those in Support levels

[15] Ministry of Health, Labor and Welfare. URL: https://www.mhlw.go.jp/topics/kaigo/kentou/15kourei/sankou3.html (Japanese)

1-2. When more generous insurance coverage is available, recipients with high care-needs increase home care services, although other services do not change significantly. The general health status of Care levels 3-5 is described as "a condition in which the recipient's physical ability to perform daily activities is significantly impaired and requires almost total nursing care." [16] It is plausible that these recipients increase home care because those with high care-needs face various difficulties associated with daily life at home. At the same time, they might not be in sufficiently good health to access day care services. For that reason, insurance coverage does not affect day care utilization for these recipients. Insurance coverage does not change the use of rehabilitation either, probably because rehabilitation is regarded as unlikely to improve the health status of recipients with high care-needs.

Previous studies have rarely analyzed the heterogeneous effects of public subsidies on LTC utilization. A notable exception is Kim and Lim [21], which examined the effect of government subsidies for home-based care and facility care on long-term care utilization among people with different health conditions. They found that less able people are more likely to increase the demand for facility care with government subsidies. My analysis focuses on home-based care and examines how insurance coverage affects demand for different home-based LTC service categories. The above results suggest that the coverage expansion tends to induce home-based LTC utilization that is highly needed according to each individual's health status.

5.3 Health Consequences of Long-Term Care Utilization

Using more home-based LTC can exert either a positive or negative influence on recipients' health. Home care can reduce the risk of household accidents involving recipients. In addition, day care encourages recipients to take exercise and to communicate with other people. These activities might help to improve their health as well. However, it is also possible that healthy recipients who rely too heavily on home care for their daily activities might eventually lose the ability to manage activities that they once were able to do. It remains unclear whether positive or negative effects are predominant. Preventing deterioration of recipients' health is beneficial both for the recipients' quality of life and for reducing the public costs of LTCI. Therefore, the health consequences of LTC constitute an important empirical question.

I use the thresholds of standardized care time which create discontinuous variation in insurance coverage as instruments for estimating health effects of LTC. Appendix Table A3 presents estimates of the first stage effect of insurance coverage on LTC utilization. The emphases of these analyses

[16] Ministry of Health, Labor and Welfare. URL: https://www.mhlw.go.jp/topics/kaigo/kentou/15kourei/sankou3.html (Japanese)

are health effects of LTC utilization during the first certification term. The estimates demonstrate that the instruments strongly affect LTC utilization for recipients who belong to low care-needs levels (Support levels 1-2, Care levels 1-2 and 2-3), although the effects are not significant for those who belong to high care-needs levels (Care levels 3-4 and 4-5). Therefore, in terms of the health effects, recipients in Support levels 1-2, Care levels 1-2 and 2-3 are specifically examined. It is noteworthy that recipients in the Support level use preventive care, whereas those in the Care level use usual LTC.

Table 6 presents OLS and 2SLS estimates of the health consequences of LTC utilization using the standardized care time as a health outcome. Positive values of the estimates imply negative health effects of LTC because the standardized care time reflects the recipient's need for LTC. Actually, OLS estimates suggest that both preventive care (Support level) and usual care (Care level) exert a slightly negative effect on a recipient's health. The 2SLS estimates also tend to have a positive value (a negative effect), with estimates even larger than those of OLS for those with low needs for care. However, the significant level of these 2SLS estimates depends on the specification. Estimates are found to be insignificant in many cases. Therefore, one can reasonably infer that few short-run effects of using more LTC on health outcomes exist for either preventive or usual care.

I also check health effects using different outcome variables. Medical studies often use medical expenditures and hospitalizations as health outcomes. Similarly, LTC utilization and the use of nursing home can also be interpreted as health outcomes: If patients' health deteriorates and their care needs increase, they will be more likely to use long-term care services or enter a nursing home. Therefore, Table 7 presents OLS and 2SLS estimates of the health effects of LTC, using LTC utilization during the term $s+1$ and whether recipients end up entering a nursing home during $s+1$ as health outcomes. The results are consistent with those obtained using standardized care time as health outcomes. Although OLS estimates indicate significant negative health effects of LTC, the 2SLS estimates are mostly not significant, except for the case where LTC utilization is used as an outcome for Care levels 2-3. These results reinforce the argument that using more preventive or usual LTC has little effect on the recipient's health outcomes in the short run.

There are some empirical limitations on estimating the health consequences of LTC in this setting. First, effects of LTCs of different types such as home care and day care cannot be identified because only one instrument exists. Therefore, the estimates are expected to be interpreted as the collective effects of all types of LTC services on health outcomes. Second, because of data limitations, estimating the health effects of total LTC that includes both LTC services and informal care is beyond the scope of this study. Some earlier studies have presented the argument that informal care can be regarded as a substitute for formal LTC service [29]. Results of these studies suggest that the change in LTC

utilization might be greater than that for all care because the change in utilization might be partially compensated by informal care. Therefore, the estimates presented above must be interpreted as an upper bound of the health effects attributed to the total amount of care a recipient receives.

6 Conclusion

This paper presents an exploration of insurance coverage effects on LTC utilization and their health consequences. The institutional setting of LTCI in Japan permits the implementation of an RD design to estimate the effect of insurance coverage on the LTC utilization of recipients with different health conditions. Furthermore, the health consequences of LTC utilization are estimated using the thresholds as instruments.

The results obtained from estimation indicate that generous insurance coverage engenders significant increases in LTC utilization. Recipients with low care-needs (Support levels 1-2) increase their LTC utilization by about 0.2 units for one unit increase in coverage limit. By contrast, those with high care-needs (Care levels 3-4, 4-5) increase their utilization by 0.5-0.7. The difference might reflect the fact that more recipients with high care-needs have exhausted insurance coverage and that they are more responsive to coverage changes. Estimation results also indicate that, when more generous insurance coverage is available, recipients with low care-needs tend to increase day care and rehabilitation services, whereas those with high care-needs increase home care services. Estimates for health effects indicate that LTC utilization has little effect on several health outcomes, at least in the short run.

The findings presented in this paper highlight the importance of insurance coverage as a policy tool to control LTC utilization. Particularly, changes in insurance coverage can exert important effect on recipients' LTC utilization, especially in situations where many recipients have exhausted their insurance coverage. In terms of health effects, quantifying the effects of LTC utilization on the health of family members is also important because the utilization might affect the provision of informal care by the family. This issue can be interesting avenues for future research.

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Figure 1: Utilization Process of Long-Term Care Services under LTCI

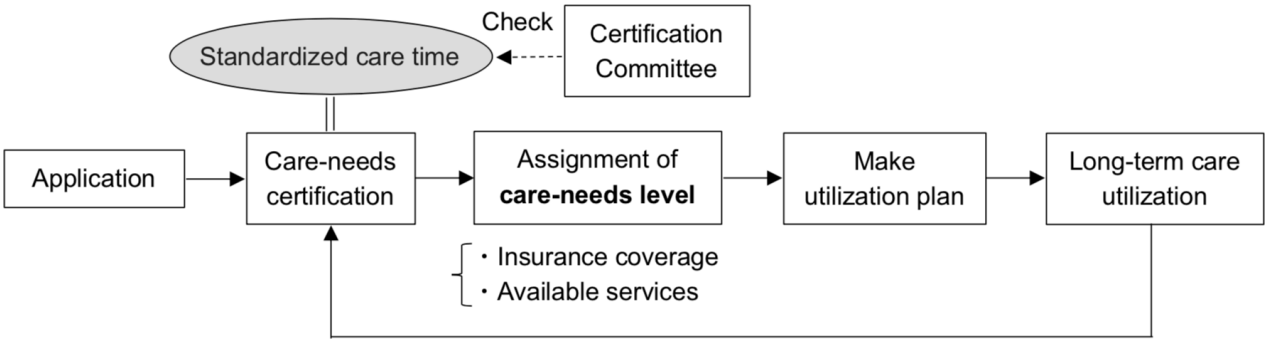
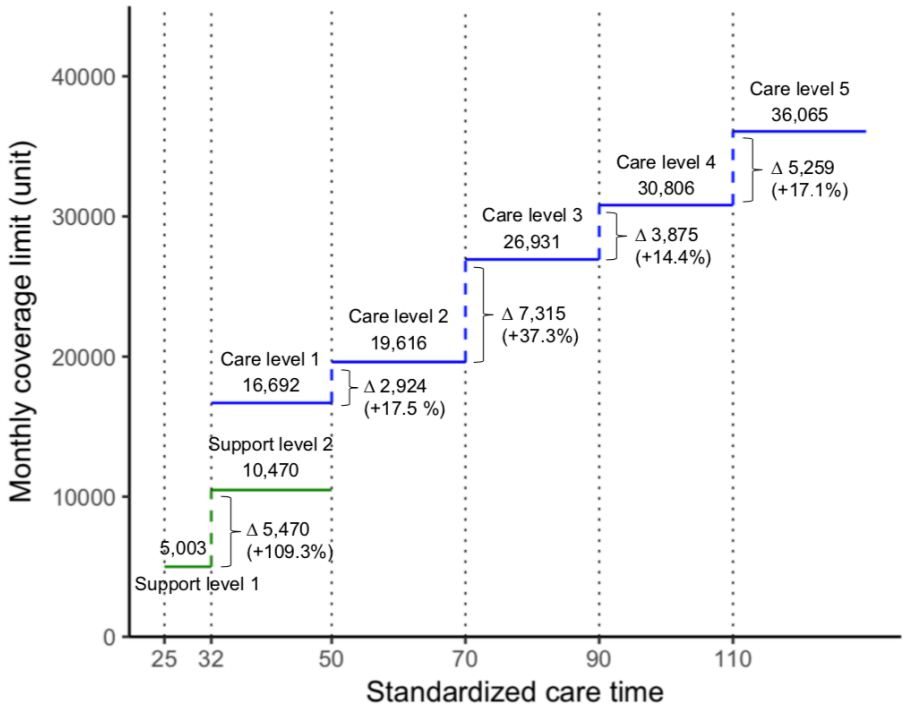
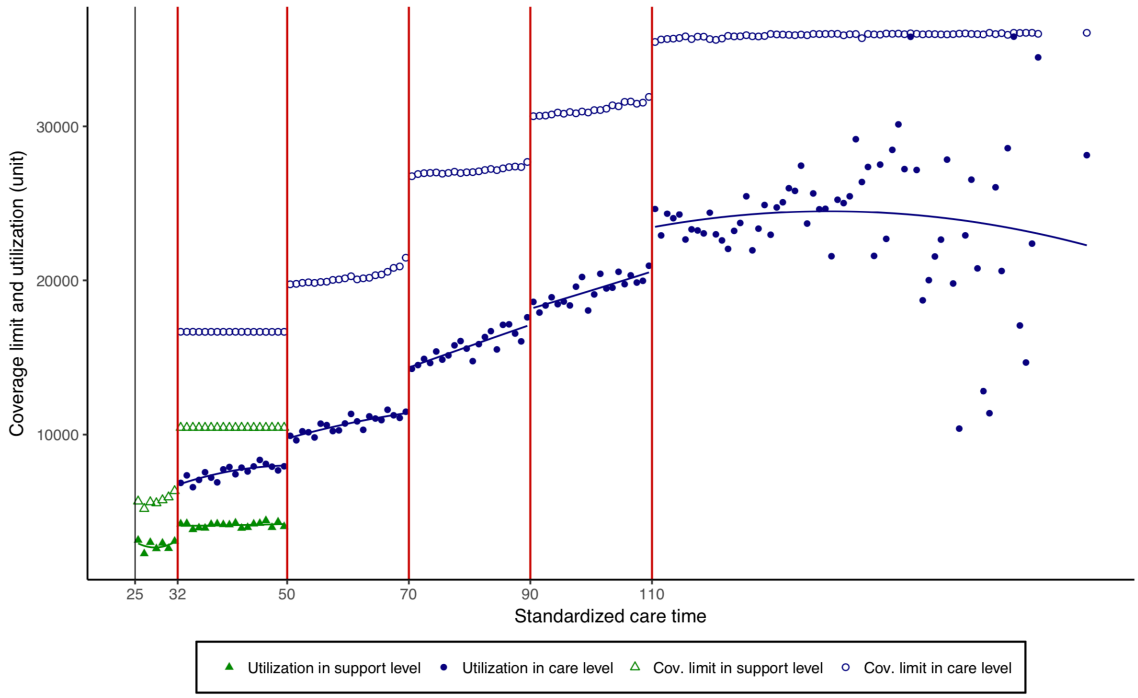


Figure 2: Standardized Care Time and Monthly Coverage Limit



Notes: This figure presents the relation between standardized care time and monthly coverage limit. The green line represents the coverage limits for the Support level; the blue line represents those for the Care level.

Figure 3: Coverage Limit and Long-Term Care Utilization



Notes: This figure presents the relation between coverage limit and LTC utilization using the baseline sample. I divide standardized care time into 1 min-wide interval (bins). Hollow circles and triangles respectively represent a local average of coverage limit for Care level and Support level. Each filled circle and triangle represents a local average of a monthly total unit of LTC utilization within bins and a quadratic prediction is fitted on the plots for each care-needs level.

Table 1: Category of Assistance and Range of Time Length

Category of assistance	Range of time length (min)
Eating	1.1–71.4
Transferring	0.4–21.4
Toileting	0.2–28.0
Hygiene	1.2–24.3
Housework	0.4–11.3
Dementia	5.8–21.2
Exercise	0.5–15.4
Medical care	1.0–37.2
Standardized care time	10.6 – 230.6

Table 2: Monthly Coverage Limits for Each Care-needs Level

Care-needs level	Standardized care time (min)	Coverage limit (unit)
(Not eligible)	< 25.0	—-
Support level 1	25.0–31.9	5,003
Support level 2	32.0–49.9	10,473
Care level 1	32.0–49.9	16,692
Care level 2	50.0–69.9	19,616
Care level 3	70.0–89.9	26,931
Care level 4	90.0–109.9	30,806
Care level 5	$\geq$110.0	36,065

Table 3: Summary Statistics

		Support level		Care level				
	Baseline sample	level 1	level 2	level 1	level 2	level 3	level 4	level 5
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Demographics								
Age	81.2	81.4	81.4	81.7	81.5	82.1	82.2	82.0
Woman	0.60	0.67	0.70	0.61	0.60	0.58	0.59	0.59
20% coinsurance	0.13	0.11	0.10	0.12	0.11	0.11	0.10	0.09
Change of care-needs level	0.05	0.00	0.06	0.07	0.01	0.09	0.09	0.07
Obs. (Recipient)	49,248	9,204	10,294	20,121	16,395	11,858	10,026	6,412
B. Care-needs certification								
Standardized care time	55.7	27.1	35.8	39.3	55.6	77.7	97.9	123.5
Eating	7.5	3.5	3.5	5.2	6.7	8.4	11.5	28.5
Transferring	6.1	0.7	2.1	2.4	5.1	11.0	17.1	17.6
Toileting	7.0	0.3	1.7	1.8	6.0	14.3	21.1	22.5
Hygiene	8.9	2.2	5.8	6.3	9.8	13.6	16.7	18.2
Housework	6.8	4.6	5.5	7.2	7.9	8.2	8.4	6.1
Dementia	6.8	5.8	5.9	6.5	7.5	7.9	7.0	6.9
Exercise	6.3	6.0	6.7	5.7	6.4	5.8	6.7	7.6
Medical care	5.8	4.0	4.6	4.2	5.1	5.9	9.1	16.1
Obs. (Recipient $\times$ Term)	132,881	18,605	20,845	32,552	23,530	15,808	12,807	8,734
C. Long-term care utilization								
Total expenditure per month (JPY)	105,120	25,078	43,259	73,615	105,681	167,705	207,286	262,789
Total unit per month	10,657	2,345	4,068	7,443	10,803	17,165	21,191	26,977
Fraction of coverage limits used		0.46	0.38	0.44	0.55	0.63	0.68	0.74
Home care	2,738	714	881	1,647	2,301	3,694	6,037	10,393
Day care	3,927	920	1,660	3,273	4,050	6,967	7,084	6,731
Home nursing	639	60	177	396	598	769	1,331	2,763
Rehabilitation	1,032	212	638	1,079	1,410	1,399	1,381	918
Exceed coverage limit	0.09	0.05	0.03	0.05	0.11	0.14	0.18	0.24
Monthly coverage limit (unit)		5,003	10,473	16,692	19,616	26,931	30,806	36,065
Obs. (Recipient $\times$ Month)	1,313,343	163,854	187,264	335,340	261,823	166,438	119,183	79,441

Notes: This table presents summary statistics for LTCI recipients analyzed for this study: recipients who use LTC services between June 2012 and March 2018. The first column shows statistics for all recipients irrespective of care-needs levels. The other columns present statistics for recipients who belong to specific care-needs levels separately. Recipients can be categorized into different care-needs levels for several care-needs certifications. Hence, the sum of recipients of each care-needs level is not equal to the number of total recipients (first column).

Table 4: Utilization Effects of Insurance Coverage

	Linear		Quadratic		Cubic		LPR			
	Coeff. (1)	SE (2)	Coeff. (3)	SE (4)	Coeff. (5)	SE (6)	Coeff. (7)	SE (8)	Obs. (9)	Cluster (10)
Support levels 1-2										
First-Stage	4,183.6***	(49.9)	3,859.1***	(107.2)	3,491.7***	(196.7)	3,291.5***	(218.5)	339,271	15,646
Second-Stage	0.260***	(0.014)	0.290***	(0.027)	0.176***	(0.049)	0.122**	(0.058)		
Care levels 1-2										
First-Stage	2,957.7***	(22.5)	3,135.6***	(28.8)	2,990.2***	(34.3)	3,038.4***	(38.7)	549,574	28,607
Second-Stage	0.550***	(0.043)	0.524***	(0.057)	0.566***	(0.080)	0.614***	(0.109)		
Care levels 2-3										
First-Stage	5,947.5***	(54.7)	5,729.2***	(92.8)	5,360.7***	(133.7)	5,193.8***	(161.7)	398,238	22,848
Second-Stage	0.459***	(0.037)	0.533***	(0.056)	0.477***	(0.082)	0.447***	(0.094)		
Care levels 3-4										
First-Stage	3,101.0***	(39.5)	3,080.6***	(56.8)	2,965.0***	(75.4)	2,856.6***	(104.1)	274,045	18,801
Second-Stage	0.522***	(0.097)	0.455***	(0.141)	0.542***	(0.189)	0.427	(0.263)		
Care levels 4-5										
First-Stage	3,942.4***	(57.5)	3,687.9***	(87.3)	3,630.3***	(120.2)	3,619.0***	(123.2)	189,281	14,371
Second-Stage	0.607***	(0.108)	0.726***	(0.156)	1.051***	(0.207)	1.003***	(0.224)		

Notes: This table presents the first-stage estimates of β_0^c in equation 2 and the second-stage estimates of β^c in equation 1. The first to sixth columns show estimates for different specifications of $f_0(SCT_{it})$ and $f(SCT_{it})$: linear, quadratic, and cubic, respectively. The seventh and eighth columns shows the nonparametric local polynomial regression (LPR) estimates using the robust confidence intervals proposed by Calonico, Cattaneo, and Titiunik (2014). *** p<0.01, ** p<0.05, * p<0.10.

Table 5: Utilization Effects by Service Category

Home care		Day care		Home nursing		Rehabilitation			
Coeff. (1)	SE (2)	Coeff. (3)	SE (4)	Coeff. (5)	SE (6)	Coeff. (7)	SE (8)	Obs. (9)	Cluster (10)
Support levels 1-2									
-0.051*	(0.031)	0.218***	(0.039)	0.015	(0.016)	0.119***	(0.030)	339,271	15,646
Care levels 1-2									
0.269***	(0.070)	0.140	(0.092)	0.080***	(0.021)	-0.064	(0.065)	549,574	28,607
Care levels 2-3									
0.088	(0.075)	0.254***	(0.080)	0.026	(0..023)	0.020	(0.063)	398,238	22,848
Care levels 3-4									
0.635***	(0.243)	0.038	(0.247)	0.131*	(0.070)	0.047	(0.090)	274,045	18,801
Care levels 4-5									
0.663***	(0.236)	0.305*	(0.184)	0.066	(0.086)	0.058	(0.074)	189,281	14,371

Notes: This table presents the second-stage estimates of β^c in equation 1 by service group. Each column shows estimates or standard error for different long-term care services. I present the nonparametric local polynomial regression (LPR) estimates using the robust confidence intervals proposed by Calonico, Cattaneo, and Titiunik [4]. *** p<0.01, ** p<0.05, * p<0.10.

Table 6: Health Effect of Long-Term Care Utilization

		2SLS				
	OLS	Linear	Quadratic	Cubic	LPR	Obs.
	(1)	(2)	(3)	(4)	(5)	(6)
Preventive care						
Support levels 1-2	0.0000	0.0001	0.0010	0.0027	0.0028	4,879
	(0.0001)	(0.0008)	(0.0014)	(0.0026)	(0.0026)	
Usual care						
Care levels 1-2	0.0004***	0.0013	-0.0050	-0.0018	0.0000	5,515
	(0.0001)	(0.0016)	(0.0189)	(0.0027)	(0.0060)	
Care levels 2-3	0.0006***	0.0010	0.0015	0.0006	0.0019	3,140
	(0.0001)	(0.0012)	(0.0010)	(0.0009)	(0.0017)	

Notes: This table presents estimates of β^c in equation 3 using standardized care time at the beginning of the term $s+1$ as a health outcome. The first column represents the OLS estimates and second to fifth columns represent the 2SLS estimates. The 2SLS estimates are presented separetely for different specifications of $f(SCT_{it})$: linear, quadratic, cubic and LPR representing nonparametric local polynomial regression estimates using the robust confidence intervals proposed by Calonico, Cattaneo, and Titiunik (2014). In the case of OLS, $f(SCT_{it})$ is linear. Standard errors are shown in parentheses under each estimate. *** p<0.01, ** p<0.05, * p<0.10.

Table 7: The Health Effect of Long-Term Care Utilization (2)

	Utilization					Nursing home					
		2SLS					2SLS ($\times 10^3$)				
	OLS (1)	Linear (2)	Quadratic (3)	Cubic (4)	LPR (5)	OLS ($\times 10^3$) (6)	Linear (7)	Quadratic (8)	Cubic (9)	LPR (10)	Obs. (11)
Preventive care											
Support levels 1-2	0.882***	-0.060	0.261	0.463	-0.192	0.014***	-0.002	-0.008	0.020	0.015	4,879
	(0.053)	(0.244)	(0.420)	(0.719)	(0.823)	(0.003)	(0.010)	(0.017)	(0.030)	(0.036)	
Usual care											
Care levels 1-2	0.877***	0.509	-0.052	0.321	-0.894	0.012***	0.016	0.003	-0.022	-0.086	5,515
	(0.017)	(0.342)	(1.590)	(0.533)	(2.054)	(0.001)	(0.018)	(0.069)	(0.031)	(0.110)	
Care levels 2-3	0.816***	0.550*	1.052***	0.773***	0.840***	0.011***	-0.001	0.005	0.002	0.005	3,140
	(0.019)	(0.294)	(0.229)	(0.214)	(0.320)	(0.001)	(0.017)	(0.013)	(0.012)	(0.018)	

Notes: This table presents estimates of β^c in equation 3 using utilization or whether to enter a nursing home as a health outcome. The first to fifth columns represent the estimates for the case of using LTC utilization as a health outcome. The sixth to tenth columns represent the case of whether to enter a nursing home. The first and sixth columns represent the OLS estimates and other columns represent the 2SLS estimates. The 2SLS estimates are presented separately for different specifications of $f(SCT_{it})$: linear, quadratic, cubic and LPR representing nonparametric local polynomial regression estimates using the robust confidence intervals proposed by Calonico, Cattaneo, and Titiunik (2014). In the case of OLS, $f(SCT_{it})$ is linear. Standard errors are shown in parentheses under each estimate. *** p<0.01, ** p<0.05, * p<0.10.

Appendix A: Figures and Tables

Table A1: Density Test

	Baseline sample		First certification	
	Est.	SE	Est.	SE
	(1)	(2)	(3)	(4)
Support levels 1-2	-0.0041	(0.0063)	0.0313	(0.0402)
Care levels 1-2	0.0251***	(0.0013)	0.0403***	(0.0096)
Care levels 2-3	0.0057**	(0.0026)	0.0076	(0.0066)
Care levels 3-4	0.0014	(0.0026)	0.0042	(0.0028)
Care levels 4-5	-0.0003	(0.0022)	0.0015	(0.0038)

Notes: This table presents results of the density test proposed by Cattaneo, Jansson, and Ma (2020). Panel A and B respectively show results for the distribution of standardized care time using all recipients-term and first care-needs certification. *** p<0.01, ** p<0.05, * p<0.10.

Table A2: Covariates Balance Tests

	Baseline sample		First certification	
	Coeff. (1)	SE (2)	Coeff. (3)	SE (4)
Support levels 1-2				
Age	-0.234	(0.193)	0.239	(0.368)
Female	0.024	(0.018)	-0.037	(0.037)
20% coinsurance	0.001	(0.006)	0.020	(0.013)
Care levels 1-2				
Age	-0.411	(0.163)	-1.857***	(0.381)
Female	-0.031***	(0.018)	-0.039	(0.022)
20% coinsurance	0.001	(0.005)	0.013	(0.013)
Care levels 2-3				
Age	-0.667***	(0.232)	-0.465	(0.336)
Female	0.014	(0.012)	-0.036	(0.030)
20% coinsurance	-0.006	(0.006)	0.013	(0.017)
Care levels 3-4				
Age	-0.078	(0.247)	0.187	(0.568)
Female	0.019	(0.015)	-0.022	(0.029)
20% coinsurance	-0.005	(0.008)	-0.008	(0.016)
Care levels 4-5				
Age	-0.381	(0.277)	-0.823	(0.691)
Female	0.001	(0.013)	-0.065*	(0.034)
20% coinsurance	-0.005	(0.007)	0.024	(0.019)

Notes: This table presents estimates of covariate balance tests based on the local linear specification from equation 5. *** p<0.01, ** p<0.05, * p<0.10.

Table A3: First-Stage Estimates for the Health Effects of Long-Term Care Utilization

	Standardized care time				Utilization / Nursing home					
	Linear (1)	Quadratic (2)	Cubic (3)	LPR (4)	Linear (5)	Quadratic (6)	Cubic (7)	LPR (Util) (8)	LPR (NH) (9)	Obs. (10)
Support levels 1-2	1,104.9***	1,134.7***	1,049.8***	760.7***	1,105.0***	1,135.1***	1,050.9***	706.6**	714.0**	4,879
	(100.4)	(184.6)	(297.5)	(275.6)	(100.4)	(184.6)	(297.6)	(291.5)	(287.3)	
Care levels 1-2	900.6***	322.4	1,199.9**	546.1	875.4***	572.6	1,247.6**	465.5	588.5	5,515
	(264.5)	(402.7)	(552.2)	(688.2)	(263.3)	(400.8)	(549.7)	(681.6)	(672.8)	
Care levels 2-3	1,541.8***	3,063.8***	4,180.8***	2,964.2**	1,482.5***	2,885.7***	4,089.6***	3,354.2**	3,359.9***	3,140
	(487.2)	(745.2)	(1,022.1)	(1,352.1)	(481.4)	(736.7)	(1,010.1)	(1,075.8)	(1,073.9)	
Care levels 3-4	617.0	-626.3	-2,036.5	-2,162.2	717.0	-567.7	-1,730.8	-1,725.0	-2,167.7	2,257
	(669.4)	(985.7)	(1,338.8)	(1,395.3)	(638.8)	(940.7)	(1,278.3)	(1,316.1)	(1,462.2)	
Care levels 4-5	256.2	1108.3	-1,500.7	-2,743.2	428.1	1,450.5	-846.0	-1,384.5	-1,364.0	1,532
	(987.1)	(1,413.8)	(1,813.0)	(2,802.8)	(900.5)	(1,289.7)	(1,654.6)	(2,146.7)	(2,204.3)	

Notes: This table presents the first-stage estimates β_0^c in equation 4. The first to fourth column show estimates for the case of using standardized care time as a health outcome. The fifth to ninth columns represent the case of utilization or whether to enter a nursing home. Estimates are separately presented for different specifications of $f(SCT_{it})$: linear, quadratic, cubic and LPR representing nonparametric local polynomial regression estimates using the robust confidence intervals proposed by Calonico, Cattaneo, and Titiunik (2014). The eighth and ninth columns represent the estimates of LPR for the case of utilization and nursing home respectively. Standard errors are shown in parentheses under each estimate. *** p<0.01, ** p<0.05, * p<0.10.