RIETI Discussion Paper Series 18-E-082

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December 2018

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Abstract

The paper provides a preference evaluation for elderly-care services, based on a conjoint survey and a rational-choice framework. For the empirical section, we conducted a conjoint survey with Japanese respondents to estimate preferences of elderly-care services. Our findings show that room sharing is the most important for both demand and consumer surplus, and it is justified to assist households in using elderly-care facilities at a middle distance with additional health-care services.

Keywords: Elderly-care, Conjoint-survey experiment, Willingness-to-pay

JEL classification: I18, J14

This study is conducted as a part of the Project "Economic Analysis of the Development of the Nursing Care Industry in China and Japan" undertaken at Research Institute of Economy, Trade and Industry (RIETI).

1. Introduction

Sustainability of elderly services is an urgent matter for aging societies. For instance, 4.57M Japanese people were certified as eligible for public elderly-care services in 2017, whereas there were 2.10M in 2007. The change in demographics caused a shift in the supply of elderly-care from family members to the market. Currently, 20.2% of certified members use market services.

When facing changes in social structure, the Japanese government has provided various policies to improve the quality of the elderly-care market. To make better policies and markets, understanding user preference for care and services is important. For example, the relative importance of service attributes can be evaluated using demand and consumer surplus. Deadweight loss is a popular indicator in welfare evaluation for measuring the effectiveness of subsidy programs. All of these indicators are defined based on preference.

Despite its importance, there are few studies estimating user preference. One key difficulty is the multidimensionality of the service, meaning that elderly-care services are characterized not only by price but also by service quality. From observed data, there are strong correlations between service quality and price.

This paper first estimates user preference via a conjoint-survey experiment. Conjoint survey (Green & Rao 1971) is a popular approach to estimating preferences for goods, services, and public policies. Whereas there are several conjoint designs (Wiley, Raghavarao, & Chitturi 2010), the design of Hainueller, Hopkins, and Yamamoto (HHY) (2014), referred as the HHY conjoint, is very popular. Their design was based on randomized attributes (Neyman 1923) and a potential-outcome framework (Rubin 1974), which allows researchers to simply identify the marginalized impacts of each attribute on service demands. This was refereed as the marginal average component effect (AMCE). However, with the potential-outcome framework, it is difficult to estimate the impacts on welfare indicators (e.g., surplus and deadweight loss). The paper extends Bhattacharya (2015, 208)'s rational-choice framework in the multi-attributes environments and shows that the conjoint data can estimate consumer surplus and deadweight loss via public subsidies.

Our approach is based on a simple rational-choice framework without any parametric assumptions on utility functions. The framework allows us to nonparametrically identify the distribution of the willingness-to-pay for a service, by which the consumer surplus and deadweight loss can be recovered.

A practical problem is the point identification of the surplus and deadweight loss requires continuous and full-support distribution on the "price" of a hypothetical service in the conjoint survey. In some practical cases (including our survey), the price has only a discrete variation. This paper shows partial identification results for use in those cases.

In the empirical part, our conjoint-survey experiment is conducted using data from 1,090 respondents, whose ages ranged between 40 and 59. They were asked about preferred elderly-care services for their parents. The data shows that room sharing is the most important for both demand and consumer surplus.

Additionally, the present paper estimates the dead-weight-losses of public assistance for the elder-care services. Lowest dead-weight-losses are estimated to assist households in using elderly-care facilities at a middle distance with additional health-care services.

There have been several economic analyses of the determinants of the monetary value of elderly-care services. However, there have been relatively few studies using the conjoint measurement method. Van den Berg et al. (2005, 2008) conducted a conjoint survey of suppliers in which informal caregivers were asked to rate four different hypothetical informal caregiving situations with different combinations of care hours, care tasks, and monetary compensations. The studies found that informal caregivers demanded an increase of 80% of their hourly compensation with a three-fold increase of hours during the work week, from 7 to 21 hrs.

On the demand side, there have been several economic analyses on the total value of caregiving services in Japan. For example, Ii & Ohkusa (2002) found that the income elasticity of in-home care service was greater than 1 and that the service was a luxury good, using service-user data. Shimizutani and Noguchi (2004) applied a contingent valuation method, finding that price elasticity of in-home care was between −0.4 and −0.2, and the income elasticity was not very large.

The present paper provides updated evidence of Japanese preferences. Moreover, our approach does not require any parametric assumptions on the individual choice model, which implies higher validity than classical approaches.

1.1. Japanese situation

Japan is currently the oldest nation in the world. The total 2016 population was 126.93M, of which 34.59M (27.3%) were aged 65 and over. That is significantly higher than the U.S. (15%) and other Asian countries, including South Korea (13%), China (10%), and Singapore (12%).

To deal with aging, beginning in 2000, Japan implemented Long-Term Care Insurance (LTCI), a mandatory public program that provides benefits for the long-term care of older persons. The LTCI obligates all people aged 40 and over to contribute to the program by paying a premium that varies according to income, guaranteeing that all people aged 65 and over can access the same benefits, including institutional, home, and community-based services, regardless of income. All services were subject to a 10% co-payment when used.

Whereas the number of insured persons aged 65 and over has increased by approximately 1.6 times over the 16 yrs since 2000 (21.65M), the number of service users reached 6.14M, which is approximately four times higher over the same period. As aging proceeds, insurance premiums (national average per month) are estimated to rise from ¥5,514 currently to ¥6,771 yen in 2020 and ¥8,165 in 2025. Because of the boom in the aging population, the LTCI has been reformed. Thus, with the current LTCI, copayments are 10% or 20%, depending on income level.

The rest of the paper is as follows. Section 2 presents the survey design and summary statistics. Section 3 introduces a theoretical framework for demand analysis, and Section 4 shows an economic model for welfare analysis. The empirical results are discussed in Section 5, and Section 6 concludes the paper.

2. Survey design

We conducted an internet-based conjoint experiment to determine the preferences for elderly-care services in Japan. NIKKEI Research conducted the survey in March, 2017. We collected data from 1,090 respondents, stratified by prefecture. All the respondents were asked to complete two surveys in a specific order: a conjoint experiment for elderly-care services; then the background survey.

In the conjoint survey, a respondent first reads the common scenario as follows:

"One of your parents now needs elderly-care services for walking, toilet, and bathing. You have three options: (1) using elderly-care facility A; (2) using elderly-care facility B; and (3) do not either service. Specific attributes of services A and B are shown in a table. Note that we assume the same services for attributes not shown in the table for both services."

Respondents were requested to rank (1, 2, and 3) the three options, repeated five times with different combinations of elderly-care services.

Each care service was characterized by six attributes: (1) monetary costs of the service; (2) nationality of care workers; (3) distance from home; (4) living-room condition; (5) health-care service; and (6) environmental service. Following HHY, the levels of those attributes and their order on the screen were randomly selected from the list of potential levels.

In our conjoint survey, the list of potential attribute levels was

Monetary costs: (i) ¥150,000; (ii) ¥200,000; (iii) ¥250,000; (iv) ¥300,000.

Nationality of care workers: (i) Including Foreigners; (ii) Only Japanese.

Distance from home: (i) 30 min; (ii) 60 min; (iii) 90 min

Room sharing: (i) Yes; (ii) No

Health-care service: (i) 24-hr nursing care; (ii) House call; (iii) No special services

Environmental service: (i) Air cleaner; (ii) No special services; (iii) Organic food

The number of potential attributes combinations is $3 \times 2 \times 3 \times 2 \times 3 \times 3 = 432$. Compared to our sample size, it was too large to estimate the demand for each combination. Alternatively, this paper focuses on the marginalized estimands, as shown in the next section.

The background survey collected the information of basic characteristics (e.g., gender, age, education level, living location, and family structure of respondents). Thus, our estimators must be unbiased without control variables, because interest treatments are randomized in our conjoint survey design. The information allows us to estimate the heterogeneous treatment effects according to individual characteristics.

2.1. Summary statistics

Tables 1, 2, and 3 report the summary statistics.

[Table 1 here]

[Table 2 here]

[Table 3 here]

Each table shows the respondents' basic characteristics (i.e., job status, marriage status, and marriage partner status).

3. Demand analysis

3.1. Average marginal component effect (AMCE)

The paper employs a potential-outcome framework (Rubin 1974). Let p and a be monetary costs and a vector of non-monetary attributes. The first estimands are the AMCE of non-monetary attributes and monetary costs, as proposed by HHY, defined as

$$\pi_l(a_1, a_0) = \sum_{a_{-l}} E\left[Y_i(p, a_1, a_{-l}) - Y_i(p, a_0, a_{-l})\right] \times f(p, a_{-l}),$$

and

$$\pi_p(p_1, p_0) = \sum_a E\,[Y_i(p_1, a) - Y_i(p_0, a)] \times f(a),$$

where $E[Y_i(a_1, a_{-l}) - Y_i(a_0, a_{-l})$ and $E[Y_i(p_1, a) - Y_i(p_0, a)]$ are component effects of attribute l and price conditioning on other attributes, respectively. The AMCE is the average of the component effects over every combination of other attributes. Note that $f(p, a_{-l})$ and $f(a)$ are weighting functions, specified as a joint uniform distribution in our empirical analysis.

As shown in HHY with the uniform weights, $f(p, a_{-l})$ and $f(a)$, the AMCE is simply identified as

$$\pi_l(a_1, a_0) = E[Y_{i,j}^{obs} | A_{j,l}^{obs} = a_1] - E[Y_{i,j}^{obs} | A_{j,l}^{obs} = a_0] \text{ if } (1),$$

and

$$\pi_p(p_1, p_0) = E[Y_{i,j}^{obs} | P_j^{obs} = p_1] - E[Y_{i,j}^{obs} | P_j^{obs} = p_0] \text{ if } (2),$$

where $Y_{i,j}^{obs}$ is respondent i's statement for a care service, j, in the conjoint survey, which is equal to 1 if the respondent prefers to use service j $\{P_j^{obs}, A_j^{obs}\}$, and equal to 0 otherwise.

3.2. Average marginal interaction effect (AMIE)

The conjoint data allows us to estimate the causal interaction effect, which is also useful for understanding demand structure. The present paper estimates the average marginal interaction effect (AMIE) introduced by Egami and Imai (2018).

The AMIE between attributes a and b is defined as

$$\pi_{ab}(a_l, b_m; a_0, b_0) = E[Y_i(a_l, b_m) - Y_i(a_0, b_0) - \sum_b (Y_i(a_l, b) - Y_i(a_0, b))f(b)$$

$$- \sum_a (Y_i(a, b_m) - Y_i(a, b_0))f(a)].$$

If $\pi_{ab}(a_l, b_m; a_0, b_0) > 0$, the change of attribute a from a_0 to a_l is complementary to the change of attribute b from b_0 to b_l. If $\pi_{ab}(a_l, b_m; a_0, b_0) < 0$, the changes can be substituted.

Whereas the estimation of AMIE is not difficult, the multiple testing problem is, because there are many attributes. To avoid the problem, this paper uses the interaction-term selection proposed by Egami and Imai (2018).

3.3. Individual heterogeneity

The background information allows us to estimate the heterogeneous effects, depending on the individual characteristics. Formally, the AMCE conditioning on an individual characteristic

$$X_i = x$$

is defined as

$$\sum_{a_{-l}} E\left[Y_i(a_1, a_{-l}) - Y_i(a_0, a_{-l}) | X_i = x\right] \times f(a_{-l}),$$

which is also simply identified.

However, the multiple testing problem may become complicated again, because many combinations of interest attributes and background characteristics exist. This paper then uses a machine-learning selection technique as the post-LASSO.

4. Welfare analysis

The additional estimands are related to welfare analysis. To connect the conjoint data and the economic welfare, a decision-theoretic framework was incorporated.

Let $u_i(I_i - p, a)$ be the utility function of a respondent, i, with income I_i, who uses an elder-care service $\{p, a\}$. Additionally, $u_i(I_i, \phi)$ denotes the utility with no care services.

This paper uses a rational-choice model with some non-parametric assumptions.

Rational choice: $E[Y_{i,j} | P_j^{obs} = p, A_{j,-p}^{obs} = a]$ is equal to one if and only if

$$u_i(I_i - p, a) \geq u_i(I_i, \phi),$$

Continuity: u_i is a continuous function over p,

Monotonicity: $u_i(I_i - p - \epsilon, a) \leq u_i(I_i - p, a)$ for any positive, ϵ.

The above assumptions allow us to recover consumer surplus. In the remainder of this section, we introduce two welfare measurements: **consumer surplus** and dead-weight-loss.

4.1. Consumer surplus

We first define and identify the marginalized consumer surplus based on the equivalent valuation (EV). The comparison of consumer surplus between different attributes provides a natural measurement of the relative importance.

Let $EV_i(p^*, a)$ be an individual EV of a care service with price p^* and attribute a, defined as

$$u_i(I_i - p^* - EV_i(p^*, a), a) = u_i(I_i, \phi) \text{ if } u_i(I_i - p^*, a) \geq u_i(I_i, \phi),$$

and

$$EV_i(p^*, a) = 0 \text{ if } u_i(I_i - p^*, a) \leq u_i(I_i, \phi).$$

The EV is a hypothetical "tax" on the care service, under which the respondent, i, is indifferent about using the service. Note that, if the respondent does not prefer to use the service without taxes, the EV is defined as 0.

The present paper estimates the distribution of EV, $F_{EV}(S|p^*, a) \equiv \Pr[EV_i(p^*, a) \leq S]$, because estimation of individual EV is quite difficult. Assumptions on the preference allows us to identify the distribution.

First, **monotonicity** ensures that $u_i(I_i - p^* - EV_i(p^*, a), a) \geq u_i(I_i - p^* - S, a)$ for any $S \geq EV_i(p^*, a)$. Therefore, $u_i(I_i, \phi) \geq u_i(I_i - p^* - S, a)$ if $EV_i(p^*, a) \leq S$. The distribution of an individual EV can then be identified as

$$F_{EV}(S|p^*, a) = \Pr[u_i(I_i, \phi) \geq u_i(I_i - p^* - S, a)] = 1 - E[Y_{i,j}|P_j^{obs} = p^* + S, A_j^{obs} = a] \text{ if } S \geq 0 \quad (3).$$

The second equality in the first equation is from **rational choice**. Note that

$$F_{EV}(S|p^*, a) = 0 \text{ if } S < 0,$$

because the EV must be positive.

The results show that the distribution of $EV_i(p^*, a)$ can be recovered from estimated conditional demand $E[Y_{i,j}|P_j^{obs} = p^* + S, A_j^{obs} = a]$. However, in many cases, the estimation of the conditional demand is difficult, owing to the sample-size problem.

Then, the paper focuses more practical estimands, including the marginalized distribution of an individual EV. The marginal distribution of the EV conditioning on only attribute l is defined as

$$F_{EV}(S|p^*, a_l) = \sum_{a_{-l}} F_{EV}(S|p^*, a_l, a_{-l}) \times f_{a_{-l}}(a_{-l}).$$

Combining Eq. (3), the marginal distribution is simply identified as the following proposition:

Proposition 1. *The marginal distribution of EV is*

$$F_{EV}(S|p^*, a_l) = 0 \text{ if } S < 0.$$

and

$$F_{EV}(S|p^*, a_l) = 1 - E[Y_{i,j}|P_j^{obs} = p^* + S, A_{j,l}^{obs} = a_l] \text{ if } S \geq 0.$$

The marginal distribution of the EV is more easily estimated than $F_{EV}(S|p^*, a)$, because the estimation requires an estimated average demand conditional on only price and an interest attribute, l.

If the EV distribution can be fully recovered, any summary statistics are also identified. For instance, the average EV is defined as

$$E[EV_i|p^*, a_l] = \int_0 S\, dF_{EV}(S|p^*, a_l),$$

identified by using the estimated EV distribution.

In some practical cases, however, it is difficult to fully recover the EV distribution, because "price" has only discrete variation. For instance, in our survey, the price takes one of four values: ¥150,000, ¥200,000, ¥250,000, or ¥300,000.

In those cases, we can identify the lower bounds of the average EV. Suppose $P_i^{obs} \in \{p_1, p_2, \dots, p_M\}$ in the conjoint survey. Here, we focus on a case where $p_1 \geq p^*$, which can easily extend more general cases. The identified set of S is then $\{p_1 - p^*, p_2 - p^*, \dots, p_M - p^*\}$.

The lower bound of the average EV is

$$MinE[EV_i|p^*, a_l] = \sum_{m=1}^{M-1} (p_m - p^*) \times [F_{EV}(p_{m+1} - p^*|p^*, a) - F_{EV}(p_m - p^*|p^*, a)]$$
$$+ (p_M - p^*) \times [1 - F_{EV}(p_M - p^*|p^*, a)].$$

With Proposition 1, the lower bound is identified as the following corollary:

Corollary 1. *The lower bound of the average EV is*

$$E_{min}[EV_i|p^*, a_l] = \sum_{m=1}^{M-1} (p_m - p^*) \times [E[Y_{i,j}|P_j^{obs} = p_m, A_{j,l}^{obs} = a_l] - E[Y_{i,j}|P_j^{obs} = p_{m+1}, A_{j,l}^{obs} = a_l]]$$
$$+ (p_M - p^*) \times E[Y_{i,j}|P_j^{obs} = p_M, A_{j,l}^{obs} = a_l].$$

Note that the upper bound of the average EV cannot be identified, because the upper bound of the individual EV is unknown, except for a special case: $F_{EV}(p_M - p^*|p^*, a) = 1$.

4.2. Surplus effect of subsidies

The welfare effect of price change is next defined and identified. Suppose the price of an elderly-care service with a increases from p_L^* to p_H^*. A related equivalent valuation, $EV_i^{price}(p_H^*, p_L^*, a)$, is defined as

$$\max\{u_i(I_i - p_L^* - EV_i^{price}(p_H^*, p_L^*, a), a), u_i(I_i - EV_i^{price}(p_H^*, p_L^*, a), \phi)\}$$
$$= \max\{u_i(I_i - p_H^*, a), u_i(I_i, \phi)\}.$$

$EV_i^{price}(p_H^*, p_L^*, a)$ can be interpreted as the willingness-to-pay to **decrease** the price from p_H^* to p_L^*.

With **monotonicity**, the above definition directly implies that

$$EV_i^{price}(p_H^*, p_L^*, a) = 0 \text{ if } u_i(I_i - p_L^*, a) \leq u_i(I_i, \phi),$$

$$u_i(I_i - p_L^* - EV_i^{price}(p_H^*, p_L^*, a), a) = u_i(I_i, \phi) \text{ if } u_i(I_i - p_L^*, a) \geq u_i(I_i, \phi)$$
$$\geq u_i(I_i - p_H^*, a),$$

and

$$EV_i^{price}(p_H^*, p_L^*, a) = p_H^* - p_L^* \text{ if } u_i(I_i - p_H^*, a) \geq u_i(I_i, \phi).$$

The EV is same value as in the consumer surplus (see Proposition 1), except for the upper bound, $EV_i(p_H^*, p_L^*, a) \leq p_H^* - p_L^*$. Moreover, with the **rational choice**, the last equation implies that $\Pr[EV_i^{price}(p_H^*, p_L^*, a) = p_H^* - p_L^*] = E[Y_{ij}^{obs} | P_{ij}^{obs} = p_H^*, A_{ij}^{obs} = a]$.

Therefore, the identified distribution of EV can be summarized as the following proposition:

Proposition 2. *The marginal distribution of EV is*

$$F_{EV^{price}}(S | p_H^*, p_L^*, a_l) = 0 \text{ if } S < 0,$$

$$F_{EV^{price}}(S | p_H^*, p_L^*, a_l) = 1 - E[Y_{i,j} | P_j^{obs} = p_L^* + S, A_{j,l}^{obs} = a_l] \text{ if } p_H^* - p_L^* > S \geq 0,$$

and

$$F_{EV^{price}}(S | p^*, a_l) = 1 \text{ if } S \geq p_H^* - p_L^*$$

.

Moreover, we can obtain bounds of the average EV. Suppose $P_i^{obs} \in \{p_1, p_2, \ldots, p_M\}$ in the conjoint survey. Here, we focus on a case where $p_1 = p_L^*$ and $p_M = p_H^*$, which can also extend to more general cases. The identified set of S is then $\{0, p_2 - p^*, \ldots, p_H^* - p_L^*\}$.

The average EV is defined as

$$E[EV_i^{price}|p_H^*, p_L^*, a_l] = \int_0^{p_H^*-p_L^*} S\, dF_{EV^{price}}(S|p_H^*, p_L^*, a_l).$$

We can identify both upper and lower bounds in the price change as the following corollary.

Corollary 2. *The lower and upper bounds of the average EV is*

$$MinE[EV_i^{price}|p_L^*, p_H^*, a_l] = \sum_{m=L}^{H}(p_m - p_L^*) \times [E[Y_{i,j}|P_j^{obs} = p_m, A_{j,l}^{obs} = a_l] - E[Y_{i,j}|P_j^{obs} = p_{m+1}, A_{j,l}^{obs} = a_l]]$$

$$+(p_H^* - p_L^*) \times E[Y_{i,j}|P_j^{obs} = p_H, A_{j,l}^{obs} = a_l],$$

and

$$Max[EV_i^{price}|p_L^*, p_H^*, a_l] = \sum_{m=L}^{H-1}(p_{m+1} - p_L^*) \times [E[Y_{i,j}|P_j^{obs} = p_m, A_{j,l}^{obs} = a_l] - E[Y_{i,j}|P_j^{obs} = p_{m+1}, A_{j,l}^{obs} = a_l]]$$

$$+(p_H^* - p_L^*) \times E[Y_{i,j}|P_j^{obs} = p_H, A_{j,l}^{obs} = a_l].$$

Whereas only the lower bound of the consumer surplus can be identified (see Proposition 1), Proposition 2 identifies both bounds. This is because **rational choice** provides an upper bound of an individual EV as $p_H - p_L$.

A standard surplus analysis of subsidies are the comparative statistics on the social surplus. Generally, the impact of price change on the social surplus decomposes into three components: (1) the change of consumer surplus (average EV); (2) tax expenditure; and (3) the change of third-party surplus, including the producer surplus. Formally, the impact can be defined as

$$\Delta S(p_L^*, p_H^*, a_l) = E[EV_i^{price}|p_L^*, p_H^*, a_l] - (p_H^* - p_L^*)E[Y_{ij}^{obs}|A_{jl}^{obs} = a_l, P_{jl}^{obs} = p_L^*]$$

$$+\Delta^{third}(p_L^*, p_H^*, a_l) \times [E[Y_{ij}^{obs}|A_{jl}^{obs} = a_l, P_{jl}^{obs} = p_L^*] - E[Y_{ij}^{obs}|A_{jl}^{obs} = a_l, P_{jl}^{obs} = p_H^*]],$$

where $\Delta^{third}(p_L^*, p_H^*, a_l)$ is a change of third-party surplus per-user.

The conjoint data can estimate first and second terms, whereas $\Delta^{third}(p_L^*, p_H^*, a_l)$ cannot be identified. Then, the empirical section reports minimum changes of third-party surplus to increase the social surplus. Thus, $\Delta S(p_L^*, p_H^*, a_l) \geq 0 \Leftrightarrow$

$$\Delta^{third}(p_L^*, p_H^*, a_l) \geq \frac{(p_H^* - p_L^*)E[Y_{ij}^{obs}|A_{jl}^{obs} = a_l, P_{jl}^{obs} = p_L^*] - E[EV_i^{price}|p_L^*, p_H^*, a_l]}{E[Y_{ij}^{obs}|A_{jl}^{obs} = a_l, P_{jl}^{obs} = p_L^*] - E[Y_{ij}^{obs}|A_{jl}^{obs} = a_l, P_{jl}^{obs} = p_H^*]}.$$

The right-hand-side is a threshold gain third-party surplus. The subsidy can be justified only if the actual surplus gain is larger than the threshold.

5. Estimation results

5.1. Estimated impacts on demand

First, the following figure shows estimated AMCE on the demand (Eqs. 1 and 2).

[Figure 1 here]

The figure shows several important findings. First, price is confirmed to have an intuitive impact on demand. Then, the demand is decreased by approximately 30% if the price is increased from ¥150,000 (reference price) to ¥300,000. Moreover, the impact of price is larger than other attributes, except for room sharing, which implies that the demand for elderly-care services is price elastic.

Among non-monetary attributes, the room type has the largest impact. Compared to the share-room, the single room has a larger demand (~20%). Distance from home, environmental, and health services also have significant and intuitive impacts on the demand; however, their magnitudes are not large.

Finally, the figure reveals a nationality effect of care workers. Households tend to prefer care services provided only by Japanese care workers.

5.1.1. Interaction effects between attributes

Next, we estimate the interactions among attributes. Because our conjoint survey includes many attributes, the multiple testing problem may be potentially serious. To avoid this problem, interaction terms are selected by Egami and Imai (2018)'s method.

[Figure 2 here]

Their method selected interactions between (i) Nationality of workers (att_2) and Type of room (att_4), (ii) Nationality of workers (att_2) and Environment (att_6), and (iii) Distance from home (att_3) and Type of room (att_4). Moreover, the figure shows significant interaction effects only between distance from home and the living-room condition. The estimated interaction effects imply that the positive impact of the single room is decreased when the distance from home is increased.

One possible interpretation is that a shorter distance means family members can easily visit the living room of the elderly person. In that case, a single room can provide a private space not only for the elderly person but also her/his family.

Another interpretation is if family cannot visit frequently, they may prefer that their elderly family member live with others to avoid loneliness.

5.1.2. Heterogeneous effects

This subsection reports the heterogeneous effects per background characteristics. Like the interaction effects, the multiple testing problem is very complicated, owing to many attributes and complex background information. Therefore, heterogeneous effects are selected by the post-LASSO approach (Chernozhukov, Chetverikov, & Kato 2013, Belloni, Chernozhukov, & Hansen 2014).

[Figure 3 here]

Figure 3 reports the heterogeneity selected by the post-LASSO approach. Our estimation shows that the heterogeneous effects with income are found. Wealthier households prefer (1) only Japanese care workers and (2) single room, which may reflect the income effect on service attributes.

5.2. Estimated consumer surplus

This section reports results of empirical welfare analysis. First, Fig. 4 reports the estimated lower bound of average consumer surplus.

[Figure 4]

The red-line reports the lower bound of average consumer surplus with no conditioning attributes. Its estimated bound is around ¥53,000. Thus, the average consumer surplus is >¥53,000.

Each dot represents point estimators of the lower bounds (bars are the 95th confidence interval). Estimated lower bounds of the consumer surplus are consistent with demand effects. The single living room provides highest bound. The shortest distance, providing nursing care, and only Japanese care workers also have the lower bounds, which are significantly larger than the average bound.

5.3. Estimated surplus effect of subsidies

[Figure 5 here]

Figure 5 shows the estimated changes of minimum third-party surplus to increase the social surplus via subsidies. We consider two scenarios: price is decreased from (1) ¥250,000 to ¥150,000 (¥100,000 subsidized) and (2) ¥300,000 to ¥150,000 (¥150,000 subsidized).

The figure reveals multiple implications. First, from the viewpoint of the social surplus, ¥100,000 of subsidies is more easily justified than ¥150,000, which is consistent with well-known theoretical principles. For instance, without conditioning attributes, the third-party surplus should increase about ¥106,000 to justify ¥150,000 in subsidies. However, ¥100,000 in subsidies can be justified by the third-party surplus gain of ¥83,000.

The subsidies for care facilities with middle distance (i.e., 60 min from home) and house care are justified more easily than other attributes. Meanwhile, subsidies for facilities with long distances are more difficult to justify.

6. Conclusion

This paper showed several results of attributes and policy evaluations related to elderly-care services. In the demand analysis, we found that the living-room condition had the largest impact, whereas impacts of additional medical and environmental services were moderate. The findings from the surplus analysis were consistent with the demand analysis. The lower bound of the consumer surplus by using the services with the single living room was the largest. Finally, this paper evaluated the subsidy policy. Among other attributes, the results justified subsidies for households using care facilities with additional medical services at a middle distance from home.

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	Level	N	%
Gender	Female	468	42.9
	Male	622	57.1
Education	College	505	46.3
	Graduate	88	8.1
	High	240	22.0
	Upper high	257	23.6
age_d	40–44	286	26.2
	45–49	355	32.6
	50–54	190	17.4
	55–59	259	23.8

Table 1

	Level	N	%
occ_own	Employed	558	51.2
	Non-regular	51	4.7
	Non-working	220	20.2
	Other	15	1.4
	Part-time	147	13.5
	Self-employed	99	9.1
Income	¥100,000–¥200,000	158	14.5
	¥200,000–¥300,000	183	16.8
	¥300,000–¥400,000	159	14.6
	¥400–¥500,000	97	8.9
	<¥100,000	124	11.4
	>¥500,000	369	33.9
hour_own	100–120 hrs	20	1.8
	120–140 hrs	19	1.7
	140–160 hrs	64	5.9
	160–180 hrs	144	13.2
	180–200 hrs	78	7.2
	200–220 hrs	69	6.3
	40–60 hrs	176	16.1
	60–80 hrs	62	5.7
	80–100 hrs	29	2.7
	<40 hrs	130	11.9
	>220 hrs	299	27.4

Table 2

	Level	N	%
partner	Employed	394	36.1
	Non-regular	33	3.0
	Non-working	129	11.8
	Not married	361	33.1
	Other	7	0.6
	Part-time	118	10.8
	Self-employed	48	4.4

Table 3

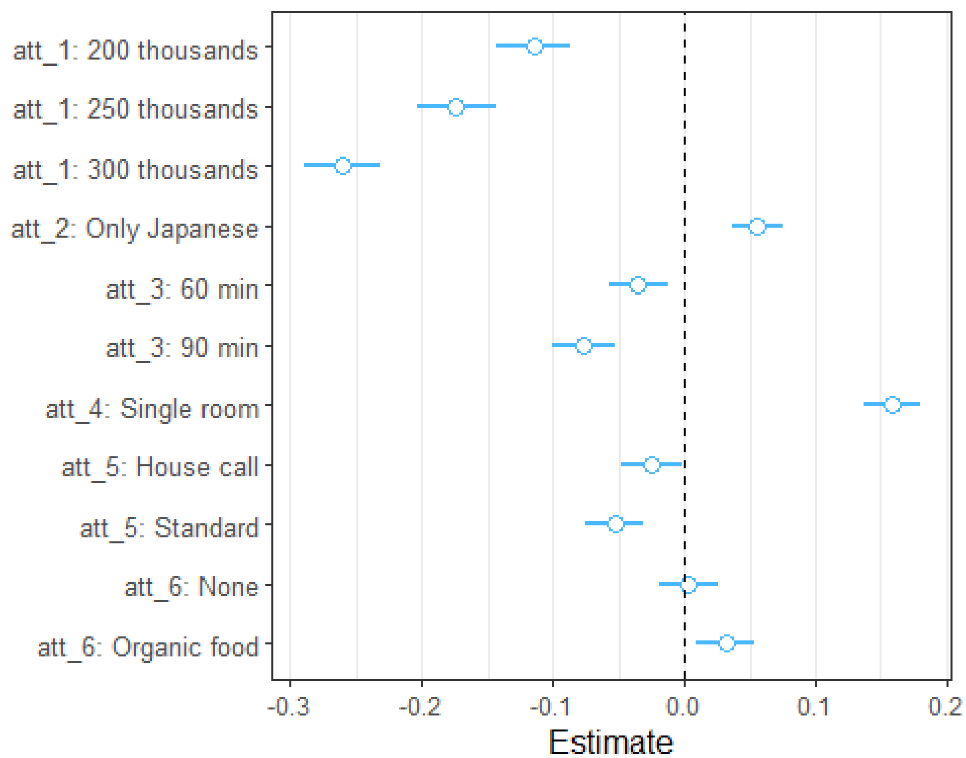

Figure 1: Estimated AMCE

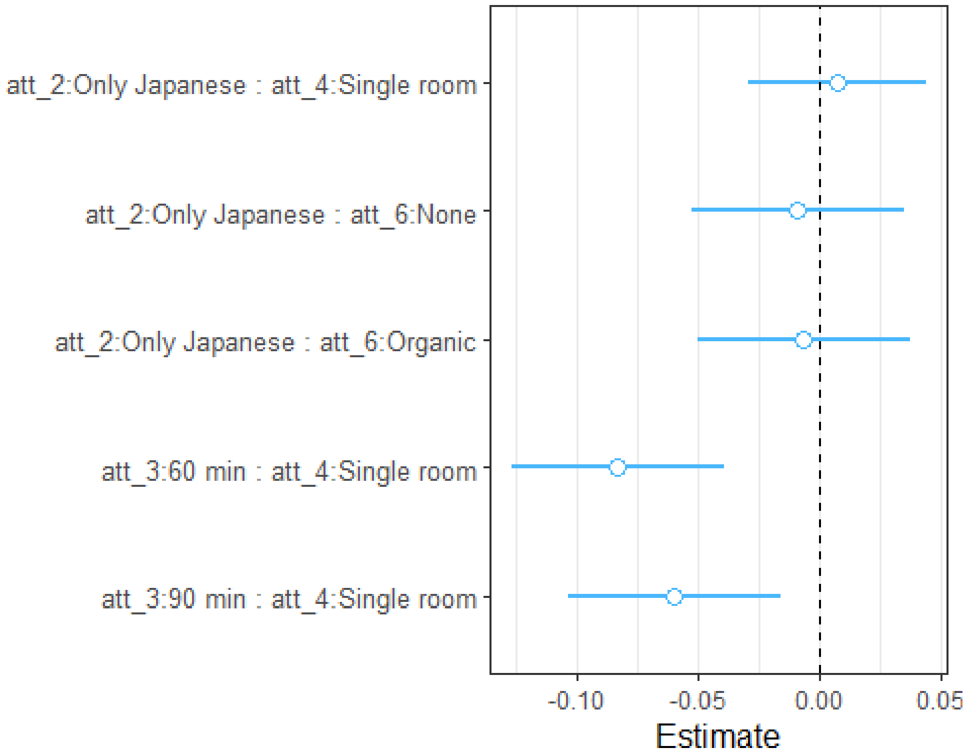

Figure 2: Estimated AMIE

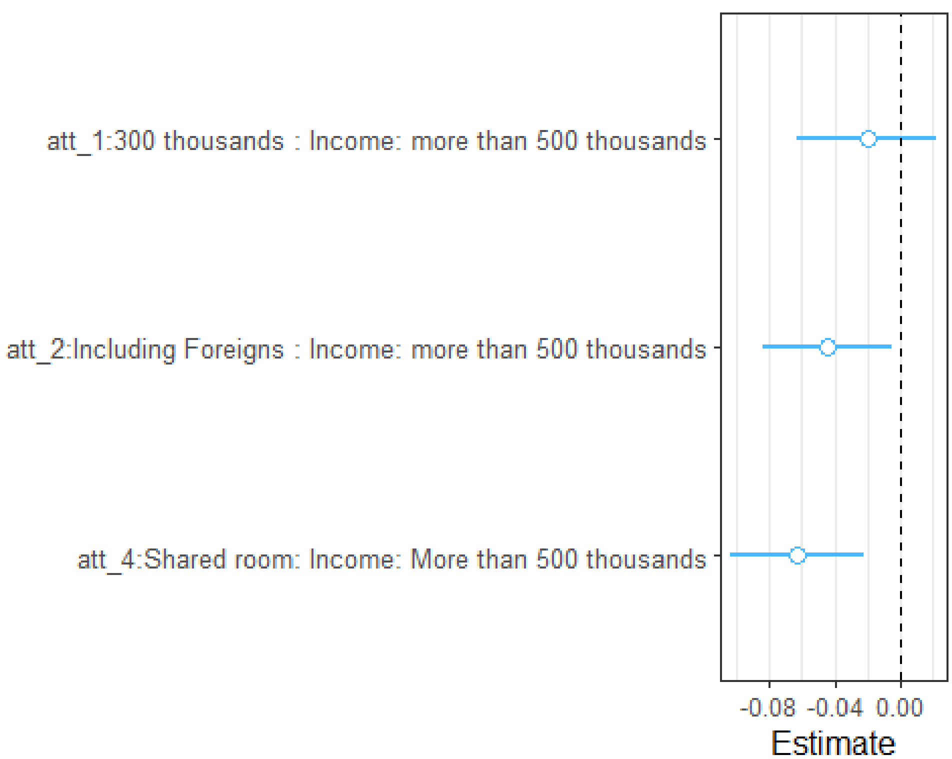

Figure 3: Heterogeneous effects

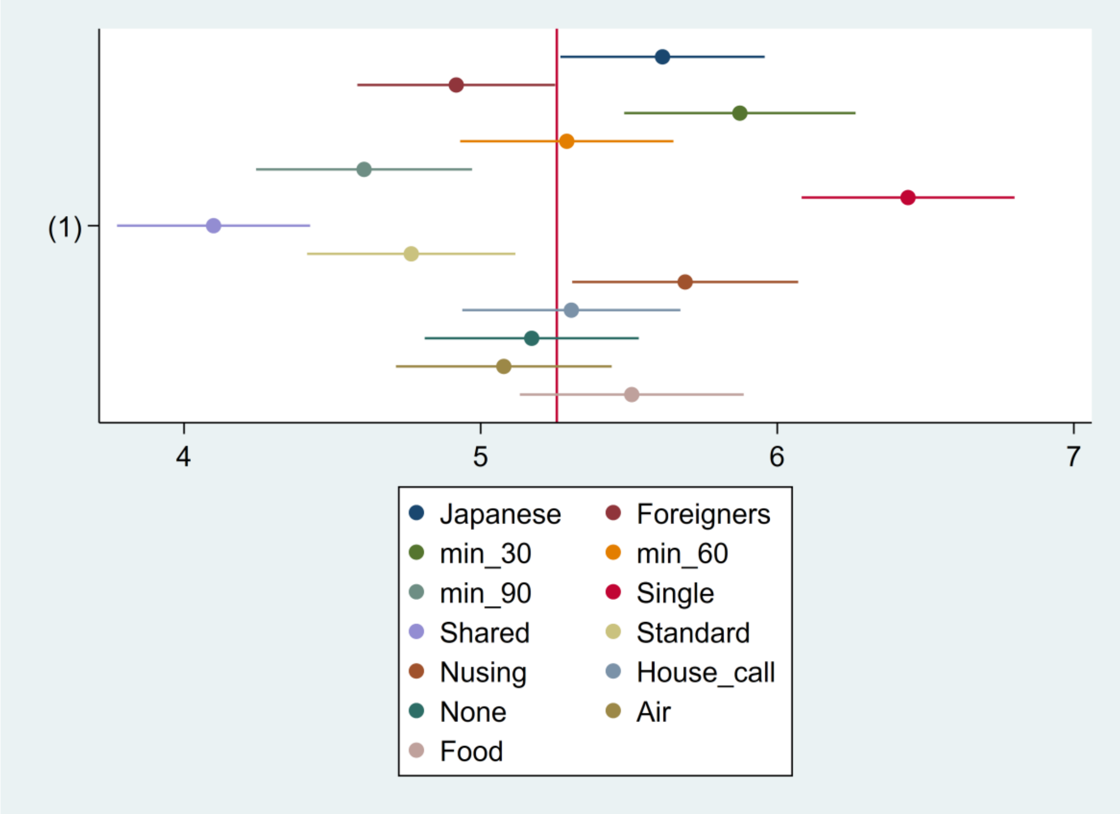

Figure 4: Lower bounds of consumer surplus.

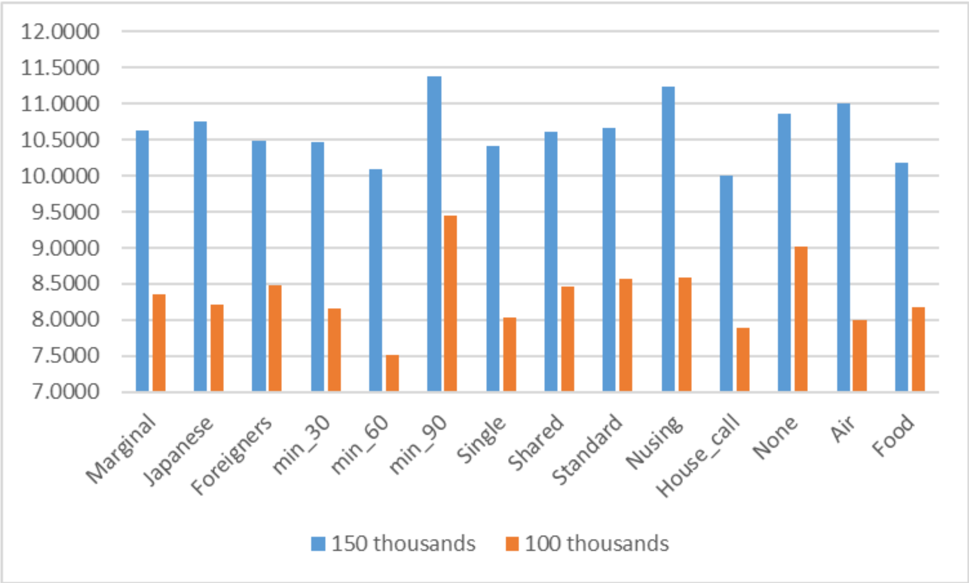

Figure 5: Sufficient externalities